The Second BUiD Doctoral Research Conference

EDITORS

Chief Editor: Prof. Ashly Pinnington
Prof. Halim Boussabaine
Dr. Solomon David
Dr. Abba Kolo

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The 2nd BUiD Doctoral Research Conference

BDRC 2016

The British University in Dubai, 14th May 2016

Conference Proceedings

Extended Abstracts and Conference Papers
Introduction

The Annual BUiD Doctoral Research Conference took place for the second year on the 14th of May 2016. The conference included submissions from both Doctoral and Masters students from the British University in Dubai and UAE based universities, including Manipal University and Heriot-Watt University. In addition, there were a large number of submissions from several UK based universities including universities from the UK Alliance. Students from Cardiff University, the University of Glasgow and Liverpool John Moores University participated and presented at the conference, as well as students from the University of Rome and Skolkovo (Moscow School of Management).

Over 100 students attended the conference, with 74 participating students from local and international universities. Keynote speaker, Professor Ghassan Aouad, President of Applied Science University in Bahrain, presented on the “Art and Science of doing a PhD.” Dr. Maureen Farrell from the University of Glasgow, one of BUiD’s UK associate universities, gave a second keynote speech in the morning on the topic of “Journeys with Children's Literature: Research with impact.”

The conference included a range of themes from several disciplines to ensure that all students who are studying a wide range of doctoral research topics can participate in the conference. The themes adopted in this year’s conference included: Innovation, Sustainability, Business, Project Management, IT, Engineering, Law and Education.

Students from both BUiD and UK Associate universities reviewed papers to gain experience and practice for their future academic activities. Academics from the University of Glasgow and the University of Manchester were also present on the day to support the conference.

Six best paper awards were given to the best submissions, which included 2 from Education, 1 from Business & Law and 3 from Engineering & IT. This year, all participating students were given the option to decide whether or not to be included in the BDRC 2016 published conference proceedings.
BDRC 2016 Editors

Professor Ashly Pinnington, Dean of Research
ashly.pinnington@buid.ac.ae

Professor Halim Boussabaine, Head of Programme, Faculty of Engineering & IT
halim@buid.ac.ae

Dr. Abba Kolo, Associate Professor, Faculty of Business & Law
abba.kolo@buid.ac.ae

Dr. Solomon David, Assistant Professor, Faculty of Education
solomon.david@buid.ac.ae

BDRC 2016 Student Organising Committee

Nada Rabie PhD BM, BUiD
Mohammed Nabil Omar CPD Structural Engineering, BUiD
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Emad Abu Ayyash EdD, BUiD
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## Keynote Presentations

- **9:15 - 10:15**
  
  **Keynote Presentation: “The Art and Science of Doing a PhD.”**
  
  Prof. Ghassan Aouad, President of Applied Science University (ASU), Bahrain.

- **10:15 - 11:00**
  
  **Keynote Presentation 2: “Journeys with Children’s Literature: Research with impact.”**
  
  Dr. Maureen Farrell, University of Glasgow, UK.

## Lunch & Prayers

**13:15 – 14:15**

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**18:15** **Awards Ceremony & Farewells**
Taxation in Islamic perspective. Profiles of social justice.

Gabriele Capogna, MSc in Law student
University of Rome

Author’s Note

This research represents a Master’s degree thesis. At the moment of the writing of this abstract the work is already at a first stage. Concluded to find sources, it is going to be written. Its last part in particular will be finalized during the period of research which is going to be spent at your university.

Abstract

Taxation has always been a distinguishing feature of each organized community: it can be defined very simply as one of the main instruments through which collects resources to work. In the contemporary economy it is furthermore one of the main factors that drive an economic operator to invest in a determinate place. In a Western-centric perspective an increasing number of investments are directed outside it; specifically towards the Gulf Cooperation Council countries. Approaching to Muslim countries it must be taken under consideration that even their fiscal policies are guided by Islamic principles. In this field it emerges predominantly the principle of social justice.

Purpose

The purpose of this work is to deepen the principle behind the Islamic concept of taxation and the role it could play in the modern financial system. In particular it will focus on the reference it continues to play on the successful fiscal policies of the Gulf Cooperation Council countries. It is a fact that they - United Arab Emirates in particular - are regarded with special attention by foreign investors. These economic data drive into a reflection on the legal aspects.

Design/ Methodology/ Approach

It was deemed appropriate to make a complete reconstruction running through again the history of Islamic taxation, since its early dawn in the first community. In doing that there is no presumption to substitute this work to the conclusions achieved by important Authors of the past century (i.e. Dennet and Lokkegaard and other English writing Authors, because my linguistic knowledge is limited to European languages and my few skills in Arabic do not allow me to study sources in the original language which contribution could have been perhaps more useful). Referring to specialized studies for the strictly economic effects of the several kind of taxes, the analysis will be conducted in a comparative law perspective eminently with Europe (primarily Italy and UK) and North America.
Findings

Since the beginning it emerges the importance of realization of social justice as a constant and the primary role of almsgiving. Another system was provided for non Muslims, significantly for the People of the Book and a reconstruction which pretend to be as completed as possible can not omit those tribute, the poll tax and the land tax, originally imposed only over them. They could not pay another one and through them they contributed to public expenditure and received in change protection too. The fiscal system as reorganized during the Caliphate survived between continuity and reforms during the following centuries; besides it other taxes flourished or acquire relevance, like commercial duties, correspondently to the extension of the empire. However, central in the work is the analysis of Zakat and its role borderline taxation and volunteering. So, regarding the last, it will be taken under consideration the sadaqa too, the difference consisting only in the absence of dutifulness. Having not the knowledge to excavate inside the religious meaning, the attention is concentrate on the socio-economic purpose: the reduction of the gap between riches and poor. They go on until today and nowadays the collection overcome the presence in a Muslim country thanks to non governmental organization consenting Muslims to absolve their duty and in the modern society they continue to pursue such a noble purpose. The reconstruction of the evolution of the Islamic fiscal system shows that despite the several kind and meaning of the different taxes characterising the different ages of Islamic history, taxation has been always founded on the principle of social justice, besides the general principles of Islamic economy. That is why in an Islamic perspective to be taxed is wealth, to realize a distributive effect. The religious connotation of Zakat marks the difference with secular taxes also regarding tax evasion; the spiritual purpose discourage this behaviour. The silence about other taxes has been interpreted by some Authors as the possibility for local governments to establish, on a discretionary basis and according to the circumstances of the case, the rules for its revenue. On the other hand it has been criticized the application of income taxes and especially of a value added tax which despite the pressure of the international community in the GCC countries is still under discussion. Social justice in different forms is again at the base of almost all western taxation systems but the greater ease in raising resources gives considerable importance to indirect taxes even if they burden at the same way on rich and poor.

Social Implications

This studies has a theoretical approach rather than a practical one. Since Islamic economy is not a separated one but a progressively important reality which overlaps other dominant economic models and public finance has a significant influence the analysis wants to highlight the effectiveness of social justice in contemporary Islamic inspired and non Islamic consistent taxation models.

Originality/Value

Islamic finance has a role increasingly important in the modern economy, due to the growing number of Muslims and especially to its intrinsic character. Europe is still taking its first steps in Islamic finance and Italy is lagging behind other countries. Most of the studies in this area deal with
the strictly financial aspects, neglecting the role of public finance. However, taxation has always been an important matter.
Impact of cross border mergers and acquisition on Indian GDP

*Rajesh Jayakar Pai, Assistant Professor (MBA)
Manipal University Dubai*

**Abstract**

Cross-border mergers and acquisitions have become the most sought after strategy for business growth and expansion. One of the main motives of cross border M&A is to spread its wings beyond its home country and take advantage of host country’s resources and grow. The aim of the study was to identify the impact of Cross border M&A on Indian GDP. In this paper, the importance has been given only to Cross Border Mergers and not Foreign Direct Investment.

FDI into two major components, (1) greenfield investment and (2) cross-border mergers and acquisitions (M&As), in the estimation process. An important motivation for this separation is based on the fact that multinational corporations can undertake FDI in the form of either greenfield investment or M&As. Greenfield investment involves building new facilities and M&As acquiring existing firms in the host country. The base this was tested using a regression model where initially the data was made stationary as it is evident from literature reviews that GDP is trend stationary data i.e. in long run it absorbs the shock and return to its original place hence the losses are not permanent. The research is based on secondary data and data is collected from reliable resources. After the final test of regression model, 5 factors were identified which had an impact on GDP. Lastly it was concluded that Repo rate and M&A were the most prominent factors which effects GDP. Cross border M&A is a subset of M&A and seeing the present dynamics of the business cross border M&A will impact the economy of India in future.

**Key Words:** Cross Border Mergers and Acquisitions, Gross Domestic Product
The relationship between work performance, satisfaction and personality similarities between employees and managers

Nadia Mohammed Abdulllah, MBA Student
The British University in Dubai

Abstract

Purpose

This paper attempts to add a significant contribution to the established studies on personality implications in business environment. It basically provides an evidence that performance appraisal rating and employee satisfaction are affected by both employee and manager personality similarity or difference despite of the various errors and biases that exist in this performance appraisal process. For this paper, certain areas in business were investigated to understand through the previous literature how to formulate the current research hypothesis. For example, different personalities’ interactions in the work place were studied to analyze the potential fit in teams for the different types. Other studies attempted to find out if there is a relationship between being promoted to managerial levels and personality type. It was also attempted to find out the factors that can affect appraisal rating for both sides; the rater’s and the ratee’s personalities, as well as the similarity of personality effect on rating decisions. Further, it was even studied how implementation of Total Quality Management (TQM) system is related to the managers’ personalities in a company.

Personality relationship with recruitment, promotion to managerial levels, as well as performance rating is not a new subject in the scientific research field. As demonstrated, certain studies used hypothetical and experimental tools to find the implications of the personality traits for raters and ratees to conclude the following:

1. The number of intuitive thinkers (NT)s are more than sensing feelers (SF)s among project managers, however, intuitive feelers (NF)s report better success in projects than intuitive thinkers (NT)s.

2. Conscientiousness, extroversion, and intuition found to be positively correlated with promotions and attaining managerial posts, while neuroticism was negatively related with promotions and career progress.

3. Top managers with intuition and extraversion preference scored higher in Deming TQM principles, and demonstrated to be more active in implementing it.

4. Introverts are more sensitive to interpersonal attitudes, and they allocated negative scores as well as less rewards in rating the extraverted disagreeable ratees.

5. Highly conscientious raters allocate lower rate in the performance evaluations than the low Conscientious scorers, and they tended to be the most accurate raters.

6. Highly open raters weighted openness behaviors higher than the others.

7. Performance appraisal is strongly related to rater’s liking regardless of job complexity of the ratee.
8. Highly conscientious raters tend to evaluate the highly conscientious ratee as a high performer.

9. Raters who combine both agreeableness and conscientiousness traits in their personalities tend to rate the most inaccurate and the most lenient ratings.

However, only one study have used real organizational set up in its methodology, and the rest used either hypothetical, experimental, or meta-analysis to conclude with the previous findings. Therefore, this research paper attempts to be the only research, as known so far which sheds the light on performance appraisal relationship with the personality of both the rater and the ratee using MBTI test, and analyzing a real case in business environment not experiments to prove the hypothesis stated below.

**Methodology/ research design:**

Guided by the existing literature the bellow hypothesis was developed and tested in an exploratory quantitative and qualitative data analysis addressing 2 government organizations:

- Hypothesis (1): when rater’s and ratee’s personalities are similar, the ratee tend to perform higher and receive a higher rating in performance appraisal, and vice versa.

- Hypothesis (2): when rater’s and ratee’s personalities are similar, the ratee tend to be satisfied the rater, and vice versa.

Managers and employees were compared in terms of personality type in a sample consisted of 58 employees and 13 managers using purposive sampling. A questionnaire, which included a personality test, was developed and sent out through an email to 2 government organizations. The questionnaire was aimed to be answered by the two ends: the manager (rater) and the employee(s) (ratee) separately. Since the questionnaire was 100% anonymous, it required the manager to agree on a secret word with the employee(s) in order for both of them to be linked for analysis. Regression and correlation analysis were used to test the validity of the hypothesis as well as to test the relationship between personality similarity, employee satisfaction about manager, and performance appraisal rating as following.

**Findings:**

1. Employees tend to receive high performance appraisal rating when their personalities are at least 50% similar to their managers’ personalities. Also, employees tend to be satisfied about their managers when their personalities are at least 50% similar.

2. There are many other than personality similarity factor that can have implications on performance appraisal rating. This finding is consistent with the earlier claim of Sutton’s (2013) that “liking” can affect performance appraisal rating; as managers tend to recall positive experience when rating someone they like, and negative experience when rating someone they dislike. More to the point, as mentioned earlier according to Erez (2015), 13%
of performance rating is accounted to the ratee, while 26% is accounted to the rater, and 36% goes for the relationship between them. Therefore, performance appraisal to be affected slightly by personality similarity is no surprise.

3. A positive but weak relationship between personality similarity and satisfaction about manager indicates that there are many factors that can play roles to improve employee’s satisfaction about his manager, and personality similarity has a small contribution in that; the more they are similar in personality, the more employee will be satisfied but in a limited score.

4. The dominant personality amongst the managers in the sample was Extroverts, which aligns with Crump (2007) claim that promotion to managerial level was related to Extroversion and Conscientiousness, as Judging and Sensing dimensions have multiple characters that are noticed to be similar to Conscientiousness, such as attention to details, being structured, preference for organizing over spontaneous.

Conclusion and recommendations

This paper provided evidence that personality similarity plays a role in performance appraisal in government organizations despite the various errors and biases that exist in this annual process. It had also provided evidence that personality similarity can affect employee satisfaction about his manager. It is true that the relationship between these variables were found to be weak in this study sample, however, with ensuring to avoid the limitations this paper faced, future research studies are recommended to test it again in different organizational set ups.

Furthermore, after knowing that personality plays a role in performance appraisal and employee satisfaction, it is highly recommended that organizations start spreading the awareness about personalities on scientific basis, such as MBTI and The Big Five to ensure a better harmonized environment. Moreover, they are also recommended to increase the awareness of managers about the commonly found biases and errors in performance appraisal ratings, which was extracted from earlier literature, in order to ensure a fairer rating.

References:


Behavioral Finance in GCC financial market Overview, theories, and effects

Nada Rabie, PhD Business Management student  
The British University in Dubai

Abstract

Behavioral finance importance has increased in the past few years a lot. The purpose of this paper is to present a critique about behavioral finance as a starting point to measure and assess the knowledge level among investors in GCC markets on how to manage their portfolios and investment decisions based on behavioral finance principles and theories in the future research. Moreover, based on that research we aim in the future to assist GCC investors to avoid unsuccessful investment decisions based on lack of appropriate knowledge of behavioral finance and psychology of investing. Despite many researchers had studied behavioral finance and discussed how it can be a rescue to investors as it can protect them from false market movements that are based on overconfidence, irrationality, and practitioners’ wrong investment decisions. Therefore, this study will discuss behavioral finance from a different perspective, which is GCC financial markets adoption of behavioral finance applications and will try to fill the knowledge gap in this area. The research questions define the main points that will be discussed and measured.


Introduction

It has been obvious almost eight years after the global financial crisis of 2008, that stock markets’ movements can have a profound economic impact on the economy and people’s life. Although this fact was well known many years ago, especially since “the stock market crash of 1929, which caused the great depression of the 1930s” (AsiaN, 2016). Nevertheless, the tech-stock bubble in March 2000 and 2008 financial crisis had reassured the importance of the evaluation of stock markets’ daily movements as well as individuals and organizations’ investment decisions. As Shefrin (2002) stated that behavioral phenomena is used to play a significant role in the major areas of finance, for instance; portfolio theory, asset pricing, corporate finance, and the pricing of options. Because of all of that, the importance of Behavioral finance started to increase as investors began to consider behavioral finance as a rescue from wrong investment decisions that can cause financial bubbles and crisis. Based on that, behavioral finance was and still considered as an effective management tool in understanding investment decisions and evaluating investors’ behaviors and finally amend investors’ decisions.

This paper discusses how behavioral finance awareness can affect the investment decisions of market practitioners on different levels from individual investors to portfolio managers and
investment managers of huge companies. As a result, it can affect financial markets’ performance and work as a safeguard from financial bubbles and crisis.

**Research objectives**

The main objectives of this study are:

- To assess the knowledge level among investors in GCC markets on how to manage their portfolios and investment decisions based on behavioral finance theories.
- Generate greater awareness among practitioners and investors on the importance of behavioral finance.
- Assist investors and practitioners in evaluating their investment decisions.
- Assist GCC investors to avoid unsuccessful investment decisions based on lack of appropriate knowledge of behavioral finance and psychology of investing.

**Literature review**

The literature review will consider research about behavioral finance in general. More specifically, it will include definitions of behavioral finance as well as its two concepts: cognitive psychology and limits to arbitrage. Moreover, it will also include theories of behavioral finance and the main contributors in the behavioral finance field.

**Behavioral finance**

The foundations of behavioral finance can be tracked back over more than 150 years. As several original books were written in, the 1800s and early 1900s marked the beginnings of the core ideas of behavioral finance school (Ricciardi & Simon, 2000). According to the classical definition of Behavioral finance, which started to appear in different academic journals in the early 1990s, Behavioral finance is “the study of the influence of psychology on the behavior of financial practitioners and the subsequent effect on markets” (Sewell, 2007, p.1). Moreover, behavioral finance investigates the psychological and sociological issues that affect the decision-making process of individuals, groups, and organizations.

Some of the early literature written about behavioral finance was found in the psychology and sociology books and journals. As many scholars and researchers discussed and investigated the financial behavior of investors from a psychological and sociological point of view. Therefore, behavioral finance cannot be studied away from these disciplines. Figure (1) shows the relationship between behavioral finance and other disciplines.
Despite the clear definition previously mentioned about behavioral finance, a more clear definition is required to have a better understanding of behavioral finance discipline, its components and how it emerged in financial markets inefficiencies’ analysis. The next section discusses some of the pioneer definitions of behavioral finance. According to Mullainathan and Thaler (2000, p.1) Behavioral finance “is part of behavioral economics, which is the combination of psychology and economics that investigates what happens in markets in which some of the agents display human limitations and complications”.

The concept of using models in behavioral finance was first introduced by Ritter (2003, p.2), as he defined Behavioral finance as “the paradigm where financial markets are studied using models that are less narrow than those based on Von Neumann-Morgenstern expected utility theory and arbitrage assumptions. Specifically, behavioral finance has two building blocks: cognitive psychology and the limits to arbitrage.”. Shiller (2003) defined Behavioral finance as a “relatively new developed field in finance that combines the behavioral and cognitive psychological theory with conventional economics and finance”. Therefore, we can conclude that behavioral finance helps to provide explanations to stock market inefficiencies by focusing on the psychological and behavioral factors. On the other hand, Barberis and Thaler stated in their book “Advances in Behavioral finance” that was published in (2005, p.1055) a more accurate definition. The definition considers Behavioral finance as

“A new approach to financial markets that has emerged at least in part, in response to the difficulties faced by the traditional paradigm. It argues that some financial phenomena can be better-understood using models in which some agents are not fully rational. More specifically, it analyzes what happens when we relax one, or both, of the two tenets that underlie individual rationality”.
Therefore, it is obvious that behavioral finance emerged from the need to have a more understanding of the psychology of investment decision-making techniques. We can summarize all the previously mentioned definitions in that definition: Behavioral finance is a part of behavioral economics that combines behavioral and cognitive psychological theory with conventional economics and finance to explain market inefficiencies. The emergence of Behavioral finance was a matter of response to the difficulties of traditional paradigm. It uses behavioral models to investigate stock market inefficiencies by focusing on psychological and behavioral factors. The two main components of behavioral finance is cognitive psychology and limits to arbitrage.

**Cognitive psychology**

According to (Pompian, 2006, p.28) Cognitive psychology is defined as ”the scientific study of cognition, or the mental processes that are believed to drive human behavior. Research in cognitive psychology investigates a variety of topics, including memory, attention, perception, knowledge representation, reasoning, creativity, and problem solving”.

Cognitive psychology means that the reality of investors’ behaviors is irrational, unlike the Efficient Market Hypothesis (EMF) that states that investors are rational all the time. The irrationality usually emerges from investors’ preferences and self-beliefs during the investment decision-making stage (Ritter, 2003). Therefore, committing systematic judgmental errors are common in financial markets that can lead to biased expectations toward the future direction of the stock market (MUN et al., 2015, p.17). The effects of cognitive psychology on financial markets is that “the cognitive factors would influence the individual investors and portfolio managers regarding the financial decision making process in terms of risk assessment and the way they process information and make decisions. Therefore, assets prices can move further away from their fair values, resulting in securities mispricing. (Statman, 1995).

**Limits to arbitrage**

“Limit to arbitrage claims that the irrational decisions made by the investors can have substantial and long-lived impact on asset prices. It assumes that irrational investors tend to misprice the securities and it is difficult for the rational investors to undo the price deviations made by the irrational investors” (Barberis and Thaler, 2003, p.17).

The next sections of the literature review aims to highlight some of the main and important historical stages, concepts, theories and the main contributors in the behavioral finance field.

**Behavioral Finance Models**

In the behavioral finance models, Chan, Frankel, and Kothari (2004) argued that:

“Systematic mispricing hinges on three critical assumptions. First, investors exhibit information-processing biases. Second, the biases are correlated across individuals so that in aggregate their effect is not canceled out or diversified away. Finally, arbitrage is limited in
that rational investors face impediments to executing a sufficient quantity of trades against those who exhibit information-processing biases”.

We can conclude that behavioral finance is based on the criteria that some investors are sometimes subject to behavioral biases and irrational financial decisions. “The Evidence of these types of biases are found in cognitive psychology literature and has then been applied in a financial context” (Byrne, Brooks, 2008, p.1).

The behavioral finance literature highlighted that the stock market inefficiencies and biases resulting from the price reversal and momentum effect, serve as the sources of the market trends or some extreme events like bubbles and crashes (MUN et al., 2015).

Therefore, in the next section, we will discuss some of the inefficiencies and biases that commonly cause investors mistaken decisions and inefficiency in the financial markets. Examples of some of the biases that can be found in financial markets:

- **Overreaction**: Dhankar and Maheshwari (2014, p.18) defined Market overreaction as “that stock prices tend to exhibit reversal behavior over the long run, in which, the past losing stocks outperform the past winning stocks, suggesting that predictability exists in stock market returns”.

- **Under reaction**: Barberis et al. (1998) refers to the tendency of stock prices to underreact to the unexpected news or events, which in turn lead to a momentum in profits over the short horizons.

Byrne and Brooks (2008, p.1) discussed the other types of biases such as:

- **Over optimism**: that investors sometimes tend to overestimate their ability and the accuracy of the information they have.

- **Representativeness**: means investors assess situations based on superficial characteristics rather than underlying probabilities.

- **Conservatism**: forecasters cling to prior beliefs in the face of new information.

- **Availability bias**: represented in investors overstating the probabilities of recently observed or experienced events because the memory is fresh.

- **Frame dependence and anchoring**: the form of presentation of information can affect the decision made.

- **Mental accounting**: means individuals allocate wealth to separate mental compartments and ignore fungibility and correlation effects.

- **Regret aversion**: represented in regret theory that will be discussed further in this paper.

To get a deeper insight about the effects of relying heavily on heuristics and biases, check the following figure (2). Alsedrah and Ahmad (2014, p.9) discussed the circle of negative consequences of relying heavily on heuristics and biases that starts with the roots of problem, which is biases, then on the personal level affect both individual rationality in decision-making and portfolio return.
negatively. On the other hand, on the market level, biases causes market mispricing, inefficient stock market that causes bubble burst and stock markets panic.

Source: Figure (2): circle of negative consequences of relying heavily on heuristics and biases (Alsedrah and Ahmad, 2014, p.9)

**Brief early history of Behavioral finance**

The focus of this section is on recent stages and developments that have resulted in the emergence of behavioral finance in financial markets as well as developing financial models to enhance investors’ decision-making inefficiency. It has been well known a long time ago that investors are irrational as well as financial markets are irrational. However, the early model of irrational investor behavior was recorded back in the sixteenth century; it was not until mid-eighteenth century that people started to observe the human and behavioral side of economic decision-making (basics of behavioral finance micro). Scholars at that time used the “utility” concept in measuring the satisfaction levels of using goods and services. Later on, Adam Smith described, in his book “the theory of moral sentiments”, the mental and emotional underpinnings of human interaction and economic interaction (Pompian, 2006, p.20).
On the other hand, the English philosopher, jurist, and social reformer, Jeremy Bentham, developed the utility theory that was adopted and improved centuries later by several scholars including Daniel Kahneman. Bentham wrote on the psychological aspects of economic utility and argued that “people ought to desire those things that will maximize their utility, where positive utility is defined as the tendency to bring pleasure, and negative utility is defined as the tendency to bring pain” (Read, 2004, p.1).

By the 70s of the eighteenth century, more contributions were added to the utility theory. Few years later, three famous economists developed a neoclassical framework. The first scholar Stanley Jevons developed in 1871 the theory of political economy while Carl Menger developed principles of economics. Moreover, Leon Warlas Introduced elements of pure economics between the years (1874 – 1877). The main contribution of those three economists was that their neoclassical framework succeeded in finding explanations of economic behaviors through analyzing the nature of economic agents. therefore, their research was distanced away from psychology and sociology discipline, and building up a new discipline that focuses on making assumptions about financial markets through the observation and analysis of investors’ behaviors (Pompian, 2006, p.22).

Following the neoclassical framework, several economists including Thorstein Velben, started to criticize the Homo economicus approach that supports the concept that human can be fully rational and informed about all circumstances and therefore maximize his expected utility. On the contrary, they presented another concept called “Bounded rationality”. Bounded rationality was presented as an “assumption that individuals’ choices are rational but subject to limitations of knowledge and cognitive capacity. Moreover, bounded rationality is concerned with ways in which final decisions are shaped by the decision-making process itself” (Pompian, 2006, pp.23-24).

Then by the early twentieth century, specifically between 1930s and 1950s, important events started to take place and shape the groundwork and basics of the renaissance of behavior economics as experimental theories started to be conducted like individual choice theory and others. In the next section, we will discuss the nature of GCC financial market in order to have a clear insight about how can behavioral economics theories and models affect it (Pompian, 2006, p.24).

Behavioral finance Theories

Behavioral finance theories are theories of studying human behavior from psychology, anthropology, and sociology. It have helped a lot in motivating conducting much recent research on the behavior of financial markets (Shiller, 1997).

Efficient Market theory

According to Alsedrah and Ahmad (October 2014, p.3) Efficient market theory, was first introduced by Fama (1969). He stated that “stock prices reflect all relevant information. Thus, if stock markets are said to be efficient, then active investors cannot beat the market return on a continuous basis. On the other hand, passive investors can profit on average as active investors do. Rational investors
(e.g. buying undervalued stock) should correct any deviation in prices. As a result, stock prices always reflect their true value” (Alsedrah and Ahmad, October 2014, p.3).

**Efficient Market hypothesis**

According to Fama, market efficiency is based on three hypotheses:

- **Weak form efficient market hypothesis**: stock prices are the reflection of historical information, where trading volume, trading prices, and rate of return are determined by historical information. The result of this weak form is that investors who use technical analysis cannot predict the market performance.

- **Semi Strong Efficient Market Hypothesis**: involves public and historical information. Stock prices are the reflection of both information. According to this form, investors base their investment decisions on technical analysis as well as public information and annual reports. The result is failure of gaining superior return.

- **Strong Form Efficient Market Hypothesis**: involves private and historical information. Stock prices are determined based on both types of information. According to Reilly and Brown (2011) investors who base their investment decisions on historical, public and private information will not be able to achieve above average risk adjusted return.

The major criticism on Efficient Market Theory is that some investment behaviors contradicts with the concept of information. Ang, Goetmann, and Schaefer (2011) stated that “there are a number of observed deviations in stock prices that appear not to be related to any information” (Alsedrah and Ahmad, October 2014, p.4).

According to Shiller (2003) point of view, the development of behavioral finance is mainly due to the regular events of market anomalies and the failure of EMH to explain these anomalies. Stock price anomalies as unjustified deviations that are not directly related to any information (Atkinson and Drake, 2013).

**Prospect theory**

According to McDermott (1998, p.15) Prospect theory is “a theory of decision making under conditions of risk. Decisions are based on judgments. Judgments are assessments about the external state of the world. They are made especially challenging under conditions of uncertainty, where it is difficult to foresee the consequences or outcomes of events with clarity”.

Kahneman and Tversky (1979, p.264) defined prospect theory as “a descriptive model of decision-making under risk first proposed prospect theory. Its key feature is that the carriers of value are not absolute levels or outcomes, but rather gains and losses in wealth”.

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On the other hand, Grinblatt and Han (August 2004) discussed the main element of prospect theory is an S-shaped value function that is concave (risk-averse) in the domain of gains and convex (risk-loving) in the domain of losses, both measured relative to a reference point.

**Behavioral Life cycle hypothesis Theory**

According to Graham and Isaac (2002, pp.2-3), “the behavioral life-cycle theory (BLCT) emphasizes self-control, mental accounting, and framing. Shefrin and Thaler (1988) stated in their definition characteristics of BLCT as enrichment of the traditional life-cycle theory of saving, but it clearly introduces considerations inimical to the neoclassical paradigm. The BLCT hypothesizes that, because of their “impatience”, consumers maintain mental accounts that lead them to treat various components of their wealth as no fungible. The BLCT uses a concept of impatience that conflicts with the neoclassical theory of the consumer”.

**Regret and Cognitive Dissonance theory**

Shefrin and Statman (1985) Regret theory plays a major role in explaining the fact that investors postpone selling stocks that have decreased in value and accelerate selling the stocks that have increased in value. Therefore, regret theory targets avoiding selling losing stocks in order to avoid the regret feeling. However, they tend to sell gaining stocks in order to avoid feeling regret by losing the selling opportunity before the stocks go down again. Later on, Shiller (1999) argued that Cognitive dissonance theory could be represented in the mental conflict that people feel when they are exposed to evidences that proves their mistaken beliefs or assumptions and therefore, their mistaken decisions that are based on their beliefs. Cognitive dissonance can be classified as pain of regret or regret over mistaken beliefs. he also supported Festinger (1957) discussion about the tendency of people to take actions and make decisions to reduce cognitive dissonance. Investors can avoid any information and arguments to maintain their beliefs or assumptions.

We can conclude that regret and cognitive dissonance theory has the effect of changing investors’ decision either by having a regret feeling from making mistaken investment decisions or by avoiding exposing to information that can prove that their investment decisions are wrong.

**Modern Contributors of behavioral finance**

This section presents some review of prior studies of behavioral finance. In this section of the literature review, we aim to focus on articles and books that presented the beginnings of behavioral finance, history of behavioral finance, psychology of investing and its relationship to practitioners’ financial decisions, as well as major contributions and articles with direct relevance to practitioners investment decisions, investment management, and personal financial planning. There is an
enormous literature in the field of behavioral finance that explores the influence of psychology and other social factors on investors’ behavior toward their financial choices.

Given the huge size of research contributions to behavioral finance, this review will be selective. Therefore, the focus here is on the main and major contributions and articles related to behavioral finance.

Despite the fact that most of the major contributions to behavioral finance and psychology of investing were found in academic journals. Amos Tversky and Daniel Kahneman published two articles that have a profound impact on behavioral finance. Their 1974 article in Science deals with heuristic-driven errors, while their 1979 article in Econometric deals with frame dependence (Shefrin, 2000).

The first book that included the basics and main contributions to behavioral finance was written by, Peter L. Bernstein “Against the Gods” book; Bernstein published the book in 1996, as he collected some of the most prominent articles about the historical perspective of behavioral finance. Therefore, Bernstein book included the history of behavioral finance development (Shefrin, 2000).

Moreover, there are number of academics and professors who have great contributions to behavioral finance. This research will briefly mention some of them, and their academic contributions to the field of behavioral finance.

In the modern time Robert Shiller, Sterling Professor of Economics at Yale University and 2013 Nobel Prize winner; have published many books that discuss the effects of Behavioral finance and the psychology of investing. The top important one of them in this discipline is “Irrational Exuberance”, which was first published in March 2000. The book discussed factors outside the stock market that can shape the market’s behavior. As well as the mechanisms that cause factors that have an outsized effect on the market, he also introduced cultural factors that reinforced the structure of the speculative bubble, and presented evidences about the psychological anchors and herd behavior that define speculative bubble (Shiller, 2015). Shiller have other publications that discuss behavioral finance related issues, for instance, “Finance and the good society”. which he argued in it that finance should not be defined as the manipulation of money or risk management but instead it should be defined as society's assets. Shiller also explains how people in financial careers--from CEO, investment manager, and banker to insurer, lawyer, and regulator--can and do manage, protect, and increase these assets. in Shiller’s point of view finance has contributed to the good of society through inventions such as insurance, mortgages, savings accounts, and pensions, and he argued that we need to find new ways to re-channel financial creativity to benefit the society as a whole (Shiller, 2013).

The Second modern contributor to behavioral finance is Professor Thaler, who have added a lot to behavioral finance literature. As he has been the most influential economist in promoting the applications of behavioral ideas to economics. “During the mid-1970s, he showed extraordinary
vision in respect to how the behavioral decision literature would influence the discipline of economics” (Shefrin, 2000, p.5). Thaler published several books all represented a contribution to behavioral finance. The most important one of them is “Advances in Behavioral finance”, published in 2005. Thaler’s book included topics such as: A survey of behavioral finance, limits to arbitrage, stock returns and the equity premium, empirical studies of overreaction and under reaction, theories of overreaction and under reaction, investor behavior and corporate finance. In addition to Thaler’s contribution by a number of academic articles, such as: “The End of behavioral finance” that was published in the Financial Analysts Journal in 1999. In this article Thaler has addressed the “controversy” surrounding behavioral finance as scholars have started to accept it as simply as a new way of doing financial economic research (Thaler, 2010).

Moreover, Shefrin is one of the high-profile behavioral finance professors. Shefrin has many books that discussed behavioral finance and represented a contribution to the academic literature. He worked with Thaler, as the latter was the first to introduce behavioral finance to Shefrin. Shefrin’s most important books in behavioral finance discipline is “Beyond Greed and Fear: understanding behavioral finance and the psychology of investing” published in 2000. He claimed in his book that “our knowledge of market psychology now extends well beyond greed and fear. Over the last twenty-five years, psychologists have discovered two important facts: first, the primary emotions that determine risk-taking behavior are not greed and fear, but hope and fear. Second, financial practitioners of all types make the same mistakes repeatedly” (Shefrin, 2000, p.3). Pompian (2011) has also described professor Shefrin’s many other additional articles and papers as it had contributed significantly to the field of behavioral finance (Pompian, 2011). Moreover, Thaler and Shefrin research paper, “The behavioral lifecycle hypothesis“, have added a lot to behavioral finance academic literature.

Two other academics Shleifer and Statman have also enriched academic literature in behavioral finance discipline. Shleifer most popular book is “Inefficient Markets: An Introduction of Behavioral Finance”, where he introduced the theory of behavioral finance, role and characteristics of noise traders, arbitrageurs, and investors. As well as the limits imposed on arbitrage by factors such as risk aversion or agency problems. Shleifer also searched how investor sentiments are built, while emphasizing some empirical violations to the idea of efficient markets such as price bubbles (Shleifer, 2000). Moreover, Statman has other publications in the field of behavioral finance, such as a paper entitled “Behavioral Finance: Past Battles and Future Engagements,” which is regarded as another reference in behavioral finance research (Statman, 1999).

Moreover, Kahneman and Smith contributions to behavioral finance discipline cannot be ignored. Kahneman was honored the Nobel Prize for having integrated insights from psychological research into economic science, especially concerning human judgment and decision-making under uncertainty. Smith similarly established laboratory experiments as a tool of economic analysis, especially in the study of alternative market mechanisms (Pompian, 2006).
The nature of GCC financial Market

The Gulf Cooperation Council (GCC) has six financial markets which are: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates. The stock markets in the GCC are relatively small, with little listed companies and majority of infrequently traded stocks and weak trading volume. The dominant sector in GCC financial markets is Commercial banks (Hassan and Al.Sultan, 2003)

According to Hammoudeh and Choi (2006, p.23), “the GCC markets differ from those of developed countries and from other emerging markets in that, they are largely segmented from the world equity markets and are overly sensitive to regional political events. In GCC markets, fads or speculative attacks (which are rare) often occur when domestic markets overheat. The GCC economies are also oil-dependent, and on a daily or a weekly basis their oil prices take their cues from the futures prices for West Texas Intermediate (WTI), a primary crude oil stream traded on the New York Mercantile Exchange (NYMEX). GCC stock markets may also be sensitive to the daily or weekly movements of stock prices in the US stock exchanges because GCC investors invest in both sets of markets” (Hammoudeh and Choi (2006, p.23).

Research Methodology

Alsedrah and Ahmad (October 2014, p.3) argued that, “Behavioral finance research is established mainly on experiment studies. Some based on observing trading activity and a few based on questionnaire, but there is a lack of studies that use the multi-method approach, which is a combination of two different quantitative techniques to measure the influence of psychological factors on stock buying decisions”.

Research questions

Based in the previous literature review, this study will attempt to answer the following questions:

RQ1: What behavioral finance add to financial markets’ performance?

RQ2: How can behavioral finance affect GCC markets’ performance?

Research design

The research design will be on two stages. First stage is represented in this paper will be literature review analysis. However, in the second stage that is represented in future research a mixed research design will be used that include both qualitative and quantitative research methods. As the research, design requires different types of data collection to achieve its objectives. The qualitative method is represented in case studies to observe and evaluate the performance of some companies portfolios in different financial markets, evaluate their behavioral finance awareness level. Besides, interviews with specialist, involved in the financial market. On the other hand, the quantitative
The method is represented in questionnaires, and surveys, that measures the level of the awareness level of the GCC financial market practitioners of behavioral finance by numbers as evidence.

The aim of using qualitative method is to, discuss the information gathered about behavioral finance, this will be done through case studies by observing some companies in different financial markets, evaluate their behavioral finance awareness level, and its effects on the markets performance, besides, interviews with specialist, who are mainly involved in the financial market. Moreover, quantitative method is used for providing questionnaires, and surveys, that shows an evidence in numbers about the level of the awareness level of the GCC financial market practitioners of behavioral finance. Both qualitative and quantitative methods will provide the specialists with a clear vision about what is needed to be added for the best of financial markets performance. In addition to, raising the limitations, that are facing the financial market, and the most appropriate way for handling these limitations.

**Scope of study**

The study will represent and evaluate different financial markets. As it will include investors in US, Europe, Iran, Malaysia and mainly the GCC financial markets. Furthermore, the study will include analyzing individual investors, portfolio managers, as well as, institutional investors’ investment decisions. The purpose of evaluating several financial markets is to, have the opportunity to evaluate behavioral finance applications in different financial markets based on cultural differences and other factors and to allow the reader to evaluate them using a comparative point of view. The diversity of behavioral finance applications in different financial markets will widen the scope of the study, and allows generalizing research results.

**Limitations**

While behavioral finance is widely known and practiced by many practitioners in stock markets around the world, its adoption in GCC countries is still less than the expectation. As GCC investors’ are still irrational in their decisions and does not have a good understanding of the philosophy of their decisions. This study is undertaken to fill this knowledge gap. It is imperative to study on how behavioral finance perspectives can enhance the performance of financial markets and maximize investors’ profit in GCC markets.

The GCC financial markets were chosen because the first priority on the political agenda of most GCC nations is the development of finance industry. Although the financial sector in the GCC has grown and developed in a good pace in the previous period. However, GCC financial markets remain small and behind their real potential as there is always a room for improvement and development. The other reason for choosing the GCC market is the region has been facing in the recent time tough challenges in competing with established markets in Europe and America and with their highly dynamic peers in the emerging world.
Moreover, there is a huge lack in the academic literature that discuss behavioral finance effects in GCC financial markets. Moreover, many investors in GCC markets are still unaware of how to manage their investment decision-making and therefore enhancing their performance in managing their portfolios.

Most of the published research papers focused on financial literacy and investors decisions in GCC, but none of them used the concept of behavioral finance to try to understand the decision-making philosophy of investors. Moreover, there is a big lack in research English language-, that focus on GCC finance and economy, as most of the GCC literature review are in Arabic.

As a result, the current study is considered the first of its kind –as far as we know- conducted on the GCC financial markets that is focusing on GCC investors’ decision-making philosophy and behavioral finance applications. To the best of our knowledge, no such studies have been conducted regarding behavioral finance and decision-making philosophy in GCC or the relationship between behavioral finance levels and its influence on investors’ financial decision. The next section will go through the literature review of behavioral finance.

**Sampling**

There will be two types of questionnaires to measure the awareness level of random samples of investors in GCC financial markets. First, questionnaire conducted pre-information session to evaluate their awareness level of behavioral finance and psychology of investing before providing them with information. Second, questionnaire conducted post information session to measure the acquired information and skills from the information session. Later on, there will be a follow-up, and evaluation for the investors’ performance based on the knowledge they acquired from the information session and how it affected their investment decisions.

**Findings, Conclusions and Expected outcomes**

The research findings is supposed to add to the knowledge and the understanding of behavioral finance, and decision-making psychology, and the effects of its applications in the GCC markets. This study succeeded in:

- Defining and assisting the understanding of behavioral finance and its importance to financial decision-makers.
- Provide useful knowledge on behavioral finance and psychology of investing in different financial markets.
- Generate greater awareness among practitioners and investors on the importance of behavioral finance.
- Assist investors and practitioners in evaluating their investment decisions.
- Assist GCC investors to avoid unsuccessful investment decisions based on lack of appropriate knowledge of behavioral finance, and psychology of investing.
Although the previous literature review has only discussed a few points on behavioral finance and its effects on investors decision making techniques and investors’ behaviors. we can confirm that this literature review assisted in providing a clear understanding on behavioral finance and the stock market behavioral inefficiencies. Based on the analysis of the literature review we can conclude that:

- Ackert & Deaves (2010, p.251) were true when arguing that behavioral finance plays an important role in shaping our understanding of how people value assets in various markets, from tulips, to stocks, to experimental assets. As Investors and academics tend more to value assets based on observable tangible factors, while real world experience indicates that human feelings and expectations affects asset-valuing process.

- All stock markets are inefficient because the investors inside it behave irrationally during making investment decisions.

- There is a variety of types of biases such as: overreaction, under reaction, anchoring, over confidence, etc that affect investors’ decisions and therefore overall market performance.

- Despite the disadvantages of market inefficiencies, it sometimes plays a positive role in assisting investors to predict stock returns and therefore obtain abnormal profits.

References


Youth Empowerment Towards Social Responsibility through Service-Learning Program: an Exploratory Analysis of a Private High School in Dubai, United Arab of Emirates

Roeia Thabet, EdD student, The British University in Dubai.

Abstract

This study investigates student personal development and sense of social responsibility through a service-learning program in a private high school in Dubai-UAE. This study utilized a qualitative research approach with a single case study design to provide a rich and contextualized picture of the program from multiple perspectives (school leadership, teachers, service-learning team and students). Data was collected through triangulation by means of semi-structured interviews, focus groups, participatory and non-participatory observations, field notes, artifacts, and document analysis. Content analysis was used in analyzing the collected data to identify emerging themes and patterns related to service-learning and its effect upon students. The study’s findings revealed that the school applied essential elements of service-learning. The participants of the service-learning program exhibited social responsibilities of greater community awareness, teamwork, commitment to community, gained self-esteem, and self satisfaction as they reflected on their ability to accomplish their tasks. This study’s goal is to bring about educational policy pertaining to service-learning as a legitimate educational pedagogy to be adopted in the UAE schools. This study hopes to contribute to service-learning program research and enrich knowledge and best practices in the UAE and worldwide.

Introduction

An urgent need for youth involvement in constructing society and contributing to a harmonious community has become a recent movement in the world and particularly in the Middle East. As the Middle East region is going through tremendous transition, a great need for social responsibility attitude is essential for creating a better society where every individual is playing a vital role in caring for others and understanding the value of social responsibility (Corps 2012). The majority of the empirical research in this area has unanimously identified common positive impacts on young students’ personal and social development. While research provided mostly quantitative evidence that service-learning has multiple benefits for students, there was clear gap in the literature for more qualitative studies regarding both process and effects of the program in schools.

This research study’s goal is to reveal rich information on how a service-learning program is applied within its known framework in a private high school in Dubai. This will shed light on the challenges and concerns that occur as the service component is linked and integrated to the UAE academic curriculum. There is a genuine need to investigate and review the newly applied service-learning program in a private high school in Dubai. The purpose of this study is twofold; the first is descriptive, which will focus on describing and exploring how private high schools (students ages 14 to 17 years
old) in Dubai are fostering and carrying out the service-learning program. The second is to investigate the empowerment of students, through the act of service, with subsequent development of social responsibility that results from their contribution in their society. The purpose of this study is to examine the role of schools in developing students’ personal and social responsibility.

The significance of this study is it will enrich service-learning literature by describing the application of a service-learning program through the UAE context. Although service-learning is valued as an active learning strategy across the globe, little is known concerning its similarities or differences within various contexts across cultures. This research is one of the few qualitative empirical service-learning studies. It is hoped that the study’s results concerning the effects of service-learning and the empowerment of young students through social responsibility will assist other schools to understand the importance of implementing this program. The study also hopes to contribute to educational policy to enhance the program by developing more detailed strategies along with support for students and schools.

**Literature review**

Many authors have utilized the theoretical framework of how service-learning promotes social and personal development in young students. This direct link was demonstrated and explained cohesively by Youniss & Yates (1997), which is built on Erikson’s (1968) theory of identity. They suggest young individuals attempt to search for their identity and develop ideologies and values, which ultimately affect their adulthood lifestyle. According to Erikson (1968), adolescence is the time that identity starts to shape one’s personality resulting in their future adulthood identity.

During this remarkable stage of the human life cycle, adolescents experience rapid psychological and physical changes. For example, by the age of 12 signs of transition start and continue till the age of 15 or 16. They will gain height, build muscles, and different hormonal changes in boys and girls start to shape their physical appearances. They will go through puberty acquiring physical changes. The physical developmental stage interrelates closely to psychological transition. They begin to experience mixed feelings of sensitivity, anxiety, and awkwardness, which might generate contradictions in one’s behavior. Erikson describes this period of time the period of ‘crises’ (Erikson 1968; Kellough & Kellough 2008). In an attempt to understand the meaning of students’ interest in community service, this study builds its argument on Erikson’s theory of identity formation as students establish their self-development within a collective social context.

Erikson (1968) refers to *identity crises* as the process that many adolescents go through to form distinctive features of their self-personality. They become fully aware of the need to form a meaningful identity that includes values, beliefs, history, and future objectives of life. This will take the individual to another stage called discovery that is linked to the philosophical concept of the true self. Individuals start to discover their potentials, capacities, values, and unique abilities that distinguish them from others and the ability to differentiate between right or wrong, etc.
This research study seeks to link the theory of identity development in students through a service-learning program and to explore the extent of its impact on students. It also emphasizes the extent to which the service-learning program affected the moral judgment of the participants by looking at specific elements and processes that led to the development of moral agency and sense of social responsibility towards society. Hence, the reason behind building this study’s framework upon the theory of identity formation goes beyond the intention of understanding how identity is formed in adolescents. The main objective is to understand what constitutes a noble and meaningful identity that reflects social responsibility.

Historical Background of the Service-Learning Program

The philosopher John Dewey (1916) was one of the first educators to introduce the concept of connecting schools to communities through service. He believes that the goal of an educational curriculum system is to link to students with the community to meet the needs of society and its social welfare (in Arenas, Bosworth, & Kwandyi 2006). Dewey’s theory of linking school life to the surrounding environment called for a new form of pedagogical approach called ‘service-learning’.

However, Dewey takes this concept deeper than mere application of academic learning to a higher level of human interaction to contribute in social life. He perceives schools as social institutions that create venue for social reform rather than mere learning institutions. As a result, students flourish in an environment where they are provided opportunities to experience and interact with the curriculum within the social context. Building on Dewey’s theory, Counts (1932) stresses that education should prepare students to become agents of change and build their society through their skills, knowledge, values rather than to become selfish consumers.

Definition of ‘Service-learning’

The name service-learning program is defined as a “pedagogical approach that integrates community service with academic study to enrich learning, enhances social responsibility, and strengthens communities” (National Service-Learning Cooperative 1998). The main differences between service-learning and community service is that service-learning is a method, which combines curriculum objectives and standards with community service for students to carry out service projects that meet real community needs. On the other hand, community service primarily focuses on applying service projects in the communities with no direct link to curriculum objectives and doesn’t necessarily involve intentional or prescribed learning goals (Edwar 2002).

Essential Quality of Service-Learning Practice Guidelines

The Essential Quality of Service-Learning Practice Guidelines developed by National Service-Learning Cooperative (1998) guided this study to explore the application of the program in the UAE context. The Essential Quality of Service-Learning Practice Guidelines were developed as a result of a series of studies and examination for the past decade to understand why some service-learning programs were able to achieve positive outcomes on some students compared with other students either within the same school or others (Billig 2000). The guidelines included linking Classroom concepts to service-
learning activities, students’ voice in planning, executing the projects, and evaluation through reflection methods.

Outcomes of service-learning program

A body of research studies conducted over the past decade reported positive outcomes of a service-learning program on students’ personal, social, and cognitive development. Findings found that participating students in this program gained: self esteem, confidence, sense of commitment to society, long-term engagement in community service, developed moral attitudes (respect for others), empathy, justice, sense of caring for others, teamwork and self-efficacy (Conrad & Hedin 1982; Newmann & Rutter 1983; Moore & Sandholtz 1999; Muscott 2000; Steinberg, Bringle & Williams 2010).

Youniss and Yates (1997) report that almost all the graduated students in his study research continued engaging in voluntary and civic acts of service in various forms, while others demonstrated deeper understanding and feelings of social relatedness, empathy, and care for others. They concluded that excerpts from the graduated students after 6 years, illustrated that as individuals move beyond adolescent into adult life they often maintain continuity with their past. The participants were involved in activities during the crucial period of identity development, which guided them with meaningful objectives in their lives (p. 128).

Service to Community in the UAE Context

On the local level, the UAE recently started encouraging schools and students to be involved in a community service program and urged schools to prepare programs in their educational system to engage students in serving the society (Al Bayan 24 April, 2014, p.7) and (Al Khaleej 22 December, 2013). The Ministry of Education and Human & Development Authority (KHDA) inspection standards share the important role of Social Responsibility in the UAE Vision 2021. They emphasize the role of schools in developing students’ personal and social responsibility in the UAE context.

School inspection reports published by Knowledge and Human Development Authority (KHDA) in Dubai indicate that many private schools provide opportunities for students to carry out community service programs for involvement in society’s affairs (Knowledge and Human Development Authority 2013). These reports indicate the existence of these activities in schools. The KHDA school report attempts to assess schools based on criteria that include ‘students’ personal and social development’. There is little known about the quality of the service programs, the extent of students’ participation in UAE private schools, and the program’s impact upon students’ sense of social responsibility. The school reports include brief descriptive paragraphs of service programs carried out by schools. This study intends to investigate this important element in high school students.
Methodology

Research Design

Most service-learning quantitative studies provided consistent evidence of the positive impact of service-learning on students’ personal development and sense of social responsibility. There are some researchers that consider it an imperfect approach, as it is a complex to evaluate students’ perspectives. This created a clear need for more qualitative studies to bridge this existent gap in research (Hamilton & Fenzel 1988; Conrad & Hedin 1981; Billig 2000; Terry 2000). Thus, this study adopted qualitative approach to bridge this gap in the literature to generate new knowledge in the field of service-learning research. It adopted an embedded single case study design to examine the application of a service-learning program in a particular school in Dubai. The subunits include the investigation of the process of application by the school management, service-learning team, teachers, and students. This includes more subunits of the investigation of each unit as well. For example, the unit of school management includes understanding the vision, mission, and policy regulation related to a service-learning program, while the service-learning team unit includes reviewing their training and preparation materials. It builds upon the teachers’ unit of lesson plans, activities, and class observations. It also includes the students’ unit of written reflective feedback, planning, and application details of the service-learning projects in the field.

Site Selection

A high private school in Dubai was selected. Care was taken in selecting the school to answer the research question and add rich-information to the service-learning research worldwide. The selection of the site was based on schools that apply a more intensive service-learning experience, which the program’s application utilized the same term ‘service-learning program’. The selected case study school is located in the Deira area in Dubai and offers K-12 education for 2,682 students and 1,802 are Emirati local students. Hence, the largest nationality group students are Emirati nationals. The school offers both American and Ministry of Education (MOE) curriculum that provides students with the choice to select their curriculum preference. This study was conducted in the American curriculum section since a service-learning program was applied only in that section. The school follows gender segregation system in which boys and girls are segregated into separate sections within the same school starting from grade 6.

Participants

Purposeful sampling was applied in selecting participants who actively were engaged in service-learning program over one academic year to provide rich information related to the purpose of the study. Participants were selected for this study based on four levels to answer the research questions and provide rich information for this study: The first level is the school management, which includes the principal and school administration. The second level is the service-learning team, which includes the team leader and the service-learning coordinators. The third level includes participants’ teachers in the service-learning program, and the fourth level is participating students in the program who are
the core of this study. This study selected students that were involved in service-learning projects with the same teachers for one whole academic year to be part of students’ focus group interviews.

Data Collection and analysis Methods

An interpretative tradition was adopted by this study to make sense of participants’ perceptive, interpret their meanings, to analyze the training materials and students’ written feedback. This research used a single case strategy with the goal of providing a rich, contextualized picture of the phenomenon under study. Data was collected using qualitative methods of semi-structured interviews, focus groups, participatory and non-participatory observations, and artifacts related to the context of service-learning application. Moreover, document review method was considered one of the important methods in data collection of this study, which included: UAE strategic plan, KHDA inspection reports, newspaper articles, students’ written reflective feedback, training materials, action plan, teachers’ time-table, SL team leader reports, students’ presentation documents, and orientation documents. An ethical approach was obtained from participants in this case study and was guided by BUiD’s (British University in Dubai) ethical code of conduct. Provisions for trustworthiness were incorporated within the study through triangulation by employing multiple data collection methods and examining participants’ perspectives from various means. In addition, other provisions included prolonged engagement on site and member checking. Multi-methods were used in analyzing interview transcripts, photographs, observations, documents and field notes depending mostly on Miles and Huberman’s (1994) guidelines. These steps included data management, reading, memoing, and coding. All interview transcripts, observational notes, and students’ reflective feedback were coded and analyzed, which were followed by presenting and displaying data. Students’ reflective feedback documents were processed and displayed in a matrix design as recommend by Miles and Huberman (1994) to facilitate interpretation. Accordingly, the interpretation phase included lessons learned and insights from analyzing data through a descriptive analytical approach. The collected data was analyzed based on content analysis approach using a coding and thematic system. In brief, 6 interviews were conducted that included school leadership, teachers and a service-learning coordinator. Total 6 focus groups including 56 students from grade 9-12 for both girls and boys. In addition 79 written reflective feedback papers were collected as well as 15 observations were conducted.

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Findings

Results presented in this section sought to answer the first research questions: How a service-learning program is applied in a private high school in Dubai?

The historical development of the service-learning program evolved over the span of years from a school-based community service program to a service-learning program due to several shortcoming of the program. The school applied a service-learning program from the beginning of the academic year 2014-2015 incorporating many elements of quality service-learning practices.

The process and strategies were applied on three main levels:

1. **On the level of school management and teachers.** This level included a short presentation about service-learning to the school principal to illustrate the main vision and objective of the program. This was followed by teachers’ orientation and request for voluntary participation in adopting the program. Then, teacher’s training sessions were held for the nominated volunteered teachers followed by expansion of the service-learning team to support and accompany teachers. Modifying teachers’ schedules and school timetable was another vital process adopted by the school management. Moreover, teachers and students engaged actively in the service-learning celebration and the school management supported all the financial cost of the celebration.

2. **On the level of students:** As for this level, many of service-learning essential elements were followed, such as allowing students’ voice in suggesting, planning, and applying service-learning projects. Prior to this stage, series of students’ workshops were carried out to prepare them for social responsibility toward society. It explained the aims, objectives, and process of the program. In addition, students played a vital role in the preparation of the program celebration to present their projects to parents and community partners.

3. **On the level of service-learning team:** Service-learning team followed a series of strategies and processes to support teachers and students. For example, they prepared the component of the program, which consisted of training materials for teachers and students. They conducted orientations for parents, developed partnerships with relevant social agencies, organization, and community partners. They also played a vital role in accompanying and assisting individual teachers in their class and service field. Moreover, developing an evaluation system and action
plan was part of their responsibility in this program. Evaluation of the service-learning program was derived from three sources. The first was from students’ self report, which included their reflective feedback, presentation of their activities, artwork, and their active involvement in the program. The second was derived from teachers’ feedback in teachers’ reflective meetings through constant verbal discussions with service-learning team. The third was based on service-learning team members as each accompanied several teachers throughout the year in all the program’s phases. Accordingly, they witnessed all types of challenges and achievements of teachers and students while in the field with them. The school applied essential service-learning elements. These included service projects linked to the curriculum, duration and intensity of project, reflection, students’ voice, partnership with community agencies, evaluation of students, and the program as a whole.

The following section focuses on answering the second research question: *To what extent does a service-learning program contribute in students’ personal development and sense of responsibility?*

**Change of Preconception Perspectives**

Many students commented on gaining new perceptions after they engaged in their service-learning projects. They clearly admitted their preconception changed once they entered the real life field and interacted with people in various contexts.

**Self Esteem and Confidence**

Many students described feelings of accomplishment and satisfaction because they were able to interact with others, help, bring joy and happiness to the people they served. As a result, they did feel confident and developed self-esteem. It was noticed that most students used similar phrases or words to describe their feelings in gaining self-esteem in their written feedback and interviews.

**Sense of Joy and Teamwork**

Sense of joy and teamwork was interrelated in students’ responses. Many students expressed great sense of joy in two contexts. The first in the context of carrying out service projects as they interacted with people and tried to help them understand their issues, etc. The second was in the context of joy in working in groups and developing a sense of teamwork. As discussed earlier in the conceptual framework that adolescents in this period seek to belong to peer groups and enjoy carrying out activities in order to feel accepted among their peers.

**Development of Knowledge and Skills**

Students reported that they developed knowledge and skills throughout the projects. Feedback included their knowledge of community’s issues increased as well as global issues. Moreover, the enhanced knowledge of their surrounding was expressed through self-investigation, research,
preparing presentations, public speaking to raise awareness among their school members and in their community. They also developed skills of planning, consulting, time-management, and communication with community agencies. In addition, their knowledge and skills went beyond mere acknowledgment of the certain issues to expressing a desire to carry out actions to make a change though it might seem small and insignificance.

Students’ Sense of Ownership

In response to the research question of understating the process of applying service-learning program in a school, part of this question was answered through student’s replies of how they carried out their service-learning projects. Most of the students’ responses indicated their ownership of the project, as they wrote in detail in their reflective feedback and talked thoroughly in their focus group interviews about their project application. They also were able to reflect on the steps and the process of their projects from the beginning till the end.

Development of Sense of Social Responsibility

Most of the responses indicated that a sense of responsibility developed in students due to their acknowledgements of their moral behavior that they acquired throughout the program.

Long-term engagement: Most of the students, who actively participated in the service-learning program in the first semester constituted with more confidence in the second semester and showed stronger commitment. The majority of them expressed their desire to continue serving their community.

Strong connection to community: Students reported a strong connection to their community to help and make changes after reflecting on their experience and entering the reality of others. They felt responsibility towards their society.

S1 “We are the citizens of this country and it’s our responsibility to help people and give ideas to build our society.”

Another student from the same class commented:

“I understood the feelings of people who have problems and tried to help them by finding solutions for them.”

Empathy and Compassion

Some students expressed empathy and compassion towards certain situations they encountered and towards some people they met during their service project. Feelings, such as sadness and disappointment followed by their desire to do something about it were quoted often in their response. This indicates that through their involvement in planning and carrying out service projects they were
able to develop awareness of the community. They realized that there are various realities in the world other than their own reality, which they are not aware of until they got involved directly in the field. However, taking action to change the situation was not in all the students’ responses. Some of them felt that it is not a responsibility of one person to change but the entire society including its intuitions. It is noticed through analyzing students’ responses that compassion was the main trigger to start reflecting on their own preconception thoughts and creating a sense of community involvement.

Recurring themes emerged while analyzing the collected data, which included greater community awareness, teamwork, commitment to community, increased self-esteem, and self-satisfaction as they reflected on their ability to accomplish their tasks. Students demonstrated acquisition of moral characteristics such as, care for others, respect and empathy, joy and happiness in applying service projects.

*Service Learning Team as Role Models*

One of the key findings in this study was analyzing the role of the SL team including the team leader as they were considered the main engine of the program. First of all, the three members of the SL team were role models for the program not only for students, but also for teachers and school management. The SL team consisted of active members in the community service program. Their knowledge and field experiences in voluntary and service activities enriched the program, which they established relationships with social and government organization to provide opportunities for students to carry out their service projects. Their commitment to volunteer to facilitate the service-learning program in the school was an example of the teachers, students, and school management believing in voluntary community service along with striving to make a difference in the society.

*Discussion*

This study provided strong empirical evidence on applying most of the essential quality elements in service-learning and adding few into these elements as the program evolved during one academic year in this school. Most interestingly, many of these essential elements were adopted due to intensive consultation and reflection between Service-learning team, school leadership, and teachers.

*Development of a Structured Program*

The school applied an organized structure for the service-learning program that was aligned with the literature review. In general, the findings of this study revealed that one of the most significant steps undertaken by the program was to develop a structured action plan. It was not rigid, which allowed for changes and modification throughout the year. This structured action plan provided clear vision for teachers and students to understand the objectives and outcome of the program. Through developing an action plan based on essential quality elements of a service-learning program, this process helped all participants in the program to understand the big picture of the program.
Consultation, Action, Reflection

‘Consultation, action, and reflection’ was one of the themes that emerged during analyzing the findings from various dimensions. This approach was adopted in different settings, phases, and among all the participants. For example, the SL team leader always consulted with the school principal from the beginning of the program till the end of the academic year concerning every step of the program. These steps included, nominating teachers, students and teachers preparation, time tables, school calendar, and spreading awareness of the program in the school, etc. Moreover, the SL team leader reflected with the school principal and updated her after applying each phase in the program reflected upon the challenges, achievements, and analyzed the outcomes. She consulted about overcoming obstacles that the program faced and this cycle of consultation and reflection continued in all the phases. This process of ‘consultation, action, reflection resulted in reviving the program rather than developing a rigid system that doesn’t allow a chance for modification. However, it doesn’t mean that the program was carried out from random un-organized activities, but it preceded a constant rhythm of consultation, action, and reflection. Hence, it can be noticed that the program was propelled by a framework and then expanded based on collective gained experiences believing that each context has its own unique needs.

Exploring Moral Identity through Action

Many students expressed their gratification for having the opportunity to perform acts of service in the community as they felt some emptiness in their lives. When they were asked about their opinion of a service-learning program in their school, some students reported that they always wanted to perform community services, but they didn’t know how and where? Erikson and Dewey could closely link this insight to the theory of identity formation in this particle stage in adolescents’ life as described. Based on evidences derived from teachers and students’ interviews in this study; some students who were labeled as inactive, shy students, or non-participative students in class, showed remarkable participation in service-learning projects.

Increase in Sense of Social Responsibility

In this study, one of the main advantages of a service-learning program, as expressed by many students, was the realization of their capacity to conduct acts of service and helping others in their community through direct interaction with people. Many students repeatedly expressed feelings of pride in their ability to ‘make the change’ after carrying out service projects. These findings indicate that students were able to discover their potential, which in this sense refers to their identity as individuals who can make a positive change through practical service projects. According to Erikson’s theory (1968), discovery of one’s self-potential starts to form during the stage of adolescence through meaningful social interactions.
Beyond Meeting Mere Curriculum Outcomes

Consistent with the literature, this study presents evidence of new learning experiences that were acquired by students beyond theoretical academic objectives. For example, some students expressed their new realization of the role of teacher and their hard work for one full school day. Their academic lesson was about *The Teacher who made a difference in students’ lives* and they had to plan for a service project relating to their lesson. Upon reflecting on their feedback, it was noticed how they tackled other aspects of a teacher’s life. They described the attributes that they developed throughout their experiences, such as patience, love, sincere love and kindness, the importance of proper preparation, the amount of work to prepare one lesson, and the importance to be a role model for their students as they look up to them. At first, students were able to reflect on the attributes and skills that they developed, but later they associated their leaning experience to the role of their teachers and resulted in expressing their appreciation of their hard-work and commitment to change their behavior in class as a token of appreciation. This means that the service project met the required pre-determined outcome objectives of a lesson to understand the role of teachers in students’ lives. It went beyond that as students encountered other aspects of teachers’ life characteristics that they hold, and actual process of their work. Various dimensions occurred during the project, such as developing communication skills, moral behavior, and discussion of the detailed work of teaching career.

Service-Learning Program Challenges

In general, challenges that faced this school are categorized into three main categorizes, challenges that faced the teachers, students, and the service-learning team. The challenges included teachers’ workload, difficulty in connecting community service with curriculum objectives, teachers’ dropouts and withdrawal, late responses from social and service provider agencies as well as lack of cooperation and support by subject department coordinators.

Recommendations

The results of this study provided many significant insights to realize that adopting and applying service-learning program cannot be achieved only by schools’ efforts. These findings suggest policy implication for applying a service-learning program to be fostered in schools on various levels as well. They are as follows:

1. Institutionalizing service-learning program in schools.
3. Integration of service-learning into the education process.
4. Developing a support system for schools.
5. Enhancing teachers training programs.
7. Enhancing community partnership.

Conclusion

Findings of this research study suggest that a service-learning program enhanced to some extent sense of social responsibility and personal development in students. The findings support the view that a service-learning program, in its various forms and structure, provide rich and valuable opportunity for students to develop identity that revolves around social responsibility. This study indicates that many students often reported that through their participation in service-learning project they acquired many values and personal attributes that helped define their sense of identity.

In evaluating the outcome of service-learning program on students’ personal development and social responsibility, it is useful to make the distinction between impact as an immediate measurable change, and process of gradual change in students as well as individual and collective change. Consequently, service projects related to curriculum produced far more outcome than predicted outcome determined by the curriculum objectives. Through the combination of these two, students gained clarity about their self, aspirations, moral attributes, and enhanced their understanding of the connection between needs of their community and their role in addressing them. In sum, these findings not only reinforce much of what is already known in the literature, but also, add a more in-depth descriptive first-hand account from participants’ perspective of service-learning program in their school.

To this point, findings of this study supported adolescent theories that emphasize the importance of providing a special platform and environment for students to form ‘meaningful’ identity, and discover their moral attributes once engaged in structured social programs. Community service projects are not considered end results; rather it is only one process among a series of other process to help young students analyze, reflect, develop sense of social responsibility, and care for others. Therefore service provision is not seen as ends, but as an important step towards understanding the concept of service as an overall social structural change, which requires more complex and long-term vision and dedication. This means that in order to develop these attributes in young students, they should go through an intensive, complex, and long process program rather than one fast shot of short term event with a tick-mark that they obtained their required service hours. Through exercises of these two elements (learning and serving) in a school life, it is hoped that this program will engrave in young students, in the long term, a meaningful and noble aspiration, in which they will strive to contribute positively to local and global affairs through their knowledge and skills.
References


A Study of Code Switching Occurrences in ESL Classes at the Tertiary Level in UAE

Doaa Mostafa, EdD Student
The British University in Dubai

Purpose

The study aims at finding the reasons behind code switching occurrences in ESL classrooms, the frequency of its occurrences and the attitudes of ESL teachers and learners towards this occurrence at UAE tertiary level.

Design/Methodology/Approach

This study poses three research questions about linguistic and sociolinguistic aspects that are related to code switching. The approach in the current study is based on triangulation; therefore, the researcher conducted classroom observations, interviews and questionnaires. The researcher used mixed methods; interviews were analyzed using qualitative methods while the observational checklists and the questionnaires were analyzed quantitatively. The rationale behind choosing qualitative methods is to be able to obtain knowledge about the subject investigated from the teachers’ point of view using interviews. It was hard to obtain this knowledge through mere questionnaires and observational checklists because the researcher needed to dig into the way teachers think and focus on the subject of investigation which is code switching. There was a need to explore why teachers switch-code if they do, and what is their frame of mind while doing so. In addition, although observational checklists are considered quantitative as they depend on numbers and the frequency of code switching occurrences, but the researcher wrote some important notes at the time of observations as there was a designated space in the observational checklists for taking notes.

The rationale behind using quantitative methods in observational checklists and questionnaires is to obtain relevant statistics reflecting the students’ acts and opinions.

The theoretical framework chosen for this study is Myers-Scotten’s Matrix language frame model: MLF (Myers-Scotten 2001). This model is used to analyse code switching occurrences.

Findings

The findings of this study cover the two aspects targeted; the sociolinguistic aspect which is dealing with motives and perceptions of teachers and students towards code switching, and the linguistic aspect which is dealing with the linguistic constraints.

As for the linguistic constraints, it was found that when students switch to L1 in the classroom, they do not do it freely. Usually they follow the structure and the syntactic rules of the ML which is English. It was also noticed that the students mainly insert content morphemes from the EL (Arabic)
to the ML (English), while system morphemes came from the ML only. On the other hand, code switching instances were not limited to intra-sentential code switching as there were many instances of inter-sentential code switching too. It is worth mentioning that during observations, the researcher noticed that inter-sentential code switching occurrences were more in number than intra-sentential code switching occurrences.

During the observations, it was obvious that students inserted some Arabic lexical items from time to time as a defense mechanism to maintain communication with their teachers and their peers. This finding corresponds to what Sert (2005) concluded in his study about the students’ need to express themselves in the classroom, and that they fulfill this need through resorting to L1. It was also noticed that code switching was used sometimes by the teachers to facilitate understanding, and this finding also agrees with Greggio & Gil’s (2007) findings in their study about code switching. They mentioned that code switching was always used to maintain effective communication. Alegría de la Colina & Del Pilar García Mayo (2009) also stated that teachers dealing with learners with lower levels used L1 to facilitate learning.

The second aspect targeted in this study, which is the sociolinguistic aspect was revealed through the perceptions of students and teachers towards code switching. Through questionnaires and interviews, it was clear that both teachers and students regard code switching to L1 negatively, and this finding agrees to the findings of Yao (2011), who mentioned that both teachers and students regarded code switching as a sign of weakness. Another example would be the fact that teachers had negative attitudes towards the use of L1 in ESL classrooms. This finding agrees to the findings of Taskin (2011), who mentioned that teachers did not think it is a good idea to use L1 in their classrooms and that’s why they kept its use to a minimum.

In addition, the use of code mixing was also noticed extensively; students produced new forms and words that are mixed and borrowed from both L1 and L2, this finding agrees with Thomason’s (2001) findings, who stated that students resorted to L1 to facilitate communication.

**Research Limitations/ Implications**

The limitations of the study are summarized in the following; the numbers of classes and the sample size were not large enough. Therefore, it is difficult to generalize the results on the country level. Another issue is the fact that the three universities chosen belong to one kind of educational institutions which are private institutions that combine Arabic and English as the language of instruction.

For future research, the sample size should be enlarged and more time should be allocated to the study, this will give researchers a better understanding and a more comprehensive view about code switching. The sample population should also include students from different levels. In addition, more research should be directed to L3 classrooms and how the use of L1 and L2 affects the process of learning and teaching in those classes.
Practical Implications

The outcome of the study confirms that using L2 solely in ESL classes is preferred by the teachers and the students. However, this does not mean that using L1 sometimes is a big problem. It was found that both teachers and students switch code, and that this phenomenon is unavoidable. Policy makers and educators can make changes to the practice by hiring bilingual teachers who are highly qualified, so they can deal with any problem or interruption of communication in ESL classes and who can understand the transfer effect from L1 to L2.

Social Implications

Most people believe that students being exposed to native speakers will cause a significant improvement in their accent. This is a misconception in society that should be corrected. Science tells us that after the critical period, students will develop an accent any way. It is better to learn on the hands of experienced and qualified teachers rather than just hiring native speakers who might not be qualified to teach English.

Originality/ Value

This study is unique because no similar studies were conducted in UAE.
References


Undergraduate physiotherapy students’ performance in theoretical and practical examinations: A correlational study to analyse the grades in a summative written examination and objective structured clinical examination.

Senthilnathan Ramakrishnan, EdD Student
The British University in Dubai

Abstract

The study aimed at finding the correlation between the theory and practical examination marks of first year physiotherapy students and explore the possible contributing factors for differences in performances. Mixed approach was employed and there was no significant differences in the scores of theory and practical exams as the mean of theory (40.05) and practical (40.03) were nearly equal and the r value (0.672) indicated moderate positive correlation but individual differences in performances between the written and OSCE noticed. Students and lecturers were interviewed and qualitative data analysis identified assessment methods, instructional strategies and learning styles were the contributing factors.

Introduction

Health sciences education prepares graduates to become healthcare professionals who would work closely with patients which demands an array of skill sets that are associated with practical application of the core knowledge. This particular attribute requires the ability to interlink the theoretical concepts to clinical context which demands competence in practical skill. But the students in healthcare education programs were often seen to read a lot and spend more time on academic tasks that are associate with theory building rather than focusing equally on practical skills. The physiotherapy undergraduate students are also not exempted from this approach to learning and the reason behind this attitude raised few queries. Major one was, what drove the students to be bookish?

From personal and colleagues experience of evaluating student’s performances there was a notion that the undergraduate physiotherapy students were not performing well in practical skills compared to theoretical testing. Numerous factors might have been responsible for such differences and this study was needed to test the trueness of the assumption stated and explore the potential factors that might have contributed to the difference in students’ performances in the written and practical assessment tasks. Teaching approach to physiotherapy practice module was both theoretical and practical that consisted of lectures, practical classes, self-directed sessions and interactive workshops. On completion of physiotherapy practice course students were expected to demonstrate range of skill sets related to diagnosis and treatment. The core objectives of this course were associated with practical skills and it was important to assess attainment of these outcomes by performance (Fchs.ac.ae, 2015).
According to Wass et al., (2001) assessment is vital to measure the learning as well as a step forward in teaching of health sciences because it provides feedback for continuous improvement. Assessment is also the way to evaluate the attainment of learning objectives and check the progress. There are various assessment methods or tools such as multiple-choice questions (MCQ), extended matching questions (EMQ), modified essay questions (MEQ), essays, quizzes, oral presentations and practical examinations with short or long cases and/or objective structured clinical examinations (OSCE) are used to assess the physiotherapy students’ performances in both the formative as well as the summative examinations for providing feedback and awarding grades. According to Jones and Sheppard (2012) to enhance the level of students’ knowledge and skills, promote autonomous practice and to be a competent clinician who is responsible and accountable for the society it is important that the assessment of practical skills should draw a wider attention in physiotherapy education.

It is often expected that if a student performs well in a written examination the same could be expected in the physiotherapy practical exam as well. But from experience it was noted that this was not true because the scope of these exam differs and tests two different domains. The written exam tests student’s ability to retrieve information from memory but the practical examination demands a different skill in which students are expected to show range of skills such as communication, lateral thinking and application of knowledge and also safe handling of patients. It is important to develop the core skills as a part of physiotherapy practice module which means students’ performance should match in two types of assessments to show that there is no theory-practice gap. This study was needed to explore the real picture of how the knowledge and skills are matched and to identify the gaps in these variables, if any, to recommend for future research in this arena.

1.1. Aims and objectives:

- The primary aim of the study was to investigate the relationship of undergraduate physiotherapy students’ marks in a summative written and practical examination by finding the correlation of the grades in the two types of assessment.
- To analyse if there was a significant difference between students’ performances in the theoretical written and an objective structured clinical examination (OSCE) in the physiotherapy practice musculoskeletal 1 course.
- To explore the possible causative factors affecting the students’ performances in the written and practical examinations of the physiotherapy practice course.

1.2. Purpose:

The main purpose of this study was to find out the relationship of the students’ marks in written and practical examinations of the physiotherapy practice musculoskeletal 1 module. In addition the research also focused on finding if there was any difference in students’ scores between the theoretical and practical examinations in the physiotherapy practice course. The other important purpose of this study was to understand the potential contributing factors for the difference, if any, in the students’ performances as well as scores in the written and objective structured clinical examinations.
1.3. Rationale:

The theory-practice gap that is existing in the field of physiotherapy is not attracting wider attention and it is the right time to evaluate the implications of theory and how is it related to practice especially in the physiotherapy discipline. The gap between knowledge and skills is one of the major concerns for newly qualified physiotherapy practitioners which means there is a need to investigate the existing teaching and assessment strategies within the field of physiotherapy education. This could be identified at early stage that is during the learning and assessment cycle to address it effectively before the transition to practice as a physical therapist. Reflective practice is proven to be an effective means to address this gap and inculcating this attribute to students would promote critical thinking abilities which is the solution to link theory and practice (Roskell, Hewison and Wildman, 1998).

Students in physiotherapy program are mandated to develop good practical skills and this should be tested along with theory knowledge. According to Newble (2004) written exams and OSCE are appropriate tools to assess the students’ performance so this study will focus on comparing the marks in the written examination and an objective structured clinical examination in the physiotherapy practice course. This study was required to reflect on students’ readiness for future practice in physiotherapy. Also the study was needed to provide recommendations for future research on instructional strategies and assessment methods in physiotherapy education to suit the different learning styles of the students.

1.4. Theoretical underpinnings:

The way healthcare professionals and students competence as well as performances are assessed has changed a lot. However the old theories of assessment were not replaced by the new theories, instead they are merged and the horizon of assessment in medical and allied health education became wider (Schuwirth and Vleuten, 2004). Even though both the old and new theories have differing opinions they also had some similarities. For many years psychometric theories dominated the assessment strategies. Assessment which is mainly a psychological measure had many implications and the main one was numerical description of the value of assessment. The other contrasting theoretical view on assessment was not in favour of pass/fail or numerical representation of performances. This theory in particular supported the view that assessment was the way to determine the strengths and weakness of individuals so that their learning process is optimised. The later theory calls for research on the areas of assessment to understand how it drives the students’ learning and also the educators’ process the development of knowledge.

Ringstead et al., (2004) thought that assessment should build confidence and be a positive driving force for their learning. The theoretical underpinning of this study would be a cognitive constructivist approach to learning and assessment because the students are required to learn not only by searching information but also transforming the complex ones to meaningful information as well as refer the existing rules and replace if they are no longer valid (Slavin, 2014). Also the motivation theories plays a key role here as the motivation factor is important to succeed in assessments.
Literature Review

Townsend et al. (2001) stated that OSCE is a useful tool for both formative and summative assessment because it will reflect the deficiencies in skills and provides a scope to improve variety of clinical skills. OSCE is a reliable tool as it evaluates an array of skill sets including but not limited to interpersonal communication, problem solving, clinical reasoning, judgement, assessment and education. According to Gormley (2013) practical examination predominantly assesses the clinical competence and the written examination usually tests the reproducible knowledge but the physiotherapy practice requires reflective thinking which could be tested better by means of OSCE. It is necessary to test both knowledge of facts and clinical skills and the OSCE assesses both factors. Below par performance in OSCE in third year medical program is associated with poor performance at later stage.

Awaisu et al., (2010) concluded in their study on pharmacy students that there is a disparity in performance of top ranking students in class room and in clinical settings. They did not agree that the MCQ's and essay questions tests the skill mastery and cognitive learning of students. This led the scope for an assessment method which is truly based on performance and OSCE is an ideal instrument to achieve such kind of evaluation. Traditional assessment methods are no longer an ideal model to evaluate clinical skill sets and competencies. OSCE is an effective way to conduct a physical examination of patients and also to evaluate the mental health of clients. A study on nursing students proved that OSCE is reliable as well as valid means to perform assessment (Ryan, Stevenson and Hassell, 2007).

According to Kirton and Kravitz (2011) inclusion of OSCE as an assessment tool in addition to standard academic achievement measures is invaluable as they measure different competencies. Their study also concludes that students who attained high grades in written assessment did not match it in clinical component of the pharmacy practice course because they both tested different domains and experience.

Dijkstra, Van der Vleuten and Schuwirth, (2009) concluded that assessment is essential to improve the clinical performance and the constructive feedback it provides will deepen the students’ learning. Healthcare context is unique and varying in nature which demands effective use of knowledge and demonstration of skills as well as appropriate behaviours. No single assessment tool could evaluate the combination of these factors. So it is vital to have an assessment battery which tests the “doing aspect” rather than just recollect, verbalize and write the information. OSCE can play a crucial role to assess this particular domain of learning (Khan and Ramachandran, 2012). OSCE replacing the standard laboratory examinations showed positive impact on students clinical and communication skills (Gallimore, Thorpe and Trapskin 2011).

Stanley et al., (2015) challenged that learning was positively affected by structured practical teaching with less focus on theory by enhancing the competence in assessing and managing acute care patients.
OSCE comprehensively evaluates students’ clinical competence, skills and proficiencies that are directly associated with safe practice thus provides the learners’ with an opportunity to fine tune these skills. Medical and allied health sciences moved forward from knowledge-based to skill-based applied sciences and this raised concerns over the students learning from the teaching provided. OSCE found to be a useful tool than conventional measures in assessing this particular context.

OSCE is a useful measure to predict future performances as well as to provide constructive feedback to the students and identifies students who might benefit from remedial teaching (Martin and Jolly, 2002). Students’ learning must target competencies in problem-solving and physical assessment of patients which could be measured by OSCE. There are variety of assessment strategies available to examine the factual knowledge and clinical competence such as essay writing, multiple-choice questions, short cases, and long cases etc. But the OSCE is proved to be an effective method to assess the clinical skills as it tests various domains (Konje, Abrams and Taylor, 2001).

McRobbie et al. (2006) on their study which evaluated the pre-registration pharmacy practitioners by means of OSCE and MCQ’s and concluded that MCQ pattern did not test the competencies in depth. OSCE is also shown to be an appropriate method to assess the “show how” level of Miller’s pyramid and this particular aspect is very much important in dealing with patients who are at health concerns. This means an assessment must include this component as a part of evaluation strategy.

Though the OSCE had the privilege of being a strong predictor of performances than the written examination, it was a combination approach to assessment which was rated with higher validity in predicting the performance of the learning which should have been performance oriented (Wilkinson and Frampton, 2004). Hodges (2013) claimed that OSCE is a gold standard tool used in medical colleges across the world to measure clinical skills and competencies.

Methodology

This study took a mixed research design which initially started with a correlational research approach with an explanatory design mainly to answer the question on the relationship between the students’ marks in written and practical examination. It started as a retrospective study based on the records of students’ marks in theoretical and objective structured clinical examinations (OSCE). No intervention was used in this study. This study looked at the students’ cumulative marks in written and practical (OSCE) examinations on the musculoskeletal physiotherapy practice module in the first year physiotherapy program. A formal ethical approval was obtained from the physiotherapy department. The name of the institution where the study took place and students’ names are not disclosed for ethical reasons. First set of data was collected from the gradebook of physiotherapy practice module a 5 credit hours course which is assessed by both written and practical examinations. The two variables that were on focus was marks obtained in written examination and practical (OSCE) examination to explain their relationship to each other and identify if there is was any significant differences between
scores of theory and practical examinations. Then the study analysed the potential causes for such differences through qualitative approach by exploring the students and faculty experiences to those two assessment methods.

Written examination was composed of multiple-choice questions, extended matching questions and modified essay type questions. This particular type of exam covers core learning objectives of the theoretical components of physiotherapy practice course. It accounted for 50% of the overall course weightage. Marking was done by the course instructors and course coordinator. The practical examination was conducted in the form of objective structured clinical examination (OSCE) which consisted of 4 stations and was assessed by an internal and external examiners. This component had equal weightage as the theory part. Across the four stations students were in need to demonstrate range of skills which included interview and assessment of patients, sound clinical reasoning and effective hands-on skills to treat the clients. They were also required to show good skills in education their patients and families. So the OSCE provided a comprehensive and in-depth evaluation of students’ performance in the physiotherapy practice course.

The theoretical and practical examination marks of the academic year 2014 – 2015 for the musculoskeletal physiotherapy practice course were compared. To understand the relationship between the written and objective structured clinical examination marks the individual students, the scores of the two types of assessment were presented by means of bar chart on the y axis. Each student was assigned with student number according to their alphabetical order which was represented in the x axis. This allowed a better visualisation of the data (Murdan, 2005). The students who completed both written and practical examinations were only included in the study so there was equal number of written and practical examination scores in the chart. Analysis of the bar chart provided an understanding that more number of students (21) scored high in theory examinations than the practical. The remaining students (17) scored more in practical examination than the theoretical examination. Correlation between the two variables that is the written and objective structured clinical examination marks were calculated using the Microsoft excel 2013 version to explain the relationship.

To explore the potential causes for the differences in the theory and practical marks two students were invited for an informal interview. One of them scored significantly higher in the theory component and the other student scored high in practical. Participants were explained about the purpose of the study to obtain their informed consent. Both were individually interviewed face to face in an informal way using an open ended questions attached in the annexure. The views of few other students were sought informally by a brief small group conversation. The two course instructors who were also the examiners were invited for an interview. They took part in the interview via Skype which was semi-structured using the questionnaire in the annexure. Probes was picked from their individual responses as well as some student responses have been used as probes while interviewing the lecturers. All the above mentioned interviews were digital audio recorded with the consent of the participants. Data triangulation was done at the end of data collection. The data collected from all the interviews were transcribed and the meaning of the same was interpreted. Finally the data were coded, themes were identified and condensed for analysing the results.
Data analysis, interpretation and discussion

Correlation between the written and practical examination marks ($r = 0.672$).

Analysis of the mean scores of written and OSCE showed no gross variation in performances (mean theory mark = 40.05 and mean practical mark = 40.03). This was a bit surprising because group students had significant difference in their individual marks between the theory and practical examinations. There was a moderate positive correlation ($r = 0.672$) between the written and OSCE scores. However at one point of time the assumption that was originally expressed might have been true but since the research was carried out at the end of the semester and only looked at the cumulative grades no significant difference was found. Perhaps if the performance at the midway was tested for correlation the findings might have been on the lines of assumption.

The finding of Eftekhar et al. (2012) study suggests that there is a high degree of correlation between the written exam and the OSCE as the knowledge is interwoven to the skills by nature so to perform well in the OSCE students need certain level of knowledge as well. Also they concluded that neither OSCE nor written examination could replace each other instead the both techniques would complement each other and adding up additional measurement ways is only going to improve the standard of assessment as in this approach multi domains are tested. However results of Salinitri et al. (2012) showed no correlation between the performance on the OSCE and written examination. This is because the former tested the skills such as communication, clinical, social as well as the ability to solve problems but the later addressed mainly the knowledge aspect and to an extent the problem solving skill. These varying findings necessitated a qualitative analysis of students’ performances which differed between the groups of students.
Analysis of the qualitative data obtained from participant interview identified three main factors influencing the students’ performances in the written and practical examinations. Those were assessment methods, learning styles/skills of students and the instructional strategies which will be discussed as themes.

Assessment methods:
“Most of the students perform well in written because they have clear understanding of what is required”. - Faculty 1.

“Theory is easier for me than practice. Not prepared enough for practical. No sufficient time to practice the practical skills taught because there are many assignments in other courses and the exams. I feel scared by seeing a new examiner and not feel comfortable. I spend little in time practice than the theory”. – Student 1.

“Students are not native English speakers who struggle language barrier made an impact in the practical. Perhaps the concept is in their head but when they speak in front of the examiner they get nervous, mentally blocked, intimidation from staff would have affected their performance” – Faculty 2.

A student participant who scored high in written examination expressed that the OSCE was a stressful assessment method as they have to face the examiners and required good thinking and communication skills which was affected by the examiners and the student was unable to express in a clear way. This student felt that the practical examination tested the core curriculum and included vast syllabus. Also it demanded skills to integrate their theoretical knowledge into a clinical situation which was not easy which was highlight by the student in the interview which is quoted above. The course instructors view was almost similar as highlighted in the quote by a faculty.

The OSCE was subjected to criticism by Hemingway et al. (2014) for its context as it is not a real-world experience instead an assessment in a simulated environment which was stressful for the learners. This particular discussion led them to recommend OSCE being a preparatory evaluation for clinical practice not a measure of formative or summative assessment of competence. The outcome of Faramarzi et al. (2013) research on the use of OSCE in bachelor degree midwifery students showed and reinstated that the tool is credible and consistent. Also the measure is reliable and possess an attribute of enhancing the level of teaching. However the nature of OSCE makes it a stressful experience for students during the assessment process. The faculty who was a participant in the study also expressed this in the interview.

The student who did not score heavily in theoretical component felt that many multiple choice questions had two very similar answers which confused the selection of right choice and was unable to recall the stored knowledge from the memory and below excerpts from the interviews justified it.
“Physiotherapy is mainly practical not theory. I spent lot of time for practical with the group in practicing the skills. I did not focus much in theory. Theory was not interesting. In the written part there were indirect questions” - Student 2.

But the faculty had different view on this aspect and asked students to increase their skills to meet the challenges of written exams according to the below quote from the interview.

“There are 4 or 5 distractors. Students must enhance their testmanship. We are not tricking them.” – Faculty 1.

“Students didn’t understand the questions. It was difficult for them as we followed the Monash University examinations which were structured very difficult especially for our students whose English language proficiency is weak” – Faculty 2.

During the informal chat with the group of students which had mix of high theory or practical performers some students who aggregated high in OSCE expressed that they did not had enough time to revise the syllabus for the written exam as they had other course works to for difference courses which affected their performances. They also stated that the practical examination was easy as they do not need to recall stored information. The opposing category students within the group had a different opinion and they felt the written examination was the more objective measure and accurately reflected their performances and rewarded their hard work whereas the practical exam was short in duration approximately 30 to 40 minutes which was not sufficient for them to express their skills in-depth. Faculty had some similar views to the student opinions where a course instructor expressed that the duration of the OSCE was too short for the students to express their practical skills.

“They only have about 50 minutes in an OSCE to show range of skills which may be not sufficient for them” – Faculty 1.

It can be concluded that the written examination usually tests the reproducibility of core subject knowledge. But a supreme assessment method should test core cognitive skills not the ability to recall and the multi-stationed OSCE has the attributes to test this particular domain which links knowledge, skills and stance.

Learning styles/skills:
“For those students who score high in practical I would say that the learning style of the students is highly contributory to this factor”. - Faculty 1.

“Some students are visual and tactile learners’ means they have to see and feel in order to learn. Lecture is hard for them to grasp but once they see it in practical then it is easy for them.” - Faculty 2.

“In practical something we touch and feel to do but in theory we just memorise. Sometime I did not understand the sentences but I just memorise it like that. I would like to learn by doing. Sometimes I feel nervous in practical but generally it is okay and better than theory” – Student 2.

On the other hand the student who scored high on the practical examination thought the written examination was very difficult and needed lot of text book knowledge which was not a preferred learning method for this student. The examiners and course instructors had a different perspective of
the potential factors contributed for varying performances in written and practical examinations. Their main argument was the difference in marks was mainly because of the students learning style and preference. One interviewee argued that every student learns in different way and it will be impossible for all students to score equally in written as well as in practical examinations because those two measures tests different skills. Objective structured clinical examination in particular demanded sound clinical reasoning skills which most of the students lack and it was not a surprise for them as they are still in the first year of the program. It will be interesting to see how this students will progress through the physiotherapy program.

“Having exited the high school most of the time performances are tested by written. The assessment methods differs and they need to adjust and grasp this change. Students ignore pre-reading especially for practical session. The scheduled hours might be enough for some but may not be enough for others” – Faculty 2

OSCE is a widely accepted tool to assess the abilities to integrate the theoretical knowledge and practical skills and it complements the traditional assessment methods such as paper or computer-based tests in a robust manner. Apart from testing the communication, interpersonal and clinical reasoning skills it also looks at students’ stand on the moral and ethical dilemmas.

Instructional strategies:

“The practical experience is new for us. More nerve reckoning in the first semester. We don’t have enough time to practice. Theory hours were more than practical. Theory was focused more than practical. Sometimes we get different information from different teachers about the practical concepts. This is conflicting in practical” – Informal group.

During the small group discussion students’ criticised the instructional method as most of time is spent on the classroom instruction and limited opportunities were given to them for developing the practical skills. Stanley et al., (2015) emphasised that the practical teaching which is well structured and had less importance to theory affected the students learning positively. However both instructors did not agree to the students’ comments on the instructional methods as they felt that the timetable had sufficient time for this five credit hours course with equal emphasize on theory and practical. It was expected from the students to be involved in plenty of self-directed practice sessions after they learn a particular skill which most student did not do as the attendance was voluntary.

“They listen well to lectures, they review well at home, and they can clearly or adequately grasp the concept of theory. They observe the demonstration but not apply it in on their peers. So there is clearly a gap between what they know and how to do.” – Faculty 1.

“We had too many lectures scheduled every week. Lot of written assignments so we could not focus in practical learning. Also more weightage to written exams” – Informal group.

Other interesting factors were also revealed in the informal group discussion. The students stated that in a semester they registered for four different courses and three out of the four were assessed predominantly by written means such as assignments, course works and reflective portfolio etc. This ultimately drove the students to be more bookish and did not push them for a practical learning as almost all students were concerned of their cumulative grade point average which depends lot on
written component of the assessment. From this study it can be concluded that more than one factor that determines the students’ assessment and learning in physiotherapy education.

Limitations and suggestions

The sample size was small and the focus was on the entry-level students at the first semester. It would be appropriate to conduct further studies on how these students progress through the second semester and so on to find the progressive learning opportunities. Study included only female participants which was inevitable as there were only female students enrolled in the program. It will be interesting to research how both gender students would perform in the course which has emphasis on practical skills perhaps with a larger sample size to bring in generalisability.

Conclusion

Study established a moderate positive correlation between the written and OSCE marks of the physiotherapy students in the physiotherapy practice musculoskeletal 1 module. Results indicated that there was no difference in students marks between the written and practical examinations of the same course as the mean values were nearly equal for both variable. Further the research identified few students who were performing unequal in theory and practical examinations and explored the causative factors behind such difference. The study concludes that the students learning style is mostly leaning towards marks not towards the learning itself. Few recommendations were made in the study to shift the students focus towards learning especially in practical skills and remove their focus from marks and/or grade point average.
References


Annexure 1: Data and Correlation Analysis

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**Mean**  
Practical: 40.05  
Written: 40.03  
Total: 80.07  

**df = 36**  
(corr. T & P) $r = 0.672375981$
Annexure 2: Interview Questionnaire

Interview questions for faculty:

- Why do you think some of the students performed grossly different between the written and practical examinations?
- Do you think any other factors are influenced the performances of the students?
- Did they have enough time to practice?
- Were there too many tricky or trap questions in the written exam?

Interview questions for students:

- What made you to score higher in theory and comparatively lower in practical part of the physiotherapy practice course?
- What made you to score higher in practical and comparatively lower in theory part of the physiotherapy practice course?
- Did you have sufficient time to practice the practical skills taught?
- How did you feel when you saw an examiner in the OSCE?
- How would you like to learn?
- How much time did you spend in books and in practice?
- How did you feel when you saw a question paper that you needed to answer?
Benchmarking of Education Leaders’ Technology Utilization
A study of the attitudes of education leaders in using technology

Heba Abdel Rahman Daraghmeh, EdD Student
The British University in Dubai

Abstract

The purpose of this research is to study the attitudes of education leaders in using technology in 13 technology-enriched private schools in the United Arab Emirates. Three research questions were formulated to achieve the purpose of the research. Five hypotheses were proposed in support of those questions. Quantitative methodology was used. Both descriptive and inferential statistical data analyses led to answer the research questions.

A survey was used as an instrument to identify the technology tools that are being used for presentation, communication, file management, class observation, and feedback collection. The significant effect of gender, age, and years of experience with relative to the six NETS-A categories: Leadership and vision, Learning and Teaching, Professional Practices, Management and Operation, Assessment of Technology Use in Schools and Social and Legal Issues were also explored.

The theoretical findings of the research revealed that education leaders need to share the vision of technology use and develop an understanding of the 21st century skills required for a competent digital citizen. Moreover, education leaders need to be prepared for the role in their higher education and the professional development they receive.

The empirical findings showed a strong tendency to use technology tools as a substitution of the conventional ones with null, or minimal functional improvement according to SAMR model. Furthermore, no significant effect of gender was noticed on the education leaders’ attitudes in terms of using technology in schools. However, age ranges and years of experience affected particular categories. The three research questions were answered and further research is recommended.

Keywords: Educational Technology, Technology Leadership, SAMR model, ISTE, Benchmarking.

Introduction

This research is being narrated to identify educational leadership attitudes in using technologies and its relationship with the international benchmarked knowledge and skills. Improving quality has become a key idea of the new philosophy of education (Chang, 2012). Charles Darwin believed that survives is not the strongest nor the most intelligent, but the one who best responds to changes (Buabeng-Andoh, 2012).
Training individuals in an educational system would help in meeting the international standards. In the current circumstances, the school teachers and university teachers are the task of training the person, who knows how to navigate the environment (Buabeng-Andoh, 2012). However, the debate about the international standardization is endless. Various models were developed to redefine the use of technology and to ensure proper implementation leads to desirable results.

Substitution, Augmentation, Modification, and Redefinition (SAMR) model was developed by Ruben R. Puontedura in 2009 to describe learning activities in schools (Puontedura, 2010). SAMR model can be an index of the transformation level (Jacobs-Israel and Moorefield-Lang, 2013).

Another example of the standardized models is the National Educational Technology Standards (NETS). The International Society for Technology in Education (ISTE) has developed a framework for students, teachers, and administrators’ technology use; NETS-S, NETS-T, and NETS-A. NETS-A were designed to help administrators create a technology enriched environment and can be used to diagnose its effectiveness.

Problem Statement

An important and effective condition for progress in any society was and is the creation and expansion of a single interactive information space (Cheung, 2013). It is a common information space that has historically contributed significantly to accelerating the development of humanity as a whole, it is a decisive factor in improving the civilization in all spheres. Sharing knowledge, joint efforts to further the knowledge of nature, the development of science, technology, culture - all this contributes to the effective increase in the material level (Chang, 2012). Schools’ technology leadership undertakes the responsibility of the interactive information space in the education sector. Hence, the commencement of proper action plans would predict better teaching and learning.

Research Questions

Three main Research Questions were the focus of this study:

1. What are the technologies possessed by education leaders with reference to SAMR model?
2. What are education leaders’ attitudes in using technology compared to the National Educational Technology Standards for Administrators (NETS-A)?
3. Is there any significant relationship between education leaders attitudes in using technology and their demographics namely gender, age, and years of experience?

Hypotheses

Five hypotheses were proposed in support of the three research questions. Hypotheses 1 and 2 support research question 1, hypothesis 2 supports research question 2, and hypotheses 3 and 4 support research question 3.
1. Education leaders tend to use various technology tools. However, these tools reflect a minimum level of interaction with staff and community.

2. Education leaders use technology tools to substitute the classical model with minimum functional improvement.

3. NETS-A can be used to generate forms to evaluate education leaders in terms of effective technology use.

4. There is no significant effect of gender on the education leaders’ attitudes in using technology.

5. There exists a significant relationship between age and years of experience and the education leaders’ attitudes in using technology.

Significance of the Study

Technology is becoming an important component of teaching and learning due to many reasons; some of them are: the accelerated rate of social media spread, the considerable power of web 2.0 tools, and the instant unlimited access to all the different digital resources of information via Internet. Technology became necessary for the change needed for the paradigm shift. However, talking about the change is much easier than doing it. On the hand, stressing the importance of technology in education would bias the whole process from its purpose. Therefore, the dilemma is remaining.

Education leaders in schools play a significant role in standardizing practices related to technology use. Administrators, teachers, and students need to possess a set of competencies that are important for effective educational technology.

Research about school leaders’ technology skills is viable (Gray, 2013). Several studies proved that educational technology has a positive impact on teaching and learning. Nevertheless, effective use of technology requires preparation plans and professional development programs, which is crucial to ensure effective performance for administrators, teachers, and students. Studying the relationship between education leaders’ attitudes in using technology and the international benchmarks would predict its efficacy and would help in generating validated evaluation forms.

Literature Review

In modern conditions, management of teaching staff to the director of the school puts more tasks. This is due to the widespread introduction in the educational process of innovation, with the increasing flow of information, constantly rising level of training of professional teaching staff and others. In this regard, the most urgent is the question of the capacity of leaders of the school to use certain kinds of activities in the manual.

Conceptual Analysis

Cheung (2013) distinguished between different approaches to the problem of identifying leadership styles, the number of styles and selecting them for various reasons. One of the most popular in
psychological science description of the styles of leadership belongs to Kurt Lewin. He identifies two aspects of leadership styles - the content of the solutions proposed by the head of the (formal aspect), and technology (methods) the implementation of these decisions (the substantive aspect).

Nevertheless, modern approach to the study of leadership styles is somewhat different. According to Cheung (2013) management styles are an integral characteristic activity of the head, which reflects not only his personal qualities, but the leader also has to react to the situation and to build relationships with employees more flexibility with taking into account the external environment (Cheung, 2013).

In Summary, the concept and basic leadership skills that styles of thinking in leadership and problem solving, motivational space and evaluation of motivation, management convictions and effective communication skills, and leadership styles and their impact have potential limitations of the leader and the ways of their development (Chang, 2012). Technologies used by education leaders reflect a certain level of high order cognitive skills and their attitudes toward having a digital management experience. Such experience would transform the management model from classic authoritarian into more flexible one.

Theoretical Framework

Relating the technology skills of an education leader to the international benchmarks would predict the effectiveness of his/her management style and would demonstrate a good example of a competent 21st century citizen.

The process of studying the discipline of professional educational programs aimed at forming students' basic professional competencies (Buabeng-Andoh, 2012). Currently, there is a growing role of information and social technologies in education, which provide a general computerization of students and teachers at that address major challenges for providing access to the Internet for each student in the learning process, and preferably, at any time and from different places of residence (Cheung, 2013). At the same time, it increased awareness that the traditional scheme of education in the first half of life is obsolete and needs to be replaced with a continuous education and training throughout life. The difference of educational technology specialists usually derived from the difference of the means of education. The use of information technology along with the computer technology determines the informational educational technologies used in schools.

Information technology brings opportunities and the need to change the model of the educational process: the transition from the reproductive study - "overflow" of knowledge from one head to another, from the teacher to the students - a creative model (as in the classroom with the help of new technological and technical support simulated life situations or process, students under the guidance of the teacher should apply their knowledge, to be creative for the analysis of simulated situations and come up with solutions to the tasks). Experts believe that the development of traditional and new technologies should follow the principle of subsidiarity that, it suggests a completely new dimension
of the educational environment - global dimension that exists in real time, and is associated in itself the totality of educational technology (Buabeng-Andoh, 2012).

However, performance benchmarking application depends on the right choice of the object of improving, the definition of company-standard and usefulness of its experience to the development of the system implementation and support of the activities of the educational experience in the organization in relation to its strategic management system (Buabeng-Andoh, 2012).

Benchmarking has been selected as the most universal means of comparison and evaluation of educational services, awareness of the needs of consumers, identify strengths and weaknesses of the university in relation to the position of other institutions of higher learning and the use of best practices of business (Cheung, 2013). The use of benchmarking in the planning system of the university's competitiveness strategy for continuously identify and those the quality of higher education institutions that are the source of the key benefits, and the qualities that are required to implement effective reforms. Thus, the tool shows the direction of ways of development, improvement and adjustment of the basic properties and principles of the functioning of the university in order to enhance its competitiveness (Chang, 2012).

The practice of benchmarking is not as common, despite the fact that it promotes openness of doing business, improve its efficiency allows to keep up with the times and take a worthy place in the global market which is very important for the economy to emerge from the global financial crisis and inter-ethnic integration in the community. Probably the fact that the use of benchmarking is associated with a number of serious problems including reluctance of some leaders to recognize the weakness of the competitive position of the educational organization and the need to change their management systems or the whole educational process (Buabeng-Andoh, 2012). Another problem is that the introduction of benchmarking techniques must take into account a number of points that it is a resource-intensive process that requires a great deal of time, money, etc. In addition, limited resources leads to a rejection of outside expertise and using the services of consulting firms (Cheung, 2013). Most management decisions are taken only on the basis of popular business books that can entail problems such as the gap between theory and practice that knowledge of the nature of the instrument does not provide the ability to possession, the negative attitude of both managers and subordinates, Abuse of benchmarking involves the violation of the “Code of benchmarking”. Complex "secrecy" of organizations, is a great obstacle to initiating benchmarking study. Moreover, the existing human resource policies and financial accounting of the company is not always possible to obtain real data on certain indicators. Until recently, the problem was so urgent on it for educational institutions, but in terms of acquisition of universities traits enterprise organizations can resound with new force.
Similar Studies

Kythreotis & Pashiardis (2006) attempted to determine the relationship between school leadership and school effectiveness in Cyprus. Whereas AlAmmari (2012) stated that educational technology can improve education quality which can be demonstrated by improved students’ achievement neglecting the role of the school director or technology leadership. An evaluation of the scientific researches conducted in the period of 2007-2012 about technology leadership in Turkey was handled by Uysal and Madenoğlu (2015).

Fisher and Waller (2013) studied the technology leadership in Texas by examining the technology leaders’ perspectives and their abilities to effectively manage technology integration in comparison to the teachers’ perspective. The results of the study showed differences in the two perspectives and a positive correlation between teachers’ effective technology integration and the professional development they receive about using technology in the classroom. Cakir (2012) conducted another study. Yet, a comparison between school administrators as technology leaders and computer teachers who were assumed to be responsible of technology integration.

Further Elaboration

Various studies were conducted in different parts of the world to explore leadership styles and its effects on teaching and learning or studied the educational technology itself and its impact on students’ achievement. Less studies were found about benchmarking of educational technology leadership. Likewise, the literature lacks a detailed study of the criteria which determine proper technology integration and the different performance indicators. The researcher of this study tried to fulfill this gap by studying education leaders’ attitudes in using technology that requires an understanding of the following perceptions:

1. Leadership Styles
2. Thinking Skills
3. Attitudes
4. The used technology tools
5. International benchmarking schemes.

A blended form of the above perceptions would generate a standard framework for proper technology utilization in schools.

2.0 Methodology

Quantitative method was used in this research. Pre-determined instrument based questions; attitude data, statistical analysis and interpretation are major features of a quantitative research (Cresswell, 2013). The quantitative data was collected thoughtfully by the researcher via none-experimental designed survey “Educational Technology Leadership Survey” of three dimensions; Demographic data, technology tools that are being used for school daily activities, and knowledge and skills that reflect
education leaders’ attitudes in using technology. The survey questions were turned into a web-based form to save cost and time (Fleming & Bowden 2009).

The survey dimensions were adapted from the reviewed literature and the International Standards of Technology in Education (ISTE). An internationally approved list of standards. The National Educational Technology Standards for Administrators (NETS-A) guided the researcher to construct six sub-categories for the third dimension.

Sampling Method

Non-probability sampling method was used, only certain elements of the population were selected according to the purpose of the study (Ghauri & Gronhaug, 2005).

The survey was distributed to 13 technology-enriched private schools in the United Arab Emirates (UAE), for which number of students was more than 800. The selection of those schools was based on observations related to the use of technology and reviews of various accreditation bodies. A population of principals, vice-principals, head of departments/head of subject, and technology/e-learning coordinators (n=97). Participants were informed of the voluntary and the anonymity nature of their contribution that would be maintained throughout the study. A stratified sample (n=69) were able to take the survey. The sample was made up of principals (n=10), vice-principals (n=12), head of departments/head of subject (n=33) and technology/e-learning coordinators (n=14).

Limitations & Delimitations

The limitations of the study were identified. As in any other quantitative research, it was assumed that the collected data was accurate and valid to be processed for the analysis of results. However, this is not always the case. The accuracy and the validity of this data could not be assured absolutely. Lack of comprehensive information about the participants’ education and background might be another limitation in addition to time management.

The delimitations of the study were the choice of topic, the survey design, and the contextual conditions of participants.

Validity & Reliability

Winter (2000) claimed that validity is associated with the methodology. This research is claimed to be valid; internal validity is proven due to the cause-effect relationship for the manipulated independent variables (Onwuegbuzie, 2000). Furthermore, the consistent results that are obtained from respondents indicated high reliability of the instrument used i.e. the survey (Kirk and Miller, 1986).
Ethical Considerations

The researcher role was clearly identified Kyvik (2013). Problem statement and research questions were shared with the participants. It was declared that the research purpose is to answer those questions and all responses would be destroyed after a certain period from finishing the study. Consent letters were obtained from the schools’ managements before communicating with staff. Furthermore, anonymity of the participants was protected and there was an account on the information for both analysis and interpretation.

Discussion and Results

Different goals require different kinds of learning, so the resources to be suitable need to correspond to the required tasks. Certain tools may be better than others for certain purposes (Wang, 2014, p.99). In other cases, use of available equipment, suitability of costs and many other factors may be determinants of choice (Hur, 2012, p.58).

Descriptive data analysis shows responses of the different items of the survey. Frequencies and percentages were found to indicate those results. Tables and charts are used to summarize numerical details for the first two sections of the survey. In addition to mean values which are used to show the central tendency of data for the third section.
Analysis of Demographic Data

Table 1 represents the demographic data collected from participants (n=69).

Table 1 Demographic Data

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>Interval</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age</td>
<td>20-29</td>
<td>5</td>
<td>7.25%</td>
</tr>
<tr>
<td></td>
<td>30-39</td>
<td>19</td>
<td>27.54%</td>
</tr>
<tr>
<td></td>
<td>40-49</td>
<td>31</td>
<td>44.93%</td>
</tr>
<tr>
<td></td>
<td>50-59</td>
<td>14</td>
<td>20.29%</td>
</tr>
<tr>
<td></td>
<td>60+</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>2. Gender</td>
<td>Male</td>
<td>41</td>
<td>59.42%</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>28</td>
<td>40.58%</td>
</tr>
<tr>
<td>3. Years of experience in education</td>
<td>0-4</td>
<td>2</td>
<td>2.90%</td>
</tr>
<tr>
<td></td>
<td>5-9</td>
<td>15</td>
<td>21.74%</td>
</tr>
<tr>
<td></td>
<td>10-14</td>
<td>17</td>
<td>24.64%</td>
</tr>
<tr>
<td></td>
<td>15-19</td>
<td>23</td>
<td>33.33%</td>
</tr>
<tr>
<td></td>
<td>20-24</td>
<td>8</td>
<td>11.59%</td>
</tr>
<tr>
<td></td>
<td>25+</td>
<td>4</td>
<td>5.80%</td>
</tr>
</tbody>
</table>

The largest group of participants (n=20, 47%) was of the age range of 40-49 years old, while only one participant (n=1, 4.35%) was of the age range 20-29 years old and none of them aged higher that 60. This matches the coherent relationship between age and years of experience where we can find that the largest number of participants were having 15-19 years of experience (n=23, 33.33%). May (2003) pointed out similar correlations in his research about technology management effectiveness. Such results would not be surprising for reasons related to the hiring requirements of school principals in the UAE, one of them is a minimum of five years of experience as vice-principal according to Abu Dhabi Educational Council (ADEC) (ADEC, 2015). Another possible reason was visa issuing restriction for expats above 60 years old. On the other hand, Male participants (n=41, 59.42%) were participating compared to Female (n=28, 40.58%).

Analysis of Technology Tools
The second section of the survey included five questions to check for the technology tools school-leaders are using. Technology tools’ list can be limitless. However, the most common ones were suggested to facilitate the analysis of results and to get participants having down-to-earth scenarios while thinking of the survey responses. Suggested tools reflect the level of technology utilization according to SAMR model (Work, 2014). Questions and answers of the second section are:

Question 1: Which of the following tools you use when you want to present something for staff/teachers?

Technology leaders used to use more PowerPoint, Keynote, and Prezi to present something for staff/teachers. Less usage of Twitter Live Chat and Nearpod, despite the fact that they are considered as interactive tools that could help audience interact effectively with the presenter. It was confirmed that pedagogical interactivity helps audience focus more on the objectives of the presentation (Kennewell et al., 2008).

Question 2: Which of the following tools you use when you communicate with parents and other community members?

Communicating with parents was being done more via email, school website, and the school wide remind account. Reasons related to the culture of the country could be possible for not having an interactive communication channel between schools and parents.

Question 3: How do you manage your files?

For saving files, school leaders choose to use easier, yet safer way to keep their documents on their computers, flash drives, or attach it to an email. Much less of them are using Google analytics (n=12, 17.39%) or Dropbox (n=25, 36.23%) to save files.

Question 4: Which of the following tools you use for classroom evaluation?

Various tools were suggested for class observations/evaluations. Promising results showed different tools are being used. Having it as an email attachment is the most popular option for participants (n=67, 97.10%). Nonetheless, only participants (n=17, 24.64%) were using Google Hangout for post observation.

Question 5: Which of the following tools you use collect input or feedback from staff?

Collecting feedback from staff was more of an interactive correspondent nature by using Google Drive and Google Forms. Yet, Email was the most common tool which substitutes a traditional approach with a basic type of interactivity.

The results of the second section of the survey showed an obvious tendency to use technology tools as substitution of the traditional ones.
Analysis of Education Leaders’ Practices

The third section of the survey consisted of six categories; Leadership and Vision, Learning and Teaching, Productivity and Professional Practice, Support Management and Operations, Assessment and Evaluation, and last but not least, Social, Legal and Ethical Issues.

Thirty-one elements were included using a five-point Likert scale ranging from Always to Not at all. For the purpose of analyzing these results, values 1 to 5 were given, where 5 indicates Always, 4 for Most of the Times, 3 for Sometimes, 2 for Rarely, and 1 indicates Not at all. The elements of the survey focused on how principals use technology, how do they employ data retrieved from various technology sources, and to what extent their education technology leadership skills affect the instructional and operational processes inside their schools.

The results of the first category, Leadership and Vision, indicated that sharing the use of technology vision with stakeholders was a common practice among participants (n=26, 37.68%) are always doing it and 34.78% are sharing the vision most of the times. Although participants (n=37, 53.62%) have plans aligned with the vision of implementing technology in their schools, only 5.8% of them used to take the risk of using new technologies. According to Dawson and Rakes (2003), Learning and Teaching category results proved more involvement of the participants in promoting and supporting the use of technology.

The third category focused on the productivity and professional practice. Participants (n=24, 34.78%) are modeling the effective use of technology and more than 90% of them use technology for communication with staff and the community. However, only 5.8% were always involved in professional communities.

Support, Management, and Operations were of less interest for principals and school leaders. Participants (n=27, 39.13%) rarely ensure communication with Human Resource and Finance departments with regard to technology integration.

The fifth category, Assessment and Evaluation, revealed more interesting results where one can find participants (n=28, 40.58%) rarely evaluate the effectiveness of using technology. This signifies the gap between their optimistic vision and the need for more professional development in this domain.

The elements of the Social, Legal, and Ethical issues category indicated less interest to ensure equity in accessing educational technologies within the school context with responses (n=39, 56.52%) rarely do that.
The Statistical Package for the Social Science (SPSS) was used to perform complex data analysis of sections 1 and 3 of the survey. The datasheets generated by Google Forms were imported into SPSS software and data were manipulated. The t-test was used to compare the two means for the study of the significance of Gender as an independent variable. Whereas, one-way Analysis of Variance (ANOVA) was used to test the significance of the independent variables Age Range and Years of Experience. ANOVA test can tell if there are at least two different groups. However, to specify which group is different, Post hoc tests should be conducted. In addition to the study of the significance of the different variables, the inferential analysis allows for more objective results.

5.3.1 Significance of gender

The t-test was carried out to find if there exists a significant difference between male and female attitudes in using technology as school leaders. The test was conducted for each category separately. Table 2 summarizes these results.

<table>
<thead>
<tr>
<th>Category</th>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Male</td>
<td>41</td>
<td>3.829</td>
<td>1.16</td>
<td>0.665</td>
<td>0.74518</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>28</td>
<td>3.643</td>
<td>1.129</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>Male</td>
<td>41</td>
<td>3.683</td>
<td>1.059</td>
<td>-1.542</td>
<td>0.0632</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>28</td>
<td>4.036</td>
<td>0.838</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>Male</td>
<td>41</td>
<td>3.756</td>
<td>0.943</td>
<td>-0.951</td>
<td>0.17211</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>28</td>
<td>3.857</td>
<td>0.803</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>Male</td>
<td>41</td>
<td>4.171</td>
<td>0.972</td>
<td>1.412</td>
<td>0.91815</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>28</td>
<td>3.786</td>
<td>1.198</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>Male</td>
<td>41</td>
<td>3.976</td>
<td>0.851</td>
<td>2.308</td>
<td>0.9869</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>28</td>
<td>3.357</td>
<td>1.233</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td>Male</td>
<td>41</td>
<td>2.561</td>
<td>0.923</td>
<td>0.101</td>
<td>0.53977</td>
</tr>
</tbody>
</table>

For the sample data, The t value demonstrates the size of the difference relative to the variation \( t(\text{df})=p \), where df is the degree of freedom.

The results indicated that there exists no significant difference between male and female for the six categories. The significance level also showed a similar conclusion. However, for category 2.0 Learning and Teaching, a close value of \( p \) to 0.05 (\( p=0.0632, p>0.05 \)) indicates a small difference. According to Johnson (1999) a small \( p \)-value (typically \( \leq 0.05 \)) indicates strong evidence against the null hypothesis. Hence the rejection of the null hypothesis.
Morris et al., (2005) pointed out that gender differences could be notified among older workers in terms of using technology. Though, a unisex pattern was obvious among younger workers. Gefen and Straub (1997) stated that female and male differ in their perception but not use of the email in the study technology acceptance model.

The Significance of Age Range differences

Table 3 shows the mean value of responses and the standard deviation for the six categories with reference to the age range.

Table 3 Attitudes of Groups of Different Age Range

<table>
<thead>
<tr>
<th>Category</th>
<th>Age Range</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>20-29</td>
<td>3</td>
<td>3.545</td>
<td>0.909</td>
</tr>
<tr>
<td></td>
<td>30-39</td>
<td>27</td>
<td>3.638</td>
<td>1.012</td>
</tr>
<tr>
<td></td>
<td>40-49</td>
<td>33</td>
<td>3.498</td>
<td>0.891</td>
</tr>
<tr>
<td></td>
<td>50-59</td>
<td>6</td>
<td>3.505</td>
<td>1.002</td>
</tr>
<tr>
<td></td>
<td>+60</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.0</td>
<td>20-29</td>
<td>3</td>
<td>3.69</td>
<td>0.892</td>
</tr>
<tr>
<td></td>
<td>30-39</td>
<td>27</td>
<td>4.374</td>
<td>1.112</td>
</tr>
<tr>
<td></td>
<td>40-49</td>
<td>33</td>
<td>4.082</td>
<td>0.824</td>
</tr>
<tr>
<td></td>
<td>50-59</td>
<td>6</td>
<td>2.571</td>
<td>0.967</td>
</tr>
<tr>
<td></td>
<td>+60</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.0</td>
<td>20-29</td>
<td>3</td>
<td>4.12</td>
<td>1.023</td>
</tr>
<tr>
<td></td>
<td>30-39</td>
<td>27</td>
<td>4.021</td>
<td>0.945</td>
</tr>
<tr>
<td></td>
<td>40-49</td>
<td>33</td>
<td>3.856</td>
<td>0.834</td>
</tr>
<tr>
<td></td>
<td>50-59</td>
<td>6</td>
<td>3.001</td>
<td>0.798</td>
</tr>
<tr>
<td></td>
<td>+60</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.0</td>
<td>20-29</td>
<td>3</td>
<td>3.233</td>
<td>0.923</td>
</tr>
<tr>
<td></td>
<td>30-39</td>
<td>27</td>
<td>3.378</td>
<td>1.025</td>
</tr>
<tr>
<td></td>
<td>40-49</td>
<td>33</td>
<td>4.012</td>
<td>1.238</td>
</tr>
<tr>
<td></td>
<td>50-59</td>
<td>6</td>
<td>3.989</td>
<td>0.719</td>
</tr>
<tr>
<td></td>
<td>+60</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Consistent means were noticed for categories 1.0, 3.0, and 4.0. Unlikely, categories 2.0 and 5.0, which have shown a variation for the age, range 50-59 years old and the mean values were 2.572 and 2.476 respectively. On the contrary, for the category 6.0, the age range 20-29 mean value was the minimum (M=2.21).

ANOVA analysis of means and standard deviation values is demonstrated in details below in table 4.

*Table 4 ANOVA results for Attitudes of Groups of Different Age Ranges*

<table>
<thead>
<tr>
<th>Category</th>
<th>Sum of Square (SS)</th>
<th>Degree of Freedom (df)</th>
<th>Mean Square (MS)</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Between Groups</td>
<td>0.309</td>
<td>3</td>
<td>0.103</td>
<td>0.114</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>58.705</td>
<td>65</td>
<td>0.903</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>59.014</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>Between Groups</td>
<td>16.381</td>
<td>3</td>
<td>5.460</td>
<td>5.901</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>60.144</td>
<td>65</td>
<td>0.925</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>59.059</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>Between Groups</td>
<td>5.330</td>
<td>3</td>
<td>1.777</td>
<td>2.275</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>50.754</td>
<td>65</td>
<td>0.781</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>56.084</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>Between Groups</td>
<td>7.113</td>
<td>3</td>
<td>2.371</td>
<td>1.909</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>80.729</td>
<td>65</td>
<td>1.242</td>
<td></td>
</tr>
</tbody>
</table>
For Category 1.0: Leadership and Vision, different age ranges have no significant difference ($p=0.951$, $p>0.05$) among the respondents’ attitudes and that was determined by the value of F ($F=0.114$). However, for category 2.0, the value of $p$ ($p=0.001$, $p<=0.05$) revealed a significant difference between the different age ranges with reference to Learning and Teaching according to NETS-A standards model.

The age ranges have no significant differences for categories 3.0 ($p=0.088$, $p>0.05$) and 4.0 ($p=0.137$, $p>0.05$). Nevertheless, a significant difference existed between the groups with reference to categories 5.0 and 6.0 i.e. ($p=0.005$, $p<=0.05$) and ($p=0.012$, $p<=0.05$) respectively.

The Significance of Years of Experience Differences

The attitudes of the different groups in terms of years of experience is summarized in Table 5.

<table>
<thead>
<tr>
<th>Table 5 Attitudes of Groups of Different Years of Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category</strong></td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>1.0</td>
</tr>
<tr>
<td>&lt; 5 yrs.</td>
</tr>
<tr>
<td>5-9 yrs.</td>
</tr>
<tr>
<td>10-14 yrs.</td>
</tr>
<tr>
<td>15-19 yrs.</td>
</tr>
<tr>
<td>20-24 yrs.</td>
</tr>
<tr>
<td>&gt;= 25 yrs.</td>
</tr>
<tr>
<td>2.0</td>
</tr>
<tr>
<td>&lt; 5 yrs.</td>
</tr>
<tr>
<td>5-9 yrs.</td>
</tr>
<tr>
<td>Group</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>&lt; 5 yrs.</td>
</tr>
<tr>
<td>5-9 yrs.</td>
</tr>
<tr>
<td>10-14 yrs.</td>
</tr>
<tr>
<td>15-19 yrs.</td>
</tr>
<tr>
<td>20-24 yrs.</td>
</tr>
<tr>
<td>&gt;= 25 yrs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group</th>
<th>Duration</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5 yrs.</td>
<td>2</td>
<td>3.267</td>
<td>0.962</td>
<td></td>
</tr>
<tr>
<td>5-9 yrs.</td>
<td>15</td>
<td>3.531</td>
<td>0.789</td>
<td></td>
</tr>
<tr>
<td>10-14 yrs.</td>
<td>17</td>
<td>4.120</td>
<td>0.929</td>
<td></td>
</tr>
<tr>
<td>15-19 yrs.</td>
<td>23</td>
<td>3.921</td>
<td>1.034</td>
<td></td>
</tr>
<tr>
<td>20-24 yrs.</td>
<td>8</td>
<td>3.672</td>
<td>1.229</td>
<td></td>
</tr>
<tr>
<td>&gt;= 25 yrs.</td>
<td>4</td>
<td>2.901</td>
<td>0.967</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group</th>
<th>Duration</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5 yrs.</td>
<td>2</td>
<td>2.341</td>
<td>0.892</td>
<td></td>
</tr>
<tr>
<td>5-9 yrs.</td>
<td>15</td>
<td>2.382</td>
<td>0.791</td>
<td></td>
</tr>
<tr>
<td>10-14 yrs.</td>
<td>17</td>
<td>2.412</td>
<td>0.911</td>
<td></td>
</tr>
<tr>
<td>15-19 yrs.</td>
<td>23</td>
<td>2.621</td>
<td>1.026</td>
<td></td>
</tr>
<tr>
<td>20-24 yrs.</td>
<td>8</td>
<td>3.061</td>
<td>0.991</td>
<td></td>
</tr>
<tr>
<td>&gt;= 25 yrs.</td>
<td>4</td>
<td>3.123</td>
<td>0.690</td>
<td></td>
</tr>
</tbody>
</table>
The attitudes of the education leaders with respect to years of experience seemed to be different from the age range. Categories 2.0 and 4.0 implied coherent results, other categories were affected more significantly.

ANOVA analysis of means and standard deviation values is demonstrated in details below in table 6.

<table>
<thead>
<tr>
<th>Category</th>
<th>Sum of Square (SS)</th>
<th>Degree of Freedom (df)</th>
<th>Mean Square (MS)</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between Groups</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>8.830</td>
<td>5</td>
<td>1.766</td>
<td>1.803</td>
<td>0.125</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>61.717</td>
<td>63</td>
<td>0.980</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>70.547</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>2.063</td>
<td>5</td>
<td>0.413</td>
<td>0.461</td>
<td>0.804</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>56.422</td>
<td>63</td>
<td>0.896</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>58.485</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>15.546</td>
<td>5</td>
<td>3.109</td>
<td>3.907</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>50.141</td>
<td>63</td>
<td>0.796</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>65.687</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>1.470</td>
<td>5</td>
<td>0.294</td>
<td>0.256</td>
<td>0.935</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>72.298</td>
<td>63</td>
<td>1.148</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>73.769</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>7.062</td>
<td>5</td>
<td>1.412</td>
<td>1.475</td>
<td>0.211</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>60.349</td>
<td>63</td>
<td>0.958</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>67.412</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td>6.119</td>
<td>5</td>
<td>1.224</td>
<td>1.420</td>
<td>0.229</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>54.296</td>
<td>63</td>
<td>0.862</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>60.415</td>
<td>68</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In terms of years of experience, different groups showed almost no significant difference except for category 3.0 ($p=0.004$, $p\leq0.05$). This indicates that different groups have variant use of technology for productivity and professional practice.

3.0 Conclusions

This paper introduced a study of the education leaders’ attitudes in terms of technology use. The tools that are mostly used were identified. Moreover, an inferential statistical study of the different variables including gender, age range and years of experience was conducted to prove or reject the hypotheses stated at the beginning of this research. The findings of this research are based on the quantitative approach. An in-depth reading of literature led to theoretical findings while empirical findings were associated with the survey results.

Theoretical Findings

A list below concludes the theoretical findings:

- Planning to have proper technology integration requires shared vision which is critical according to Costello (1997).
- Education leaders need to develop an understanding of the 21st century skills and align them with the technology-immersed generation needs.
- Educational Technology leadership standards need to be internationally identified; NETS-can be the basis to create one. The idea was supported by Davies (2012).
- The 'distribution' of most disciplines of training related to new media also presents problems: first, seems to assume a faculty uniformly equipped with the necessary skills to use new technology in education, and in turn to train students to use them. It is no use denying, however, that the situation is not so rosy.
- Educational technology is the result of practices of different educational concepts and theories to solve a range of problems related to teaching and learning.
- The use of technological tools is an excellent support for students when they are raised to generate their own knowledge and develop strategies for autonomous learning (Wang Et al., 2014).

Empirical Findings

The descriptive analysis of the survey results led to the following findings:

- Education leaders use technology tools for different purposes; presentation, file management, communication, classroom evaluation and for feedback collection.
- Participants of the survey tend to stay on the basic level with reference to SAMR model to substitute the traditional tool with minimal functional improvement. Only for file management, educators tend to use Google drive or dropbox. Romrell, Kidder, and Wood (2014) stated that SAMR model provides a framework to evaluate mLearning activities.
The inferential statistical analysis revealed that:

- Gender has almost no significant effect on the use of technology for all categories according to NETS-A standards. It was a small difference only for the category 2.0 Learning and Teaching.
- The Age range groups have shown significant difference in terms of Learning and Teaching, Assessment and Evaluation, and Social, Legal, and Ethical issues. However, for Leadership and Vision, Productivity and Professional Practice, and for support, Management and Operation were not affected. Previous research pointed out no significant effect of age difference on the attitudes in using technology, yet, experienced people would show amenity, and more productivity in this regard (Czaja and Sharit, 1998). This implies a significant need for more professional development for principals and school leaders. Better preparation for the role is a necessity.
- These is a need to involve school leaders in creating policies and plans for technology integration.
- The distance between the instructional managers and both human resource and financial departments lead to mismatch in plans and have contradictory visions.

Implications of the Study

There are different aspects to highlight in relation to the implications of the study. The study would reveal more reliable and generalizable results if the sample size was larger. A larger population could be targeted if the study was conducted in other emirates or probably other countries. School leaders need to be supported by their upper management. Administrators will, in turn, be able to support teachers and contribute to school policies (ISTE, 2015).

The lack of instructional technology courses in the stage of preparing of education leaders is confirmed. More school improvement could be achieved if school leaders are capable of using technology in school operations and use the retrieved data about technology usage. Thus, the need to have technology standards for administrators becomes a necessity. Education leaders need to model the best practices (McLeod and Richardson, 2011).

A research conducted by Peterson (2002) about the importance of preparing school leaders to use technology, showed that more courses and more research need to be conducted for them. Huge efforts are being paid in the same field now, yet, no considerable change can be detected.

Recommendations
Technology integration effectiveness can be detected by the technology leadership style. The education leaders’ attitudes should reflect less reluctance to change and work to improve their professional practices.

A deeper statistical study of the relationship between dependent and independent variables would help to identify the differences between two or more groups (McMillan & Wergin, 2009). Moreover, a comprehensive study of other demographic data for participants such as their qualifications, and interests can be conducted. Pot-hoc comparisons are recommended.

Reluctance of administrators to improve should be resolved by exposing them to rigorous professional development programs and addressing their competencies. More involvement in creating policies and technology integration plans is highly recommended.

In addition to strategic planning targeting to improve the higher education sector and revamp their readiness for the transition into the new 21st century qualities. More interdisciplinary courses need to be included in the preparation stages of principals and school leaders. Thus, a paradigm shift.

References


Implementing the Inclusive Education Policy in Three RAK Primary Government Schools: An Investigation study

Khawla Al Shehhi, EdD Student
The British University in Dubai

Abstract

In recent years, many efforts have been developed to apply the latest methods in the special education field. Ratifying the UN Convention on the Rights of Persons with Disabilities, the UAE issued the Federal Law No. 14/2009, amending Law No. 29/2006, to ensure that all individuals with special needs have access to education in mainstream or special classrooms (Ministry of Social Affairs, 2006). This study aims to investigate the implementation of Inclusive Education policy in three RAK primary government schools. Mixed methods were used to collect data from 113 participants. The results indicate that there seems to be a “Masked Inclusion” where all schools do welcome these students but there is little care for their education. Based on these results, recommendations have been offered to involved parties.

Keywords: Inclusive Education, UAE, Inclusion, Ministry of Education, Policy, Individualized Educational Plan, Special needs.

Introduction

These days’ integration of the disabled students has become a fashionable term, but are all society aware of the meaning of it? Recently there is a lot of discussion going on regarding the inclusion of disabled students in regular schools. This includes a number of disabilities such as mental retardation, giftedness, talents, hearing impairments, physical and health impairments, learning disabilities, behavior disorder and communication disorders. These students have their own kind of creativity and abilities, and they need someone to support them by giving them the opportunities to express their talents. Also, it helps them to engage with their friends by gaining social behavior. Most of the community has started to talk about the inclusion issue and the right of people with disabilities to live in such an environment among their families and friends.

Every child has the right to an education, and this is where the United Arab Emirates’ interest lies, developing a learning environment for all students with and without disabilities. This is since His Highness Sheikh Khalifa Bin Zayed Al Nahyan the President of the United Arab Emirates approved the Federal Law No.29 of 2006. This law is to protect the rights of these students by ensuring that they have been integrated fully with others with appropriate services (Gaad, 2010).
In general, school is an environment of educational, social and psychological support for students including special needs by knowing that they can provide special services for them according to their difficulties. Beside this, the success of inclusion depends on school leaders when they do “good things” to all students equally then the result will come naturally (Taylor & Esq 2010).

The inclusion issue raised researcher’s attention to exploring more about this issue and to find the needs to include these students with disabilities into education in normal classrooms. Education for all is a very important issue for everyone where this has been mentioned in the world conference in Spain. This statement focused on adopting a new framework for action where everyone has a right to education (United Nation 1994). Furthermore, it also stated that believing every child is unique with their own interest, abilities and characteristics where they can access through regular schools.

Consequently, the researcher attended an international conference on Inclusive Education in Lisbon for four days, and this is to explore more about Inclusive Education (ISEC2015 2015). Also, it is to promote the equality of education system across the world by ensuring that education for ‘all’ were it has been mentioned in the Salamanca statement that United Nation agenda is all about education for all (United Nation 1994).

**Literature Review**

The main purpose of this chapter is to answer these study questions. Nowadays Inclusive Education has become a fashionable term. However, recently many discussions started to come out about this issue. Subsequently, the next chapter of the methodology will explore the study questions by investigating how policy is implemented for Inclusive Education in selected schools. Finally, to examine the assessment steps, when they assess them by finding some solutions for a better education plan and accommodation.

**Literature Review Methods Used**

Two main libraries were used to review and identify previous research. The first library is The British University in Dubai (BUiD) library while the second is the Higher Colleges of Technology (HCT) library. Both libraries have access to many research articles and other sources that can be accessed in or off campus.

Also, they offer numerous materials with a wide range of resources including books, journals, and newspapers. Moreover, the study mainly considered literature from both International Journal of Inclusive Education (IJIE) and Education Recourses Information Center (ERIC). Also, some recourse from ProQuest Educational Journals and ebrary online books.
Finally, the study was done by using particular keywords: Inclusion, Education in UAE, Federal Law No.29, and Policy in Education, MOE, MOHERS, Assessment and Procedures, History of Education in UAE, Inclusive Education and UAE Strategy 2020.

Development of Inclusion

Since the sixties century and until now Inclusive Education shows the interest of many researchers regarding inclusion to find the right of special needs. Starting with the 1973 Rehabilitation Act, this was the first law to protect the right of special needs students. This act reviews the identification, referral and accommodation for those students to protect them from discrimination (Bethel 2008).

In United States 1975 inclusion started to be implemented with the start of the Education of the Handicapped Act (EACHA) where special needs started to be included in regular classes (Debnam 2008). After that in 2001 another act was signed into law, the No Child Left Behind (NCLB) act, which was to make sure that all schools are making progress toward students’ academic performance (Dolde 2008). After four years in 2004 another act was signed, Individuals with Disabilities Education Improvement (IDEIA), a modification document of the Individualized Education Plan (IEP). This document is for students with learning difficulties and it provides a better education service according to students needs. In general, both IDEIA and NCLB acts are trying to focus on challenging the schools to determine and meet their standards (Bethel 2008).

Inclusion did not start fully from the beginning; it started from different education to partial inclusion and this to be full inclusion. It started to be known as normalization, where it allows special needs students to practice daily life activities with their classmates. This helps them to live in the Least Restrictive Environment (LRE). Thus, many researchers start to care more about special needs by putting some methods for alternative care to ensure that these students are in regular classes, called mainstreaming, longer as possible with all the assistance they need.

Daniel (1997) investigates definitions of (LRE) from other researchers, where some define it as mainstream where special needs students are placed with others in regular classes with a suitable support. Suitable support can implement in the classroom for students with learning difficulties (e.g. reading, writing and mathematics) and this can be done with cooperation between students’ parents and teachers (Thathong 2010). According to Thathong (2010), suitable support is the main goal of Inclusive Education to make sure that everybody can access free education by implementing individual support to learn.

On the other hand, there are still many barriers to including special needs students into the regular classes with normal students, and this leads to inclusion meaning that everyone can participate to
support this concept with appropriate educational services including administration, teachers, and parents for the best results.

*Inclusive Education*

Inclusive Education is a program prepared to include all students together regardless of their differences and difficulties in regular schools. It is "a multi-component strategy or, perhaps, a mega-strategy" (Mitchell, 2014 p.289). Moreover, it is a process that contributes to minimizing present barriers to learning for all (Ainscow 1999). Every child has as much right to education as any other. These students need to be given a chance to join regular classes. Thus, schools are the ones who undertake this program by fighting against discrimination and isolation between both special needs students and regular students to teach everyone for a better society.

Inclusion policy is the best way for all in regular schools to understand how to deal with special needs. Therefore, inclusion education in regular schools is the most important element still facing some difficulties from schools’ principals and teachers. Also, when schools are not ready to welcome special needs students especially when it comes to assessing and evaluating them. UNESCO (2008) defines inclusion as a process which addresses and responds to the diversity of needs for all learners by increasing participation in learning and communication. According to Opertti and Belalcazar (2008) Inclusive Education is a growing universal concern that challenges the process of education in both development regions and development.

Subsequently, it increases the social need student value (Hardman, Drew & Egan 2005) where this value raises many things by focusing on learning environment, particularly recourse beyond the one their class teachers can supply it (UNESCO 2008).

In her recent doctoral thesis, Emran (2013), examines the journey into Inclusive Education by looking at three Emirate government primary schools at the United Arab Emirates. Emran concentrates her research on investigating the implementation of the educational provisions through the initiative of the School for All. Her research aims to explore the move from the selected government schools into inclusive education.

Another study done by Gaad (2010) where she explores Inclusive Education in different countries in the Middle East, focusing on the United Arab Emirates, Oman, Saudi Arabia, Qatar, Bahrain, Egypt, Palestine, and lastly Tunisia, examines the definition used for such a controversial topic in the region. However, this research concentrates on the Inclusive Education in UAE.
Inclusive Education in the UAE

Education in the UAE started in the 1970s. It is free for the citizens when they join government schools. However, it is not free for non-citizens, who must enter private schools. Furthermore, education in the UAE is mandatory for all children to study until grade nine. Gaad (2010) investigates that there is a philosophy behind this education based on four main Islamic human rights; the right to equality, social welfare, not to be abused and lastly the right of education. However, the Ministry of Education (MOE) is responsible for the education system in the UAE which it includes both public and private sectors.

Currently, the MOE divided the UAE educational system into main four stages. According to Gaad (2010) the first phase is for kindergarten learners from four to five years, which takes two years to finish. The second phase is for primary education from age six to twelve which takes six years to complete. The third phase is preparatory education for students who are from twelve to fourteen years old where the learners need to complete it within three years. The final phase is the secondary learners from fifteen to seventeen years, and the length of this phase is the same as stage three.

There is a lack of Emirati teachers to cover subjects because of full teaching schedule; (Gaad 2010) Ergo, government hires expatriated teachers to help solve immediate education needs, where at the same time this may lead some problems (Austin et al. 2014). To that end, the government in the UAE has setup a new initiative called 'Emiratization' designed to hire Emiratis for both public and private sectors (Kirk & Napier 2009), for both males and females. However, this initiative may change dramatically to raise education opportunities for them (Raven 2011).

The improvements of the UAE education system are growing a new system for people with disabilities by providing them with the best services besides Inclusive Education. This can help special needs to overcome disabilities (ADEGG 2015) while often it can be difficult to provide these services especially after the identification of students who needs these services (Gaad & Almotairi 2013).

Subsequently, the Ministry of Education (MOE) and the Ministry of Social Affairs (MOSA) both ministers are looking after Inclusive Education for people with disabilities in the UAE in both sectors (OBG 2013). This improvement started by introducing a Federal Law No.29/2006 (Gaad & Almotairi 2013). Furthermore, there are four main articles from this law that brought to attention to education and this category, and these articles are 12, 13, 14 and 15 (MOE, 2010). Inclusive Education in the UAE provides opportunities for all learners where this helps them to become successful learners.
Successful Inclusion

For success inclusion, an appropriate support system and amount of preparation is needed. Boyle and Topping (2012) examine that to inclusion success field should listen to teachers voice by providing the necessary support. David (2015) investigates Inclusive Education elements as a “magic formula” that includes ten main components as Inclusive Education (IE) which is IE =V+P+5As+S+R+L. Mitchell (2008) believes that the success of Inclusive Education depends on what is going on in classrooms day-to-day and minute-by-minute depending on administrators’ leadership.

Special Education Process

A suitable identification process for learners with difficulties relies on three things; referral, assessment and placement (Poon-McBrayer & Garcia 2000). Likewise, this need to be done at an early age, for learners to succeed in the program (Reschly 2005).

According to Harwell and Jackson (2008) referral is a very important process to assist a child with learning difficulties. Beside this, learners with difficulties may be referred by teachers, parents, principles, and social workers by completing a particular form where it categorizes the problem (Mcloughlin & Lewis 2009). This is to know why the child is not accessing regular schools the same as others. However, it is very important to document parents a written request especially when they feel that their child is not learning like others (e.g. when teachers ask notice that they do not get the same information as their peers in class). Therefore, the communication between parents and teachers is very important (Crane, Winsler & Sands 2013).

Evaluation is another process that leads to decisions about ion and what work better for special needs students (see below Figure 1). This includes eligibility for the students and identifying strength to develop an Individualized Educational Plan (IEP). One top of this, it is very important to make sure that the evaluation covers all areas of student’s needs. Crane, Winsler and Sands (2013) investigate that the importance of early referral and without this process learners with difficulties may not receive a particular service for education that they need (Artiles & Trent 1994; Delgado & Scott 2006).
Through this, parent referral and request for an evaluation needs to be written by planning their child problem as well as, why this evaluation was needed. However, it is better if parents request an early evaluation between births to five years (Harwell & Jackson 2008).

Consequently, there are several requirements for an educate evaluation such as; (1) giving more than one test, (2) test materials and evaluation materials which helps to communicate with them (e.g. students with visual hearing impairment, they need to be testing in a way what communicate and lastly, (3) making sure that they assess in all areas that is related to a suspected disability (e.g. hearing, vision, health, social, emotional, motor skills, behavior and academic performance problems) (Poon-McBrayer & Garcia 2000). Also, evaluation specialists investigate more categories for students with learning difficulties such as; (1) writing that includes poor spelling, (2) math calculation, and (3) reading such as pronunciation as well as, attendance problems (Harwell & Jackson 2008).

However, the test needs to be given to a trained person. This evaluation is the basis to develop an Individualized Educational Plan (IEP). Furthermore, it is a very important process that can help teachers to do differently.

Thus, teachers need to go through this process. Longsdon (2014) argues that this process is confused. While, Hardman, Drew & Egan (2011) mentioned that this process is a particular process in that each learner is unique.

**Literature Review about Inclusion in the UAE**

In the last few years, there has been a growing interest in inclusion in the United Arab Emirates, but the UAE has few works of research about inclusion than the vast literature in the United States (US).
(Alahbabi 2009). Currently the Ministry of Education (MOE) in the UAE is taking over this program (Gaad 2004). Starting from 1973 the UAE government has known the importance of policies for special needs see below Table 2.

<table>
<thead>
<tr>
<th>Law</th>
<th>Year</th>
<th>Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>UAE Constitution, Article 14</td>
<td>1973</td>
<td>Emphasizes social equality, fairness, safety and security for all citizens</td>
</tr>
<tr>
<td>UAE Constitution, Article 16</td>
<td>1973</td>
<td>Emphasizes the protection of minors and others who are unable to take care of themselves for any reason such as illness or disability.</td>
</tr>
<tr>
<td>UAE Constitution, Article 17</td>
<td>1973</td>
<td>Education is general, unified, compulsory and free in all cycles all over the territory.</td>
</tr>
<tr>
<td>Cabinet Resolution No. 1</td>
<td>1977</td>
<td>Provides for governmental support to care for people with disabilities.</td>
</tr>
<tr>
<td>Article 356 of the Disablement Benefit Act</td>
<td>1979</td>
<td>Governs the education of disabled students and delegates responsibility for the foundation of rehabilitation centers for people with special needs.</td>
</tr>
<tr>
<td>Cabinet Resolution, Article 96</td>
<td>1981</td>
<td>Establishment of rehabilitation and training centers for persons with special needs.</td>
</tr>
<tr>
<td>Cabinet Resolution No. 5</td>
<td>1990</td>
<td>Expands the help for those in need, disabled and old age people in society.</td>
</tr>
</tbody>
</table>

Inclusive Education in the UAE means different things to different people. As well as, it is to provide them with equal education opportunities for placing them on appropriate environment where they meet their needs. Moreover, a parent believes that resource rooms and special education is better for their children with disabilities than to include then with others in regular classrooms. As a result of this, nowadays inclusion in the UAE is a key topic and international phenomenon (Perarpoint & Forest 1994).

In May 2010, the Ministry of Education in the UAE initiated a schools guideline for both public and private schools, and this initiative is to help and support all learners who cannot cope in the mainstream (MOE 2010).

According to Almanal (2002), parents reject the inclusion idea to include their children in regular classrooms after referral of special education process, believing that it is better for their children to stay in special centers. Thus, the purpose of this rejection is because parents do not trust that regular teachers are all trained enough to manage and teach their children.

Successful implementation is an important issue for inclusion and this need support and preparation (Millter 2000). Also, the attitude of parents, teachers, and management toward this Inclusive Education program (Gaad 2004). This may affect the program either in a positive or negative way (Buell et al. 1999). In comparison, the literature shows that many teachers prefer a special center for students with disabilities rather than regular classrooms (Alghazo & Gaad 2004; Gaad Khan 2007).
McLeskey and Waldorn (2000) investigated that administrators and teachers do not want to attend training, as well wishing not to learn new skills to implement inclusion program as a new role. Subsequently, teachers’ contributions with a positive attitude can help to success the implementation for Inclusive Education (Buell et al. 1999).

Dispel forty years of progress, there are still vast barriers of implementing of Inclusive Education in the United Arab Emirates.

**Methodology**

*Data collection tools*

The researcher used mixed methods to collect data from the three selected schools. The purpose of this study, is to investigate how the three schools are implementing Inclusive Education in primary schools regarding identification, referral and procedures. Data collection tools were utilized to fulfill this purpose.

This study used (1) official documents (a) the United Arab Emirates Federal Law No.20/2006 (see Appendix 11 - Federal Law No. 20 of 2006), (b) The second document used was the guideline of general rules for provision of special education programs and services for both public and private schools (MOE 2010). (c) UNESCO guideline documents for 2008 and 2009, these documents raised the researcher’s attention to how students with disabilities can access education like others (UNESCO 2008; UNESCO 2009). (2) observations, of actual classes was also used to collect data. The researcher observed both special needs students and their subject teachers using a T-Chart method, and this is very easy to use as well as being quick to create (Malu 2015). The main purpose of this method is to conduct and observe the class environment, including class size, accommodation, student seating and teacher interaction (3) interviews, this study used semi-structured, face-to-face and telephone interviews. Nevertheless, they all were reminded each time about the confidentiality of data. This can demonstrate trustworthiness between the interviewer and participants (Rogers 2006). Lastly, (4) questionnaires, using questionnaires is a flexible tool to use (Walliman 2010). This study questionnaire contained eighteen items including horizontal listing, open-ended questions, and Likert-scale. In the first part of this questionnaire the researcher preferred to use horizontal listing and to save space on the page, and also to look organized. The main purpose of using horizontal listing is to make it clear and simple for all respondents in order for them to understand all the questions.

*Research Participants*

Total number of participants in this study was 113; this includes the selected schools’ teachers, special needs students, special needs parents, other school staff and Support Special Education Center team (SSEC). 89% of subject teachers have a bachelor degree teaching students (grade one to grade five). Furthermore, 44% of these participant teachers are teaching in regular class with more than eleven years of experience; however, these 44% of participants did not receive any training in special education. (see Appendix 26), (see below Table 3) for all the study participants.
Table 3: All Study Participants

<table>
<thead>
<tr>
<th>School</th>
<th>Observation</th>
<th>Interview</th>
<th>Questionnaire</th>
<th>Observation</th>
<th>Interview</th>
<th>Observation</th>
<th>Interview</th>
<th>Questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>School A</td>
<td>3</td>
<td>5</td>
<td>20</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Total:</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School B</td>
<td>3</td>
<td>5</td>
<td>17</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total:</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School C</td>
<td>2</td>
<td>5</td>
<td>23</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total:</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSEC</td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total:</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total of all participants: 113</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Limitation and Challenges
There are two major limitations that may have influenced this study: (a) Language barrier, the first challenge for this study was the questionnaire and interview questions that were all written in English while research participants’ first language is Arabic and their English as a second language is not that strong. The researcher had to translate everything with a request from the MOE, RAK Educational Zone. Moreover, most of Arabic speakers involved cannot speak or read English and most government school teachers teach and communicate with their students in Arabic. Because of this limitation half of the participants may have decided to leave the last question blank. (b) Availability issues, since the researcher started to collect all data, the issue of time and the availability of subject teachers of special needs students to interview them individually was a major challenge. Similarly, the availability of special needs students during events (e.g. National Day Celebrations) for observation purposes was also limited.

Validity and Reliability
According to Zohrabi (2013) researchers need to consider both validity and reliability before and after collecting any data. Validity is a particular standard to evaluate the quality of research. If the findings were matching the study or no (Robson 2002). Ebert the reliability is an essential requirement for any research to find data, whether it is similar results or no (Bell 1999). This is the reason the researcher used similar disability to observe. Furthermore, all data were collected by using different methods of data collection through the interview, receiving some documentary, observation, and questionnaire. Thereby, triangulation of data could help increase the validity of this study. Above all, the researcher in this study kept a record of everything (e.g. observation, interview notes, and documents).

Ethics
The researcher went through few processes before the start of the study to ensure that the research is carried out in accordance with research ethics. (see Appendix 13 and Appendix 14). This study was conducted along the ethical guideline of the British University in Dubai (BUiD) (see Appendix 15 for
This is a very important document where it includes very important points about the roles and responsibility (dissertation supervisor and researcher). To conduct this study the researcher needed a permission letter from BUiD, (see Appendix 16 - BUiD permission letter to schools).

With BUiD support the researcher received a permission letter from the Ministry of Education from RAK Educational Zone (see Appendix 1) to conduct this study.

This study main purpose was to explore how Inclusive Education is implemented in RAK primary government schools that follow the Ministry of Education guideline (MOE 2010) and then to investigate the procedures of identification of disabilities, referral, implementation and evaluation. Therefore, this study questions examine how Inclusive Education is implemented in the real field in each selected primary schools by exploring the Ministry of Education guideline of School for All. Consequently, findings will be analyzed in the next chapter.

Results

Document Findings

Inclusive Education Definitions

Inclusive Education definition has been discussed in details in chapter one, section 1.3 while defending this program as a process. According to UNESCO (2005) guideline for inclusion is identified in terms of the following elements in Table 4 bellow.

<table>
<thead>
<tr>
<th>Inclusion IS about</th>
<th>Inclusion is NOT about</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welcoming diversity</td>
<td>Reforms of special education alone, but reform of both the formal and non-formal education system</td>
</tr>
<tr>
<td>Benefiting all learners, not only targeting the excluded</td>
<td>Responding only to diversity, but also improving the quality of education for all learners</td>
</tr>
<tr>
<td>Children in school who may feel excluded</td>
<td>Special schools but perhaps additional support to students within the regular school system</td>
</tr>
<tr>
<td>Providing equal access to education or making certain provisions for children without excluding them</td>
<td>Meeting the needs of children with disabilities only</td>
</tr>
<tr>
<td></td>
<td>Meeting one child’s needs at the expense of another child</td>
</tr>
</tbody>
</table>

Also, UNESCO (2008) defines inclusion as a process that addresses and responds to the participation in learning and communication.
**Policy**

The findings indicate that each selected schools’ education system are following the MOE guideline of the School for All to implement Inclusive Education in their schools. Furthermore, each selected school has diffident needs to serve learners with difficulties. However, most of the subject teachers and special education teachers did not collaborate with each other to send these students for assessment. Also, there is a lack of monitoring for schools to follow up inclusion process for special needs identification where they integrate them into the regular classes with other students.

A policy related to the United Arab Emirates Education system was developed, and it is not like the past years since 1971. However, Gaad, Arif and Scott (2006) in their paper found that the UAE Education system policy needs to cope and suit a current change. Furthermore, the Federal Law No. 29 of 2006 were announced, but still most of the selected schools’ teachers and parents did not know about this Law and the School for All guideline from the Ministry of Education. Onto the other hand, it is the government responsible for making sure if it is implemented and caring about students with learning difficulties. However, they need to make sure that these students are meeting their needs and to follow their identification process.

In summary, policy for special needs students is very important in the United Arab Emirates and highly needed to meet their needs as well as, to enjoy their life and live like others.

**MOE Procedures for Identification and Implementation**

Analysis of UAE MOE School for All guidelines reveals that the procedures to identify special needs students should follow six main steps (Figure 2).

*Figure 2: Procedures for Identification and Eligibility Determination (MOE 2010, P.27)*

**Questionnaire Findings**

Teachers’ perceptions of including special needs students in regular classes revealed a need for raising awareness regarding inclusive education, a need for more support for inclusion to work, also inclusive education was seen as unfair to all involved parties. Below section provides related detailed findings.

**General Attitude towards Inclusion**
Inclusion is to include special need students with normal students in regular class where they receive same education. 76% of subject teachers disagree from to include special needs students in their classes. While 48% thinking that including less sever disabled students can improve the inclusion program. In general, the results indicate that 80% of participants’ support (33% strongly agree and 47% agree) increasing inclusion awareness for all.

**Required Support for Inclusion Implementation**

Results indicate that teachers’ recognized a need to be supported while implementing inclusion program. Their responses highlight the need for training, support staff, and MOE support. Three different aspects of this support: the need for training, the need for support staff and the need for support from MOE. Findings related to these aspects detailed below. **Firstly**, the training, the results indicate that 55% of school teachers did not receive any special education training. Hence, 94% of participants are in favour of (agree and strongly agree) receiving specific and suitable training. (see below Figure 3).

![The importance of specific and suitable training](image)

**Secondly**, teachers perceived the importance of the availability of support staff in terms of TA and specialist. The results show that 80% of teachers strongly agree to have a TA in their classes (see below Figure 4). While 70% of teachers also strongly agree to have one specialist to assist students with learning difficulties in and out the classrooms.

*Figure 4: Availability of Teacher Assistant*
Thirdly, the Ministry of Education (MOE) support is very important where 55% of participants strongly agree that the MOE visits to their schools are highly needed.

**Inclusion is Unfair**

From open-ended questions responses indicate that teachers believe that inclusion is unfair neither to them nor to students (both normal and special needs). For example, one teacher put it this way: “I don’t agree about this at all to include special needs students with others because… they need special services. This is because teachers are not qualified enough for this field as well as they do not have enough skills to deal with them at all”. Interestingly, teachers are aware that they lack the qualification and skills to deal with special need students in regular classrooms. While another teacher mentioned the importance of reducing class size. For example, one teacher did not agree about inclusion by saying “I don’t agree with inclusion because of the class size” (see below Figure 5 where 70% of participants are teaching more than 25 students in their class.

*Figure 5: Number of students in class*
Interview Findings

Semi-Structured Interviews Findings

The results indicate that only school C (including subject teachers, activity teachers (e.g. Art, Music and sport teachers), parents, cleaners and security) were fully informed about inclusion. Normal students in inclusive classrooms were also aware of their special needs peers in and out of the classrooms. Results show that school C administration is highly supportive of Inclusive Education by encouraging all teachers to visit other fields to observe different inclusive classes to explore more about the implementation of this program. Below section presents interview findings in more details.

Knowledge Regarding Inclusive Education

School A and school B do not have any clear information about the study topic (inclusion) as they said “we only follow the School for All guideline”. While in school C it is the opposite, where the researcher found that in spite of challenges, inclusion practices seem to be common knowledge.

Challenges to Inclusive Classrooms

One of the most challenges that face subject teachers is the class size. The results from the interviews show that all interviewees are teaching more than 27 students including special needs students without shadow teachers. This causes difficulties in teaching them with normal students. However, some interviewees do agree to include special need students by highlighting that this is their right to learn like others. Moreover, the researcher found that there is a very high need for a TA. Their findings validate similar responses by surveyed teachers.

Teachers’ Attitude towards Specific Training

There is a very high interest from participants to receive a special education training, particularly to know more about their special needs students’ characteristics in their classes. For example, T4 (grade 4) and T5 (grade 5) from school C pointed out that they are both teaching Autistic students and sometimes when they scream or cry they do not know how to control them while teaching. Similarly, T5 from School A mentioned, “this will be great if I will be trained to know and understand their needs”. Moreover, T2 from school B highlighted her training needs to be better able to manage special needs students’ problems: “this (training) will help me to know how to deal with their difficulties”.

Furthermore, while attending RAK EDZ training provided teachers with relevant workshops, a few teachers, who attended the training, felt they needed more specific training sessions tailored to special needs students in their classes. On the other hand, data reveals that when the training fails to address teachers’ concerns, they assume other future training initiatives would be useless and a
waste of time. As mentioned by T4 from school C said, “of course I need it because I did attend all ten workshops that were provided from RAK Educational Zone particularly from the Support Special Education Center where I completed 30 hours of training, but I did not learn anything at all!

Telephone Interviews findings: Parents’ Perceptions towards Inclusion

Telephone interviews with special needs students’ parents reveal that although parents’ awareness of the inclusive education program may be limited, their perceptions of teachers’ readiness to deal with special needs students in regular classes reflect deep understanding of the challenge. Parents’ views regarding their involvement in the school, the development/implementation of IEP, and school support are detailed below.

Parents Limited Awareness of Inclusive Education

Responses indicate that parents’ awareness of Inclusive Education process is limited and especially when they include their children into the regular classes. Parents from school A and B indicate that they had no background about Inclusive Education before. At the same time, they were happy to participate in the study saying “please help our children”. Parents from school A and B were not informed by the school about the study topic. With the explanation from the researcher about the study topic they were able to agree to answer all questions. Yet, the concept of Inclusive Education is something new to them.

Parents’ Perceptions of Teachers’ Readiness

Parents believe that teachers are still not ready to teach special needs students saying: “teachers do not understand how to reach the right information’s for them”, while other parent said “teachers keep telling me to take my child to special need center”; whereas another parent from school C mentioned “not all teachers do not know how to teach, but they still need training specially how to deal with an Autistic child”. This view is also confirmed by observation findings where there is a need for teachers to know more about the students with disabilities and how to teach them like normal students.

Parents’ Involvement

Data exposes that school A and B do not involve parents in school activities nor the class presentations, while school C does. For example, P1 said “last year I did participate with my son to distribute flags for the UAE Flag Day for many students as well as school staff and we both enjoyed”. This shows that the school C is engaging parents through different activities, where it is the opposite in school A and B. Clearly, the data shows that there is less communication in (school A and B) between the school and parents and especially between the subject teachers and parents. Furthermore, school C data reveals that P1 mentioned by saying “they all supporting him”, where P2 said “they always communicate with me”, and this clarifies that the school shows a huge interest to
implement the inclusive education by welcoming special needs students and their parents to join others and learn.

Parents’ Perceptions of IEP

According to the results from the school B, the observed students used to have a plan received from RAK Support Special Education Center for both (Aisha who suffers from the Cerebral palsy/ physical and intellectual disability and Farah who suffers from the intellectual disability), where either cannot read or write. Currently, both are in regular class without an IEP to be followed. Interviewing their parents’ reveals that both were not involved in the IEP development or implementation. P2 from school B wondered: “What do you mean by IEP and what this plan for?” (see Appendix 20, school B, question number 13). On the other hand, school C parents’ responses reflect their interest in the IEP through implementing it according to the MOE guideline. Therefore, parents from school C are aware of everything related to their children as well as they attend a weekly meeting to discuss the IEP plan for their children. (see Appendix 20).

Parents Views regarding accessibility and school support

In general, parents (from school A and B) were blaming schools as a whole as they perceived that there is little support for special needs students. P2 from school B mentioned that her daughter suffers from Cerebral palsy/ physical and intellectual disability and is using a wheelchair, and she cannot use a computer for her computer lesson. P2 from school B said, “my daughter cannot use a computer during her class since she joined this school, because there is no space for her wheelchair, to access a computer desk, so she sets in class doing nothing, and when she come home she keeps crying” In light of this parent comment, it is very important for the MET from the RAK EDZ to visit the field and observe classes.

Observations Findings

In this study six special needs students were observed from the three selected schools. Two students were observed from each school. Below section reports observation results for school B (Aisha and Farah). Please see Table 5 below for more information about observed students.
Table 5: Observed special needs students’ details

<table>
<thead>
<tr>
<th>School Name</th>
<th>Student name</th>
<th>Grade</th>
<th>Age</th>
<th>Gender</th>
<th>Type of disability</th>
<th>Has an IEP-YES/NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>School A</td>
<td>Majed</td>
<td>5</td>
<td>10</td>
<td>M</td>
<td>Intellectual disability</td>
<td>NO</td>
</tr>
<tr>
<td>School A</td>
<td>Hamdan</td>
<td>4</td>
<td>9</td>
<td>M</td>
<td>behavioral disabilities/ intellectual disability</td>
<td>YES</td>
</tr>
<tr>
<td>School B</td>
<td>Aisha</td>
<td>5</td>
<td>10</td>
<td>F</td>
<td>Cerebral palsy/ physical and intellectual disability</td>
<td>NO</td>
</tr>
<tr>
<td>School B</td>
<td>Farah</td>
<td>3</td>
<td>7</td>
<td>F</td>
<td>intellectual disability</td>
<td>NO</td>
</tr>
<tr>
<td>School C</td>
<td>Ahmed</td>
<td>4</td>
<td>9</td>
<td>M</td>
<td>Autism</td>
<td>YES</td>
</tr>
<tr>
<td>School C</td>
<td>Haamed</td>
<td>5</td>
<td>10</td>
<td>M</td>
<td>Autism</td>
<td>YES</td>
</tr>
</tbody>
</table>

For example: Farah from school B, suffers from intellectual disability. Farah’s Arabic teacher has asked the class to copy one full page from the course book, and you can see from below extract what she needs to copy (see below Figure 6 Farah’s Arabic course book).

**Figure 6: Farah’s Arabic course book page 47**

![Figure 6: Farah’s Arabic course book page 47](image)

Farah was observed when she was copying what her teacher has asked her to do, but it was all scribbles (see below Figure 7 Farah’s specimen handwriting) with unclear hand writing, and hardly any recognizable words.

**Figure 7: Farah’s specimen handwriting**

![Figure 7: Farah’s specimen handwriting](image)

**School-Based Support: IEP development and implementation**

The UAE MOE guidelines indicate that any special needs students who are enrolled in regular classes and suffer from specific disability, they need an IEP to attend individual or group support in the
school setting (MOE 2010). The results for Farah from school B indicate that she used to write letters before when she was in Grade two (see Appendix 21), because she was attending a few classes in the resource room but as her sample writing shows above her developing skill to recognize Arabic letters has deteriorated. Moreover, she did have an IEP when she was in Grade two albeit incomplete (see Appendix 22); there was nothing written on it, only one or two dates, her parents’ name was not included either. Currently, she does not have an IEP for this year, which is the same as the second observed student below.

Aisha form school B suffers from Cerebral palsy and physical and intellectual disability. Aisha is a wheelchair user, and she cannot write. She used to have an IEP when she was in grade four, but nothing was written in her plan (see Appendix 23). Attending an inclusive classroom without an IEP for both students is not conducive of any kind of learning.

Discussion

Discussion of the First Question

1- How has the inclusion policy been implemented in Ras Al Khaimah primary government schools in terms of: (1) identification and referral, (2) procedures, (3) placement?

Identification and Referral

All teachers from selected schools are the main key for identification of students with learning difficulties. Most of these teachers keep communicating with the school social worker in case if they did not understand how to deal with the special needs students. Findings indicated that most of the teachers commented that they did not receive any special education training since they joined schools to teach. Moreover, these teachers do not have any background about students with disabilities inside their classes and how to deal with them. An example was given in chapter four (section 4.3.1) of data collected from the interview. For this result, it is clear that subject teachers can identify their special needs students inside their classes, yet all selected school teachers need more training to support these students. Moreover, interviewing results show that there is a lack of communication between teachers and parents of special needs students. This lack of training and lack of communication with special needs students’ parents left students with disabilities invisible in the mainstream classrooms without learning or understanding anything; an example was provided in chapter four for the observation findings for two students from school B (section 4.4). While this may reflect lack of care on the teachers’ side to teach special needs students like others or to send them for a specialized assessment which can help them improve their literacy skills, it does highlight the importance of training teachers in various aspects of inclusive education in particular the prereferral stage.

Furthermore, each of selected schools is aware of the Individualized Educational Plan (IEP) for students who face difficulties in school. However, some of these selected schools do not follow this plan, they do not include parents in it either. But, school C does show a very high concern with IEP, and they do meet parents weekly to talk about their children’s improvements. This overall schools’
awareness of IEP as an aspect of inclusive education is encouraging, yet the differences in how each of the three schools follow these IEPs indicate that further efforts need to be made to support schools in utilizing these IEPs to the benefit of the special needs students’.

Procedures and Policies

None of the selected schools has their own policy or procedures because all schools in the United Arab Emirates are following one policy from the Ministry of Education guidelines for School for All. Additionally, they all follow one vision, mission, and values from the Ministry of Education. Interviewing subjects’ teachers revealed that some of the school teachers do not know how to deal with their special needs students in their classes where they left them and focused on others. This is because they did not have any background about their special needs students and how to deal with them. At the same time, they did not attend any special education training. As the results of this, teachers failed to attend to the needs of these students.

It needs to be emphasized that teachers are following the new guideline for School for All, in the sense that they do not fail any special needs in the academic year. Consequently, these students are present in schools daily and they will move on to a higher grade by the end of the academic year but without real learning. Interestingly, some parents did suggest that a specialist from the Ministry of Education must visit schools to observe their kids inside classes.

Putting this suggestion into practice could be beneficial for all parties particularly for the teachers who think that the Ministry of Education is increasing their work load by including special needs students in mainstream classes. An MOE specialist visiting schools could act as a link between policy makers and practitioners to help solve problems and provide needed support. A study published recently by Alobaidly in the the Emarat Elyoum (28 December 2015, p.1) reports that in the UAE 88% of teachers believe that teaching students with disabilities in public schools is an additional load on them. Some participant teachers in this study share the same belief, hence the role of MOE to follow-up on the implementation stage is further underlined.

Many parents believe that it is the responsibility of the MOE Special Needs Department when they include any students with difficulties in regular classes in public or private schools by setting their IEPs, to follow up on the implementation of these IEPs. That is why, these students need to be monitored and assessed from an early age. This is by setting an Individualized Educational Plan (IEP) for them and by meeting their parents weekly. However, the researcher noticed that some schools are not following the MOE guideline with this regard. In addition, teachers’ attitude is very important for successful implementation of inclusion. Otherwise, it will be hard to manage, which highlight the importance of both teachers’ training and regular follow up.

Placement

After the researcher observed six of special needs students who are in regular classes with others but they are not appropriately placed. Collecting data from interviews and observations, it shows that none of the selected schools has a teacher assistant. Therefore, there is a very high need to have one in each school to help special needs students. A recent study was done by Gaad (2015) about the teacher assistant program across the United Arab Emirates. This program focused on female Emirate non-working and those who are searching for jobs. As she mentioned in her paper
that this training, (1) will help them to be able and to support both schools and subject teachers as well as students with learning difficulties for both pull-in and pull-out support, (2) they will be able to get full knowledge about different types of disabilities mainly the intellectual disabilities because the UAE has one of the highest averages of Down Syndrome in the world. Also, teachers did mention that such a program can help the school to provide them with this assistance while they teach the class. Furthermore, the class size was another issue raised in this study, because there are classes with more than 28 or 35 students in each class. Thus, subject teachers see that the availability of teachers’ assistants may help in controlling the class, and this can help teachers view the Inclusive Education program in positive light.

**Conclusions and Recommendations**

**Conclusions**

This study explored the implementation of inclusive education policy in the field of Ras Al Khaimah government school (grade one to grade five). This study was conducted in two boys’ schools and one school for girls. The researcher used mixed methods of qualitative and quantitative methods where it included interviews, questionnaire, observation in selected schools and document analysis. The results of this study shows that the Ministry of Education and RAK Education Zone need to provide a few important techniques to make sure that inclusion is being implemented well in RAK. After discussing the results, the following recommendations could be drawn.

**Recommendations**

As mentioned earlier the researcher found that in the UAE, the MOE is the one entity in charge of all education policies that are related to special needs students and students with learning difficulties who were included in regular classrooms. The MOE provided the School for All guideline for all schools, and this guideline presents the main policy by respecting the special education in all schools in public and private schools. But, from this study, it is found that some schools are not following this guide. In general, all staff in school does understand the policy of inclusion and integration of special needs students in regular classes. Also, they all know about the IEP plan, but some never heard about it. Moreover, teachers do accept special needs students in their class to teach them but because of their lack of knowledge and experience they do not support inclusion at all. In this study, all the teachers underline the need for reducing the class size especially for teachers who teach special needs students or those with learning difficulties in their classes. Also, teachers in this study expressed the high needs for teacher assistants’ availability while they teach in classes. Furthermore, for best practices more study and research need to be done to investigate the implementation and procedures to make the MOE School for All guideline work more effectively.
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A Study on the Perceptions of UAE private Secondary School Mathematics Teachers on the Impact of CPD Program Improvement

Lara Nabil Abdallah, EdD Student
The British University in Dubai

Purpose

Continuous professional development (CPD) is an ongoing training and education that allow professionals to acquire new competencies and to improve their performance. CPD engage staff members in a series of learning activities to enhance their individual practices (Mansour et al., 2014; Khan and Chrishti, 2012). CPD is a catalyst that speeds up the school improvement process, unifies the teaching approaches and enhance the teachers’ capabilities. In this light, Khan and Chrishti (2012) identify CPD as a tool that empower teachers and guarantee quality education.

The 21st century is witnessing a major educational reformation which demands a broad spectrum of changes from schools. Hargreaves and Fink (2010) consider education change as easy to plan, difficult to implement and hard to sustain. CPD is considered the means to establish consistency, unity and successful change within an education institution. Successful transition is attained once teachers are engaged in CPD training that is relevant to their needs (Ifanti and Fotopoulou, 2011; Hartsell et al., 2009).

This study is underpinned by learning theories (Lewin’s theory, Piaget’s theory, Vygotsky’s social development theory, and Bandura’s social learning theory) and motivational theory (Achievement goal theory, Expectancy-value theory, Selfdetermination theory). Bandura’s social learning theory describes human behavior as a result of continuous interaction between cognitive, behavioral and contextual influences. In CPD, learning is attained when attendees interact to share experience and discuss the relevance of new trends in education to their classroom experiences. Achievement goal theory aims to connect teachers’ qualifications to their willingness to attend professional programs. Whereas, the Expectancy-value theory focus on ascertaining the factors that motivate candidates to choose teaching profession. Those theories come to support the core features of effective CPD which are investigated in this study.

Several studies investigated the effectiveness of CPD (Gunnarsdotter, 2014; Getenet et al., 2013), impact of CPD on improving teaching process (Sabah et al., 2014; Ponte, 2012; Kwakman, 2003) as well as the key features of a successful CPD (Ponte, 2012; Earley and Bubb, 2004). CPD content remains obsolete until the sessions are conducted. The relevance of the content to the daily classroom setup of teacher is what proves that the CPD session is effective. The relevance of the content of the CPD to the classroom issues makes it fit for purpose (Getenet et al., 2013; Nisbet, 2004; Lee, 2002).
Design/Methodology/Approach

This study used a quantitative-qualitative model, sequential qualitative of mixed method design to investigate the perceptions of private secondary mathematics teachers on the impact of CPD program improvement. Adapting a mixed method approach allows deep analysis of the topic and prevents bias (Meriam, 2015; Creswell, 2003). The instruments consist of a semi-structured questionnaire, reflective professional development journal and interviews. Twenty secondary teachers participated in this study and those were all the secondary mathematics teachers of the school where the study took place. The content of the CPD was designed to enable the new reformation of curriculum implementation at the school and to provide participants with the required knowledge and skills to meet the expectations.

Figure 1: CPD content

The quantitative data was analyzed using SPSS while themes emerged from the analysis of the qualitative data. Hence, it provided rich information about the perceptions of the secondary mathematics teachers about CPD programs. The collective information obtained from analyzing all the results indicated that time span, relevance of content to classroom practices and collaboration throughout the sessions are the core aspects of CPD.
Findings

The study findings indicated that the participants were willing to try new approaches in their classrooms. They favored collaborative learning approach during CPD sessions. Participants were convinced about the usefulness of new ideas after they discussed it together. Collaboration consolidate the ideas and allows participants to engage in inquiry-based practice (Landt 2002; Harris 2002; Kwakman 2003; Gordon 2004; Skinner 2010; Sabah, Fayez, Alshamrani, & Mansour 2014).

The analysis of the results confirm that CPD improved the participants’ competencies and had a positive impact on their ability to enhance the teaching pedagogies. Those findings confirm that CPD program has a positive impact on participants’ abilities (Gunnarsdottir, 2014; Getenet et al., 2013). The relevance of CPD content was identified as the most important feature that results in a visible impact. Visible CPD impact is achievable once its content is relevant (Sabah et al., 2014; Goodall et al., 2005). Although most secondary mathematics teachers indicated that the practices promoted in CPD are practical but they did not adapt them when planning for their lessons.

Participants were active when the CPD trainer adapted an inquiry-based approach. This allowed them to share their experiences and to reflect on the newly promoted ideas based on their understanding and knowledge. They were motivated to communicate together and to design possible plans to implement the ideas. The approach used to deliver the CPD content has a major influence on participants’ willingness to learn (Sabah et al., 2014; Cimer et al., 2013; Rogers and Horrocks, 2010; Hartsell, Herrison, Fang, Rathod, 2009).

Research Limitations/Implications

This study concluded that CPD program provided participants with valuable experiences and knowledge to improve their teaching, exposes them to new trends in education to develop their pedagogical knowledge, and an opportunity to collaborate with colleagues to build good relationships. The impact of CPD was firmly established on both behavioral and affective clusters.

This study has several implications in the field of teacher training and education. Investigating the participants’ views immediately after the training sessions has a limited value while reflective journals encourage the attendees to express themselves widely. CPD trainers can use action research to evaluate and enhance their practices.

Originality/Value

The global chances demands continuous school improvements that are designed based on latest trends in education. This study comes to confirm that CPD is a powerful process that can make this change reachable once the content is designed carefully. The uniqueness of this study is due to the CPD approach, time span and the context. The CPD content was designed by the researcher based on identified needs of the private school where the study was conducted. Span of the CPD training
was three months. This provided the attendees with a chance to grasp the content slowly and to connect the topics to their daily practices.

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The Effects of Optimal Phonics Instruction on the Reading Achievement of Arab Learners of English

Mohammed Assaf, EdD Student
The British University in Dubai

Abstract

This article reports findings from an experimental study that assesses the impact of the ‘ASWAT’ (‘sounds’ in Arabic) reading intervention programme on developing students’ ability to read the 100 high-frequency words (McNally & Murray, 1964) by using the 64 most frequently occurring grapheme-phoneme correspondences identified by Solity and Vousden (2009). A total of 30 male Emirati students between the ages of 15 and 21, who were attending the English-medium Modern Vocational Center in the United Arab Emirates (UAE), took part in the classroom-based experimental study. The findings of the pre- and post-tests showed that the experimental group (optimal phonics instruction) outperformed the control group (whole-language approach to reading) and achieved a 66.4% rise in the correct answers while the control group only achieved a 22.7% rise. The findings support the effectiveness of phonics instruction on developing the students’ ability in phonetic decoding of the high-frequency target words employing the most frequently occurring 64 grapheme-phoneme correspondences. The implications of these findings for teaching reading and the training of professionals are provided.

Keywords: phonics, reading, high-frequency words, grapheme-phoneme correspondence

Introduction

Finding the best methods for reading instruction has been a perennial controversy regarding the different approaches to phonics instruction. The general trend for teaching reading in Arabic and English in the UAE, is to favour the whole-language approach. This approach by definition holds that “that youngsters acquire language rather than learn it through direct teaching; that language learning is child-centered, not teacher-dominated; that language is integrated rather than fragmented” (Heald-Taylor, 1989, p. 16). Direct/Explicit and systematic phonics instruction, by contrast, is overlooked in the UAE public high schools (Al Mehairi, 2006; Suliman, 2000), one of which, is the Modern Vocational Centre (MVC) where the researcher conducted this study. The low achievement on the pre-reading of the 100 high-frequency English words test, by 30 selected MVC students forming the experimental and control groups for this study, provided the real impetus for the researcher to design a reading intervention programme called “ASWAT” (Arabic for ‘sounds’) to improve reading standards. ASWAT will focus on teaching the 64 high frequency “grapheme-phoneme correspondences” (GPCs) identified
by Solity and Vousden (2009) besides the 100 high-frequency English words (HFEWs) used in the Early The present study seeks to address the following two research questions:

1) Does systematic phonics instruction help students learn to read more effectively than instruction teaching no phonics?
2) What are the main performance differences between the control and the experimental group?
3) Previous UAE-based studies (e.g. Alfalasi, 2008; Al Mehairi, 2006; Gobert, 2009; Taylor 2008) have examined the reading difficulties of Arab learners of English but without referring to a certain set of word list. This study is the first of its kind since it focuses on phonics instruction for adult vocational students, which is implemented through the Early Reading Research (ERR) framework, which advocates phonics and sight word vocabulary instruction employing the 64 GPCs suggested by Solity and Vousden (2009). Reading Research (ERR) conducted by Solity and Vousden (2009)

Literature Review

Approaches to Phonics Instruction

There are a number of definitions of phonics instruction, whether taught explicitly or implicitly. For example, Goodman (2005) defines phonics instruction as “the set of relationships between the sound system of oral language and the letter system of written language” (p. 39). By contrast, Strickland (1998) defines phonics as the explicit instruction of the relationships between sounds and the letters they represent when used in reading and writing. Nevertheless, this definition is criticised by Goodman (2005) for making reading and writing a matter of matching graphemes with phonemes. Strickland’s definition describes phonics as a method of teaching to develop students’ phonemic awareness (PA). Phonemic awareness refers to the “ability to hear and remember the order of phonemes in words (McGuinness, 2005, p. 444). However, the act of remembering is more applied to languages with deep orthography such as English. PA constructs the main part of phonological awareness (PHA) which refers to an individual’s awareness of and ability to attend and make judgements about the phonological structure of spoken words (Gillon, 2004; Rvachew 2003; Schuele & Boudreau, 2008). This study will utilise Strickland’s definition since it aims to assess the effectiveness of explicit phonics instruction.

The National Reading Panel (NRP) reviewed several hundreds of reading studies from a selection of 100,000 reading studies after 1996 and 10,000 before that time. The purpose was to provide the Congress in the US with the best methods to teach children how to read. The NRP’s (2000) evaluation of the existing research and evidence concluded that the best approach to reading instruction is one that combines the following techniques: explicit instruction in phonemic awareness; systematic phonics instruction; methods to improve fluency; guided oral reading; teaching vocabulary words; and ways to enhance comprehension. It is clear that the first two techniques highlight the importance of
phonics instruction in teaching reading especially for reading beginners and older students with reading fluency problems beginning readers and struggling students (Solity & Vousden 2009).

With respect to phonics instruction, the NRP (2000) outlines five approaches which have been supported by research (e.g. Carnine, Silbert & Kame'enui 2004; Freeman & Freeman, 2004; Reutzel 2010). In teaching phonics explicitly and systematically, the following approaches have been delineated: synthetic phonics, analytic phonics, embedded phonics, analogy phonics, onset-rime phonics, and phonics through spelling (NRP, 2000, p. 2-89). The table below summarizes the five approaches to phonics instruction.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Description</th>
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<tbody>
<tr>
<td>Synthetic</td>
<td>teach children to convert letters into sounds or phonemes and then blend the sounds to form recognizable words.</td>
</tr>
<tr>
<td>Analytic phonics</td>
<td>avoids having children pronounce sounds in isolation to figure out words. Rather children are taught to analyze letter-sound relations once the word is identified.</td>
</tr>
<tr>
<td>Analogy based phonics</td>
<td>teach children to use parts of written words they already know to identify new words.</td>
</tr>
<tr>
<td>Phonics through spelling</td>
<td>teach children to transform sounds into letters to write words.</td>
</tr>
<tr>
<td>Embedded phonics</td>
<td>teach children to use sound-letter correspondences along with context cues to identify unfamiliar words they encounter in text.</td>
</tr>
</tbody>
</table>

Table 1: Phonics Instruction Approaches (NRP, 2000, p. 2.89)

The aim of these five different approaches is to teach students the relationships between graphemes and phonemes. In the same vein, they teach students how to use the different relations and combinations in reading and writing words. Although differences exist among the five approaches, they teach phonics explicitly and systematically. It is worth mentioning that the NRP did not find a single approach that can have unquestioned superiority. Rather, an eclectic approach is not only suggested, but is also practiced in reality since each approach has strengths and weaknesses.

The whole language approach implemented at the MVC has not proved to be effective in helping students who are struggling with the basics when it comes to reading aloud (decoding). For instance, students have a noticeable difficulty in sounding out the 100 HFEWs, as demonstrated by the reading pretest and anecdotal observations. There is opposition by those in charge of the curriculum department at the MVC, to teaching phonics explicitly and systematically, in spite of the many pieces of evidence of its effectiveness in helping students improve their decoding skills. For example, the National Institute of Child Health and Human Development (NICHD) (2000) emphasises the
effectiveness of teaching children to read through explicit instruction in learning and working with phonemes. Furthermore, research done on word recognition for L1 Arabic students by Gobert (2009) showed that students “may not be sounding out words when they encounter words that are unknown in their graphic form for the first time as native English speakers do” (p. 59). Therefore, she asserts that explicit phonics instruction has to be an important part of the English language curriculum for native adult L1 Arabic students. This echoes with Solity’s (2005) emphasis on the effectiveness of phonics instruction not only for children but also for adults who face real challenges in reading.

Several lists of high-frequency English words have been assembled to teach reading (e.g. Dolch, 1936; Fry, 2004; Oxford Dictionaries, 2006; Solity & Vousden, 2009). Grade 12 public school students in the UAE need to pass The Common Educational Proficiency Assessment (CEPA) to join the government universities. They have to learn the first 2000 General Service List. The first hundred words that appear across all lists including the CEPA, have been recommended to be an essential component of reading programmes since students encounter them in most written texts. Researcher (e.g. McNally & Murray, 1964; Solity & Vousden, 2009; Stuart, Dixon, Masterson & Gray 2003) estimated that the 100 HFEWs represent about 1% of all word types and 54% of all word tokens in the studied database of hundred thousands of word token. The present study will utilise the 100 HFEWs employed in the ERR, which account for “53% of all the words in a database of 850,000 words analysed in the adult texts” (Solity, 2005 as cited in BBC NEWS, 2005). The ERR 100 HFEWs used in this study has certain features that distinguish them from other lexical items.

The majority of the ERR 100 HFEWs are function words (e.g. articles, pronouns) that help build sentences. As in the previous sentence, the words the, of, and are link the different parts of the sentence to clarify its idea or meaning. It is apparent that at least one or two of the 100 HFEWs have been included in the various sentences in this paper or others. Of the ERR 100 HFEWs, 84 are function words; for the most common 50 words, all but four are function words. Content words like verbs, nouns and adjectives (e.g. call, time, big respectively) account for 16 lexical items. More importantly, the function words are difficult to be recognized rapidly because students cannot associate them with familiar or concrete items as they can with content words as cat or car. Additionally, Lems, Miller and Soro (2010) point out that the function words have opaque spelling like could and of, some are homophones there, their and others include silent letters (e.g. would and could). Therefore, students need to have the opportunity to learn them to be fluent readers and to use them in connecting content words to produce meaningful utterances or sentences.

The English language has a high orthographic depth because of its lack of spelling-to-sound mapping (Ehri, 2005; Fender, 2003; Perfetti, 1998). Graphemes usually do not match with the sounds they make. For instance, the graphemes ‘f’ in fan, ‘ph’ in phone, and ‘gh’ in enough correspond with the phoneme /f/. The Arabic language, however, has a shallow orthographic depth since each grapheme “represents a speech sound, either a phoneme or a syllable” (Steinberg & Sciarini, 2006, p. 65). Researchers (e.g. Ellis et al., 2004; Grabe, 1991; Paulesu et al., 2011; Wade-Woolky, 1999) have stated that languages with deep orthographic structures might cause difficulties for non-native learners to read using-word-identification processes involving the phonology of the target languages. Solity and Vousden (2009) point out that English has 195 graphemes that can be combined in 461 possible
Grapheme-phoneme mappings and consists of three categories: 1) single letter grapheme (n=31), 2) multiple-letter grapheme (n=31) and 3) suffix grapheme (n=2). Words in the first category are termed “phonically regular” within the ERR programme. For example, in a word such as _mat_ each single letter grapheme ‘m’, ‘a’ and ‘t’ represents a single phoneme. When students learn the 64 GPCs, they can apply them to pronounce words. These GPCs include 16 different combinations of consonants (C) and vowels (V) of phonically regular words. For example; CCCVC in _scrap_, CCCVCC in _strand_, CVCC in _bend_, CVCe in _made_ and VCe in _ale_. On the other hand, the second category contains 31 GPCs where a letter combination represents a phoneme (e.g. ‘ai’ in _aid_, ‘ey’ in _key_). As with ERR 100 HFEWs, the aim of learning a small number of GPCs (64 out of 461) is to enable students to read a correspondingly large proportion of words by learning an optimal amount of information.

According to Solity (2005), teaching the 64 GPCs “enables children to read somewhere in the region of 70% of all the phonically regular words in the adult literature” (BBC NEWS, 2005). This conclusion was arrived at as a result of the generated database of words in 685 children’s books (5-7 years) used in the UK’s schools. The study was conducted by Solity and Vousden, (2009) and Vousden, Ellefson, Solity and Chater, 2011). The study by Vousden et al. (2011) showed that the same word types in both children and adult texts contain the 64 GPCs, which occur frequently in these texts. Chen and Savage (2014) describe this characteristic of the 64 GPCs as the ‘simplicity principle’. They assert using “the principled selection of the optimally efficient GPCs units that lead to greatest generalisation and usage in reading words in children’s books” (p. 198). They add the implementation of the simplicity principle is beneficial for at-risk readers because it develops their reading and motivation. The simplicity principle has strong relationship with the theory of optimal instruction.

The simplicity principle supports the theory of optimal instruction, which holds that there is an “optimal amount of information to teach that will lead to maximum generalisation” (Solity & Vousden, 2009, p. 475). They point out that providing students with too little information does not help them learn new words through generalisation. Equally, teaching students too much information means that they have to “retain information that is either perplexing or simply of little or no use” (2009, p. 475). This is also in line with the Pareto’s Principle, which affirms that a small amount of input usually leads to outstanding and satisfactory outputs or rewards (also known as the 80/20 Principle, see Koch, 2007). Interestingly, the 64 GPCs, 100 HFEWs and Pareto’s Principle reflect Zipf’s law (1999). Zipf’s law, named after George Kingsley Zipf, “states that when words are arranged in rank order, from high to low frequency, the frequency with which those words occur starts high and then tapers off rapidly” (Solity & Vousden, 2009, p. 475). In other words, a few English words occur very often (e.g. the 100 HFEWs) while many other words come about once in a blue moon. The same can be said about the 64 GPCs since the 64 occur more than the rest of the 461 GPCs. This means that 397 GPCs occur rarely.

In theory, the GPCs can help students decode at least 39 words from the ERR 100 HFEWs. The other 61/100 HFEWs are to be recognised as sight-words, for teaching phonics does not exclude this approach. On the contrary, it is expected that students will benefit from their grapheme–phoneme knowledge in reading these words. Furthermore, the words that share similar sounds can be grouped (analogy-based) such as _all_ and _call_ [ˈɔl] and _the_, _this_, and _they_ [ð]. Students who are aware of the pattern shared by _all_ and _call_ are expected to recognise words like _ball_, _mall_ and _tall_. Therefore,
teaching the 64 GPCs is expected to help students at the MVC to improve their reading pace and accuracy. First, the students will understand that words are made up of individual sounds, and second they distinguish between graphemes and phonemes and their GPCs (Freeman & Freeman, 2004, p. 130). Once, students realise the existence of these GPCs, then a small number of students might continue to read is as two different phonemes /I/ and /s/ or they as four different phonemes, as found out in the pre-reading test.

Intervention

The current reading intervention programme, ASWAT, has been drawn from the evidence provided by previous studies, which have shown a strong correlation between reading and alphabetic and phonological coding (Adams, 1990; Vellutino, Fletcher, Scanlon, & Snowling, 2004).

The intervention programme suggested by Solity and Vousden (2009) is one of the recent studies that particularly “analyse the structures of adult literature, children’s real books, and reading schemes, and examines the demands that they make on children’s sight vocabulary and phonic skills” (p. 469). They developed the Early Reading Research project to beginning readers over a period of three years that involves both phonics and sight vocabulary that resulted in reducing the percentage of students with problems of reading from 20-25% to less than 2% (Solity, 2005). In addition to these words, learners need to study the high and critical GPCs to be able to read the majority of phonically regular and irregular phonically words they come across. Moreover, Solity et al., (2000) and McGuinness (2005) stress on teaching the two most important phonological skills (segmentation and blending) rather than all nine phonological skills (e.g. identification of rhyming words, identifying and manipulating syllabuses, etc.). These skills can be easily taught if a well-designed linguist-phonics instruction exists (McGuinness, 2005).

Interlingual and Intralingual Errors of Native Arabic Students

A study by Fender (2003) demonstrates that Arab learners “experience difficulties acquiring aspects of English literacy, namely, orthographic or spelling representations of the English words” (p. 19). He also stresses that these difficulties hinder L2 reading skills. This highlights the need for phonic instructions, and the explicit teaching of grapheme–phoneme correspondence in English, may enable Arab students to overcome certain interlingual and intralingual errors.

Within the phonetic level, Modern Standard Arabic (MSA) does not exhibit the following English phonemes: /p/, /g/, /v/, /ʃ/, /ŋ/ and /ʒ/ and are therefore substituted with its corresponding Arabic phonemes: /b/, /f/, /ʃ/, /k/ and /ʤ/. For example, pray with bray, and get with jet. Within the phonological level, MSA exhibits consonant clusters at coda position only (CVCC), and therefore has a relatively simple syllable structure in comparison to the English language (CCCVC CCC), e.g. ‘strengths’. Therefore, Arab learners of English tend to repair complex consonant clusters with epenthesis or prothesis (e.g. neexit for next). English loanwords create further difficulty to Arab learners and often adapted to the phonetic and phonological system of the host language (e.g. bas for ‘bus’, secrab for ‘scrap’). ‘th’ in thin, etc.)
In addition to the interlingual errors, Mahmoud (2013) has identified the following four types of intralingual errors: 1) sound-based (e.g. /s/ could be read as ‘s’ or ‘c’); 2) homophonous-based (e.g. too, to, two); 3) ignorance of spelling rules and over-generalization (e.g. sayed for said) 4) and anomalous misspellings where an explanation is not possible. Arab students as well as most speakers of shallow orthography languages (e.g. Welsh and German) rely more on a grapheme–phoneme correspondence strategy than do the speakers of deep orthography languages.

Right Letters Wrong Place and Dyslexia

Dyslexia is a common cause for hindering the reading ability of atypical learners. Dyslexia comes in multiple forms; these include developmental (result of an injury or a disease) and acquired (cognitive disability) dyslexia, and/or deep or surface dyslexia. Surface dyslexia results in errorful reading of low-frequency and irregular pronounced words. Deep dyslexia results in poor semantic interpretation, and poor letter-to-sound correspondences, and poor non-word reading. A shared characteristic with all dyslexias is that they have core phonological processing deficiencies (e.g. Ralph and Patterson, 2005; Wolf, 2007). Previous studies have shown that an estimate of 18% of UAE University female students reflects some of the traits of dyslexia (Aboudan et al., 2011). Directionality confusion (also referred to as ‘Right Letters Wrong Place’, Bowen, 2008) (e.g. ‘b’–‘d’, ‘b’–‘p’, ‘n’–‘u’, or ‘m’–‘w’), difficulty in learning grapheme-phoneme correspondence and mixing lower and upper case letters are all noticed among students at the MVC. Another explanation for reading errors of dyslexic Arabic readers by (Abu-Rabia & Taha, 2004) states that the Arabic orthography is responsible for morphological and semiphonetic errors which are considered the most prominent ones. Thus, it is critical for class teachers to identify the best approach to enhance dyslexic students’ phonemic awareness to help them develop their reading ability. In addition, intervention programmes need to help students become good at reading by developing their PHA before teaching phonics.

The Current Study
Methodology

Since the present study seeks to determine whether ASWAT had the intended causal impact on participants’ achievement in reading the ERR 100 HFEWs, experimentation is an appropriate methodology to collect numerical data to explain the gains in mean in pre-post-test. The experimental and the control group were assigned randomly. Subsequently, an experimental research approach rather than a naturalistic approach was used in this study. However, testing students in reading the ERR 100 HFEWs is time-consuming if it is to be naturalistic. Furthermore, it would be a long process to collect enough samples that contain all of ERR 100 HFEWs. Hence, a pre-test and post-test with the comparison group design were more practical for this study.
Identification of participants

The experimental (N=15) and the control (N=15) group for this study consisted of 30 UAE male citizen students. They represent 15% of a population of 200 students at a public vocational centre in the UAE. They were second-year students with military sciences as their field of study and attended 3.5 hours of general English per week. Although there are no standard proficiency tests to assess students’ English level except the Key English Test (KET) for graduates, the majority of students can be absolute, false beginners or basic users (A1 according to the Framework of Reference for Languages: Learning, Teaching, Assessment (CEFR) (Little, 2007). Sixty percent of the subjects are false beginners, 30% are basic users (A1), and 10% are absolute learners, whose performance is similar to those who have had no contact with English at all. Around 45% were without formal education for two-three years before joining the MVC. Their ages ranged from 15 to 21 years old. The two groups were similar in terms of their English level, age and education. They almost had the same average in the pre-test: the experimental group was 32.7, whereas that of the control group was 32.9. This similarity is vital to give more confidence that the reading achievements of the experimental group, but not the control group were actually a result of ASWAT.

Stimuli

In this study, there were three primary sets of stimulus items. Firstly, a hard copy of the ERR 100 HFEWs and the 61 GPCs suggested by Solity and Vousden (2009). A story that contains all of the ERR 100 HFEWs was also used to introduce them meaningfully. Secondly, a recording of the ERR 100 HFEWs by a native speaker in addition to a soft copy of the new British Council phonemic chart (BCPC) (Editor, 2010) to help students hear the sounds of English. Thirdly, the students attempted a number of phonological awareness and phonics assessment worksheets from www.readinga-z.com once a week.

Procedures

ASWAT was held for duration of 11 weeks during the 2013/14 academic year. Students had 80 sessions, where each session was 10–15 minutes. The intervention consisted of the following three stages: 1) Preparation/ Induction; 2) Implementation and 3) Assessment. Each stage is discussed respectively.

Stage 1: Preparation/ Induction (1 week). During the first week, students had an idea about the aims of ASWAT, and the researcher assured the learners of the anonymity and the confidentiality of their responses by completing a consent form. A pre-reading test was administered to 30 students after piloting it with six students to make the necessary changes to avoid any problems in administrating the test. The task was to read aloud the ERR 100 HFEWs as individual words. The students were given four seconds to read each word since in the piloting stage, the average time needed was four (the two low achievers took three-six seconds to read each word, the middle achievers two-four seconds, and the high achievers one-two second(s)). The students’ responses were logged as correct response (CR), incorrect response (IR) or null response (NR) (See Appendix A).
Stage 2: Implementation (8 weeks). The names and the sounds of the alphabet were introduced in the second week. For this task, the new BCPC was used to teach students the sounds of English. The chart was used on a daily basis to introduce one sound or more. Furthermore, the GPCs chart was also distributed to the students, and they were trained on how to use it in reading. The researcher practiced whole class, pair and group and one-to-one teaching to meet the needs of the different levels of students. A number of internet sites were used to enhance students’ PA and PHA and to make learning more engaging.

Identifying the initial sounds of the ERR 100 HFEWs was the focus of weeks 3, 4, 5 and 6. Students were asked to use the BCPC and the GPCs to identify the initial sounds. The concepts of diphthongs, consonants and vowels were introduced. Most of the discussion was done orally by giving examples from the ERR 100 HFEWs or the textbook. Examples were written on the board, and the researcher checked the students’ performance by asking them to read words from the ERR 100 HFEWs and other words from their textbook. To introduce the ERR 100 HFEWs meaningfully, students read an adaptation of the “The Best Thing in the World” (Mrs. Perkins' Dolch Words 2012) which was used to teach the 220 Dolch Basic Sight Words. Furthermore, a number of internet phonics games prepared by the British Council were used to make phonics instruction more practical and attractive.

Week seven and eight focus on the final sounds of the ERR 100 HFEWs by using nursery rhymes (e.g. London Bridge is Falling Down and oral drills (e.g. What’s the last sound that you hear in ‘the’?)). The BCPC was often visited to remind students of English sounds. Students worked in pairs and groups to find out the final sounds of the ERR 100 HFEWs, and they were encouraged to ask about other words if they liked. By the end of week eight, some students were able to identify most of the sounds and to refer to the GPCs to make sure of their answers. Consequently, the concepts of segmenting and blending were introduced in week nine and ten.

Segmenting and blending drilling took the form of answering two questions. The question ‘What are the sounds in ...?’ was used to practice segmenting the ERR 100 HFEWs whereas “What word do these sounds make?” (e.g. mmm-aaaa-nnnn -- man) encouraged students to blend. At the beginning, students were asked to practice segmenting and blending the sounds of their names. Later on, they practiced with the ERR 100 HFEWs, and they were assisted by using the BCPC and the GPCs. Moreover, interactive websites were visited to practice segmenting and blending sounds (e.g. http://teacher.scholastic.com/ips/game4.htm).

Finally, each student was assigned to segment and blend the sounds of 5-10 words of the ERR 100 HFEWs. Then, they worked in pairs and groups to share their responses and make the necessary correction with the guidance of the researcher. The students were provided with a chart that shows the sounds and their numbers of the ERR 100 HFEWs to help them in segmenting and blending tasks.

Stage 3: Assessment (1 week). The experimental group completed an assessment task every week to inform the researcher about the progress of the students in identifying the different sounds of English. During the last week of ASWAT, a post-test, identical to the pre-test was administered to find out the
impact of the explicit teaching of phonics on the experimental and controlled groups’ ability to read the ERR 100 HFEWs.

Results

In order to answer the questions of the study, a number of descriptive statistics were run to compare the achievement scores of the two groups. At the pre-test phase, there was no significant difference between the two groups. This implied that the pre-test reading aloud of the ERR 100 HFEWs achievement of the two groups was almost identical (see Figure 3). However, at the post-test phase, the experimental group achieved a mean of 50.6, compared to the control group mean of 38.7. In answer to the first research question as to whether phonics instruction improves reading the ERR 100 HFEWs, the immediate conclusion is that phonics instruction added a lot to reading gains. The significant difference between the two groups showed evident development in reading, whose mean rose from 32.7 to 50.6.

In answer to the second research question, which aimed at identifying the main differences between the two groups regarding reading errors, the experimental group outscored the control group regarding individual achievements. The percentage increase in the correct answers in the post-test for the experimental group was 66.4%, whereas the control group had a 22.7% increase. Importantly, the experimental group made fewer errors in the pre-test (Figure 4).
Discussion

The result of the post-reading test corresponds with Solity (2005) about the positive impact of Early Reading Research on children having problems with reading. The results also mirror the findings of the NICHD (2000) that “phonics instruction produces gains in reading and spelling not only in the early grades (kindergarten and 1st grades) but also in the later grades (2nd through 6th grades) and among children having difficulty learning to read” (p. 122). Statistics show that ASWAT has been successful in enabling the experimental group to make significant progress in reading the ERR 100 HFEWs. The experimental group generally made more progress than the control group. When broken down into individual responses (correct (CR), incorrect (IR) and null responses (NR)), the experimental group made significant progress in CR, IR and NR, while the control group made less significant progress, especially in terms of NR as shown in Figure 5.
The experimental group was able to reduce the number of IR from 41.5 to 29.2 which indicates that the experimental group has benefited from ASWAT. Similarly, the number of NR was reduced by 5.2. Despite the positive increase of the mean for both groups, the increase in the standard deviation is estimated at 8.9, whereas that of the control group was just 5.8, which does not reflect the consistency of the post-test figures (Figure 6).

There are several possible factors that may have led to this negative correlation between student improvement and the increase of the STDEV for both groups. One factor may be that some of the students have behavioural problems that make them less interested in their study. Another possible reason may be due to attendance. Five students from the experimental group missed an average of three weeks of study, while five students from the control group missed an average of four weeks, or 25 to 30 sessions of phonics instruction. Results that were anomalously high or low could also be attributed to individual student motivation. If the sample size of students were larger, it would be more sensible to exclude those extreme marks to decrease the precision of the figures in the STDEV.

Using descriptive statistics is useful to compare the increase in errors committed by the two groups. The experimental group was able to reduce the total number of errors from 601 to 438 while the experimental
group decreased the errors from 686 to 493. Although the control group did not receive explicit phonics instruction, their reading errors decreased in number in the post-test. This suggests that not only explicit phonics instruction can improve students' reading performance. However, the main difference lies in the ability of the experimental group to use its phonological knowledge to overcome some of the various types of reading errors, whereas the control group did not.

Another significant difference is the decrease of NR by the experimental group from 387 to 141, whereas it increased for the control group from 321 to 426. The experimental group was able to reduce the number of IR from 41.5 to 29.2, which indicates that the experimental group has benefited from ASWAT. Similarly, the number of NR was reduced by 5.2. Conversely, the NR of the control group increased. Most control group students continued dealing with words as graphemes rather than sounds. For example, some students read ‘the’ as /t+i:əti:/ as three separate phonemes. This almost disappeared among the experimental group.

Furthermore, the experimental group outscored the control group in terms of individual differences in providing correct responses before and after ASWAT. The percentage of gains for the experimental group was 66.4%, whereas that of the control group was just 22.7% (Table 2).

<table>
<thead>
<tr>
<th>Student #</th>
<th>CG Pre</th>
<th>CG Post</th>
<th>Difference Post-Pre</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>48</td>
<td>58</td>
<td>10</td>
<td>20.83%</td>
</tr>
<tr>
<td>2</td>
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<td>-5</td>
<td>-21.13%</td>
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<td>3</td>
<td>47</td>
<td>46</td>
<td>-1</td>
<td>0.00%</td>
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<td>49</td>
<td>15</td>
<td>226.67%</td>
</tr>
<tr>
<td>5</td>
<td>13</td>
<td>13</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>6</td>
<td>15</td>
<td>16</td>
<td>-1</td>
<td>-6.67%</td>
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<td>11</td>
<td>15</td>
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<td>55</td>
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<td>14</td>
<td>75</td>
<td>88</td>
<td>13</td>
<td>17.33%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>22.74%</td>
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</table>

<table>
<thead>
<tr>
<th>Student #</th>
<th>EG Pre</th>
<th>EG Post</th>
<th>Difference Post-Pre</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>42</td>
<td>97</td>
<td>55</td>
<td>130.95%</td>
</tr>
<tr>
<td>2</td>
<td>23</td>
<td>70</td>
<td>47</td>
<td>204.35%</td>
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<td>22</td>
<td>18</td>
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<tr>
<td>5</td>
<td>36</td>
<td>33</td>
<td>-3</td>
<td>-8.33%</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>3</td>
<td>-1</td>
<td>-20.00%</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>22</td>
<td>14</td>
<td>172.73%</td>
</tr>
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<td>9</td>
<td>15</td>
<td>6</td>
<td>66.67%</td>
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<td>9</td>
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<td>15</td>
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<td>2</td>
<td>13.33%</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>15</td>
<td>2</td>
<td>13.33%</td>
</tr>
</tbody>
</table>

Table 2. Percentage of increase of correct responses of EG and CG in reading ERR (out of 1000)

The highest mark from the control group in the post-test was 97/100, an increase of 45. In the control group, the highest mark was 94/100, but this was a far lesser gain of 12 compared to his pre-test result. The difference in the first case (42-97) caused the researcher to interview the student (S1) to explore the
reasons for that dramatic change. According to S1, his reading ability improved because he started treating graphemes as sounds. He added that understanding the relationship between graphemes and the phonemes they represent helped him to identify the different sounds of English. “Now, I stop reading English as I do Arabic. In Arabic, we read what we see, but in English we must say the sounds of what we see,” said S1.

Six control group students and three experimental group students did not show any improvement. These cases failed the pre-post tests and their non-word responses (e.g. /ti: ɛntʃi/, /wentʃi/) point to dyslexia as a possible cause. In such cases, there should be a clear referral route to a specialist dyslexia assessment with associated support.

After removing conventionally correct reading and null responses, reading errors were categorized as: interlingual (phonological: absence of phoneme (AP) or syllabic structure (CVC) or intralingual (sound based system (SB), whole-word substitutions, non-word response and directionality confusion as a sign of dyslexia (D). More importantly, the experimental group was able to reduce the number of sound-based errors from 164 to 75, which shows that because their knowledge of GPCs is improved, they were able to avoid making more errors (Table 3). This improvement has led to a decrease in the number of NWR and WWS.

<table>
<thead>
<tr>
<th></th>
<th>Total of Incorrect responses</th>
<th>Absence of Phoneme</th>
<th>Syllabic Structure</th>
<th>Sound-Based</th>
<th>Directionality</th>
<th>Whole Word Substitution</th>
<th>Non-Word Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EG</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test</td>
<td>601</td>
<td>33</td>
<td>22</td>
<td>164</td>
<td>38</td>
<td>144</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>5.4%</td>
<td>3.6%</td>
<td>27%</td>
<td>6.3%</td>
<td>24%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Post-test</td>
<td>438</td>
<td>15</td>
<td>20</td>
<td>75</td>
<td>34</td>
<td>137</td>
<td>157</td>
</tr>
<tr>
<td></td>
<td>2.4%</td>
<td>3.5%</td>
<td>12.5%</td>
<td>5.4%</td>
<td>4.8%</td>
<td>26%</td>
<td></td>
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<tr>
<td><strong>CG</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test</td>
<td>686</td>
<td>63</td>
<td>20</td>
<td>177</td>
<td>40</td>
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<td></td>
<td>10.4%</td>
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<td>29%</td>
<td>5%</td>
<td>29.9%</td>
<td>38%</td>
<td></td>
</tr>
<tr>
<td>Post-test</td>
<td>493</td>
<td>50</td>
<td>20</td>
<td>154</td>
<td>29</td>
<td>100</td>
<td>140</td>
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<tr>
<td></td>
<td>8.3%</td>
<td>2.5%</td>
<td>25.6%</td>
<td>4.8%</td>
<td>12.6%</td>
<td>23%</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. A comparison of the number and percentage* of the errors made by the EG and CG
The control group reduced SB errors from 177 to 154 (27% - 12.5%), which suggests that explicit instruction on GPCs can help students identify the relationship between graphemes and their phonemes. In addition, the experimental group had gains in dealing with English restricted phonemes especially (/p/, /v/ and /g/); however, it requires more training to minimize such errors. Since there was no high focus on vowels in Arabic, students continued to insert vowels into English words. Therefore, more drills are needed to cover this area, which is necessary for teaching spelling.

The most evident difference between the two groups was the approach used by students in attempting to pronounce words. The control group continued to ask: How do we read ‘uncle’? while the experimental group started asking about the sounds of graphemes because of the improvement of their PHA and PA.
This knowledge was expected to be transferable to deal with unknown words, which the control group lacks. Some experimental group students began to take risks and applied their understanding of the different sounds and their relationships to read unknown words. Moreover, they started raising questions about the sounds of graphemes and asking for justifications. For example, what is the sound of ‘au’ in August? is there a sound between ‘t’ and ‘t’ in family?, is ‘u’ in uncle similar to ‘u’ in June?, etc. In short, the word sound has become a buzzword among the majority of the experimental group.

Pedagogical Implications and Limitations

The aim of this paper was to examine the impact of the ASWAT programme on developing students’ ability to read the ERR 100 HFEWs suggested by Solity and Vousden (2009). The amount of improvement on the post-test has been educationally and statistically, significant and this justifies the efforts of implementing ASWAT. It can be argued that such optimal phonics instruction, in addition to the various skills-based explicit phonics tasks, students accomplished (e.g. identifying initial and final sounds, matching graphemes to phonemes), and finally, evaluating their progress, all contributed to the development of their reading ability. In addition, it is highly recommended that training well-designed programs for teachers with respect to phonics instruction should be offered to overcome the difficulties in implementing ASWAT.

These research findings have pedagogical implications for learners, teachers, and curriculum designers. Students must read aloud and be read aloud to if they wish to practice saying and listening to the different sounds of English. Furthermore, students must be encouraged to stop relying heavily on whole language strategy used in Arabic to read English since the two languages differ in their GPCs. This does not mean that whole-language programmes cannot be used along with phonics instruction. Teachers must still help students develop their phonological awareness to be good readers, and this can be achieved through the use of different phonics instruction appropriate to the needs of the targeted students. In addition, teachers are advised to systematically infuse and reinforce phonics instruction so that students can transfer their acquired knowledge of phonics outside the classroom. In this way, students could begin to value English as another language to use rather than just a foreign language to learn.

Similarly, curriculum designers at the MVC need to include a satisfactory amount of phonics instruction in the English textbooks to encourage teachers and students to experiment with phonics as an effective teaching method of reading and spelling. Importantly, there is a need to take care of those students who might suffer from dyslexia. Teachers, curriculum designers, and social workers at the MVC should work together to meet the students’ phonological needs. In short, a need for the inclusion of, and emphasis on, learning and teaching phonics is a necessity for all stakeholders at the MVC.

Given that this current study is limited to one teacher and one training department in a vocational centre, it has a number of limitations. First, it is unlikely to replicate or generalise the results since the size of the sample is quite small. Secondly, the subjects of the study differ in many ways from students in public
schools (e.g. English level, course of study, motivation to learn English). Implementing ASWAT in other departments would increase the possibility of generalizing the findings of the study.

**Conclusion and Future Study**

The findings of this study support, and are at the same time corroborated, by extensive research literature on phonics instruction. Moreover, it can be said that ASWAT is an effective programme for developing reading fluency and accuracy in a vocational setting, with the majority of students who have a high affective filter and poor (beginners) English to begin with. The researcher’s plan is to develop ASWAT into a six-stage model (3 years long), emulating the layout of the “Letters and Sounds” programme produced by the UK Department for Education and Skills in 2007. The new ASWAT will make use of different phonics programmes, in general, and ‘ERR and ‘Letters and Sounds’ in particular. Besides, the researcher will make use of the reading programme (www.learninga-z.com) to enable students to listen to and read hundreds of differentiated fiction and nonfiction texts, which emphasise phonics awareness.

In order to gain a complete understanding of the real effects ASWAT can have on students, it is crucial to conduct a study that examines the impact of the phonics instruction approach on improving spelling, which is a main concern at the Modern Vocational Centre. Further, research on how to develop a phonics programme that combines multiple pathways to learning phonics that works for all learners remains an area for future research. Moreover, research is required to decide whether and how phonics instruction might be taught more effectively using modern technology such as IPads, cell phones and computers so that transfer to spelling as well as reading become more effective. Finally, research is needed to pinpoint what teachers of English must know and be able to do to teach phonemic awareness and phonics productively and to incorporate them with other components of direct/explicit reading instruction suggested by the NRP (2000).
References


**Appendices**

**Appendix A: A sample of a student’s reading responses (48/100) (pre-reading test January 07, 2013)**

<table>
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<tr>
<th>#</th>
<th>Word</th>
<th>Responses</th>
<th>Type of errors</th>
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<td>CR (✓)</td>
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<td>AP</td>
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<td>in</td>
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<td>8</td>
<td>that</td>
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<tr>
<td>9</td>
<td>have</td>
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<td>11</td>
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<td>43</td>
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<td>44</td>
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<tr>
<td>47</td>
<td>am</td>
<td>x</td>
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</tbody>
</table>

1 GPCs: Grapheme–phoneme correspondences
2 See word banks for more examples (all phases)
3 See Appendix 1 in the Letters and Sounds Six-phase Teaching Programme
4 Note that the teaching of spelling cannot be completed in Year 2 – it needs to continue rigorously throughout primary school, and beyond if necessary.
* (“Letters and Sounds” is available for download from: www.standards.dfes.gov.uk or www.teachernet.gov.uk/publications.)
The Story, the Child, and the Touchscreen: How Story Apps Tell Stories

*Yan Zheng, PhD Education student*

*School of Education, College of Social Sciences, University of Glasgow*

Since around 2010, computer technology has been moving stories from page to touchscreen, from story books, to story apps. This trend has become a serious concern of parents and educators because, although there has been research that consistently shows that storytelling plays an important role in child development, this research is based on traditional ways of storytelling. Today, modes of storytelling seem to have undergone a revolution with the appearance of apps, yet we barely know how app storytelling works, what story apps can offer to children, and whether they are any good for child development. My PhD research is aimed to offer some guidance for evaluating and using story apps in family and school education.

Specifically, this is conceptual research trying to theorise the narrative strategies used in story apps. It asks three major questions:

- What is a story app?
- How does it tell stories?
- What are the implications of the findings?

As a story app is a hybrid of picturebooks, films, computer games, etc. to have a better understanding of how a story app works, requires an interdisciplinary approach. Narrative theory, or any single theory cannot serve the purpose of this study. Therefore, this research utilises scholarship from picturebook studies, narratology, media studies, social semiotics and game studies.

This research focuses on an original construction of a storytelling mechanism (see Figure 1) I developed based on the definition of storytelling proposed by Eileen Colwell (Colwell, 1980). This mechanism consists of three elements: the *narrative content*, the *medium* and the *interpreter*. I argue that the mechanism has two layers: the *mechanical layer*, where the disposition and the formation of signs are concerned, and the *interpretative layer*, where the interpretation and meaning-making is concerned. Based on this mechanism, this research investigates how story apps work, with particular attention on whether story apps bring anything new to the two layers of this storytelling mechanism. The investigation focuses particularly on the medium, and the relationship between the narrative content, the medium and the interpreter, i.e. the *interactivity.*
A review of the relevant literature shows that most of the research surrounding the elements of the storytelling mechanism (narratology, media studies and social semiotics) focus on the interpretative layer while the mechanical layer of the storytelling mechanism has been neglected for a long time. Moreover, in children's literature where both digital and nondigital texts are concerned, much attention has been given to the narrative content with approaches from narrative theory (e.g. Nodelman, 1988; Stichnothe, 2014), literary theories (e.g. Hunt, 1991; Nikolajeva, 2009; Turrión, 2014), postmodernism (e.g. Sipe and Pantaleo, 2008), rhetoric (e.g. Nikolajeva, 2002), semiotics (e.g. Nikolajeva and Scott, 2001), aesthetics (e.g. Nikolajeva, 2005; Schwebs, 2014), genre studies (e.g. Nodelman, 2008), etc., and on the interpreter from reader response theory (e.g. Arizpe and Smith, 2016), educational perspective (e.g. Arizpe, Farrell and McAdam, 2013; Bus, Takacs and Kegel, 2015), cognitive approach (e.g. Nikolajeva, 2014), childhood studies (e.g. Grenby, 2011), etc., but not much attention has been paid to the role the medium from the perspective of the mechanical layer of the storytelling.

So far, my research is at the stage of studying the mechanical layer of the storytelling mechanism. Based on the mechanical textual behaviour\(^1\) in a narrative text in children’s literature, I have developed an original typology for children’s narrative texts with objective media \(^2\) (a full typology with both the objective medium and the subjective one is the aim of the next stage of the research). This typology

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\(^1\) I define “the mechanical textual behaviour” as the actual disposition of signs on the medium of storytelling, and such a disposition is decided by the nature of the medium, is independent of the interpreter’s meaningmaking, but is influencing and influenced by the interpreter’s interaction with the narrative content via the medium (such as lifting a flap in a picturebook, turning a page, tapping on a touchscreen, activating a hotspot on a touchscreen, etc.).

\(^2\) “Objective medium” refers to the medium that is stable and consistent in terms of its performance, such as a piece of paper, a (touch)screen. “Subjective medium” is the medium that does not have stable and consistent performance, such as a human being (performer, singer, etc.)
consists of 32 text positions in the space of textuality. Any narrative text with an object medium can identify itself with a position. The position of a particular text is a matter of debate, but such debates will not invalidate the typology. The typology is theoretical, which means there might be some positions that do not have identified empirical equivalents.

According to this typology, the mechanical textual behaviours found in story apps are evident in some other platforms of storytelling, which suggests that in the mechanical layer of storytelling, story apps have not (yet) invented any new strategies to tell stories, though some of them have “created” a complicated mechanical pattern by combining strategies used by other platforms of storytelling, while the differences between some other story apps with printed books are actually less than those between one printed book and another. I believe that my typology has some heuristic value for story creators in terms of innovating the ways of storytelling.

As the research is not yet complete, the findings so far are limited. However, based on data I have already analysed, it seems possible to develop a universal grammar of storytelling for all kinds of narrative texts based on the mechanical textual behaviours, and the narrative texts in children’s literature as well as literature in general can be studied independent of the medium. This conclusion indicates a possible route towards developing a universal teaching method that based on the essence of storytelling rather than the platform used.

The next step of my research is to complete the study of interactivity in the mechanical layer of the storytelling mechanism, and move on to enquire into the interpretative layer, and investigate what story apps may offer to this layer. Although story apps do not have any unique mechanical textual behaviours, they do have quite complicated narrative patterns, and based on my observation of the digital market and the development of computer technology, I believe that story apps have great potential to realise some theoretical positions in my typology that do not have empirical equivalent yet.

Based on what I have found, I tend to believe that story apps are neutral artefacts, that is, the apps themselves are neither good nor bad; what makes story apps good or bad is how they are used in practice. Story apps have great potential to become useful tools for literacy teaching. However, as this is conceptual research, the findings need to be put into practice for testing. Moreover, as this research is not concerned directly with physical and psychological child development, the findings cannot be used precisely to support or contradict the argument that story apps are good/bad for child development. In general, my research is hoped to serve as a small but important step towards a fuller understanding of digital children’s literature and its implications for education.
References


The sociolinguistic functions of codeswitching in the Arabic religious discourse

Nesrin Tantawy, MSc Education student
The British University in Dubai

Introduction

This study is chiefly meant to investigate the social functions of bidialectal code switching between Standard Arabic (SA) or ‘ʔ-ʕamijjah’, the high code (H), and the Egyptian Colloquial Arabic (ECA) or ‘ʔ-ʕamijjah’, the low code (L), in the domain of various religious speeches or monologues delivered by a range of famous Egyptian, Islamic preachers or ‘Duʕah’. The results suggest that Muslim preachers assign different sociolinguistic and communicative functions to each code. This research has a specific relevance to the intention of the researcher, as a part of the Egyptian diglossic society as well as several miscellaneous Egyptian speech communities, to accentuate the notion that the dissemination of ECA vernacular in formal domains, e.g. religious speeches, is not random and to dispute the historically accepted perception of the low code (L) as being linked to low prestige and low social status. The positive teaching implications of code switching, bilingual or bidialectal, as an intrinsic feature of any bilingual as well as diglossic speech community are treasured particularly in situations that require the teacher to share the same languages or language variations with the learners. Expert teachers should feel the compelling need to develop a diversity of conversational strategies, e.g. code switching, for both communicative and pedagogical purposes.

Review of Concepts

Ferguson’s (1959) definition of diglossia as the language situation in which “two or more varieties of the same language are used by some speakers under different conditions” (p. 325) points out the existence of two functionally distinct codes or varieties in each situation within the same speech community, a superposed, prestigious, and powerful variety namely the high code (H) that is utilized in formal settings such as giving political and religious speeches, and another colloquial, less prestigious, and less powerful variety namely the low code (L) that is used in daily exchanges with family members, domestic laborers...etc (Wardhaugh 2010). Ferguson goes on to claim that the functional specialization of high and low varieties is the core and essence of diglossia; while L is considered appropriate in a specific set of situations, H is the standard in another in a way that makes a speaker subject to ridicule upon using them interchangeably (Ferguson 1959). The “natural superiority of H variety” over the L variety is said to be rooted in the different methods through which each of them is acquired; the H variety is taught in formal settings, e.g. classrooms, due to “the availability of grammars, dictionaries, standardized texts...”, whereas the L variety, which lacks comparable linguistic features, is likely to be learned by the normal means of
learning one’s vernacular, the language used in a person’s daily social interactions since his/her childhood (Wardhaugh 2010, p. 86-87). Thus, the H code has always been seen as the elevated variety spoken by the elite and the L variety is associated with the ordinary population.

Though Fishman’s definition of functional diglossia broadened the scope of Ferguson’s to encompass multilingual societies in which they implement various dialects, registers or language varieties that play different roles (Fishman 1967, p. 30) and so aims to determine the societal factors by means of which a speaker identifies one variety as more appropriate than another, Ferguson’s work has been widely recognized as the theoretical framework of many studies that tackle the sociolinguistic phenomenon of code-switching in diglossic communities (Mejdell 2006; Soliman 2008; Albirini 2011) including the current study.

For a person to function in a diglossic situation, he/she has to have command of at least two codes, languages or dialects; people usually face situations that require them to select one code, switch from one code to another, or even mix codes within the same utterance. Consequently, code-switching is defined by Wardhaugh (2010) as a conversational strategy used by speakers to create and change interpersonal relationships; Woolard describes code-switching as the speaker’s use of more than one language variety in one exchange (cited in Duranti 2004, p. 73-74) which falls under the umbrella of code alternation as asserted by Albirini (2011) who mentions that code-switching is a creative speech act employed by speakers for communicative purposes and is agreed to be “the alternation between two language varieties in a speech episode” (p. 537) . The code choice in a diglossic language situation is claimed to lie with the speaker; the speaker’s motivation, e.g. accommodation to listeners and solidarity, is a key factor in determining his/her code choice (Wardhaugh 2010).

Applying Ferguson’s model or theory to the Egyptian society shows that the language situation, referred to as the language variations used by language communities inhabiting the same geographical region (Ferguson & Huebner 1996), in Egypt is typically diglossic in which two varieties of the Arabic language coexist, probably in the same stretch of discourse, to fulfill divergent functions (Bassiouney 2006; Jabbari 2012; Yacoub 2015); the highly codified variety (H) is the Standard Arabic (SA) and the common, low variety (L) is the Egyptian Colloquial Arabic (ECA). In spite of the extensive criticism Ferguson’s proposal about diglossia was prone to for not taking into consideration the formal and contextual overlap between the so called two poles, H and L varieties, the H-L division is still valid (Bassiouney 2006). According to Al-Wer (1997), SA is held in high regard for its religious value since its early stages; in addition, SA is closely linked with the culture and identity of Arab societies which instigate unity among them. This supposition is reinforced through Haeri’s (2000) statement that SA is the unifying cornerstone of Arabs across the Arab world which in turn facilitates communication when cross-dialect variations come forth; she explains that SA gained its status as the high code (H) from being the language of Islam and pan-Arab nationalism, which paved the way for SA to become a fundamental symbol of Arab and Muslim identity. Upon investigating
the functions of code switching in the Egyptian society, Bassiouney (2006) expounds the proposition that speakers usually exploit SA in stating abstract facts while resorting to ECA to provide explanations and examples; she also remarks that SA is used to add a tone of seriousness to certain topics, whereas ECA is seen as more effective in narration.

Moreover, in his attempt to examine the phenomenon of code switching between SA and ECA and the H-L correlation in the Egyptian religious discourse, Soliman (2008) emphasizes that several modern Egyptian scholars shift to ECA in delivering their speeches; he argues that Egyptian speakers in religious domains tend to employ ECA rather than SA in formal contexts, the practice that can be ascribed to Wardhaugh’s (2010) supposition that the message being communicated has a direct impact on one’s code choice. Soliman concludes that each of the two varieties has its own power in the Egyptian speech communities; SA symbolizes their Arab and Islamic identity for being the language of Qur’an, while ECA signifies their local identity as Egyptian.

Stadlbauer (2010) contends that ECA is the Egyptians’ mother tongue and the lingua franca in their daily exchanges and thus denotes their national identity; although many voices judge ECA as the light, easily accessible vernacular of ordinary people, it is still criticized as weak or permissive for its vast borrowed lexical repertoire. On the other hand, SA attained such high prestige through its literary richness and well-established, codified orthography that stemmed from the Holly Qur’an and Hadith as early as the ninth century; the linkage between SA and Islam is constantly reinforced due to the fact that 88% of Egyptian people are Muslims. Albirini’s study results (2011) come in line with Bassiouney’s (2006); he attributes the asymmetric relationship between SA and ECA to the status and role of each variety as well as to what he calls “prestige boundary” (p. 559) that places each of the two codes in contexts of different formality levels.

Methodology

The descriptive qualitative research method chosen for this study is defined by Creswell (2014) as “an approach for exploring and understanding the meaning individuals or group ascribe to a social or human problem” (p.4) by which data is naturally collected to provide thorough interpretations of natural behaviours (Lodico, Spaulding &Voegtle 2010); the significance of mustering naturalistic data lies in relying on spontaneous rather than artificial data. Qualitative researchers claim that such methods facilitate observing people's cultures and communicative behaviors in natural settings so as to have the ability to offer more careful justifications (Johnstone 2000); they conclude that the qualitative methods are recognized to be more appropriate than quantitative approaches in dealing with social, ethnical, and interactional relations since a qualitative researcher is required to express interest in understanding the social world from the participants’ point of view and highlight the context in which events occur (Law et al. 1998). Moreover, validity is among the strengths of qualitative research in deciding on the accuracy of
findings from the researcher’s, the participant’s, and the readers’ viewpoint. The data used in this research is collected by a nonparticipant or complete observer-researcher whose role is to observe and record information as it occurs without participating (Creswell 2014).

The linguistic phenomenon to be observed for this study is the patterns of bidirectional, bidialectal code switching between SA and ECA and the different functions achieved by each code even when both codes are intertwined within the same stretch of discourse. The selected purposeful sample, defined by Maxwell (2005) as deliberately chosen individuals for the ample information they can present, are two different religious TV programs delivered by two famous Egyptian Islamic preachers, namely ‘Amr Khalid’ in ‘Sla khut’a ʔl-ʔabeeb’ or ‘Following in Muhammad’s footsteps’ aired on ‘ʔqrʔ’ TV channel, and ‘Mustafa Hosny’ in ‘Sla t’reeq Allah’ or ‘On the way to Allah’ aired on ‘Al-Nahar’ TV channel. These TV shows are chosen in the same domain of religious contexts for their convenience to the aim of illuminating the phenomenon of interest in the current research; the unyielding, reciprocal relation between Islamic religion and SA or H would shed the light on the potential social functions of alternating codes or the so called H-L functional division in religious speeches. The two well-known, educated Egyptian preachers are also selected as the target population due to expediency purposes of mastering both codes. The study utilizes naturalistic data of 7 hours, equivalent to 10 episodes- 5 from each program, of qualitative audio and visual materials as a category of qualitative research (Creswell 2014).

For codification and transcription procedures, ‘The Leipzig Glossing Rules’(2008) are used for interlinear morpheme-by-morpheme glosses; the ECA segments are transliterated (Appendix A) and underlined, SA segments are typed in bold to evade any confusion on the part of the reader, and the rest are neutral words (N) that are normally used in both codes. The transcribed data was first read, and then the segments that are relevant to the research purpose were coded with special regards to the Arabic sociolinguistic contexts.

**Main Findings and Analysis**

The data analysis shows that the stimulation of CS from SA to ECA and vice versa is basically governed by their particular statuses, as H and L codes, in the Arabic diglossic situation; the results of the current study mirror the functional division of the two codes, SA and ECA, and largely verifies Ferguson’s (1959) supposition about the functional specialization of H and L as a key feature of any diglossic language situation.

Three basic functions of CS to SA have been identified through analyzing the religious speeches under scrutiny: Firstly, SA or H is employed in introducing direct quotations; the two Islamic preachers resort to SA while reciting Qur’anic verses, Hadith, Prophetic narratives, and traditional supplications. The two
scholarly preachers initiate their speeches by offering supplications to Allah or literally quoting from Holy Qur’an in SA with the intention of paving the way for the points to be discussed afterwards and adding credibility to the materials disposed to analysis; using a quote allows the speaker to dissociate him/herself and alternatively depute the responsibility of what is being said to a divine entity, i.e. Allah, to bear superior objectivity and meaningfulness. As stated by Ferguson (1959), H variety is extensively believed to represent “the actual words of God” (p. 238) and thus leaves the issues raised by the speaker indisputable (Albirini 2011). Another possible explanation of employing direct quotes delivered in SA is Bhatt and Bolonyai’s (2011) principle of ‘Faithful Interpretiveness’ which induces the economical expression of the speaker’s intended meaning which eliminates the chances of misinterpreting the speaker’s message. In line with the current study, Albirini (2011) and Soliman (2008) detected the same function while investigating the sociolinguistic phenomenon of CS in the Arabic diglossic situation.

Examples: (SA)

(1) “wa ʔiʃal ʔadeeθ-i l-walhi-k la ʔadeeθ rijaʔ wa-la sumʕah” (supplication)
and make.1M speech-my for-sake-your.2M not speech duplicity and-not deception

‘And make my sincere words devoid of duplicity and deception’

(2) “rab ishraḥ l-ee sˤadr-i wa jassir l-ee ʔmr-i wa iḥlul ʔoqdah min lisan-i
God enlighten for-me chest-my and ease for-me demand-my and resolve tie from tongue-my

  jafqah-u qawl-i” (Qur’anic verses- Surah ‘tˤaha’, verses 25-28)

decipher-they speech-my

‘Oh Lord, enlighten my heart, make my life easier, and make me articulate for them to understand my words’

Secondly, formulaic expressions are inseparable constituents of the Arabs’ communicative exchanges and particularly Islamic religious discourse; the association of formulaic expressions with “piety and God-consciousness” induces their significance in the eyes of all Muslims and hence such expressions are usually uttered in their typical SA or H forms (Albirini 2011, p. 541). Formulaic expressions are identified by Wray and Perkins (2000) as sequences of discourse structures that enhance comprehension and production; they are also defined by Simpson (2004) as salient and coherent lexical units that are employed to achieve a range of discursive functions, e.g. summarizing, paraphrasing, sequencing, and focusing. In addition, the need to construct language and to accomplish communicative goals without enduring processing burdens is a key function of integrating formulaic expressions in daily exchanges (Kecskes 2000).

Examples: (SA/ ECA/ N= neutral-used in both codes)

(3) “tˤareeq? rabina subhana-h wa t-ʕala ʔilli ʔwilu-h sʕadah...”
‘The way to God, glorified and exalted, that starts with happiness...’

(4) “w ḥkhrīt-ū ṭid’a Allah ṣāz wa Ṣāl...”

and end-its pleasure. M Allah omnipotent and Almighty

‘And the endpoint is to be granted pleasure from Allah the Omnipotent and Almighty’

Examples (3) and (4) show two different SA formulaic expressions used mainly to keep the audience attentive to what is being said, to add divine salience and a serious tone to the point under discussion, and to work as a transitional point before introducing an extended stretch of discourse in SA (Reyes 2004; Bassiouney 2006; Albirini 2011).

Thirdly, the speakers in the two religious contexts revert to SA so as to denote their pan-Arab nationalism and Muslim affiliation, the function that is found in Albirini’s study (2011). Language is widely seen as a collective identity marker with all the associated values as it categorizes individuals in a way that marks their group membership (Reyes 2004; John and Dumanig 2014). People in the Arab world typically identify themselves with their native language to “endow themselves with a sense of belonging” (Bassiouney 2009, p. 273); not to mention, the prestigious variety or SA is promoted in the religious domain by the high merit of being the language emphasizing the Arab-Islamic identity (Bagui 2014, p. 191).

Examples: (SA/ ECA/ N)

(5) “w ṭnā bshkhor tilifizjōn ṭn-Nahar ṭn-u ṭtaḥ l-ee ṭl-forsāh ṭn-i ṭtawas’il mš ṭl-ʔikhwāh

and I thank TV Al-Nahar that-it gave to-me the-chance. F to-I communicate with the-brothers

fi ṭl-watśan ṭl-Şarabi...”

in the-nation. M the-Arabic

‘And I would like to thank Al-Nahar TV for giving me the opportunity to communicate with people across the Arab world...’

(6) “h-şhraḥ b-shakl baseetš bšdš ṭl-ʔbakm ṭl-fiqhiyjah ṭlāti jaḥtaghu-ḥa ṭl-muslim-un...”

will-explain in-shape simple some the-concepts the-jurisprudential. F that need-it.3. M the-muslims. M

‘I will simply explain some jurisprudential concepts that Muslims need...’

The speakers shift to H or SA as a strategy for identifying themselves with Arabic and Muslim communities. In example (5), the speaker takes pride in addressing all Arabs through his program; in example (6), the
presenter offers explanations of specific Islamic concepts that he, as a Muslim-community affiliated, is fully aware his addressees would need. SA is perceived as the unifying force of all Arabs and Muslims in particular (Albirini 2011).

On the other hand, patterns of CS to ECA seem to serve an entirely different array of functions among which fall the two prevalent purposes: First, simplifying and paraphrasing a previously presented idea which comes in accordance with Bassiouney’s (2006) finding of following an abstract fact by a simplified version as a means of explaining it. Accommodation to audience through ‘audience design’, proposed by Wardhaugh (2010) as a form of convergence that aims to adjust speech to listeners through code choice, as well as appealing to the uneducated sector of the society provide a solid explanation of the speakers’ choice of ECA or L variety in simplifying complex ideas. Another hypothesis that puts forward a logical account of such a phenomenon is Myers-Scotton’s (2002) theory of ‘minimizing costs and maximizing rewards’ which implies the speakers’ inclination towards obtaining substantial and immediate results through using ECA as the easy code.

Examples:  \(\text{(SA/ ECA/ N)}\)

(7) “\text{ʔhdi-na ħl-sˤratˤ ħl-mustaqim maʔna-ha ja rab saʔid-na n-imshi ħla tˤreeʔ Allah}”

lead-us the-path.M the-straight.M means-it.F oh God help-us we-walk on way Allah

‘Lead us to the straight path...’ (Qur’anic verse- Surah ‘ʔl-Fatihah’, verse 6) it means: Oh Lord, help us find our way to you’ (explanation)

(8) “\text{Jihad l-nafs-iʔ lik lafi bajn Jambaj-k haʔhi ħl-nafs lli ja ħimma twasˤl-ok ħla Allah...}”

striving for-soul-your that.F between sides-your that.F soul that either walks.3.F-you to Allah

‘Striving for your own self, that exact soul that would either lead you to Allah...’

In example (7), the speaker recites a Qu’anic verse followed by a paraphrase delivered in the ECA variety for its accessibility to the listeners. In example (8), the preacher starts discussing the religious concept of ‘Jihad’ or striving and clarifies which exact type of ‘Jihad’ using the L code so as to eliminate any confusion with other types of ‘Jihad’ on the part of the listeners.

The second systematic pattern of CS to ECA, which is closely linked to the first one, demonstrates the social function of exemplifying or illustrating a certain topic through giving relevant examples that would facilitate conveying the speaker’s message to the audience. Bassiouney (2006) and Albirini (2011) confirm the same function of providing examples in ECA as an alternative way of clarifying complicated and theoretical concepts; using personal narratives or real-life instances inspires listeners to relate to their own daily lives and thus fosters their deep understanding of the idea. With the same token, ‘national identity’, assumed by Wodak (2009) to emphasize “national uniqueness and intra-national uniformity” (p.
4), is to be another target of referring to daily occurrences in elucidating ambiguous issues; ‘local solidarity’ usually entails the use of a low variety of a language (Wardhaugh 2010, p. 108).

Examples:  (SA/ ECA/ N)

(9) “ʔl-khalwah hijaʔn jajtamiʕʔl-raqul waʔl-marʔah fi mkan mughaʔaq māʕlan ʔna fi
the-seclusion.F it.F that gather.M.SG the-man and the-woman in place closed example I in
maktab-i wʔl-bab maʔʔool ʕla-jāʔna w zmilt-i…”

office.M-my and the-door.M closed on-me I and colleague-my.1.F

‘Seclusion implies the state of a man and a woman privately staying in a closed room for example I and my female colleague are in my office while the door is closed…’

(10) “fi ʔl-sʕiraʕsat waʔl-muʕʕahrat w l-khinaʔat l-kteer ʔli bteʕsʕal fi balad-na maʕʕr…”

in shadow the-struggles.F and the-demonstrations.F and the-fights.F the-many that happen.F in
country-our Egypt

‘With the struggles, demonstrations and the so many fights that take place in our country Egypt…’

In example (9), the speaker makes the meaning of ‘Seclusion’ in Islam comprehensible to the listeners by depicting a personal situation in ECA as a means of illustration; in example (10), he refers to the current political scene in Egypt, which signifies their shared national identity, as the gate through which he gets his point across to the audience.

Evidently, each of the two codes, SA and ECA, are employed within the Egyptian religious contexts for a whole different range of functions that are bound by their statuses as high and low varieties; while SA or H is used by Egyptian scholars to introduce direct quotations, formulaic expressions, and indicate their Arabic and Islamic identities, they exploit ECA or L to provide simplified explanations and realistic examples to make complex concepts available to the audience. As a result, the current study seems to refute Ferguson’s theory about the contextual compartmentalization of the H and L codes; however, it advocates Ferguson’s supposition about the functional specialization of each code.

Implications for Teaching and Learning

According to Cook (2008), “[c]odeswitching is found wherever bilingual speakers talk to each other” and therefore it is never considered as an abnormal linguistic behavior (p. 175). Cook expounds her argument for exploiting the mother tongue or L1 in L2 settings saying that codeswitching intuitively takes place when both the speaker and the listener share the same languages and that the theory of ‘language compartmentalism’ is inapplicable; she affirms that codeswitching becomes a normal classroom practice when the teacher and students speak the same two languages. Accordingly, a call for additive bilingual
education, which aims to add the second language to the students’ repertoire at no cost to their mother tongue, sounds crucial for bilingual teaching and learning. Admitting the fundamental role of L1 as a solid language system to rely on in teaching L2 would contribute to overcoming the linguistic obstacles that hamper students’ L2 learning. In EFL classrooms, codeswitching is a typical daily practice in student-student interactions and in teacher-student interactions if the teacher is a non-native English speaker. Codeswitching to L1 in EFL contexts is believed to have a plethora of pedagogical and social functions: It facilitates explaining complex lexical items and grammatical rules, scaffolding students with limited linguistic repertoire, establishing good rapport with students, maintaining classroom regulations and discipline, checking for understanding on the part of the students, saving time through translating abstract or religious concepts, and stressing cross-linguistic links through drawing linguistic and cultural analogies. Wardhaugh (2010) points out that codeswitching is one way of achieving a shared identity; preserving and relating to students’ national or shared identity should be a focal objective of the teaching and learning process as a means of maintaining a humanistic approach to teaching English in any educational institution.

As mentioned in Harmer’s (1998) work, a lesson plan is the framework that gives teachers a clear destination; Scrivener (2005) asserts that planning a lesson ahead extends the teacher’s options and thus increases his/her chances of delivering a successful lesson. Given that the teacher is the decision-maker whose responsibility is to decide on the most appropriate method to buttress students’ learning, planning a lesson that encompasses various activities to ensure students’ positive interdependence and active involvement is “a prerequisite to success” (Orlich et al. 2013, p. 260). Cooperative learning is a successful, student-centered instructional approach that relies on peer assistance; the teacher plays the role of a guide who supports students’ learning through instructions which in turn enhances students’ autonomy. Placing students in small groups and holding them liable for group achievement teaches them to cooperate and scaffold each other in every possible way. A number of studies show that students usually resort to their shared L1 to negotiate aspects of L2 which is proved to have a facilitating role in addressing cognitively demanding tasks (Butzkamm 2003; Storch and Wigglesworth 2003; Jafari and Shokrpour 2013); thus allowing for codeswitching among bilingual students in EFL classrooms would corroborate quality learning. Teachers’ efficacy is a fundamental instructional construct that is reflected through their readiness in dealing with any learning difficulties on the part of their students; developing alternative teaching methods and aids, e.g. bilingual dictionaries, is a professional way of facing EFL classroom challenges.

**Conclusion**

Despite the fact that the two codes, SA and ECA, are presented in literature as opposites in terms of status, with regard to communicative competence they are not. The relation between both varieties cannot be seen as superior-to-inferior; they are rather seen as functionally diverse. Considering ECA as the low, less prestigious variety does not seem to affect the way Egyptians perceive it as their native, easy, and light variety or vernacular (Haeri 2003). Markedly, there is an increasing number of Egyptian religious
scholars who predominantly employ ECA variety in their pursuit of developing the religious discourse which implies teaching people about the principles of Islam in a more communicatively appealing manner. Besides, the results of this study disagree with Saeed’s (1997) which suggest that speakers in formal settings use the H variety to express what they think is positive and the L variety to communicate what they perceive as negative.

In short, codeswitching is a common linguistic phenomenon that can be constructively exploited in English language teaching to enhance learning among bilingual learners; using the Bilingual Method, for example, in teaching English can be a valid instructional method especially in the early years of schooling. EFL teachers and policy makers need to acknowledge the pivotal role of offering a bilingual-social learning context that respects bilingual students’ language, culture, and identity. Furthermore, the role of formulaic expressions in any language is said to be so significant that Simpson (2004) advocates the explicit instruction of the most frequently employed formulaic expressions in academic speeches for their value as discursive devices. Integrating English formulaic expressions, that have equivalents in the learners’ L1, in EFL/ESL curricula should be beneficial for students in making contrastive analysis of both languages and in making sense of their L2.
References


### Appendix A

Transliteration system of Arabic letters:

<table>
<thead>
<tr>
<th>Arabic Letter</th>
<th>Transliteration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>آ</td>
<td>a</td>
<td>voiceless epiglottal plosive</td>
</tr>
<tr>
<td>ط</td>
<td>t</td>
<td>voiceless velarised dentoalveolar plosive</td>
</tr>
<tr>
<td>ب</td>
<td>b</td>
<td>voiceless bilabial plosive</td>
</tr>
<tr>
<td>ئ</td>
<td>e</td>
<td>voiceless velarised alveolar fricative</td>
</tr>
<tr>
<td>ت</td>
<td>t</td>
<td>voiceless denti-alveolar plosive</td>
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<tr>
<td>ع</td>
<td>u</td>
<td>voiced pharyngeal frictionless continuant</td>
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<tr>
<td>ث</td>
<td>th</td>
<td>voiceless inter-dental fricative</td>
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<tr>
<td>ض</td>
<td>gh</td>
<td>voiced uvular fricative</td>
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<tr>
<td>ض</td>
<td>j</td>
<td>voiced velar fricative</td>
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<tr>
<td>ح</td>
<td>j</td>
<td>voiceless labio-dental fricative</td>
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<tr>
<td>ح</td>
<td>h</td>
<td>voiceless pharyngeal fricative</td>
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<tr>
<td>ق</td>
<td>q</td>
<td>voiceless uvular plosive</td>
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<tr>
<td>خ</td>
<td>kh</td>
<td>semi-voice uvular fricative</td>
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<tr>
<td>ك</td>
<td>k</td>
<td>voiceless velar plosive</td>
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<tr>
<td>د</td>
<td>d</td>
<td>voiceless denti-alveolar plosive</td>
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<td>ل</td>
<td>l</td>
<td>voiced alveolar lateral</td>
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<td>ذ</td>
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<td>voiced inter-dental fricative</td>
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<td>م</td>
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<td>voiced bilabial nasal</td>
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<td>voiced alveolar trill</td>
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<td>ن</td>
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<td>voiced alveolar nasal</td>
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Adapted from Albirini (2011) and Sabir & Alsaeed (2014)

Appendix B

Standard Abbreviations:

1. First Person
2. Second Person
3. Third Person
F. Feminine
M. Masculine
SG. Singular
Effects of Science Inquiry-based Professional Development (IBPD) on Teachers’ Attitudes, Knowledge, and Practices in UAE

Rania Amaireh, MSc Education Student
The British University in Dubai

Abstract

Teachers’ education is one of the important features of schools and education systems. It is the main reason to promote improvements and transformations claimed by changing societies (Day 2001, cited in Lino 2014). In science, there is a trend of inquiry-based learning and a claim of supporting teachers to develop their inquiry instructions (Forawi & Liang 2011). Science educators are directed to think of PD programs that enhance this skill and prepare teachers to implement it. Through inquiry learning, students will develop important skills that allow them to ask questions, plan investigations, collect data and use tools, analyze the data, and communicate the result (Friedl 2005). The lack of teachers’ knowledge and skills about the inquiry-based learning (IBL) in addition to teachers’ previous traditional perspectives are all reasons for not applying this approach in practice during science lessons in UAE (Dikson & Kadbey 2014). Therefore the need for an inquiry-focused professional development program is crucial to prepare science teachers and to enrich their knowledge about IBL. This study examines the impact of five days of professional development (PD) on science teachers when teaching science using the inquiry-based learning approach (IBL). Thirty-nine science teachers from different phases (K to 12) participated in this study in one of the private schools in Dubai that follows the American curriculum. All participants attended the five days of PD and responded to 41 items in pre- and post-PD surveys addressing teachers’ perceptions of their confidence levels and their concerns and interests in implementing the IBL approach, in addition to their knowledge and practices in class. Several class observations and in-depth interviews were conducted to provide more accurate indications of teachers’ attitudes and practices.

The major results of the study indicate that teachers’ attitudes, knowledge, and practices of IBL have improved after attending the inquiry-based learning professional development (IBPD) program. Interestingly, the study found that teachers from scientific backgrounds were more affected by the IBPD as they practice more inquiry when teaching science than their peers from non-scientific background; however, KG and elementary teachers have shown more positive attitudes towards IBL after the PD sessions than middle and high school teachers. The study revealed some challenges when implementing the IBL approach in science lessons, such as: limited resources, lack of time, teaching the students with academic difficulties, special needs, and language disability of ESL students. The study has limitations due to the small size of the sample and small number of observed classes and conducted interviews. Therefore, the results cannot be generalized to all of the UAE. Extending the PD programs by conducting continuous professional development (CPD) sessions related to inquiry is recommended by the study so teachers can gain the complete knowledge about how to apply this approach in addition to allowing...
teachers to practice what they have learned after the IBPD by providing ample time to try the IBL approach and reflect on it. Investigating the impact of IBPD programs on teachers can help in enhancing their knowledge, perspectives, and practices and these changes can be linked to enhance students’ achievements (Capps et al. 2012). It will lead teachers to use more student-centered and constructivist approaches in teaching (Kanselaar 2002, cited in Rooney 2012). Furthermore, it will help teachers to re-evaluate their teaching approaches in science and replace their old traditional methods with the IBL approach. Knowing the impact of the IBPD on teaching can drive schools’ districts, policies, and decision maker to conduct science inquiry PD on a regular basis (Capps et al. 2012). Therefore, this research will be of interest nationally and internationally to other countries experiencing educational improvement in science and trying to train science teachers to teach using an approach which may be completely different than what they have experienced as students.

**Keywords**: professional development, inquiry-based learning, teachers’ attitudes, teaching practices, teachers’ knowledge, challenges of IBL.

**References**


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Factors that Influence Student Satisfaction in Higher Education Learning Environments

Hannah Wilson, PhD Education student  
Liverpool John Moores University

Abstract

Purpose

When designing educational buildings, the physical learning space must motivate students and promote learning (JISC, 2006). Research addressing the design of higher education physical learning environments (PLE’s) have identified the importance of understanding users need to develop suitable workspaces (Neary and Saunders, 2011). Understanding the individual requirements of all who attend university requires further exploration, specifically the influence personality has on preferences and satisfaction of the PLE (Pawlowska et al., 2014). It is not only important to develop PLE allowing for individual preferences but the involvement of learning communities is important for student satisfaction (Zhao and Kuh, 2004). Therefore identifying factors of the PLE that supports the development of both individual’s satisfaction and learning communities is important for the development of future universities.

The purpose of the current research is to develop a composite model to support the design of higher education learning environments with the understanding of student’s requirements. Currently developers fail to understand the impact of the environment on students learning experiences (Rullman and Van den Kieboom, 2012) and further understanding of student’s requirements is needed (JISC, 2006; Muhammad et al., 2014). The research endeavors to explore this, to understand the individual differences in user’s requirements, measured by personality traits, in their PLE. Incorporated within this, to develop PLE engaging for both the individual students, but also the university as a whole features of the PLE that develop a sense of community will be identified.

Design / Methodology / Approach

To explore student’s perceptions of the PLE to identify features of the environment considered important a mixed method design was utilized. Questionnaires were collected from students to identify a relationship between personality traits and features of the PLE. Additionally, they were used to identify factors of the PLE that are important for students and which can support learning communities. Structural Equation Modelling was employed to explore the relationships between variables.

Qualitative focus groups were then conducted to further explore student’s preferences for features of their PLE’s. This allowed student’s to discuss factors in their PLE’s to gain a deeper understanding...
of the influence of the environment on student’s satisfaction; by exploring student’s feelings towards features of the PLE.

Findings

Findings from the survey identified a difference in personality’s traits between subject cohorts. Furthermore there was a relationship with preferences for factors within the PLE. Therefore people with different personality traits have a preferences for different features in their PLE. Additionally it was found students from different subjects prefer different factors in the design of their learning environments. Through an exploratory factors analysis twelve factors of the PLE were identified that should be used to design learning environments, to positively impact students experiences and to develop a sense of community. The relationships between these variables and the measures of personality traits and different disciplines was explored through a structural equation model.

The findings from the focus group show a consensus with the survey findings and interesting insights into their feelings towards design elements. The focus group analysis identified seven high level themes that students discussed as important in their PLE. Operations, design, facilities, workspaces, social areas, environment and cosmetics. Highlighting elements such as “how clean it is, it’s big thing” and “I would say if it looks nice to me I am going to use it”. The focus group analysis also identified themes on the development of community for example, ‘identifying with space’ and ‘layout’. Noting that the PLE “facilitates a sense of community”. These findings suggests factors of the PLE that students regard as most important, and that there is individual differences in requirements between disciplines and personality traits.

Research Limitations / Implications

Those responsible for the development of higher education institutions whether managing, designing or refurbishing will find this research beneficial. By understanding students preferences and differing requirements in their PLE’s practitioners can develop specific spaces that increase student’s satisfaction. Therefore positively contributing to students learning experiences within university.

Practical Implications

Developing and refurbishing Higher education facilities with the users need in mind will help future proof the lifespan of the buildings. With the development of new technologies and pedagogic theories, teaching and learning is developing, buildings should also progress alongside. By designing PLE’s with students requirements in mind, spending on further redevelopment would be minimized. Therefore have an economic impact on university development. This model could be used to influence section policy in university design. Universities nationwide could adopt this model to develop and refurbish their institutions to maximize student’s satisfaction.
**Originality / Value**

The current research provides a new perspective regarding the development of higher education facilities. Presently research rarely informs on the design processes (Rullman and Van den Kieboom, 2012), so a simple model of specific features of the environment could help develop this process. By identifying these specific features of the higher education PLE’s that students prefer, facilities can be design to positively impact upon the students learning experiences. Understanding how the PLE can be design for individual differences in requirements and develop a learning communities will enable universities to develop supportive learning environments.

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The State-of-the-art E-Commerce and Start-ups Challenges in the UAE and the Gulf Region

Hamdy Kamal, MSc ITM student
The British University in Dubai

Abstract

This paper demonstrates the state-of-the-art and trends in E-Commerce within the UAE context. Firstly, it provides a brief statement of the problem for adopting e-commerce in the UAE and the Gulf Region with associated relevant literature. Secondly, discuss the challenges faced by the E-Commerce SMEs or start-ups in the UAE and the Gulf Region.

Introduction

E-Commerce stands for “Electronic Commerce” and defined as “a business done with the help of the internet as a medium of conducting a sale” (Emiratesdiary.com, 2016).

Before E-commerce, shopping was based on the assumption that if you intended to sell a product or service, you would need to rent or own a physical shop in a location where you would expect your targeted customers to come in and shop. They would, then, explore the products and/or services, think about their options and alternatives, and finally make a purchasing decision immediately at the shop. Thanks to the accessibility of the Internet and smart phones, and the fast-pace nature of our lives, the entire traditional shopping cycle has been technologically converted into online activities on an E-commerce platform.

So, what do you do when you find a good online deal on an attractive product or service through your email, SMS, or a social media ad? First, you check the product’s specifications and the available descriptive photos. Second, you check the price to make sure it is within your budget, then you read customers’ reviews to make sure it is the right choice. Third, you check the website’s payment security schema, and whether there are any shipping options and other overhead fees. Finally, you make your purchase.

The above mentioned scenario explains how customers interact with the E-commerce platform through the purchasing life cycle, and depending on this model, it is very important for E-commerce startups to know what customers think about when they want to buy a product or service electronically in terms of product display, trust & security, and finally the delivery options.

The E-commerce industry in the UAE is currently estimated to be worth $2.5 billion, which surprisingly makes it amongst the lowest in the world as a percentage of total sales. It has been argued that this is mainly due to Dubai being one of the big international retail shopping destinations with the biggest shopping malls over the world. However, now as a large number of users are not only surfing the internet for information but are also paying transactions online for
everyday purposes such as paying e-bills, parking fees, booking flights and ordering food, the culture of making transactions online is increasing more and more (DubaiChamber.com, 2016).

The waves of daily deal sites as well as aggressive ads launched by E-commerce businesses have aided to improve comfort level and increase the share of E-commerce in the UAE market. Over the last few years, the number of online retailers has steadily increased in the Middle East, UAE representing the highest share of the Gulf region’s E-commerce.

Awok.com has reported that 46% of residents in Dubai city buy products through Internet, based on a survey of purchasing behavior by a well-known payment solutions provider, one among three residents in the UAE makes one to five online transactions in a week. The study also finds that, among the residents, 5% make online payments more than 5 times weekly (Kippreport.com, 2015).

E-Commerce is expected to continue to be an incredible high trend for investment in the UAE. It is expected to be valued at 36.7 billion Dirhams by 2018 (DubaiChamber.com, 2016). Therefore, this is a very interesting time for the online industry growth in the UAE.

Literature Review

Over the past few years, it has been noticed that the E-commerce industry in the UAE is going to be a promising business especially for the small and medium scale business startups. Despite of the well-established infrastructure and environment in UAE, E-commerce startups and SMEs are still facing barriers and challenges to run a new E-commerce business or even transform from physical business to online one. These barriers include some behavioral challenges such as: trust, security and privacy, along with some environmental challenges like: Internet Infrastructure and logistics, and some legal aspects such as the country’s regulations and laws. The following literature will demonstrate the challenges and difficulties from the consumer as well as the Startups perspectives.

A lot of studies were conducted to understand the challenges that face the adoption of E-commerce. Many shoppers in the Middle East are reluctant to use E-commerce Services because they are concerned about credit card fraud and return policies. Some feel that shopping online does not give them a real shopping experience, especially if they need help from a sales person and are worried that they cannot really judge the product just by checking it picture (WeWantTraffic blog, 2014).

From the consumer’s perspective, most challenges are probably caused by trust issues related to security and privacy issues, being forced to disclose credit cards information, the habit of in-store shopping, the sometimes complex user interface, and the quality of the websites (AlGhamdi, 2013).

Moreover, different elements of the market environment influence the E-commerce industry growth, such as: technology infrastructure, diverse online payment systems, culture of using the credit card, country legislative and regulatory framework, logistics, and the society’s education and awareness (AlGhamdi, 2013).
The Theory of Reasoned Action “TRA” model proposed that human beings make rational decisions based on the information available to them (Fishbein and Ajzen, 1975).

Accordingly, the quality of information provided by the E-commerce website, its reliability and accuracy can significantly affect the intention to purchase. Subsequently, this will increase the consumer satisfaction and trust which will direct the consumer to make the initial purchase. Thus customer satisfaction and trust in E-commerce websites will affect consumer retention and loyalty positively.

The Expectation Confirmation Theory (ECT) proposed by (Oliver, 1980) states that consumers firstly form an initial expectation prior to purchase, and then build perceptions about the performance of the product/service after a period of initial consumption. Then, consumers will decide on the level of satisfaction based on the extent to which their expectation is confirmed by comparing the actual performance of the product/service against their initial expectation of the performance. Therefore, satisfied consumers will form repurchasing intentions and develop consumer loyalty.

Analysis

1. State-of-the-art & trends in E-commerce in the UAE and Gulf

In the UAE and Gulf, E-commerce is exceedingly on the rise. Many of the shoppers in the Middle East are motivated to switch to online shopping because of the better offers, different payment options, ability to compare products more easily, ability to check reviews from other people, and finally convenience, as they like browsing a wide range of products from the comfort of their homes or using their phone.

Although in the year 2013, only 10% of online shopping in the region was directed to region-specific E-Commerce websites, it seems that currently the residents of the region prefer them as websites like Souq.com, Namshi, and MarkaVIP are now more popular than Amazon for example. Souq.com alone has attracted 52% of the online purchases in UAE, Qatar, and Saudi Arabia. However, Amazon is still pretty popular in the UAE; third on the list with 11% of online sales. In fact, when it comes to international online shopping in the MENA region, 35% of the online shoppers bought products on US E-commerce websites, 30% on Asian E-commerce websites and 25% on European E-commerce websites (WeWantTraffic blog, 2014).

Below is an overview of some of the latest E-commerce trends in the UAE:

- e-Government Initiatives

It is evident that the government in UAE has played a major role in making E-Commerce a second nature to its residents. Every year, customers in the UAE pay $230 billion to 170 governmental entities and more than 350 thousand merchants.

This is a strong signal that E-commerce in the UAE is growing very quickly, especially in the government section, in keeping with the global trend of consumers and sellers preferring online payments over cash payment (Kippreport.com, 2015).
UAE’s government has played a dynamic role in building online commerce trust in the country over the last couple of years by proceeding in a lot of electronic Government initiatives. As such, the integration of different traditional offline services like Utilities Services, Visa Services, building permits, and Traffic Utilities and others onto online platforms has made life easier for UAE people to access numerous services online. As a result, this has promoted the use of the internet to handle diverse tasks. With such measures being effectively put in place, it is easy to see why UAE’s E-commerce market is growing so fast.

- Air Travel

When it comes to the commercial use of E-Commerce, air travel represents the most popular category for online purchases in the Middle East. Airlines are particularly important to residents of the region as it connects them to the rest of the world, especially with many residents needing to make frequent business flights. Many customers prefer to book their tickets online as it gives them more freedom to choose their airlines, dates, and even seats and meals on their own time, E-Commerce makes the experience a lot easier and safer (PayPal Insights E-commerce in the Middle East, 2013).

- Souq.com

Souq.com has gone from strength to strength, paving the way for E-commerce to succeed and for local and global businesses to flourish in the UAE and Gulf. The introduction of Souq’s mobile app has also led Mobile commerce to be a huge driver of growth in 2014 and 2015. M-commerce grew exponentially in 2015 so much that over 50% of the year’s sales were driven by mobile shopping (Arabian Business, 2016).

Souq.com also launched interesting new initiatives behind the scenes, allowing third party sellers to benefit by being the first player in the Middle East to introduce its API (Application Program Interface), which allows 3rd party businesses to show Souq shopping deals in their site or smart mobile application (Arabian Business, 2016).

Moreover, when Souq.com tossed the first White Friday sale in 2014, and 2015, they recreated E-commerce history for the Middle East region with 13 million visitors and close to 600,000 items sold. After that, they had six times more new buyers every day, obviously indicating that Souq.com is building the awareness of online purchasing and leading the E-commerce growth in the UAE and Gulf (Arabian Business, 2016).

- Online food ordering

Are you Hungry? Open your computer or smart phone App!

With online food orders per month ranging in the thousands, the trend of online food ordering has caught on in the UAE.

Online food ordering allows you to search different cuisines and view hundreds of menus online and with a few clicks, place your order. The order then directly goes to the restaurant through an integrated system and food will be delivered within certain predetermined time on the website.
modern and fast-paced life such as the one people lead in the UAE, online food ordering was bound to be popular.

A lot of online food ordering platforms exist today in the Gulf and UAE such as Talabat.com, FoodOnClick, and Zomato. Those platforms offer website and smart phone App access to their ordering systems. Also, they provide a variety of payment options such as: credit card and cash-on-delivery.

- Online portals for retail stores

It is very common now to see online shopping websites for many well-known retail stores. One of the successful examples is the electronics and appliances store Sharaf DG, which offers both a website and a mobile App where you can get notifications about daily deals, high-discounted products, and even better rates on online orders to encourage online shopping.

Similarly, clothes and fashion brands also have their goods available on their websites and mobile Apps. Even supermarket shopping is now just a click away; a successful example is the Geant online supermarket. The popular supermarket’s online portal is available on both web and mobile platforms, offering consumers the chance to buy electronics, health, beauty and household products as well as groceries (Duncan, 2013).

- Matajiricom

Dubai Emirate will shortly launch Matajiricom, the world’s first purpose-built E-commerce hub, with the intention of appealing, promoting and streamlining the establishment of entities running E-commerce in Dubai. Matajiricom will offer both free zone and non-free zone licensing options. It will also help E-commerce organizations that are looking to start up in Dubai by fast-tracking the registration service, and providing offices, warehouses and logistics services (Law360.com, 2016).

The initiative transforms traditional retail into a smart platform by bringing all the E-commerce supply chain in a purpose-built hub. The collaborative partnerships incorporated within Matajiricom will allow companies to start online business in a cost effective manner. This model fundamentally changes trade in the UAE from a physical marketplace to an online one (Mohebi Logistics, 2014)

2. Challenges Facing the Adoption of E-Commerce

Over the past few years, it has been noticed that the E-commerce industry in the UAE is going to be a promising business especially for the small and medium scale business startups. Despite of the well-established infrastructure and environment in UAE, E-commerce startups and SMEs are still facing barriers and challenges to run a new E-commerce business or even transform from physical business to online one. These barriers include some behavioral challenges such as: trust, security and privacy, along with some environmental challenges like: Internet Infrastructure and logistics, and some legal aspects such as the country’s regulations and laws.

- Consumer-oriented challenges
1. Payment Options
Information shows that the Internet users in the Middle East panic from fraud and aren’t comfortable with online payments. 46% of the users have claimed that they feel some kind of a barrier to E-commerce adoption and don’t trust the payment options. The unsuitable payment options are another reason for this barrier; For example, PayPal doesn’t support paying in local currencies. This payment platform collaborates with almost every E-commerce website in the Middle East, but it accounts 500 thousand active users.

2. Security and privacy
Kolsaker and Payne proved that security reflects perceptions regarding the reliability of the payment options used and the data transmission techniques and storage (Kolsaker and Payne, 2002). The security issues as perceived by E-commerce consumers represent a high risk and a main obstacle to the development and startups of E-commerce (Dong-Her et al., 2004).

(Flavia’n and Guinalý’u, 2006) demonstrated that trust in the Internet is particularly influenced by the security and privacy perceived by consumers regarding the handling of their private data. Websites can increase consumer trust by reducing environmental risks or by raising the security measures (Warrington et al. 2000) and that privacy is a critical factor in acquiring potential online customers and retaining existing customers (Park and Kim, 2003).

Lee and Lin suggested that trust encourages online purchasing and affects customer attitudes towards purchasing from e-retailers (Lee and Lin 2005). Moreover, loyalty adds to the ongoing process of continuing and maintaining a valued relationship that has been created by trust (Chaudhuri and Holbrook, 2001).

In E-commerce, loyal customers are particularly valuable. Today, e-retailers are seeking information on how to build customer loyalty. A good example of building loyalty is Uber’s offer to its first time users, as they are offered their first ride for free as long as it costs less than 70 AED. Loyal customers not only require more information themselves, but they are considered as an information source for other customers.

Going back to the Uber example, as customers were satisfied with the service they got, they shared their experience with others, and others shared it with more people, etc. This word-of-mouth marketing technique was very successful and has actually brought Uber a lot of new customers, so much that the ride sharing company calculated that every seven rides generated one new user because of a word-of-mouth recommendation (the Guardian, 2014).

3. Addressing Systems
The addressing system is another problem that face consumers that want to shop online. In some areas, addresses could be misstructured or misleading. In that case, customers might need to manually verify their address before delivery. This is many Internet users are discouraged from shopping online because of the unreliable delivery caused by the confusing addressing systems.
Moreover, a lot of users are afraid they will not be able to exchange or return the product if it is faulty or if they happen to change their minds (WeWantTraffic blog, 2014).

4. User interface

Park and Kim found that the quality of the user interface affects the customer satisfaction directly. They also concluded that the product/service information quality is defined as the customer perception of the quality of information about the product/service that is provided by a website (Park and Kim, 2003). Tan, Tung, and Xu identified fourteen important factors for developing effective B2C E-commerce websites (Tan et al., 2009). Srinivansan et al. proved that the interactivity characteristic of E-commerce user interface is intensely related to customer loyalty (Srinivansan et al., 2002). Cyr investigated the effect of E-commerce website user interface design factors such as information, navigation, and visual designs on trust as well as satisfaction (Cyr, 2008).

- Other Challenges for SMEs

1. Payment Options

The major problem facing E-commerce in the Arab region is the reliance on cash on delivery. Fouad Jreis, the co-founder of Bitcoin Jordan, considers that paying with cash will not vanish soon, because we live in a society that considers paying with cash a part of its culture (Wamda.com, 2016).

Elias Ghanem, General Manager MENA at PayPal, explained how Cash-on-Delivery type of payment has become tricky and pricy for both the seller and consumer. The main reason why COD is so high is the common lack of trust of the consumer in using their credit card on the Internet. He also said that as attitudes begin to transform and more companies make the switch from COD to credit card options, there will be more room for sellers to invest more into customer service, technology and user experience (SME Advisor Middle East, 2013).
2. Logistical and legal Problems:

Some of the biggest challenges that face startups and SMEs have to do with the high cost of different logistical items such as: shipping and importing products, most of which are manufactured abroad, logistic services, customs, and taxes. All of which have made E-commerce a very tough and expensive (Wamda.com, 2016).

Other problems that face startups are related to governmental legislations. For example, in UAE, to form a web-based company, a license is needed from the Department of Economic Development (DED) or the relevant free zone authority. Moreover, setting up a physical office is obligatory as all UAE-based companies must have a physical office space in the country to be considered legal. This adds a lot of overhead cost to any individual or entity to launch an online business (Khaleejtimes.com, 2016).

A partnership has been announced by Paypal with Aramex, the popular shipping service provider, to offer a one-stop shop for SMEs and startups that are looking to acquire a plug-and-play E-commerce platform. Through the proper partnerships with software development providers, the service will offer the comprehensive package for startups and SMEs who want to convert their business online. They will set up the store front-end and inventory management system, payments will be handled by PayPal, shipping through Aramex; all those benefits can be purchased together (SME Advisor Middle East., 2013).

Conclusion

Undoubtedly, a lot of challenges stand in the face of E-commerce startups and SMEs in Gulf and UAE, from the untrusting culture of the masses, to the rather complicated and expensive logistics. However, must also be admitted that a lot of effort from the big E-commerce entities and governmental authorities is being put into making it a success, and it is apparent that those efforts are not in vain as E-commerce is clearly growing steadily and is continually gaining more loyal customers.

E-commerce industry in UAE needs more attention to support SMEs who are working in a full time job and they need to establish a private online business but the local regulations framework doesn’t allow that unless they go through the standard operating procedure to run a business such as getting a license, having office space, and so on.

As for the E-commerce future in UAE, it’s very obvious from the records that have been explained in the paper that the online consumers are increasing rapidly which reflect a very optimistic sign to have a bigger share for the E-commerce in the UAE market in the near future.
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Case Studies of Nationwide Unified Medical Record

Shaikha Abdool, PhD Student in Computer Science
The British University in Dubai

Alya Harbi, PhD Student in Computer Science
The British University in Dubai

Abstract

This co-authorship paper intends to study a nation-wide initiative by 2025 to have a unified medical record across United Arab Emirates (UAE) and identify similar experiences and case studies in the same area as well as lessons that can be learned to develop new directions to implement the initiative of UAE-Unified Medical Record (UAE-UMR) program. Systematic search of the published literature, journals and governmental reports are the main methods to fulfill the aim of this paper. As a result, the concept of System of Systems to be utilized and new directions to be considered for these initiatives as lessons from Singapore’s case study. The main three lessons that were driven from Singapore’s case study were making the complex simple, valuing the importance of governance, and addressing the operational requirements with intense discipline. On the other hand, a failed attempt was examined which can be found in the case study of United Kingdom National Program for Information Technology (UK NPfIT). New directions that can be utilized from this experiences is the importance of having simple yet proper contract management system as well involving the users in the program lifecycle as they are the key stakeholders and should never be neglected.

Introduction

Nowadays, technology is becoming a core business to our daily operation which includes operations related to healthcare. Many hospitals and healthcare providers are utilizing systems to maintain medical records as well their laboratory and pharmacy operations. However those systems are getting out of control since the absent of software engineering and system of systems (SoS) concepts. Software, hardware and systems are often costs more to maintain that it does to develop therefore, software engineering is crucial for the future and the next decades to maintain cost effects software development.

Having several Electronic Medical Records (EMRs) that don’t interoperate is the current practice in (UAE) for the healthcare field, causing to have challenges in quality of healthcare services and could lead to repetitive tests and procedures and financial loss. Most importantly, the data and health information as nationwide is very difficult to be obtained and cannot be accessed in a timely manner. Hence, it is extremely challenging to harness data for precise decision making. Moreover, as the current practice does not have systems the interoperate, innovative technologies in the tele-health and telemedicine field are limited to selected organizations and cannot be implemented in a
nationwide country where all healthcare organizations can share, exchange and communicate in a smoothly matter.

Nevertheless, software and technology in the next decade will demand software systems that work at completely different scales and completely different constrains than today’s systems. Luckily, the new research and technology evolutions such as big data, System of Systems (SoS) and Internet of Things (IOT) give a promising chance to overcome healthcare tailbacks by the year 2025 (Baheti & Gill, 2011; Jose, 2015). To ensure improved patient care and enhance health care delivery across the UAE, the UAE-Unified Medical Record (UAE-UMR) would be the state of the art initiative for 2025 to sustain nationwide health integration platform for sharing patient information through interoperability among all healthcare providers and authorities including public and private.

Objective of the Paper

It is anticipated that healthcare in 2025 will have challenges and that software engineering would be the key to overcome them. The aim of this paper is to look into case studies, experiences reports, practices, techniques and frameworks that address the likelihood that the idea of UAE-UMR and discuss the challenges faced in these case studies.

Methodology

In research methods there are mainly two types of research approaches that a researcher can take; Quantitative and qualitative approaches. As our objective is to describe rather than quantify, a qualitative measurement would take place as it would be suitable than the quantitative. Study design will be iterative where data collection and research questions will be adjusted according to what is learned. The following methods were used as a data collection tools to obtain secondary data from existing peer reviewed journal articles, reports of government agencies, and related health organizations:

- Systematic search of the published literature.
- Publications/reports by health authorities, government agencies, and local hospitals.

Case Studies

There are many attempts that took place in order to conduct the concept of (SoS) and nationwide electronic medical record. The below table summaries those case studies.
In this paper, two case studies will be discussed in details and will be associated to the mentioned state of art initiative (UAE-UMR):

- A Successful Case: Singapore (NEHR).
- A Failed Case: United Kingdoms (UK) National Program for IT (NPIT).

### Singapore (NEHR)

There are other countries as mentioned above who attempted to embrace the vision of nationwide EMR. One of the case studies that to be examined here is Singapore.

Singapore is considered a small country with population of 5.2 million (Chai & Lam, 2012), and initiated their national unified medical record project couple of years ago which is referred to as NEHR. However, till this stage NEHR is covering the public sector and the remaining private healthcare facilities are not yet on board. Singapore utilized a Logical Information Model (LIM) to complement the terminology which assists in consolidating diverse information from different sources.
systems into single electronic medical record. This model outlines the references and structure terminology required for healthcare messages and clinical concepts. Moreover, certain approaches were considered in Singapore case study as depicted below:

![Diagram](image)

**Figure 1. EA and EBC; From. Chai & Lam, 2012**
Singapore did not go for point to point integration; instead it relied heavily on the Enterprise Services Bus (ESB). This is a consideration that must be taken for UAE-UMR initiative.

From the graphs above, it is evident that Enterprise Service Bus (ESB) was utilized instead of the point to point integration. It is obvious that the enterprise architectures was needed since there are many systems and applications in place and demanded to put together to conduct their day to day business and deals. Point to point integration is not advised in this complex projects like NEHR as it is used with small infrastructure where only two or three systems can be maintained. Therefore, rather than each system or application requiring a separate connector to communicate with the other connector, ESB was utilized which act like a broker like manner. ("Understanding Enterprise Application Integration," 2015).

New directions for the UAE-UMR Emerged from Singapore Case Study

Many counties attempted to grape the dilemma of how to proceed with a nationwide EMR, and as discussed previously Singapore has advanced considerably in this area. This gives UAE some insightful lessons to help out in the direction for the state of art initiative of UAE-UMR. Therefore, what UAE can learn from this case study and this experience can be summarized as below (Leung, 2016; Sin, 2015):

1. Simplifying the complex
2. Putting importance in governance
3. Handling operational requirements with strong discipline

Simplifying the complex is a critical point that needs to be adapted in the UAE-UMR initiative. The blueprint for the Singapore’s NEHR initiative solution has a sophisticated framework for business logic and services. However, for the initiation phase the concentration was on the continuity of care.
and they implemented a simple architecture where the technology of ESB was utilized. (Leung, 2016).

Having multiple data sources for this solution has raised the level of complexity associated with data standardization. As a result of the differences between the healthcare providers and their associated health information systems that they are utilizing, there was a big variation in their data. The variations span across: Medical coding of data, how well structure the data is, how well populated the data is, the data dictionary of basic terminologies. Therefore mapping all the different health providers’ data sources to a common data model is a major challenge that has to be taken into consideration before advancing further. Deep analysis of the data from the live systems confirmed that and caused the solution design team to be more focused in having the data as it is rather that what the data should be. The logic behind such decision was that if this data had a gap or differences in meaning, then the system doing the interpretation might introduce clinical risks to the patients. To overcome this complexity, the decision was made to concentrate the raw data from the sources initially (Leung, 2016).

Engaging the users such as the clinicians will definitely add value to the project adaption. Singapore used screen mock-ups of their nationwide EMR project for the clinician workshops this helped out in identifying features and functionalities that tempted the users. Those users were engaged in the first stage of the project which helped in understanding the user’s preferences and helped in driving a simpler and more intuitive interface (Leung, 2016).

Moreover, UAE must consider integrating the discussion of functional, operational and technical concerns from the early development of the program lifecycle in order to shape the final product of the solution design decisions. This approach helped Singapore to support the data and the functionality from the technical and operational point of views and greatly assist in meeting the service level agreement (Leung, 2016).

**UK National Program for IT (NPfIT)**

One of the major and well-known programs that might share some commonality with UAE-UMR was initiated in 2002, in the United Kingdom (UK) and was known as National Program for Information Technology (NPfIT) under UK National Health Service (NHS) (Sessions, 2008). The program’s aims were to automate patients’ care information and develop centralized platform to access, exchange and share medical records by authorized healthcare professionals regardless of their location and time. The aims were in somehow similar to the UAE-UMR.

NPfIT functionality can be divided into three main categories:

1. Regional Clinical Information System (CIS) to connect healthcare providers.
2. Infrastructure systems related to connectivity, security and directory services.
3- Shared applications, such as: choose and book appointments, electronic transfer of prescriptions and Picture Achieving and Communication Service (PACS).

The program was split according to five regional groups: North East, North West and West Midland, Eastern, London and Southern. Different vendors were involved as primary, CIS and miscellaneous secondary. For each regional group; a primary, CIS and secondary vendors was available. For instance, in North West and West Midland; the primary vendor was Computer Science Cooperation (CSC) and CIS was iSoft, while in Southern Region; Fujitsu was primary vendor and IDX as CIS. Having many vendors has potential consequences of difficulty to manage them, which increased the cost and complexity in terms of control and changing processes and policies (Iron Mountain Incorporated, n.d.).

The program was centralized and distributed and different architectures were used, such as: Client/Server and SOA. HL7, SNOMED CT and other standards were followed (Pinto, 2013; Saranummi, Piggott, Katehakis, Tsiknakis, & Bernstein, 2005, pp. 176-185). Nevertheless, with SOA for large-scale distributed systems would be complicated to draw boundaries (Ge, Paige, & McDermid, 2009). The below figure (3) illustrates NPfIT architecture. NPfIT architecture had evolved over years (Ge, Paige, & McDermid, 2009).

In order to maintain confidentiality and security, a [Care Record Guarantee] was developed that defined the principles to handle electronic medical records. This Guarantee to be reviewed annually to consider developments in the NPfIT and NHS (House of Commons Public Accounts Committee, 2009). Smartcards and passcodes were utilized to access care records. However, not all regional groups were able to follow these strategies as the early release of care records in the Southern and London Regions did not support it. This resulted for these regions to rely on one way authentication only which was utilizing the basic concept of passwords.
New directions for the UAE-UMR Emerged from NPfIT

Many points can be highlighted to be as lessons from the UAE-UMR. Things that can be avoided and things that need to be adapted, such lessons are depicted as below:

- Geographical evaluation to determine the locations for UMR initiative along with healthcare services and population required per location in order to identify the capacity, storage and other technical, organizational, economic and social aspects. For UK, the population is scattered across the country and is significantly larger than UAE population; more than 60 million people in UK, while about 9 million in the UAE. By 2025, UAE population might increase more based on the current population growth, lifestyle and health improvement initiatives. This would impact the daily transactions of the population in different fields, such as healthcare would require initiatives that absorb these complexities (Sessions, 2008). Therefore, as mentioned earlier, a proper study regarding the geographical features must be considered in the initiation of the program.

- Contracting with different vendors as what happened in NPfIT can have potential consequences as there will be different management styles, communications challenges, variation in performance...etc. (Iron Mountain Incorporated, n.d.; Sessions, 2008). So, to
avoid this, selecting vendors to be done as per defined selection requirements. According to Johnson (2011) changing in vendors also impacts software components. Therefore, a proper contract system management to be in place.

- Involvement of healthcare professionals, customers and patients. It is not about having technology and automated services only, but about winning people’s hearts and minds who will interact with the technology (Sessions, 2008). Those are the main stakeholders and must be included in the planning and execution phase of the program.

- NHS was impressed with LORENZO product of iSoft; one of CIS vendor and encountered to use it as a core component in its all regional CIS systems. However, the problem that was identified later according to an audit conducted in 2005 related to its architecture client/server model. Accenture which was a primary vendor of iSoft did not declare its awareness of this matter. (Holland & Bordoni 2006, cited in Sessions, 2008). Client/server model has limitations that does not scale and it works great for small number of users, but not for large number of users such the case in UK or UAE where all healthcare organizations, other agencies and users would use the technology. Also, the limitation of client/server model occurs due to the client machines are in a one-to-one relationship to users, which limits to number of the system’s users at any one time. If this deficiency was recognized at the beginning, the risk of transferring from one architecture to another would have been lower or avoided, especially transferring between different architectures, such as in LORENZO, where client/server was changed to SOA. This would require further resources, efforts, time, cost...etc. and sometimes it would be less expensive to re-implement a software and systems than to make necessary changes.

- Considering such these initiatives as projects is not the right strategy. These initiatives are complex involve many other agencies, existed systems to be integrated, continuous improvements, organizational, social, political and economic aspects (Henshaw, M. 2012).

- According to Magrabi et al. (2015), NPfIT had some consequences of implementing such program. Those were classified as human, technical and large-scale events. The last category was related to impact on ten or more IT systems’ users, patients or their records and multiple components or systems. For instance, human aspects, such as: training and clinical workflows, while technical aspects, such as: hardware and software issues (e.g. power failure and system configuration) (Henshaw, M. 2012). Problems involving human aspects were four times likely to harm patients than technical aspects, which demonstrate the criticality of having policies to govern safe use of a technology.

NPfIT was dismantled on 2011 and according to Charette (2011) and Sessions (2006) it can be said as one of the largest and most expensive failure program in IT. The estimated cost spent was 12.7 Pound Sterling and went up. To accurately estimate the cost till the program was dismantled would not be easy (Charette 2011; Johnson, 2011; Pinto 2013; Sessions, 2008). Hence, it is crucial to avoid their mistakes and learn from experience not to replicate the case in UAE.
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The Future of Software Engineering in Healthcare: Visions of 2025 and Beyond

Alya Harbi, PhD Student in Computer Science
The British University in Dubai

Abstract

Many of the challenges faced by healthcare providers in the next decades will require software systems that work at completely different scales and completely different constraints than today’s system. United Arab Emirates (UAE) currently has different systems for electronic medical records and are difficult to managed since the absent of proper governance over all those systems and absent of a proper structure to control them. The aim of this paper is to propose a research direction for the next decade and propose state of art of software engineering in the field of healthcare informatics in 2025. Systematic search of the published literature, Journals and governmental reports are the main methods to fulfill the aim of this paper. As a result, system of systems (SoS) concept to be utilized for managing all health information systems in UAE to provide a nationwide medical record in order to assess in reading nationwide data through business intelligent solution (BI) embedded over the SoS.

Introduction

Advanced technology is the backbone for the future of healthcare; according to the study conducted by Polycom, Inc. the Survey covered more than 1000 healthcare providers from different countries of the world who anticipated that over the next 10 years, the rapidly fast growing of the population would lead to challenges in quality of care. Nevertheless, software and technology in the next decade will demand software systems that work at completely different scales and completely different constrains than today’s systems. Luckily, the new research and technology evolutions such as big data, System of Systems (SoS) and Internet of Things (IOT) give a promising chance to overcome healthcare tailbacks by the year 2025 (Baheti & Gill, 2011; Jose, 2015). According to Ron Emerson, the global director of healthcare at Polycom said that “Healthcare delivery is evidently shifting in light of challenges such as physician shortages and rapidly aging societies, and requires digital transformation in order to cope with the pressures placed on the industry” (Jose, 2015). Ron Emerson stated that technology is the key to 2025 healthcare system which will open the door for better healthcare services and maximize its potential.

Currently, here in United Arab Emirates, most patient information is found in disparate systems across the healthcare community, and those systems do not interoperable. Hence, complete information about a patient can be really difficult to obtain. This might cause challenges in the quality of healthcare services and could cause some repetitive tests and procedures and great
financial loss. However, one state of the art solution for this major challenge is to have a unified medical record that covers the private and public sector on a nationwide level (Bhartiya & Mehrotra, 2014; Loney & El-Obaid, 2013).

**Objective of the paper**

It is anticipated that healthcare in 2025 will have challenges and that technology would be the key to overcome them. The aim of this paper is to look into the possible direction and challenges faced by the healthcare community and the software reengineering community which will need to start in order to be relevant tomorrow. This paper emphasizes on long term challenges in the healthcare and the role of software engineering in the filed which will be related to the idea of having UAE Unified Medical Record (UAE-UMD).

The justification of this paper is to evaluate the state of the art idea of having UAE-UMD initiative and elaborate in the following concept:

- Description of the state of the art and state of the practice to this software engineering concept that might take place in 2025 in this field
- Major challenges to this initiative
- Visionary ideas for overcoming those challenges

**Methodology**

In research methods there are mainly two types of research approaches that a researcher can take; Quantitative and qualitative approaches. As our objective is to describe rather than quantify, a qualitative measurement would take place as it would be suitable than the quantitative. Study design will be iterative where data collection and research questions will be adjusted according to what is learned.

The following methods were used as a data collection tools to obtain secondary data from existing peer reviewed journal articles, reports of government agencies, and related health organizations:

- Systematic search of the published literature
- Publications/reports by health authorities, government agencies, and local hospitals.

**Research Questions**

**The State of Practice**

The health data management is becoming very challenging in UAE as there are many disparate systems and fragmented processes. The amount of data is increasing and the ability to analyze these data becoming very challenging. There are many government entities providing healthcare and each has its own network of health information system and electronic medical record. Private sector on
the other hands got its share of different Health Information Systems. This gives us a major challenge to harness the data and utilize it. Hence, the healthcare planning and decision making process are getting effected (Loney & El-Obaid, 2013).

The current scenario for people living in UAE is the following:

- People live in different cities and visit different hospitals
- People may end up having multiple medical records across the different hospitals
- Health data sharing is not properly in place and rarely exist
- Current treating hospital has to contact individual hospitals to seek any past record needed
- All this results in loss of major elements, such as time, cost and quality

Moreover, the lack of integration between the healthcare systems and lack of electronic health exchange is causing managing patient care and the health of the population to be difficult, because information is not accessed easily and not shared properly which raise the risk of inadequate decision making information for healthcare management. Not to mention that having to visit multiple care providers leads to have unnecessary repetitive procedures and tests that are not shared among all healthcare providers, that cause serious financial cost and reduction in efficiency and effectiveness. There is no unified health medical repository needed to determine health programs and causing the lack of plans to reduce the incidence of chronic diseases as UAE showed high rates in this area.

In addition, planning for better healthcare is extremely challenging if we do not have the data in timely manner. The aim of having one patient one record concept will definitely assess in making this dream come true. A major obstacle to provide health statistics in UAE is that there is no concept of SoS, making it difficult to plan for better future for the health of UAE population. Even more challenging is implementing Business Intelligence (BI) as there is no data warehouse to have BI over it. Hence, UAE-UMD is needed and SoS would be a demand and a requirement so health analytics can be easily obtained.

**The State of the Art of Software Engineering be in 2025 in Healthcare Field**

To ensure improved patient care and enhance health care delivery across the UAE, the UAE-UMD would be the state of the art initiative to sustain nationwide health integration platform for sharing patient information through interoperability among all healthcare providers and authorities including public and private.
There are different ways in order to achieve this vision (see figure 1), one of the high level concept is to have links between all the healthcare facilities that facilitate a patient centric coordination of care and provide up to date patient medical information.

<table>
<thead>
<tr>
<th>Description</th>
<th>Centralized repository</th>
<th>Distributed databases</th>
<th>Hybrid</th>
<th>Switch</th>
<th>Patient managed</th>
<th>Cloud</th>
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<td>• Multiple independent enterprises agree to share resources using a central data repository</td>
<td>• Consistent databases: multiple independent enterprises agree to connect and share specific information managed centrally but with independent repositories</td>
<td>• Combination of decentralized and centralized databases (e.g., lab data centralized in HIE while pharmacy data decentralized at various hospitals)</td>
<td>• A service that enables the exchange of information across multiple independent enterprises that have unilateral agreements to exchange data (e.g., e-prescribing gateway)</td>
<td>• Patients “carry” their own electronic records or subscribe to a service that enables the patient to direct exchange of data (e.g., PHR, health record bank)</td>
<td>• Data management in the cloud with an open API and standardized interfaces</td>
</tr>
</tbody>
</table>

Figure 1: Different Approaches for Implementing UAE-UMD

While all of these architectures can be ways to the UAE-UMD, there are many challenges associated to each one of them:

- Centralized repository can be very costly and might lead to duplicate records if not structured well
- Distributed databases can as well be very costly and complex to maintain
- Hybrid architecture is costly and need more players onboard with less bargaining power from strong leadership compared to consolidated
- Switch architecture although it is very simple to implement but its main drawback is that it cannot manage complex data or multiple formats
- Patient managed architecture relies on patient input and can be largely disappearing or converting into patient financial tools
- Cloud architecture is completely relying on internet connectivity

However, visioning 2025, Hybrid architecture might be the way to go as it simplifies data management, which in turn will help to provide statistical measures and health indicators that would improve the strategy for healthcare in UAE, it is the most flexible way to implement. However, it should be clearly noted that there is no single manager for all of the parts of the system of systems.
and that different parts of a system are subject to different management and control policies and rules which very much suits the environment of UAE with the different government entities and different authorization bodies (Chyn & Austin, 2015). All systems would be composed of elements with relationships between these elements of the system. This architecture would be characterized as complex.

SoS can be classified into three classifications; Directed SoS, Collaborative SoS and, Virtual system. For our case study we can classify it as collaborative SoS where there is no central authority to set management priorities and resolve disputes. Typically, elements of the system are owned and governed by different organizations (Sommerville, 2015).

The security architecture structured would target 5 key dimensions (Sommerville, 2015):

- End point security where security controls would applied to end users devices
- Application security where it would be applied to server based applications that are embedded security into the business fronted of IT
- IT infrastructure security where the security would be applied to the IT infrastructure examples, servers, routers
- Data security where security mechanism would be applied to protect data, overarching of its location and status and that guarantees safe transfer
- Perimeter and network security where security would be applied to protect the physical and logical parameter around group’s data

Below is the high level solution concept of the state of the art UAE-UMD project. Through having the concept of SoS, BI solution can be easily built over it which will make harnessing data easier for precise decision making and real time data to improve healthcare outcomes. It will facilitate timely access to healthcare data and UAE will be able to present nationwide health analytics into dashboards to assess in making decisions as well as providing opportunities to incorporate Decision Support System (DSS) over it to alert top management of there are concerns to be highlighted or opportunities need to be captured, such as alarming the top management on the need to build a cardiology center in an area as there is a huge demand seen (Kosyk & Arnold, 2012).
Possible Challenges of the Proposed UAE-UMD and Solutions to Overcome

Having SoS for UAE-UMD might be associated with multiple challenges. Below are descriptions to those challenges as and it is possible solutions on how to overcome them.

One of the major challenges is the lack of control over system functionality and performance. Developers of SoS might have different and incompatible assumptions of the different systems which actually cause different evolution strategies and timetables for the different systems. Therefore, for architecting SoS, ones must design the systems so that they can deliver value if they are incomplete and must be realistic about what can be controlled. SoS must be designed as node and web architecture and system vulnerabilities must be understood and managed carefully (McCarthy, 2015). Moreover, lack of support from system owners when problems arise can be noticeable in SoS projects. Therefore, collaboration incentives when architecting SoS to be considered.

According to a study done by Mckinsey Global Institute, there will be a huge shortage of data scientists and analytics talents at least through 2020, meaning that more than 50% of the data analysts positions will remain unfilled. Therefore, educational institutes must consider this fact in order to build future generation who can hold the talents and skills for data analytical and data science (McKesson Corporation, 2016).

In any SoS environment the challenges of health authorities participations might be existed. Therefore a governing committee must be established and contractual relationship among the
stakeholders is needed to promote coordination. This will bring together different organizations and services into an integrated health system.

Privacy and confidentiality of such system is highly sensitive therefore, legislation and standards as HIPPA compliance for the privacy and confidentiality of sharing patient medical data must be ensured (C & JR, 1996; Smith, Austin, & King, 2011).

Data availability and quality of data is very important especially in this case where medical records might not be consistent between all the systems and varies in terms of data quality, ICD coding. Hence, a detailed study to understand the data sets must be considered and appropriate standards, interfaces and interoperability must be defined (Miller & Sim, 2012).

References


Critical Survey: National Unified Medical Record in UAE and the Concept of Interoperability

Alya Harbi, PhD Student in Computer Science
The British University in Dubai

Abstract

Background

Most patient information is stored in disparate systems across the healthcare community and different hospitals and those systems do not interoperate. Just recently, the government of United Arab Emirates (UAE) announced the initiative of National Unified Medical Record (NUMR) to provide nationwide health integration platform for sharing patient information to improved patient care and enhance health care delivery across UAE through interoperability. The initiative is not yet started and it is only to be initiated soon.

Aim

The aim of this paper is to look into the previous case studies of similar initiatives and provide some important key concepts in how UAE can accomplish this initiative. As well to examine its challenges and highlights its key success factors.

Methods

Systematic search of the published literature, governmental reports and structured interviews with leaders in the government entities and agencies in the field of health information exchange are the main methods to fulfill the aim of this paper.

Results

Strategy, proper planning and governance are the main element to implement such initiative. From the examination of Singapore case study, it is found out that standardization and proper integration is crucial where enterprise service bus need to be adapted rather than point to point integration. As well service orientated architecture model (SOA) is suggested. Cyber security is one the crucial challenges that need to be properly planned to maintain confidentiality and protect the main assets of this initiative.
Conclusion

UAE should comply with Health Insurance Portability and Accountability Act (HIPPA) and Certification Commission for Health Information Technology (CCHIT) to maintain confidentiality, integrity and availability of NUMR and ensure that certain security guidelines are in place. During strategizing phase of the project and planning, integration model need to be studied well, and ESB and SOA need to be considered.

Acknowledgment

This paper is dedicated to my supervisor Dr Cornelius Ncube who showed all his support and guidance to assist me in completing this research paper and have been a tremendous mentor for me. I further dedicated this paper to Mrs. Mubaraka Ibrahim and Mr. Muhammad Ahsan who were willing to participate in the interview and took a time out of their busy schedule to address my concerns and questions. I would especially like to thank Ministry of Health management for trusting me and encouraging me to achieve more especially Mr. Awadh Al Ketbi the current CEO of MOH. As well, I would like to thank Mr. Khalid Lootah, the former CEO of MOH who was the main motivator and main support for me to continue my academic study. A special thanks to my family and my friends. Words cannot express how grateful I am for all you did and for supported me in writing, and incented me to strive towards my goal. Your prayer for me was what sustained me this far. Conducting this research paper has been joyous experience that I will treasure forever. Thank you all.

Introduction

Cyper-Physical Systems (CPS) is considered the new generation of systems. It can interact with humans through various new modalities by the concept of integrated computational and physical capabilities (Baheti & Gill, 2011). Over the years, system reengineering and computer sciences have experienced drastic development especially in the area of programming languages, real time computing, visualization methods, cyber security and of all these interoperability become the topic of this new era.

The trend of the CPS and interoperability is witnessed in many countries, and United Arab Emirates (UAE) has its share of it. Information and Communications Technologies have great impact on the ways Governments and businesses interact with each other. It is evident nowadays how pervasive the technology has become especially with all the rapid diffusion of the network, mobile telephony and interoperability. From that UAE adapted the idea of e-government strategic framework and to make it official His Highness Sheikh Mohammed Bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, announced the post e-Government era to speed up the revolutionary pace toward smart and great utilization of the technology. From this perspective, Ministry of Health (MOH) in UAE has incorporated the advance technology in their strategies and
embraced many changes not only to fulfill the UAE overall e-Government strategy, but to enhance the quality of patient care and facilitate their services. It started since 2008 when MOH announced the project of electronic health records in the hospitals and facilities under MOH, and by 2009. MOH of UAE implemented its first electronic medical record in its premises.

The United Arab Emirates is aiming to build a high quality healthcare system in order to provide outstanding services to the patients. The vision got developed to have accessibility to patients no matter where they are and to be able to enhance the health of its population, so whether the patient is treated in a private or a public sector his or her medical information would be easily accessed.

Recently, the UAE cabinet approved the National Unified Medical Record (NUMR), in order to pose the UAE healthcare sector, and as stated by Sheikh Mohammed bin Rashid Al Maktoum, Vice President, Prime Minister and Ruler of Dubai that “Providing healthcare services in the UAE as a joint work among federal, local governments and private sector. Improving the healthcare services will never stop, as the health of our citizens is our utmost priority.” (WAM, 2015)

Nowadays, most patient information is found in disparate systems across the healthcare community, and those systems don’t interoperable. Hence, complete information about a patient can be really difficult to obtain. This might cause repetitive tests and procedures.

NUMR main objective is to be able to provide nationwide integrated platform for sharing data and ensure improved care through interoperability among all health care authorizes and medical practitioners as well to be able to utilize the big data that is accumulated from all the scattered systems that are in place.

This initiative is aimed to bring in timely sharing of vital patient information that will ensure better decision making and would eliminate the medication errors, readmissions duplicate testing. Consequences quality and care would be improved, safety would be ensured, efficiency would take place and health disparities would be reduced.

NUMR is aimed to facilitate the management of chronic diseases such as diabetes and hypertension which are turning out to be a serious problem in the country that actually consume majority of national healthcare funding.
Background

About UAE

The UAE witnessed a rapid development and growth during the last decades, which is probably because of the increased rate of the expatriates’ workers migration. To elaborate, UAE population was around 287000 when the country was formed in 1971, and in 2010 it was estimated to reach 8.3 million people (Loney & El-Obaid, 2013).

UAE is a country with multinational population with different educational backgrounds, cultural, and religious beliefs, which as a consequences created a challenge on population based health strategies. Adding to that, UAE is a country with seven emirates and there is a federal entity for managing health sector and local governments, not mentioning the private sector. This created to have multiple systems and different resources to reach the data and information in the healthcare sectors, posing a great need to have system of systems (SoS) in order to view all the disparate and independent systems in a context that will assist to form a unified system to facilitate the interaction and assist in pulling all the needed data in real time and accurately.

Healthcare Challenges

Having the disparate systems actually caused challenges to manage the health community. It has been announced by World Healthcare Organization (WHO) that the life style disease are responsible for more than 50% of all death the gulf region, and talking about UAE, almost 90% of the mortality are caused by chronic lifestyle induced diseases and injuries, of them 30% where due to cardiovascular diseases. As well, Diabetes type two is becoming an epidemic, almost 20% of UAE population is suffering from it. Moreover, recent statistic showed that lifestyle diseases is actually causing a huge burden on the Gulf Corporation Council (GCC) countries that worth thirty-six billion dollar cost, which is expected to reach sixty-eight billion by the year 2022 at the current pace. Having said that, it is expected that GCC population to be doubled between 2010 and 2025 which will increase the treatment demands and cost, as recent forecasting predicted that the treatment demands will increase by 240% by the next 20 years (United Arab Emirates Healthcare, 2013).

Moreover, in a different perspective, technology and IT in healthcare become the trend in this new era, and the main concern in UAE that might be a challenge in the NUMR initiative is the regulatory framework, which actually differs from an emirate to emirate. Moreover, the absence of the e-legislation might cause serious risk on the Health Information Exchange (HIE) and NUMR.
Current Scenarios

The current scenario for people living in UAE is the following:

- People live in different cities and visit different hospitals
- People may end up having multiple medical records across the different hospitals
- Health data sharing is not properly in place and rarely exist
- Current treating hospital has to contact individual hospitals to seek any past record needed
- All this results in loss of major elements, such as time, cost and quality

Current Healthcare Systems in UAE and its Main Healthcare Providers

As stated above, UAE is consisted of seven emirates. Ministry of Health in UAE is acting the federal entity where is mainly responsible for governing the healthcare, legalization and acting as an operator for part of Dubai hospitals and primary healthcare centers and all of northern emirates which include, Sharjah, Ajman, Ras Al Khaima, Fujairah, and Umm Al Quwain. The emirates of Abu Dhabi has its own operator which is “Seha “ that is governed by the Health Authority of Abu Dhabi (HAAD), while most of the public health entities in Dubai is governed by Dubai Health Authority (DHA). Ministry of defense and Ministry of interior in UAE do provide healthcare services through their hospitals, such as Zayed Military hospital.

MOH of UAE consume about 36% of all hospitals in UAE, it is crucial to mention that the private sector has been gaining an increased in patient encounters, where in 2011 the private sector controlled almost two third of the market share as opposite of 2006 where there was an equal split between the sectors (See figure 1). Nevertheless, the bed capacity at MoH hospitals is more than 73% compared to almost 26.927% for the private sector (United Arab Emirates Healthcare, 2013)
Overall, the below are the healthcare providers and entities.

- Ministry of Health
- DHA
- HAAD
- SEAH
- Ministry of Defense through Zayed Military Hospital
- Ministry of Interiors through the police hospitals
- Dubai Healthcare City (DHCC)
- Private sector

The electronic health systems that are utilized in these facilities are different and vary from Cerner Medical Solutions, to Epic Medical Solution and other software and solutions. In addition, some facilities still operate manually without having the electronic system administrative to their environment.

Potential Stakeholders of NUMR

NUMR initiative, will not only have an impact on the health government authorities or healthcare providers, it will actually drive the concern of many other stakeholders. The below table summarize those potential stakeholders.

Table 1. NUMR Potential Stakeholders

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>How they have a stake on the initiative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Authorities</td>
<td>Authorities that make and enforce policies for healthy community</td>
</tr>
<tr>
<td>Providers</td>
<td>People or organization who provide care and services</td>
</tr>
<tr>
<td>Patients /People</td>
<td>People who receive care</td>
</tr>
<tr>
<td>Payers</td>
<td>People or the organization who pay for the care</td>
</tr>
<tr>
<td>Suppliers/ Vendors/ Partners</td>
<td>Organization that support healthcare ecosystem</td>
</tr>
<tr>
<td>Standards organizations</td>
<td>Organization that create healthcare Standards</td>
</tr>
</tbody>
</table>
Accountable Care Organizations  People or organization who are involved in better public health

Researchers & Quality Improvers  People or organization who works to improve quality of care

So Why UAE has These Challenges?

Viewing the above points, the crucial question that needs to be asked is why UAE has healthcare challenges and high rates of lifestyle disease? To answer that it is obvious that the lack of integration between the healthcare systems and lack of electronic health exchange is causing managing patient care and the health of the population to be difficult, because information is not accessed easily and not shared properly which raise the risk of inadequate decision making for healthcare management. Not to mention that having to visit multiple care providers leads to have unnecessary repetitive procedures and test that are not shared among all healthcare providers, that cause serious financial cost and reduction in efficiency and effectiveness. There is no unified health medical repository that is needed to determine health programs and causing the lack of plans to reduce the incidence of chronic diseases as it was evident on the statistics provided above.

Literature Review

During the last decade, a high demand for having interoperability standards and having smooth data flows increased dramatically. As defined by ISO TC 215, interoperability of electronic health records (HER) means “the ability of two or more applications being able to communicate in an effective manner without compromising the content of transmitted EHR” (Bhartiya & Mehrotra, 2014). Moreover, studied showed that health data exchange experienced challenges and constraints when it comes to implementation of the concept of interoperability and EHR. Some of the challenges of sharing health data between different healthcare systems are listed below (Bhartiya & Mehrotra, 2014):

- Different ways of representing data that varies from system to system
- One term might has multiple meaning, in another word different vocabulary lead to different interpretation of similar terms, which make the full meaning in health data to remain ambiguous
- Lack of standard rules for data sharing. For example, difficulty in deciding on how much data should be available for referral cases to healthcare providers
- Lack of integration between disparate systems resulting in generation of independent silos of EHR storage
- Confidentiality
- Different requirements when exchanging data as there might be different network requirements within an organization. For example, radiology department required intensive bandwidth because of the high volume of the image files transferred between the radiology biomedical devices into the picture archiving communications system (PACS)
- Data ownership

**Architecture and Models for Interoperability**

Discussing the above challenges when sharing data, many organizations tried to mitigate these challenges through the establishments of defined architectures, models and standards.

There are different healthcare models that allow data exchange among different facilities. Many of these models and architectures have incorporated standards that are compatible with ISO which allow seamless and secured sharing of data. Below are the details of some of these models (Bhartiya & Mehrotra, 2014):

<table>
<thead>
<tr>
<th>Table 2. Architectures and Models</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Architecture / Models</strong></td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>CORBA; which is developed in 1995 by Objective Operating Management Group (OMG)</td>
</tr>
<tr>
<td>COM/ DCOM; developed in 1994</td>
</tr>
<tr>
<td>Topic</td>
</tr>
<tr>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Net Framework ; developed in 2000</td>
</tr>
<tr>
<td>GUMO (General User Model Ontology) developed in 2004</td>
</tr>
<tr>
<td>Web services</td>
</tr>
<tr>
<td>Open Systems</td>
</tr>
<tr>
<td>Service Oriented Architectures</td>
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<td></td>
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</tbody>
</table>
It is standards helps to achieve semantic interoperability in healthcare domain to achieve the shared and secured healthcare scenario. The necessity to represent the context of sharing clinical information is vital in healthcare domain and will stay as a challenge in the current models. Having large scale applications of the standards suggested would require greater contribution of the concerned parties to implement them.

From: Bhartiya & Mehrotra, 2014

EHR Exchange Standards

EHR exchange standards or what is called by health information exchange (HIE) is being the backbone of the interoperability in healthcare computer systems. The below is the list of the EHR exchange standards that would facilitate and ease the process of exchanging the health data among institutions (Bhartiya & Mehrotra, 2014):

- **Health Level Seven (HL7):** It provides a set of standards and framework for the exchange, integration, sharing, and retrieval of electronic health information. It will assist in defining how information is packaged and communicated from one location to another, establishing the language, structure and data types that are needed for seamless integration between systems. It uses the concept of application to application message exchange. It supports clinical practice and the management, delivery, and evaluation of health services, that made it recognized worldwide and to be as the most commonly used. (Introduction to HL7 Standards, 2015):

- **Digital Imaging and Communication in Medicine (DICOM):** It is a messaging standard for digital images and consisted of attributes that has a multitude of image related information. The Client Server concept is incorporated by DICOM.

- **The US Health Information Technology for Economic and Clinical Health (HITECH) ACT:** It is a legislation that is created in 2009 to stimulate the adoption of electronic health records. It addresses the privacy and security concerns associated with the electronic transmission of health information and promotes meaningful use of health information technology (HITECH Act Health Information, 2015).

Technical Interoperability Standards for EHR

It is very important to have data standardization to assist organization in exchanging, comparing and aggregating or integrating data among multiples systems. Data standardization associated to the
utilization of the same set of codes to encode data throughout the system. Below are some of the examples of the technical interoperability standards for HER (Bhartiya & Mehrotra, 2014):

- **Systematized Nomenclature of Medicine.** Clinical Terms (SNOMED CT): Systematized Nomenclature of Medicine and clinical terms that records healthcare encounters. It can be described as a standardized, multilingual vocabulary of clinical terminology which is used by healthcare providers for the electronic exchange of clinical health information.

- **ISO/IEEE 1073 Point of Care Medical Device Communication**: It concerns about standards related to a family of medical devices communications. This would assist in achieving plug and play interoperability between medical instrumentation and computerized healthcare information systems.

- **HIPPA ASC X12 and National Council for Prescription Drug Programs (NCPDP) Batch Transaction Standard**: Specialized for pharmacy setting, as it provides practical guidelines for file submission standards used between pharmacies, switches and processors.

- **Logical Observation Identifier Names and Codes (LOINC)**: a standard for identifying medical laboratory observations. It is utilized to identify clinical observation or test results. It is very compatible with HL7 and actually been identified as the preferred standard of the organization Health Level 7 International.

- **Continuity of Care Document (CCD)**: Standards for sharing patient summary information that includes the most commonly needed relevant information about current and past health status. It is created in a form that can be shared by all computer applications, including web brows EMR and EHR. This enables the electronic transfer of multiple types of the clinical data from one healthcare entity to another.

**Case Studies of Countries implemented National Unified Medical Records**

There are many initiatives at a level of nations that took place to design a nation level programs aiming to enable availability and accessibility of the patient’s medical record irrespective of time, place and locations. Table three summarizes those initiatives (Bhartiya & Mehrotra, 2014):

In this paper, Singapore case study will be examined in more details.
Singapore and Its National Electronic Health Record (NEHR) initiative

To fulfill the strategic vision of Singapore, National Electronic Health Record (NEHR) program was established. Singapore is considered a small country with population of 5.2 million of them 74% are Chinese, 13% Malay, 9% are Indian and 4% Eurasian and other ethnic groups. It prepares for the “Silver Tsunami” through a different pattern of healthcare; such pattern is evident by the integrated healthcare delivery to deliver effective treatment, whereby 2030 it is predicted to have 1 in 5 Singaporeans to be over 65 and by 2050 Singapore would be among the world’s demographic oldest countries with median age of 54 (Chai & Lam, 2012).

This successfully consolidated the view of patient’s medical history and ensured healthcare providers to have the necessary information to help the best care decision for the patient. It is a data exchange
system that stores the medical record of every person in Singapore who has been treated in a healthcare public sector since February 2011. The below show the medical information that is included in NEHR (Chai & Lam, 2012):

- Admission and visit history
- Hospital inpatient discharge summaries
- Laboratory results
- Radiology results
- Medication history
- History of past operations
- Allergies and adverse drug reactions
- Immunizations

The confidentiality of the medical record is governed by law to make sure that the medical record is safe and only authorized users of the NEHR got the privilege to access it. All access to the medical records are captured and closely monitored and a review check is carried out periodically (Chai & Lam, 2012).

Enhancements have been induced since the existence of NEHR. For example, redesigned user interface and customized care setting views for better support clinical workflows, data augmentation to expand the breadth of patient centric information to support decision making and case management system which provided better support to chronically ill patients who requires complex care demands (Song, 2015).

Till this stage NEHR only covers the public sector without the private sector, however according to MOH of Singapore NEHR will continue to develop new IT functions to provide support to the integrated healthcare services. This includes providing mechanism for institutions to share patient’s active problem list and its care plans with the end state throughout the development of continuity of care record (CCR) functionality. As well, MOH of Singapore is planning to use data analytics to support the national planning of healthcare services (Song, 2015).

The model of NEHR is still continually evolving to meet the growing of the healthcare needs and it is staged across many years. A Health IT Master Plan or what is called HITMAP is created and developed with the involvement of both public and private sector stakeholders to guide the path forward for NEHR (Song, 2015).

The budget for NEHER has not been revealed by MOH of Singapore yet however it was stated that the IT solutions for NEHR are involving many procurement exercises.

As stated above, patients who visited the public sector healthcare facilities already have a single healthcare record shared among all the public entities, however the remaining private healthcare facilities are not yet on board, but still MOH of Singapore working actively with them to urge all
healthcare facilities across the nation of Singapore weather private or public to support and participate in the NEHR to achieve their vision of “One Patient, One Health Record.

Every project or program has its ups and downs. According to Colleen Brooks (2011) Singapore has have many challenges when it comes to pursuing the semantic interoperability of the NEHR. The current lack of message standardization was hindering Singapore to seamlessly share its information among the healthcare clusters, sectors and facilities. To achieve international standards for transferring clinical and administrative data among software applications that are utilized in healthcare we would need HL7. Giving the fact that HL7 v2 is the current messaging standards in Singapore project, there are other message profiles that are utilized for HL7 which as a result made the national information exchange a challenge for Singapore. Not to mention that the need to sustain a hybrid SOA for exchanging these messages made it more difficult.

Having addressing some of the interoperability issues as stated earlier a Logical Information Model (LIM) was put in place to harmonize the terminology which aims to consolidate different information from disparate systems into a single electronic health record for each individual patient. LIM can be defined as “an implementation-independent information model for healthcare data exchange”, which is based on the “logical reference model” (LRM). LIM consisted of archetypes which are “a set of reusable clinical building blocks that can be constrained and assembled into templates to meet the certain use cases”. The LIM outlines the references and structure terminology required for healthcare messages and clinical concepts which are used within these messages. It generates a variety of artifact that contains “exchange format specifications, conformance validation software, user interface and human readable documentation”. Singapore added a unique feature into its LIM which is allowing clinical systems to populate the resulting messages using their native interface terms, that resolved pre-coordination differences with the assistance of specialized design patter constructs,

The development of LIM for Singapore’s initiative can be demonstrated as below (Brooks, 2011):

![Diagram of Logical Information Model and Artifacts](image)
So the process started with building a LRM to offer standards based modeling framework for LIM. This LRM was built based on ISO-13606-1 reference model and ISO 21090 data types which cater for local usage and information availability. The second phase was the establishment of LIM that conforms to the LRM. Its requirement analysis was based onto two main approaches (Brooks; 2011).

- An evidence-based approach that involved the examination of existing healthcare information exchange. All relevant message profiles (primarily HL7 v2) in Singapore were fully recognized in a reliable format, and validated against several million messages in aggregation with local implementation groups.
- A clinician-driven approach for collecting NEHR’s requirements and Discharge Summary documents.

Moving forward Singapore considered certain approaches and methods to obtain that NEHR put place is demonstrated as well, through Architecture Bundle Card (ABC) and Enterprise Architect (EP) refer to the below images (Chai & Lam, 2012):

![Image](image-url)

**Figure 3.** EA and EBC; From Chai & Lam, 2012
From the graphs above, it is evident that Enterprise Service Bus (ESB) was utilized instead of the point to point integration. It is obvious that the enterprise architectures was needed since there are many systems and applications in place and demanded to put together to conduct their day to day business and deals. Point to point integration is not advised in this complex projects like NEHR as it is used with small infrastructure where only two or three systems can be maintained. Therefore, rather than each system or application requiring a separate connector to communicate with the other connector, ESB was utilized which act like a broker like manner, but not exactly a broker. By broker we mean incorporating all the functionality required for integration into central hub. ESB facilitated the below for Singapore’s initiative (“Understanding Enterprise Application Integration,” 2015):

- Location Transparency: a consumer application will not require specifications and information about a message producer to receive messages as ESB is a way of centrally configuring endpoints for messages.
- Transformation so messages will be easily converted into a format that is usable by the consumer application.
- Protocol Conversion: ESB would enable sending messages in all major protocols, and converting them to the format required by the end consumer.
- Routing: ESB would determine the appropriate end consumer and dynamically created requests.
- Enhancement: it would retrieve missing data in incoming messages, based on the existing message data, and attach it to the message to maintain comprehensiveness when it reaches its final destination.
• Monitoring / Administration: ESB would provide an easy method of monitoring the performance of the system, and provide a simple means of managing the system so as to deliver its proposed value to an infrastructure.

• Security: the two main components of ESB security relies on making sure that ESB itself handles messages in a fully secure manner, and exchanging between the security assurance systems used by each of the systems which would be integrated.

The ESB approach got many advantages, such advantages would be associated to the fact ESB made up of many interoperating services rather than a single hub that contains every possible service, so ESB can be heavy or light according to the organization needs. Secondly it is easy to expand and connect additional applications or systems to the architecture, and allows right away connection and integration. Moreover, it can be distributable and scalable and can be easily dispersed across a geographically distributed network as required which is something cannot be achieved by the broker architectures. ESB are built with service oriented architecture (SOA). This was a crucial point for MOH Singapore as they are seeking to migrate towards an SOA, and ESB is SOA friendly and can do so incrementally allowing them to continue using their existing systems while plugging in re-usable services as they implement them.

Aim of this Research Paper

Justification of the Importance of the Research Study

Although many research studies were carried out to study interoperability and HIE in the healthcare field, none of these studies were conducted to evaluate this context in UAE healthcare field. This research is considered the first conducted in this region. Such studies are needed so other health organizations whether in UAE or even the Middle East region especially with the announcement of the initiative of NUMR.

Aims

The main inquiry that is investigated in this paper is how UAE can achieve the National Unified Medical Record? What are the possible challenges that need to be considered and what is the proposed ways to overcome them? What are the critical success factors for the initiative?

Methodology

In research methods there are mainly two types of research approaches that a researcher can take; Quantities and qualitative approaches. As our objective is to describe rather than quantify a qualitative measurement would take place as it would be suitable than the quantitative. Study design will be iterative where data collection and research questions will be adjusted according to what is learned.
The following methods were used as a data collection tools to obtain secondary data from existing peer reviewed journal articles and reports of government agencies and related health organizations:

- Systematic search of the published literature
- Structured interviews with vendors, agencies, government entities would be carried out; who will be considered the main subjects to this research
- Publications/reports by health authorities, government agencies, and local hospitals.

Results & Discussion

Proposed Key Aspects on How UAE Can Achieve NUMR

One of the aims of the study was to identify key elements in how to accomplish the UAE NUMR project. Therefore, couples of interviews with MOH employees who have a stake on the project were carried out.

According to Mubaraka Mubarak Ali Ibrahim, Director, Health Information Systems Department, Ministry of Health, UAE, NUMR is needed to accomplish a nationwide real-time patient centric records whenever and wherever needed for improved care through health information exchange leveraging patient engagement and maintaining security and privacy in a sustainable model. Mubaraka Ibrahim stated that for UAE to be able to accomplish this project there must be a proper strategy in place as well governance.

She summarized the approach into three simple words; strategize, implement and sustain (see figures 5 & 6)

![Figure 5. Key Aspects in How to Implement NUMR](image-url)
Usually, in IT and Health Information Systems (HIS) projects proper strategy aspects are ignored or not being emphasized but this is not the case with UAE NUMR, the key success factor for any project is to have proper strategy in place, said Ibrahim M. Therefore, UAE would be releasing an RFP for consultancy company to aid in the strategy where there main focus will be in the below:

- Create 10 years EHR strategic plan, initiatives, roadmap.
- Benchmark with other countries
- Environment Assessment (Current Situation Analysis)
- Create Standards
  - EHR Data Definition, Coding and other Standards
  - Quality Standards
  - Privacy & Security Standards
  - Technology Standards
- Technology Architecture
- Prepare RFP for Implementation.
- Oversee Implementation- Project Management Services

As well, Mrs. Ibrahim M, emphasized that proper governance should be in place for such an initiative and in summary the governance to be as below:
Having this governance in place will help in implementing the project in a sustainable way. This will assist in the below as specified by Ms. Ibrahim M.:

Table 4. Group for NUMR Governance and Their Responsibility

<table>
<thead>
<tr>
<th>Group of the governance</th>
<th>Responsible of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Majlis Al Seha</td>
<td>• Report UAE Leadership on the status of the Program.</td>
</tr>
<tr>
<td></td>
<td>• Review program progress on quarterly basis.</td>
</tr>
<tr>
<td></td>
<td>• Make Executive &amp; Policy Making Decisions</td>
</tr>
</tbody>
</table>
• Present and seek approval on new laws and regulations from Federal Cabinet.

• Provide coordination with Federal and Local Government Authorities

• Provide necessary support, resources and commitment to the program

Steering Committee

• Responsible for the program feasibility, strategic plan and achievement of outcomes.

• Ensure the program scope aligns with stakeholders requirements.

• Oversee Program Progress (time, achievement, scope, issues & risks) and assist in Decision Making Process

• Responsible for activities related to their Authority

• Provide necessary support, resources and commitment to the program.

• Reconcile differences in opinion and approach, and resolve disputes arising from them.

MOH Internal Process Committee

• Assist in financial, legal, purchasing and other MoH Internal processes

• Provide regular updates on these processes.

• Assist in implementing new policies to facilitate program requirements

Subject Matter Expert Group

• Share knowledge, experience & concerns in their respective area

• Draft relevant documents for approval (rules, policies, architecture, standards etc.)

• Nominations from all stakeholder authorities
Standards Group

• Work on defining UAE level healthcare interoperability standards
• Perform comparative analysis on industry standards and identify their pros, cons, legal, social & economic implication from UAE perspective
• Work on defining program related policies & procedures.
• Achieve consensus on standards from all stakeholders
• Drafting and publishing standards documents
• Maintain new changes in standards using continuous improvement approach
• Monitoring program implementation for compliance of the standards(review meetings).
• Provide necessary support, resources and commitment to the program.

Technical Group

• Define overall technology approach and roadmap
• Work on defining Information & Technology Architecture for the program
• Perform technology assessment and comparative analysis.
• Develop technical policies & procedures for the program.
• Perform vendor evaluation
• Achieve consensus on standards from all stakeholders
• Drafting and publishing technology documents
• Maintain new changes in technology using continuous improvement approach
• Monitoring program implementation for compliance of agreed architecture(review meetings).
<table>
<thead>
<tr>
<th>Medical Group</th>
<th>Security and Privacy Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Provide necessary support, resources and commitment to the program.</td>
<td>- Work on defining EHR security &amp; patient privacy policies.</td>
</tr>
<tr>
<td>- Work on defining EHR clinical workflows, dataset and standards.</td>
<td>- Perform comparative analysis on various industry approaches.</td>
</tr>
<tr>
<td>- Perform comparative analysis on various industry approaches.</td>
<td>- Achieve consensus on security &amp; privacy policies from all stakeholders.</td>
</tr>
<tr>
<td>- Achieve consensus on clinical workflows and standards from all stakeholders.</td>
<td>- Drafting and publishing security &amp; privacy policies documents.</td>
</tr>
<tr>
<td>- Drafting and publishing clinical workflows and standards documents.</td>
<td>- Maintain new changes in security &amp; privacy policies using continuous improvement approach.</td>
</tr>
<tr>
<td>- Maintain new changes in standards using continuous improvement approach.</td>
<td>- Monitoring program implementation for compliance of the standards (review meetings).</td>
</tr>
<tr>
<td>- Monitoring program implementation for compliance of the standards (review meetings).</td>
<td>- Provide necessary support, resources and commitment to the program.</td>
</tr>
<tr>
<td>- Provide necessary support, resources and commitment to the program.</td>
<td>- Provide necessary support, resources and commitment to the program.</td>
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Furthermore, another interview was carried out with Muhammad Ahsan; an HIS consultant and leader in e-Health Practice where the main focus in that interview was about the proposed architecture that need to be considered for achieving this initiative.

Ahsan specified such initiative would require a proper set up cloud that hosts all solutions and components of EHR. This cloud must be owned by government and its infrastructure managed by main implementation partner. (see figure 8)

According to Ahsan M. that a government health link must be designed to maintain health data, claims link, facilities and professional networks, registers and other. In addition, UAE secure health link to be as Connectivity backbone to provide secure health integration services across UAE.

Licensed Integration Partner (LIP) is an important aspect to be considered for this project. The plan is to maintain the integration and support services for private facilities through LIP by having the private facilities to subscribe to LIP services which are proposed to be licensed by MOH for revenue generation to support NUMR cost. Moreover, it is suggested to link the registered research institutes to help UAE improve healthcare situation and improving outcomes. Registered Application Services Providers (RASP) is to be considered in the secure link for NUMR as it will help in extending
EHR capabilities and focus on developing value added services for patient, physicians and providers. Last but not least, having Accountable Care Organization linked with the UAE secure health link proposed is important as these organizations would be working with UAE government to improve public health.

In addition to that, Ahsan M. specified that learning from Singapore case study we are planning to consider SOA technical architecture and making sure that interoperability standards for healthcare are met. Such standards are HI7, SNOMED, CCD and ISO IEEE 1073. This will aid in unifying the data and standardize the ways of representing those data. Ahsan M added that point to point integration must not be utilized for this initiative, as there are many applications and systems to be integrated and advised to have ESB, which was the same concept utilized in Singapore case study.

Moreover, a federal law must be in place for such initiative as it tends to be the dominant legal influence on health information sharing. Hence, urgent need of federal law to facilitate health information exchange across all healthcare providers and setting regulation and standards for this exchange is required.

**Possible Challenges of NUMR**

Singapore case has brought us many lessons learned. For this initiative, UAE must be aware of the challenges upon it. After consulting different vendors who practiced in different EHR projects as well, who worked with Singapore in their project, challenges that might be occurred with NUMR is summarized in the below table with a suggested way in overcoming them:
From the above challenges, this paper will elaborate on one of challenges which privacy and security.

**Cyber Security in the current HIE Environment (Its Concerns and Challenges)**

Having HIE and interoperability of electronic medical records would allow health information to be accessed by any approved healthcare provider that will improve the quality of healthcare especially during emergency care. However, to exchange health information through interoperability environment requires extended technical and political processes among with standardization and modifications of currents systems.

Many healthcare organization and providers are concerned about confidentiality of their records which makes HIE a challenge, especially with the threats that are raised in the interoperable environments. The NUMR initiative would summarize valuable **assets** in the following points:

- Health Records: that contains sensitive information about the patient medical condition
- The services: that are provided by the software system
- Identify and billing information: that includes credit card information, social security number (Emirates ID number), patient’s address and all the demographic data which makes it a target for any attackers who is tempted to steal patient’s identify or commit credit card fraud.
• The authenticity and audit trail of data contained in medical record. For example, if patient have incorrect listing of a certain allergy because of malicious attack, patient safety could be jeopardize

For our NUMR to be successful the dimensions of security should be met, as below (Sommerville, 2015):

• Confidentiality where information in the system should only be disclosed to authorized personnel
• Integrity where measurements are put in place to avoid damaged or corrupted information in the system
• Availability where access to the system and its data available to who are authorized

System security management should be carried out. This would include user and permission management, software deployment and maintenance, and attack monitoring, detection and recovery. Moreover vulnerability avoidance is crucial where the system is designed so that vulnerabilities do not occur. Moreover, attack detection and elimination through virus checkers to find and remove viruses before affecting the system negatively (Sommerville, 2015). As well, disaster recovery is important for such huge initiative and it should be as vital step in the backup policy to allow damaged information to be restored.

Security policy for HIE and EHR should be in place and it should be influenced by (C & JR, 1996):

• The functional requirements which pertains to what the user need to accomplish from the system
• The security requirements that pertains to what the items in the system that needs to be protected
• Threats model that pertains to what the expected motives and resources of potential perpetrators

From the case studies mentioned in the literature review, we came to know that there are certain polices and standards that need to be in place to ensure security compliance. Such standards and polices are Certification Commission for Health Information Technology (CCHIT) and HIPPA compliance (Bhartiya & Mehrotra, 2014). In order for NUMR to be maintained and implemented successfully those polices and standards must be met, along with many other standards for HIE and interoperability as mentioned in the literature review. Moreover, during the implementation phase enhanced test scripts should be utilized to address any design flows. The CCHIT certification process should include misuse cases that are a solid way of modeling that attacks an electronic health care system could suffer. As many security issues might be emerged if there is any implementation bugs or designs flows (Bhartiya & Mehrotra, 2014). In addition to that there are many areas that need polices related to security. Below are 14 areas where policy regarding security is needed and must
be consider for NUMR initiative to make sure that security and confidentiality are not jeopardized (C & JR, 1996):

1. User authentication
2. System integrity
3. Physical security of data center sites
4. Network security
5. Access control to system resources
6. Informed consents
7. Data ownership
8. Education of users
9. Data protection policies
10. User profiles
11. Building security into systems
12. Problem identification and resolutions
13. Security of hard copy materials
14. Legal and liability issues

Protection is crucial and might involve many aspects that vary from platform level to application level to record level protection (see figure 9). Therefore certain guidelines must be established in order to protect these layers and ensure security of medical record. Such guidelines are presented as below (Sommerville, 2015):

- Avoid of a single point of failure
- Base security decisions on an explicit security policy
- Fail securely
- Balance security and usability
- Log user actions
- Use redundancy and diversity to reduce risk
- Specify the format of all system inputs
- Compartmentalize the assets
- Design for deployment
- Design for recoverability
Best practices and proven solutions should be utilized with a focus on compliance with HIPPA Privacy/security rules or similar. Policies and procedures and technical process should be defined considering:

- Access: who can access the information
- Authorization” which functions and the data will a user be authorized to access

Figure 9. Level Protection Types. From Sommerville, 2015
Authentication and authorization mechanism would be linked to medical practitioners’ license, license category and facilities license validity. Moreover, defining security and privacy controls such as audit log controls, identification and authentication controls, data access controls, data integrity controls, and patient privacy controls.

**Critical Success Factors**

After discussing the possible methodologies of implementing NUMR, and it is challenges we can summarize the critical success factors of this initiative in the below table:

<table>
<thead>
<tr>
<th>#</th>
<th>Critical Success Factors</th>
<th>Objective of the Initiative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Identify the Value Proposition for Each Community Stakeholder Group</td>
<td>Define the community and identify the individual stakeholders that will be impacted by information exchange which includes Provider, Practitioner, and Patient across UAE.</td>
</tr>
<tr>
<td>2</td>
<td>Define the Common Goals of NUMR</td>
<td>Clearly defines vision, purpose &amp; goals that achieve the overall objective of the NUMR. This would create shared vision and community buy-in.</td>
</tr>
<tr>
<td>3</td>
<td>Stakeholders Involvement and communication</td>
<td>To achieve common goal and vision, stakeholder involvement and open dialogue on differences between stakeholder values and expectations are critical.</td>
</tr>
<tr>
<td>4</td>
<td>Management support</td>
<td>Timely support and active involvement from top management is essential.</td>
</tr>
<tr>
<td>5</td>
<td>Ensure Privacy &amp; Confidentiality</td>
<td>Sufficient privacy, confidentiality and protection measures of patient medical information are important to ensure patient confidence and authorized medical record access.</td>
</tr>
<tr>
<td>6</td>
<td>Tools and Infrastructure Selection</td>
<td>A scalable and robust HIS software and infrastructure is critical to meet the current and future business requirements, availability and performance criteria. Custom configurable interface for all healthcare providers for seamless integration.</td>
</tr>
<tr>
<td>7</td>
<td>Data availability &amp; quality</td>
<td>Data availability and data qualities are important factors to NUMR.</td>
</tr>
<tr>
<td>8</td>
<td>Resources &amp; Domain Knowledge</td>
<td>Dedicated resources, domain knowledge and engaging subject matter experts are crucial for the successful implementation of NUMR.</td>
</tr>
<tr>
<td>9</td>
<td>Workshop &amp; Training</td>
<td>A comprehensive training and workshop would encourage community to use the initiatives and realise the value &amp; benefits.</td>
</tr>
<tr>
<td>10</td>
<td>Rollout Approach</td>
<td>A phased implementation would be preferable than big-bang approach (everything launched at once). This would ensure providers a gentle learning curve to grow with the capabilities of the system and positive EHR experience.</td>
</tr>
<tr>
<td>11</td>
<td>Governance</td>
<td>To oversee and provide governance for a successful rollout of NUMR across UAE. Reliable and transparent governing body is necessary in enhancing the public and private participation.</td>
</tr>
</tbody>
</table>

**Conclusion**

To sum up, delivering effective and efficient healthcare for patients across UAE, proper communication and coordination is essential. Considering the growing burden of chronic diseases, costly treatment and aging population, lack of coordination and not sharing patient information in a
proper timing manner might lead to higher administrative costs and limited effectiveness, hence NUMR is solution to integrate health information exchange to deliver better quality of care. In order to achieve that, proper planning should be in place. One of the main concerns is security and confidentiality of such initiative. While examining different case studies of different countries we learned out that to maintain such concern, NUMR should be compliance with Health Insurance Portability and Accountability Act (HIPPA) and Certification Commission for Health Information Technology (CCHIT) to maintain confidentiality, integrity and availability of EHR and ensure that certain security guidelines are in place. During strategizing phase of the project and planning, integration model need to be studied well, and ESB and SOA need to be considered

References


Chai, V., & Lam, C. (2012, April). A converging approach toward EA and SOA.

HITECH Act (Health Information Technology for Economic and Clinical Health Act) definition. (2015). Retrieved from TechTarget website: http://HITECH Act (Health Information Technology for Economic and Clinical Health Act) definition


Demand of Telemedicine in the United Arab Emirates Federal Healthcare Organization

Shaikha Abdool, PhD Computer Science student
The British University in Dubai

Abstract

Background: Telemedicine is considered a complex model in technology field as it composes of different modules that need to be interconnected. For instance, physical component, such as: machines for video conferencing, computation, communications tools and techniques to control and interact. In the Arab Region still telemedicine is considered as a new concept of innovation and the United Arab Emirates (UAE) is one of the countries that are aiming to implement such technology. For that, a cross-sectional study was conducted about the demand of telemedicine in the UAE Federal Healthcare Organization and quantitative method was followed.

Aims: The study covered the UAE Federal Healthcare Organization as it is planning to implement telemedicine. Thus, the study will be beneficial to decision makers, healthcare professionals, patients, vendors...etc. whether to implement such complex and innovative technology that requires a huge effort and resources. Furthermore, the number of studies conducted in the region about this technology is very limited compared to the developed countries.

Methods: A mixed cross-sectional study was conducted regarding telemedicine. This type of study design is more appropriate for the study’s aims due to its easiness to gather the required data, time and cost effectiveness. Simple random sampling technique was followed as it is more suitable compared to other techniques for different reasons, such as: easiness to collect data as the targeted population were healthcare providers in the UAE Federal healthcare Organization and patients. Also, there is less bias chance as individuals in the population have the same chance of being selected randomly.

The data collection method was mainly quantitative measurement. A self-administered questionnaire was distributed in both languages; Arabic and English. There reason for administering the questionnaire in two languages because of multi-nationalities in the country and not all of them speak Arabic or English as their mother language. World-wide, English is considered the most spoken language. Appropriate data analysis techniques were used. Participation was completely voluntary and no real identifications were disclosed.

Results: the number of participants was 45 from different backgrounds and nationalities. A hypothesis for demanding telemedicine was tested and the result was to reject this hypothesis. Overall, there is no high demand for telemedicine in the UAE Federal Healthcare Organization.
Introduction

The number of individuals using Internet world-wide is increasing vastly regardless of age, gender, purpose,...etc. and it is becoming a vital component in the daily-life of the population. Government, such as: UAE started to provide Internet services in public areas. However, since many services are provided over Internet and new technologies are arising from time-to-time, there are possible consequences that may occur, such as: violations of rights, security and privacy. In healthcare, technologies are emerging on regular basis that require technical activities, such as: connectivity and networking, which lead to use Internet.

Healthcare becoming an interesting filed and attracts diverse people regardless of their purposes. For instance, Information Technology (IT) firms, medical devices vendors, insurance companies, public...etc. However, Information Technology (IT) is becoming one of the focal aspects in healthcare organizations to serve customers and reach ultimate goals. In addition, because of the rapid growth of population, increase demands on healthcare services beside other factors, there is high demand to utilize information and communication technology and its related aspects to meet the demands as well as connecting various devices and platforms to feed data to diverse entities. This is known as Internet of Things (IoT).

One of the new concepts in healthcare is Cyber-Physical Systems (CPS) which consists of physical parts, computation, communication and controlling. Such systems are complex and have various challenges, for example: security and effective interactions between different components. Nowadays, wide ranges of systems follow CPS, such as in healthcare and nuclear power (University of Luxemburg 2015).

In healthcare field, CPS allows ensuring medical care to patients via accessing, computing and communicating distant platforms interactively. In such situation, telemedicine is one of the technologies in CPS. Telemedicine consists of different components that are related to IT, medicine, automation, telecommunication and electronic. It is becoming the trend in healthcare due to its benefits, such as: consultations, monitoring, information transmission instead of physical transport of patients and breaking geographical barriers (Horoba et al. 2014, p. 59)

Thus, telemedicine can be defined as diagnosing and treating patients remotely by using telecommunication means (Oxford University Press 2015). Al-Qirim (2007, page 545) defined telemedicine as providing medical care remotely, where patients and healthcare professionals are brought close via telecommunication technologies.
Problems and Objectives

The study aimed to evaluate the demand for telemedicine in the UAE as it is planned to be implemented by the UAE Federal Healthcare Organization. Patients and healthcare providers were included in this study as they are the main users of the planned technology and the one who will identify the reasons for needing such complex and innovative technology or having contrary reasons to not implement it. Also, a list of possible consequences related to telemedicine were reviewed and evaluated by those targeted population.

Setting of Interest

The UAE Federal Healthcare Organization consists of nearly 15 hospitals and 67 primary healthcare centres and other specialised facilities, such as: for diabetes and rehabilitation. Those facilities are scattered across the country (MOH 2013). Most of these facilities are connected with a health information system.

Rational for the Study

Nowadays, CPS and Internet of Things are trending concepts, particularly in the UAE. Telemedicine is one of the technologies that applies CPS and Internet of Things and it is a new technology in the Arab Region in general, and in the United Arab Emirate; in particular. The number of studies conducted in the UAE related to telemedicine is very limited and most of them were conducted on single Emirate Level. However, this study covered telemedicine in the UAE Federal Healthcare Organization, which is considered as the central authority for healthcare in the country and covers almost 15 hospitals and 67 primary healthcare centers (MOH 2013).

Since the study covered a new technology that is planned to be implemented by the UAE Federal Healthcare Organization, decision-makers will benefit from this study as it evaluated the demand for telemedicine in the country and to take the right decision before it is too late and to avoid consequences.

Review of Literature

Abu Dhabi 24hours Telemedicine Center

According to Rizvi (2014), Abu Dhabi Telemedicine Center was launched as a joint venture between Medgate; a Swiss company and Mubadala Healthcare Company. This service involved 11 doctors and 7 nurses. The main aims of it were to reduce workload on emergency rooms and provide care for non-emergency cases.
The service is provided over phone and follow-up after a few hours is done to monitor the status of the patient. If the case requires emergency care, the service requester is asked to visit an emergency room.

One of the physicians stated that telemedicine allowed him to spend extra time with patients and ensure their health condition is better. Also, it allowed him for second opinion by his patients before taking a decision about their health. In addition, this service opened a gate for patients who feel embracement of face-to-face communication with their physicians related to some health conditions, such as: contraception and bleeding.

Overall, telemedicine is leading to provide care to people in remote distances and been implemented at minimum in 85 countries (Rizvi 2014).

This article stated telemedicine implementation in Abu Dhabi without indication of healthcare facilities involved. Furthermore, there was not clear indication of technology used to implement telemedicine in terms of connectivity, equipment...etc.

Furthermore, the implemented telemedicine is based on telephone conversation, which nowadays most of telemedicine technology moving toward e-visit. Also, patients’ feedbacks were not identified regarding this technology.

**Ethical Problems in Telemedicine**

A study was conducted by Atac, Kurt and Yurfakul (2013) about telemedicine ethical problems. Telemedicine as defined in the study means using electronic signals to transfer information between different points in order to provide care. Different researchers descried telemedicine in different ways, but almost had the same concept of using information technology to provide medical care remotely (Al-Qirim 2007; Horoba et al. 2014 & Sochacki, A. & Sochacki, C. (2015).

The technology as stated by Atac, Kurt and Yurfakul (2013) has benefits which in somehow are common with other studies. For instance, cost reduction, remote access, healthcare professionals will be able to provide care to a larger number of patients and support other healthcare providers in remote areas (Sochacki, A. & Sochacki, C. 2015 & Al-Qirim 2007).

On the other hand, ethical problems were identified. For instance, security and liability, which were also the concerns for other researchers (Sochacki, A. & Sochacki, C. 2015 & Al-Qirim 2007). Furthermore, communication between a patient and a healthcare provider might be broken, confidentiality, privacy and in some cases, third party might be involved which could lead to legal and ethical problem in terms of capturing or changing patients’ data (Gurkan 2009, cited in Atac, Kurt & Yurfakul 2013). Unclear regulations and policies related to the use of telemedicine was another problem identified, which needs to be overcome (Gurkan 2009, cited in Atac, Kurt & Yurfakul 2013). In Sochacki, A. and Sochacki, M. (2015), this was raised as well. There is an urgent demand on constituting regulations and policies that direct the use of such technology.
The study outlined telemedicine benefits and ethical problems that existed or may arise. Most of the identified benefits and problems were as well stated in other studies.

**Adoption of Telemedicine in the United Arab Emirates (UAE)**

A study was conducted by Al-Qirim (2007) about adoption of telemedicine in the United Arab Emirates (UAE). Three organizations were involved: Tawam and Mafraq Hospitals as well as UAE University. All these three organizations are property of Abu Dhabi Emirate.

The study covered an adopted telemedicine technology in these three organizations, purpose of using it, challenges and level of adoption. The study was exploratory in nature and qualitative paradigm was followed. Site visits took place to these organizations and interviews were conducted.

In the UAE University, telemedicine was used mainly for educational purposes in the Faculty of Medicine and Health Sciences. It was used to deliver educational sessions for both male and female students in separate classes, but at the same time via video-conference. Also, for seminars with students in other hospitals, events, teaching clinical procedures, exposing to medical cases and techniques that are not available or applicable in the university.

However, for Tawam and Mafraq Hospitals, the purpose of using telemedicine was for medical care. In both sites, Mayo Clinic was a party. The services provided were various, such as: sharing medical knowledge, professional certification and educational practices. Many advantages and concerns were identified. For instance, telemedicine has positive outcomes, such as: reducing costs of travelling, sharing knowledge and interacting with other colleagues in the field locally or abroad, virtual attendance of overseas events, more opportunities to access medical care for rural and urban populations while avoiding unforeseen weather conditions, expenses, long distance...etc. and covering staff shortage in rural areas.

On the other hand, some possible consequences were identified. For instance, in case of Tawam Hospital who signed a contract with Mayo Clinic in USA; time difference caused a concern, so the hospital had to look for other well-known healthcare centers. Also, security was raised related to transferring patients’ information. Another concern was accuracy of diagnosis as the interaction is virtual, which may not allow to elicit the accurate information needed.

The researcher site visited these locations to gather the required data and observe the installed telemedicine. However, in this study, the targeted technology, which is telemedicine is still not implemented and the purpose was to state the demand of telemedicine in the UAE Federal Healthcare Organization that covers most of the Emirates.
According to Al-Qirim (2007), one of the respondents from Tawam Hospital stated that telemedicine might easily fit-in with other technologies in the facility and integrate with the hospital information system. In the UAE Federal Healthcare Organization, the target is to implement telemedicine and be integrated with the existed health information system that is already connected to other technologies.

**Telemedicine for Monitoring Pregnancy**

In Horoba et al. (2014) study, a telemedicine system for monitoring pregnancy at home with challenges related to computing, modeling, networking and other embedded concerns were addressed. Also, a medical cyber-physical system (MCPS) was covered.

The system consisted of two parts: one at the patient’s home and the other one in the hospital. The pregnant woman was provided with monitoring instruments that were connected to a workstation in the hospital. A designated team from the hospital conducted regular visits to the patient with mobile instrumentations upon agreed schedule.

Part two was hospital network. Different workstations were assigned and equipped with the required resources, such as: wireless interface units, surveillance centers, communication platforms and administrative workstation to process signals obtained in off-line mode and create paper documentation in case of communication disruption. WAN Internet and GSM were utilized to connect with home monitoring station and mobile instrumentation was utilized by care team while visiting the patient. Within the hospital, LAN was utilized for networking.

Both, the mother and fetus as physical objects were monitored by sensors. To obtain the fetus’s signals, advanced signals processing was required to get the required data due to the fact that fetus is a hidden object in the mother.

Different classes of telemedicine users were identified. For example, patients, operators and medical staff. Due to the integration between hospital information system and other systems, data were transmitted along with patients’ recordings from telemedicine to doctors’ terminal. This was raised as well in Al-Qirim (2007) study.

Overall, the use of telemedicine was positive for patients and economically. For instance, healthcare costs and transportation were diminished. However, there were possible consequences identified, such as: costs of providing each pregnant with monitoring instruments incurring extra costs.

Although the study proposed a class of telemedicine to monitor pregnant women remotely and identified technical aspects of the system along with brief functionalities, the study did not illustrate
the involved healthcare facilities and whether the covered telemedicine was evaluated by the users, such as: patients and healthcare professionals as well as barriers.

**Telemedicine in the UAE**

According to Sochacki, A. and Sochacki, C. (2015), telemedicine can be described as utilizing digital technologies to deliver healthcare services remotely. As indicated above, Oxford University Press (2015); Al-Qirim (2007) and Atac, Kurt and Yurfakul (2013) described telemedicine differently but shared common concept: remote, technology and providing healthcare services.

In the UAE, different factors leading to deploy such technology. For instance, increasing population’s growth, variety of lifestyle diseases that impact all ages and booming tourism sector, which is causing massive pressure on healthcare sector and quality of services provided.

To minimize these impacts with maintaining quality of care, telemedicine is one of the possible solutions as well for rural areas. Also, it might assist in reducing costs, cover shortage of healthcare providers and allow for better access to healthcare services via digital mediums.

There are different digital mediums that can be utilized in these days, particularly with availability of 4G networks, such as: video-conference and medical imaging sharing software (Sochacki, A. & Sochacki, M. 2015), which is available in the UAE. However, telemedicine is still considered in its infancy stage in the country.

Sochacki, A. and Sochacki, C. (2015), mentioned that Abu Dhabi Healthcare Authority had set minimum standards and regulations for telemedicine, while Dhabi Healthcare Authority only covered teleradiology in their regulatory standards (Sochacki, A. & Sochacki, M. 2015).

Although telemedicine has many positives impacts, there are some aspects that need to be covered, which can be barriers to the success of this technology. For instance, information security, medical liability as well as users’ rights and protections.

The reasons for utilizing telemedicine in the UAE were depicted well by to Sochacki, A. and Sochacki, C. (2015). Also, possible barriers which can be sometimes underestimated or ignored were identified. However, evaluation of patient’ perspectives regarding telemedicine was not indicated as they are one of the main users.
Research Questions

The study aimed to cover the following:

1- The need for Telemedicine in the UAE.
2- What are the reasons for demanding such innovative technology?

Methodology

Study Design

To cover the aims of this study, mixed study design was followed. The reasons for choosing mixed study design were due to the fact that the study aims were related to describe the demands for telemedicine in the UAE as well as answer the reasons for needing this technology. Also, a hypothesis was generated and tested (NIHR 2010). By this, it is possible to collect the required information in less time, efforts and test hypotheses. Different statistical measurements were estimated in this study, such as: central tendency. Furthermore, to test the generated hypothesis that there is a demand for telemedicine in the UAE Federal Healthcare Organization; p-value was calculated. Graphical representations, such as: bar and pie charts, were made to demonstrate the obtained findings for easier view and interpretation.

Subjects for Study

The evaluated technology is still not implemented and the aims were to identify the demand for telemedicine and the reasons.

Different sampling methods are available, such as: simple random sampling, cluster, stratified...etc. However, for this study, it was applicable to follow simple random sampling. For instance, the public are from different backgrounds and healthcare professionals who might be as well patients in the UAE Federal Healthcare Organization. In addition, simple random sampling is easy to conduct and gather the required data. Also, there is less bias in selecting subjects as individuals in the population would have the same chance of being selected.

Furthermore, since the UAE Federal Healthcare Organization covers the majority of governmental facilities in the country, it would be difficult to cover all facilities and as a result, the Headquarter organization was involved in this. The number of participants in this study was 45.

The targeted population was the public (patients) and healthcare professionals (physicians) who are the main users of the proposed telemedicine and would be difficult to cover the entire population due to time constrains and resources required; those who visit or work in the Headquarter were
covered. Most of who visit the Headquarter come from different emirates, background, ethnicity...etc.

In order to avoid individuals being selected more than once, some demographic data were required, such as: name, age, gender, contact numbers, position (job)...etc. Minimally, two attributes of demographic data were required to provide, such as: name and contact number. In addition, each participant was assigned a unique number (Neutens & Rubinson 2010, pp. 136-137).

**Measurements**

In order to cover the above research questions, a questionnaire was administered among the targeted population, randomly. Mostly, the questions were in form of close-ended. However, there was a space for the participants to write down their comments. Simple straightforward questions were asked to avoid misunderstanding as much as possible. Also, for few questions, they had the space to indicate other answers than those listed. Both, the public and healthcare professionals were provided with the same questionnaire.

**Data Collection**

Quantitative method was followed in this study. Participant had to complete a questionnaire that consisted mostly of close-ended questions and follow the instructions given in the questionnaire. This type of data collection is easy to conduct, obtain information and fewer resources required compared to other types, such as: interview. Also, it eliminates interview bias as there is no major interaction with participants while completing the questionnaire. However, this might lead to false understanding of thoughts and truthfulness of inputs.

The mode of questionnaire administered was paper-pencil in which questions were on paper rather than via technology devices, such as: computers and tablets as it could not afford these devices to cover several subjects at the same time. So, paper-pencil mode was most applicable to collect the required data. In addition, since the subjects were selected randomly without knowing their contact details before administering the questionnaire, it was not possible to send the questionnaire via e-mail.

The questionnaire was available in two languages; Arabic and English (Refer to appendix A and B: Demand of Telemedicine in the UAE Federal Healthcare Organization Questionnaire). Due to the fact that there are multi-nationalities in the country and not all of the speak Arabic or English as their mother language, but English is considered the most spoken language around the world.

The participants were to answer the questions by selecting the applicable answer. For questions with possibility to add other answers than those listed, a blank space was provided in order to
achieve the study’s aims, the designed questionnaire composed of several questions. Likert scale was applied for responding. A brief introduction about telemedicine was given for understanding the covered topic. The participants were asked to answer by selecting the applicable answers, based on Likert scale; ranged from strongly agree to strongly disagree.

Before starting the questionnaire, the participants had to provide some demographical information, such as: name, age, position and nationality as whether local or non-local.

To avoid selecting the same individual twice, at least two attributes of demographic were required to be provided. Also, each participant was assigned with a unique identification labeled on the top of the questionnaire (Neutens & Rubinson 2010, pp.136-137).

Gender, age and nationality were included in the questionnaire to evaluate participants’ perspective related to telemedicine and their tendency. Age was categorized as below 20, in 20s (ranged from 20-29) and last category was above 60. Nationality was categorized as local and non-local to identify the demand of telemedicine between these two groups regardless of their exact nationality. Also, for non-local, it is possible that they are not residents in the UAE rather are visitors, so will have different perspective for needing telemedicine.

Position was required to provide as the targeted population for this study were physicians and patients who are the key players for telemedicine. So, different categories were listed for position: physicians, employee in public sector, employee in private sector and customers (e.g. patients). It is truth that physicians and patients could be as well employees in public or private sector, yet, the aim was to distinguish these two players and conduct evaluation specifically related to these two groups. Contact details were to be provided for completing missing data and to distinguish participants.

The questionnaire was structured as the following:

- First page (Cover Page) as an introduction that explain the topic under study and aim of it as well as confidentiality statement.
- Page two to three included questions and answers. The questions were mainly related to telemedicine benefits, demand level for telemedicine, reasons and possible consequences of this technology.
- Page 4 was for further comments and ending the questionnaire along with the researcher’s contact details for any enquires related to the study.

Analysis

Results

Evaluation of Study Participants

The study covered telemedicine technology that is targeted to be implemented in the UAE by the Federal Healthcare Organization. Currently, this technology is in the study phase. Based on that, a cross-sectional study was conducted to evaluate the demand of telemedicine in the UAE along with reasons for it and possible consequences that may arise.
Study subjects were selected randomly from the population. Since it would be difficult to cover all facilities under the Federal Healthcare Organization, the Headquarter was selected as the setting for the study. The reasons beside difficulty in covering the entire population were that the Headquarter is a central organization that deals with various type of individuals with different goals, such as: healthcare providers, patients, investors...etc. Also, major decisions are taken by those in the Headquarter, so it would be more practical to collect the required information.

To maintain ethical aspects of scientific research, no real identifications were disclosed. Participants were not obligated to provide their names and to identify them; numeric identifications were given.

The below results were obtained from this study by distributing a questionnaire. Statistical Packages for the Social Sciences (SPSS) was used to analyze results obtained.

In this study, several demographic attributes were included, such as: age, gender and nationality (local and non-local). Those attributes were as well considered to evaluate the correlation with other aspects. For instance, age and utilizing telemedicine. The total number of participants in this study was 45. The below tables (1) summarize the data obtained related to age, gender, nationality and position.

<table>
<thead>
<tr>
<th>N</th>
<th>Gender</th>
<th>Age</th>
<th>Nationality</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mean</td>
<td>33.33</td>
<td>.47</td>
<td>1.56</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Participants’ demographic data.
Figure (1) depicts percentage of participants’ gender involved in the study. More than half of the participants were males.

Figure (2) depicts percentage of participants’ involved in the study based on age. Majority of the participants were in their 30s, which ranges from 30-39 years and in 40s. None of the participants were under 20. This could be due to the fact that in the UAE most of individuals who are below 20 accompanied by their guardian when it comes to visiting healthcare organizations either to receive medical care or for other purposes.
Figure (3) depicts percentage of participants’ involved in the study based on their nationality. This was categorized as local and non-local. More than the half was local. The reason could be that the organization under study is a government property.

Figure (4) depicts percentage of participants’ involved in the study based on their position. This was categorized as physician, employee in a public sector, employee in a private sector and customer (e.g. patient). Although, someone would argue that a physician might be as well an employee in a public or private sector. Also, a patient might be an employee in a public or private sector or a physician.
However, the purpose of this study was to cover and distinguish two main players in telemedicine, which are physicians and patients. As indicated in figure (3), majority of the participants were customers (e.g. patients) and physicians, 29% and 27%, respectively.

**Correlation between Variables**

When a relationship between variables is measured, it is known as correlation analysis. The result obtained is known as correlation coefficient (Achelis 2015):

- Correlation coefficient = 1.0 means that the change in one variable results in change on the second variable, at the same direction.
- Correlation coefficient = -1.0 means that the change in one variable results in change on the second variable, but in the opposite direction.
- Correlation coefficient = zero means no relationship between variables.
- Correlation coefficient less than ± 0.10 means not significant or non-existent relationship.

The below tables (2-4) depicts the statistical analysis for telemedicine as a known concept based on the relationship with other variables.

<table>
<thead>
<tr>
<th>Response</th>
<th>Valid Frequency</th>
<th>Percentage %</th>
<th>Valid Percentage %</th>
<th>Cumulative Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>5</td>
<td>11.1</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Agree</td>
<td>14</td>
<td>31.1</td>
<td>31.1</td>
<td>42.2</td>
</tr>
<tr>
<td>Neutral</td>
<td>14</td>
<td>31.1</td>
<td>31.1</td>
<td>73.3</td>
</tr>
<tr>
<td>Disagree</td>
<td>10</td>
<td>22.2</td>
<td>22.2</td>
<td>95.6</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>2</td>
<td>4.4</td>
<td>4.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Frequency on telemedicine as known concept.
Table 3: Relationship between age and telemedicine concept.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>33.33</td>
<td>9.045</td>
<td>45</td>
</tr>
<tr>
<td>Known Concept</td>
<td>1.78</td>
<td>1.064</td>
<td>45</td>
</tr>
</tbody>
</table>

Table 4: Relationship between position and telemedicine concept.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>1.56</td>
<td>1.179</td>
<td>45</td>
</tr>
<tr>
<td>Known Concept</td>
<td>1.78</td>
<td>1.064</td>
<td>45</td>
</tr>
</tbody>
</table>

The below tables (5-7) depicts the statistical analysis for utilizing telemedicine personally by the participants based on the relationship with other variables.

Table 5: Relationship between age and utilizing telemedicine.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>33.33</td>
<td>9.045</td>
<td>45</td>
</tr>
<tr>
<td>Personally Utilizing</td>
<td>1.29</td>
<td>.695</td>
<td>45</td>
</tr>
</tbody>
</table>

Table 6: Relationship between nationality and utilizing telemedicine.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nationality (Local and non-local)</td>
<td>.47</td>
<td>.505</td>
<td>45</td>
</tr>
<tr>
<td>Personally Utilizing</td>
<td>1.29</td>
<td>.695</td>
<td>45</td>
</tr>
</tbody>
</table>

Table 7: Relationship between position and utilizing telemedicine.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>1.56</td>
<td>1.179</td>
<td>45</td>
</tr>
<tr>
<td>Personally Utilizing</td>
<td>1.29</td>
<td>.695</td>
<td>45</td>
</tr>
</tbody>
</table>
The below table (8) illustrates correlation coefficient between different variables.

<table>
<thead>
<tr>
<th>Correlation</th>
<th>Correlation Coefficient</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age and telemedicine as known concept</td>
<td>-0.087</td>
<td>No significant relationship between position and personal utilizing of telemedicine.</td>
</tr>
<tr>
<td>Position and telemedicine as known concept</td>
<td>0.45</td>
<td>No significant relationship between position and personal utilizing of telemedicine.</td>
</tr>
<tr>
<td>Age and personally utilizing telemedicine</td>
<td>-0.16</td>
<td>No significant relationship between position and personal utilizing of telemedicine.</td>
</tr>
<tr>
<td>Nationality and personally utilizing telemedicine</td>
<td>-0.13</td>
<td>No significant relationship between position and personal utilizing of telemedicine.</td>
</tr>
<tr>
<td>Position and personally utilizing telemedicine</td>
<td>-0.034</td>
<td>No significant relationship between position and personal utilizing of telemedicine.</td>
</tr>
</tbody>
</table>

Table 8: Correlation results.

The below table (9) illustrates the need to involve telemedicine users in the related activities, such as: requirement gathering and implementation strategy.

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percentage</th>
<th>Valid Percentage</th>
<th>Cumulative Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>15</td>
<td>33.3</td>
<td>33.3</td>
<td>33.3</td>
</tr>
</tbody>
</table>
Table 9: User’s involvement in telemedicine activities.

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Valid Percentage %</th>
<th>Cumulative Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>23</td>
<td>51.1</td>
<td>51.1</td>
</tr>
<tr>
<td>Agree</td>
<td>17</td>
<td>37.8</td>
<td>88.9</td>
</tr>
<tr>
<td>Neutral</td>
<td>5</td>
<td>11.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 10: Telemedicine requires training.

The below figure (5) depicts the reason for demanding telemedicine. Participants had the option to select more than one response. As noticed, the need for telemedicine to serve rural areas was selected by the majority of the participants. Other reasons were identified, such as: cover shortage of specialized physicians and patients’ care management.
The below figure (6) depicts possible consequences that may arise from telemedicine technology. The participants had the option to select more than one response. As noticed, none of the participants selected that telemedicine has no consequences. The majority selected confidentiality as a consequence for telemedicine. Other consequences were identified, such as: time consumption to be familiar with this technology and lack of knowledge about telemedicine.
The below figure (7) illustrates the extent that telemedicine would improve healthcare services in the UAE. Most of the participants agreed that telemedicine would lead to minor improvement on healthcare services. Few of the participants stated good improvement.

Figure 7: Telemedicine improves healthcare services.

1.1 Hypothesis Testing

1.1.1 There is a Demand for Telemedicine in the UAE

SPSS was used to analyze the collected data and evaluate the stated hypothesis.

- Null hypothesis ($H_0$): there is a demand for telemedicine in the UAE Federal Healthcare Organization.

The below table (11) depicts the demand for telemedicine in the UAE Federal Healthcare Organization, while table (12) depicts the results obtained of testing the stated hypothesis.

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percentage %</th>
<th>Valid Percentage %</th>
<th>Cumulative Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>No need</td>
<td>9</td>
<td>20.0</td>
<td>20.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Low</td>
<td>9</td>
<td>20.0</td>
<td>20.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Average</td>
<td>18</td>
<td>40.0</td>
<td>40.0</td>
<td>80.0</td>
</tr>
<tr>
<td>High</td>
<td>9</td>
<td>20.0</td>
<td>20.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>100.0</td>
<td></td>
<td>100.0</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td>1.60</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td></td>
<td></td>
<td></td>
<td>1.03</td>
</tr>
</tbody>
</table>
Table 11: Demand for Telemedicine.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
<th>Std. Deviation</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand of Telemedicine in the UAE</td>
<td>10.08</td>
<td>44</td>
<td>.00</td>
<td>1.60</td>
<td>1.03</td>
<td>Lower</td>
</tr>
<tr>
<td>P-value</td>
<td>0.00001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 12: Hypothesis testing.

P-value was applied to support the stated null hypothesis. Generally, null hypothesis (H₀) is related to chance when testing H₀. This means that there is a chance of wrong conclusion. Two types of errors are there:

- Type 1 error, which occurs when H₀ is rejected despite of being true and this is known as false positive. The acceptable level is alpha α=0.05 and 0.01. It means that type 1 error is acceptable up to 5%.
- Type 2 error, which occurs when H₀ is rejected while it is false and known as false negative. For acceptable level, Beta (β) is used.

In this study, p-value as [p ≤ α] was applied to test the null hypothesis (H₀). Based on the study’s results, the p-value = 0.00001 is smaller than 0.05. This means there is statistical significance at the level of 5% and the null hypothesis (H₀) is rejected.

Discussion

Response Level

There are several factors that might impact participation in a study, such as: clear study’s objectives, data collection methodology to be easy and straight-forward, time and location to collect the required data. For instance, reaching study subject instead of waiting for them to come and select the appropriate time, not while they are busy.

All of the participants completed the administered questionnaire. Although some would argue that the number of participants is small = 45, however, when data saturating is met, the number of participants would not be considered as a quality indicator for a research.

Data saturation is met when the responses are becoming repetitive in somehow and no new inputs are added (O’Reilly & Parker 2012; Walker 2012, cited in Fusch & Ness 2015). In this study, data saturation was met as what noticed during data entry in the SPSS, participants started to replicate responses and no new inputs were added.

Here, this point was reached and results started to replicate itself. So by this, it was possible to say that the study sample size represented the population. Also, there was no minimum or maximum number of participants required for responses as saturation point was applied as a criterion (Fusch & Ness 2015).
Data Validation

Although the study reached its saturation point and replicated itself, it can not be said that the study is accurate 100% for several reasons. For instance, data collection methodology was a questionnaire. This type of data collection does not allow evaluating the truth thoughts and inputs for participants. Also, the study covered only the Federal Healthcare Organization. In the UAE, there are other local healthcare authorities, such as: Abu Dhabi and Dubai Healthcare Authorities as well as private sector. These public and private organizations need to be incorporated in such study.

There are internal and external data validations. Internal validation is related to the study’s structure and the way it is done, while external validation is related to generalizing the results obtained. In this study a hypothesis was generated and tested statistically as per the null hypothesis for accepting or rejecting it. In addition, for external validation, the results are reliable and can be used to make decisions due to several reasons. For instance, the participants were from different backgrounds, nationality and gender. Also, different statistical tests, such as: $p$-value and correlations were used to analyze and interpret results obtained. Furthermore, participation was voluntary and individuals had the same chance of being selected. Another reason, all questionnaires were checked for completion during the data collection phase.

Telemedicine Challenges

Security is an important aspect in telemedicine because this technology deals with different dimensions, such as: patients and healthcare professionals. Also, various attributes involved in telemedicine that to be secured, for example, patients’ health information. A study was conducted by Hossain, Zishan and Ahasan (2014) about telemedicine security issues. It was stated that in telemedicine, it is important to address security, which is not related only to privacy. Confidentiality is part of security. If a system is not secure, the information can be easily obtained by unauthorized individuals, so privacy is breached. In telemedicine, security with its dimensions are critical factors. In case the technology was breached, patients’ data can be easily accessed or misused by attackers. Also, network and connectivity challenges. For instance, network in rural areas would be different and might be difficult compared to urban areas.

In order to maintain security and privacy as well as overcoming other barriers, there are some possible solutions:
- Data cryptography, which means hiding original data in a sequential meaningless scrambled code when it is transmitted. This allows encrypting data and protecting it (Yan and Dittmann 2014).
- Access control measurements.
- Authentication, which can be done by verifying valid users in the network and avoid impersonation (Yan and Dittmann 2014).
- Increase user awareness of not sharing access credentials with others and what possible issues might occur.
- Unclear regulations and policies related to the use of telemedicine is another problem that needs to be overcome (Gurkan 2009, cited in Atac, Kurt & Yurfakul 2013). In Sochacki, A. and Sochacki, M. (2015), this was raised as well. There is an urgent demand on constituting regulations and policies that direct the use of such technology.
- In some cases, having scattered servers than central might minimize the consequences of security attacks.
- Security risk assessment to be designed and in place that address different aspects, such as: asset to be protected, exposure assessment, threat, control identification and feasibility assessment (The British University in Dubai (Buid) 2014).

Here, for telemedicine technology, the below table (13) depicts an example for asset analysis:

<table>
<thead>
<tr>
<th>Asset (system or service asset)</th>
<th>- A patient’s health information. The addressed telemedicine would be integrated with the existed health information system.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value (asset’s value: low, medium, high)</td>
<td>- Medium</td>
</tr>
<tr>
<td>Exposure (potential losses)</td>
<td>- Possibility to loss clinical information, reputation, privacy and confidentiality.</td>
</tr>
<tr>
<td>- Users will not utilize telemedicine.</td>
<td></td>
</tr>
<tr>
<td>Threat (possible treats to the asset)</td>
<td>- Impersonating telemedicine users.</td>
</tr>
<tr>
<td>- Impersonating telemedicine mangers.</td>
<td></td>
</tr>
<tr>
<td>Probability</td>
<td>- Medium</td>
</tr>
<tr>
<td>Control (mechanism to protect an asset)</td>
<td>- Creating usernames and password that consists of upper/lower letters and numbers.</td>
</tr>
<tr>
<td>- Data cryptography.</td>
<td></td>
</tr>
<tr>
<td>Feasibility</td>
<td>- Low costs.</td>
</tr>
</tbody>
</table>
- User’s resistance to change access credentials from a while to while.

Security requirement definition (on application or infrastructure level)
- Patients’ information to be encrypted.
- Patients’ information to be uploaded to servers immediately after the session is over and deleted from users’ computers.

Table 13: Asset analysis.

**General Discussion**

The study aimed to cover the demand for telemedicine in the UAE Federal Healthcare Organization as well as reasons for this technology. Also, it covered the possible consequences, such as: security and effectiveness that may occur.

Mixed study design was applied here. Descriptive study to state the overall demand for telemedicine and generate the stated hypothesis, while analytical study design to test the generated hypothesis.

A questionnaire was administered to collect the required data. The following aspects were covered:

- Knowledge about Telemedicine as a known concept.
- Easiness to use telemedicine.
- Improving patients’ care and healthcare services.
- Reducing costs.
- Telemedicine would reduce costs related to healthcare services provided.
- Users’ involvement.
- Trainings for users.
- Reasons and consequences.
- Demand level for telemedicine in the UAE.

The reasons listed in this study with possible consequences that may arise from telemedicine technology were also identified in other research. Al-Qirim (2007), Sochacki, A. & Sochacki, C. (2015) as well as Atac, Kurt and Yurfakul (2013) stated that telemedicine would reduce costs and provide care for rural areas, which what was found in this study. As indicated in the [Result Section], providing care in rural areas was selected the most.

On the other hand, for the consequences listed here, such as: security and liability were also the concerns of other researchers (Atac, Kurt & Yurfakul 2013, Sochacki, A. & Sochacki, C. 2015 & Al-Qirim 2007). However, here confidentiality as a possible consequence was selected by the majority of the participants. Confidentiality, privacy, integrity are all interrelated and can be part of security. For instance, if telemedicine security was attacked, there is possibility to breach patients’ privacy, information integrity and availability of the technology.
**Study Limitations**

Although the study covered mainly physicians and patients who are the key players in the telemedicine, other players need to be involved, such as: information technology specialists for evaluating telemedicine in terms of technical aspects.

Also, due to time-frame constraint, other data collection methodology was not used. Only questionnaire was administered.

**Future Work and Recommendations**

Telemedicine is a complex technology that involves wide range of components and applications. This means that there is a need for further researches before implementing it. Although telemedicine has many benefits, such as: for medical tourism, which the country is aiming to achieve as indicated in (Sochacki, A. & Sochacki, M. 2015), this does not underestimate the need to evaluate and investigate this technology comprehensively. UAE is not a large country in terms of size and population compared to other countries that implemented telemedicine, such as: US. So, it would be easier to conduct trials and further investigations before any actual implementation took place.

In order to improve telemedicine in later stages, benchmarking with other healthcare authorities in the country and overseas, while maintaining rights, privacy, security, confidentiality as well as ethical and legal standards is a worthy strategy.

A collaboration to take place on national level involving local authorities: Abu Dhabi and Dubai Healthcare Authorities along with private sector.

**Ethical Consideration**

To maintain the ethical aspects of scientific research, participation in this study was voluntary and no real identifications were disclosed. Participants were not obligated to provide their names and to identify them; numeric identifications were given to each participant.

**Conclusion**

In conclusion, telemedicine is a complex technology that requires in-depth evaluation and cross-match with previous implemented technology to identify possible risks and consequences.

This study outlined the demand of telemedicine in the UAE Federal Healthcare Organization, which can be then expanded to evaluate the need for such technology in the Arab Region and later for connecting with other countries in different continents.
From such views, it is possible to say that the demands for telemedicine is not high and as stated by Al-Qirim (2007 page 552), adopting telemedicine on national level can be achieved by identifying successful initiatives in the field. Almost after 8 years of Al-Qirim’s study (2007) and possibility to adopt telemedicine on national-level, the UAE Federal Healthcare Organization is aiming to achieve such complex initiative.

UAE government’s support is obvious and tremendous to all, healthcare is gaining the attention of decision-makers and a lot of resources are given to improve the quality of services provided and enhance healthcare outcomes with utilizing latest technologies.

Currently the UAE Federal Healthcare Organization is addressing to implement telemedicine, particularly that this organization covers the majority of the public healthcare facilities in the country. There is a strategic view to connect with other governmental healthcare authorities in the country under one umbrella; at later stages. Once this accomplished, connecting with private sector is also possible.

Such innovative and complex technology could place UAE as one of the leading healthcare destinations, which is a possible factor to achieve other futuristic goals, such as: medical tourism.

References


Electronic National Unified Medical Records and Application of Telemedicine

*Shaikha Abdool, PhD in Computer Science student*
*The British University in Dubai*

**Abstract**
Implementing an electronic national level unified medical record across United Arab Emirates (UAE) could be a futuristic strategic goal to achieve. However, such innovative huge goal could be challenging and require proper evaluation as it will cover not only technical aspects, but as well other dimensions, such as: society, economy implications and legality. Such technology would definitely play a significant role in delivering other qualitative services, such as: telemedicine, where remote care can be provided as healthcare providers would be able to access and store medical records centrally. Such strategic goal would require time (years) to achieve it as desired. This would allow furthering on long term to connect with other abroad healthcare agencies. As a result, this visionary paper discuss the current practice of healthcare in the UAE and state-of-art of the initiative as well as possible challenges and visionary ideas to overcome these challenges that might be faced in 2025. This would be useful for decision makers and the market about UAE-National Unified Medical Record (UAE-NUMR). Systematics search of previous published literatures and governmental reports to fulfil the aim of this paper were followed. In addition, qualitative measurements would be taken for several reasons, such as: suitability for the study’s purpose, however, iterative design might be done to fit with what is learned. Data collections were based on research papers, governmental reports and other online documents available in the Internet.

**Introduction**
Technology is becoming inevitable in the daily life of human beings. Comparing technologies many years ago to the current time, there is evident change. So, what it would be the life at the future, let’s to say in 2025? What innovative technologies will be embedded? Yet this does not mean the life would be easier, as more technology usage, means more possible challenges that can be problematic, which needs strategies and solutions to overcome it.

Internet of Things (IOT) could be known in some areas time ago, however, majority of people do not have enough knowledge about it and the application of IoT. By this, it can be defined as interconnecting embedded computing devices in objects through Internet to exchange data, grasp aspects by transferring data and act based on it. In IoT, information would be generated, communicated and consumed through different relationships, such as: machines –to-machines (Duncan 2014 & Oxforddictionaries n.d.). In healthcare, IoT can allow interoperability of multisystem distributed that is known as system of systems (SOs) to exchange data and make it available in real-time for decision-making, such as between two physicians; one from a public hospital and one from a private hospital. This is can be applied in the UAE as currently the connection is missing (Kramer 2015).
To process complex and large sets of data, such in healthcare that involves multi-dimensional data, for example: patients’ information, medical inventory, disease registry...etc., a technology that can absorb,
process and compute these data need to be considered in order to have available data all the time to take decisions, increase efficiency and quality.

With the challenging facing healthcare field, the demand for solutions to ingest the pressures is increasing as well. For instance, rapid population growth, new diseases outbreaks and difficulty in delivering healthcare to as much as possible of humans, which requires quick access to medical records. The last challenge is the concern for most organizations as there are many public and private healthcare facilities that need to be interconnected and within standards that guide interoperability of electronic national unified medical records.

Having electronic unified medical records on national level would require huge efforts from individuals and organizations, such as: healthcare providers, technologists, regulators, software engineers...etc. Each would be required to be part in various phases of requirements definition, designing, coding, testing...etc. (Schrenker 2006 & Bhartiya & Mehrotra 2014).

Since electronic UAE NUMR would involve different agencies as depicted below (Figure 1:UAE NUMR key stakeholders), interoperability between them as well as between various applications, systems, devices...etc., has to be well structured to ensure reaching the targeted goal.

The aim of this paper is to look into possible directions and challenges faced by the healthcare community and the software reengineering community which will need to start in order to be relevant tomorrow. This paper emphasis on long term challenges in healthcare and the role of software engineering in the field and what possible ideas are to tackle these challenges.

The justification of this paper is to have proper research to evaluate the state of art of having electronic UAE NUMR and support the idea and to seek for a proper reporting case studied, experienced reports, practices, approached, techniques, and guidelines. The idea of UAE NUMR is a state of art initiative that requires to be well evaluated.

**Research Questions**

The state of art and state of practice of software engineering in 2025 in healthcare field.
Possible challenges of the proposed UAE NUMR.
Possible solutions to overcome UAE NUMR’s challenges.

**Methodology**

Fulfil the objectives listed in this paper, qualitative measurements would be taken for several reasons, such as: suitability for the study purpose, iterative design might be done to fit with what is learned. To obtain further data from previous research papers, articles, governmental reports and other healthcare organizations, such as: World Health Organization (WHO) were used as data collection tools.
**Results and Discussion**

**The state of art and state of practice of software engineering in 2025 in healthcare field.**

**State-of-Practice**

The United Arab Emirates consists of seven emirates that are scattered geographically. Each emirate has different urban and rural areas with different population distribution. According to WHO, the number of the population in the UAE is around 9,346,000 (WHO 2016) which is increasing promptly. Also, the number of healthcare facilities; private and public are increasing. This means different level of services required to meet the demands with maintaining quality of life. One of the demands that is under continuous pressure and requires a significant efforts and resources is healthcare. So, to reach the ultimate goals in healthcare, unified healthcare services across the country need to be provided. In healthcare, the main component that all stakeholders rely on to take decisions is availability of data 24/7, which can be pulled from having electronic national unified medical record. About 90% of deaths in the UAE is due to chronic disease and injuries induced by lifestyle (Delliote 2011, cited in MOH n.d.). Those diseases range from cardiovascular diseases, diabetes mellitus to obesity, which the third one occurs in adults and children and it is growing further. UAE’s expenditure on patients seeking medical treatment abroad is about $2 billion annually (MOH n.d.). In addition, the obstacles in healthcare that can be anticipated in 2025 based on current status, such as: shortage in healthcare funding, unavailability of new technology that supports healthcare revolution, heterogeneous healthcare systems in the UAE; public and private with no integration between them and central repository to depend on while determining health programs. Furthermore, absence of federal law for health information exchange among authorities and providers as well as undefined standards across the country regarding sharing patient data (Batra, Sachdeva & Mukherjee 2015).

**State-of-Art**

United Arab Emirates Unified Medical Records (UAE-NUMR) and application of Telemedicine as part of this state-of-art initiative.

**Why UAE-NUMR would be different?**

Improving mobility thus avoiding redundancy. Also, enabling physicians to timely access accurate and up-to-date patients’ information thus avoiding or minimizing malpractices, errors, costs and other challenges that the current healthcare system in the UAE is facing. Furthermore, sharing knowledge and experiences between healthcare professionals which will improve care coordination and reduce costs of seeking medical care abroad and repetitive examinations (Bharitya & Mehrota 2014). Having electronic NUMR will play a core role in implementing telemedicine across hospitals in the country and abroad.
Possible risks of not implementing UAE-NUMR

- Waste time and financial resources for both patients and healthcare providers, for instance, patients to receive medical care.
- Pressures on healthcare facilities of non-emergency cases.
- Lack of access to historical patients’ medical data with heterogeneous healthcare systems.
- Redundancy of tests, examinations, etc.

Figure (1) depicts key stakeholders of UAE-NUMR. These are the main stakeholders who shall be involved. However, there are other stakeholders who might add value. For instance, Ministry of finance for billing transactions, Ministry of Interior for police cases brought to healthcare facilities and National Ambulance Company, which is part of Ministry of Interior. National Emergency Crisis and Disasters Management Authority, which is part of National Security Council. In addition, since UAE-NUMR would help to implement telemedicine technology easily and with less constrains, Telecommunication Regulatory Authority need to be involved for networking and communications as well as providing standards and protocols.

Although, there are many models; such as: cloud, push (centralized), pull (decentralized), Service-Oriented Architecture (SOA), etc., each one of them has its own benefits and drawbacks, for instance, open systems has limitation of memory problem that is related to inability to deal with large terminologies (Bhartiya & Mehrotra 2014), so, proper re-evaluating of the situation at that time is critical as healthcare domain is a dynamic inevitable environment that would require changes from time-to-time.
Ministry of Health: Federal healthcare entity in the UAE act as well as a legislative authority for healthcare (private and public).

Healthcare Professionals (e.g. physicians)

Private Healthcare Sector

Emirates Identity Authority (EIDA)

Health Authority- Abu Dhabi (HAAD)

Dubai Health Authority (DHA)

Zayed Military Hospital (Ministry of Defence’s entity)

Insurance

Patients

UAE-NUMR

Figure 1: UAE-NUMR key stakeholders.
However, since the aim is to have such state-of-art technology, push model would suit better UAE-NUMR. The following table (1) depicts the aspects of push model to have electronic NUMR (Batra, Sachdeva & Mukherjee 2015):

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient medical records</td>
<td>Preserving patient medical records in a central repository.</td>
</tr>
<tr>
<td>Sharing medical records</td>
<td>During each encounter; a patient’s medical record should be sent to UAE-NUMR.</td>
</tr>
<tr>
<td>Query response time</td>
<td>Because the patient’s medical record would be stored in a central repository, the response time would be low.</td>
</tr>
<tr>
<td>Provider security concerns</td>
<td>Healthcare professionals will only send relevant data to NUMR during the medical events over a well secured interface. So, low concerns.</td>
</tr>
<tr>
<td>Infrastructure and storage</td>
<td>Would require large storage and high end infrastructure to manage large and diverse volumes of data.</td>
</tr>
<tr>
<td>Operation costs</td>
<td>Such complex technology would be very costly to ensure availability of reliable data and maintaining it.</td>
</tr>
<tr>
<td></td>
<td>▪ Generating more accurate statistics on national level.</td>
</tr>
<tr>
<td></td>
<td>▪ Conducting nationwide medical research by providing consolidated data, this can be used later for conducting research beyond the country’s level.</td>
</tr>
<tr>
<td></td>
<td>▪ For disaster and crisis management.</td>
</tr>
<tr>
<td></td>
<td>▪ Also, facilitate application of telemedicine as by having electronic NUMR, the same telemedicine would be used and accessed by healthcare professionals whether in public or private sector. Also, patients from different healthcare facilities would be able to benefit from telemedicine as their medical records can be accessed by authorized healthcare professionals (public and private).</td>
</tr>
<tr>
<td></td>
<td>▪ Sharing revenues between organizations.</td>
</tr>
</tbody>
</table>

Table 1: Push model aspects for UAE-NUMR.
The below figure (2) depicts push model in which medical records will be stored in a central repository that can be accessed by authorized personnel from different healthcare organizations (public and private).

The next figure (3) illustrates an example of how public and private hospitals would be linked to a central repository.

This would facilitate accessing data via a central channel. The motivations behind this model would be that it allows integrating as it grows, share with multiple entities whether private or public and developing nationwide registries, such as: cancer registry that can be later integrated with international registries and would be easier to standardize process and procedures.

Figure 2: Push model; Adapted from MOH n.d.
To have unified medical records, the below dataset (2) can be used for UAE-NUMR. However, this would be changed according to the organizations’ requirements.

### Table 2: UAE-NUMR dataset.

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic personal information</td>
<td>Name, date of birth (age, gender, nationality, National ID, contact details…etc.)</td>
</tr>
<tr>
<td>Triage and vital signs</td>
<td>Triage is used in emergency departments for classifying and prioritizing cases. Vital signs are recorded for every patient’s encounter. It includes, but not limited to: height, weight, oxygen level, blood pressure…etc.</td>
</tr>
<tr>
<td>Medical conditions</td>
<td>Diagnoses, medical complaints as well as history.</td>
</tr>
<tr>
<td>Healthcare providers</td>
<td>Previous and current providers.</td>
</tr>
<tr>
<td>Medical tests</td>
<td>Radiology, laboratory…etc.</td>
</tr>
<tr>
<td>Procedures</td>
<td>Minor and major operations.</td>
</tr>
<tr>
<td>Allergies</td>
<td>Any kind of allergy the patient might have, such as: food, medications, insects…etc.</td>
</tr>
<tr>
<td>Immunization</td>
<td>Any taken or to be taken immunization dosages.</td>
</tr>
<tr>
<td>Medications</td>
<td>Present medications and previous medications that were taken.</td>
</tr>
<tr>
<td>Insurance</td>
<td>To identify insurance company and plans.</td>
</tr>
<tr>
<td>Family history</td>
<td>To link a patient’s history with the family, particularly for genetic diseases.</td>
</tr>
</tbody>
</table>

Figure 3: How public and private hospitals would be linked to a central repository.
Possible challenges of the proposed UAE-NUMR and solutions

Recently, Emirate of Dubai has announced Unified Medical Records on local level that connect Dubai public and private healthcare facilities (Salama and Nabidh) (Webster 2016). However, since there will be unified medical records across the country, some consequences may occur as what happened to the Nation Health Services Patient Records Project in UK, where the project failed due to several reasons, which were not considered at that time. For instance, rushing toward contracts rather than focusing and thorough analysing of scope, deliverables...etc. Lessons can be learned from UK project that working out the scope, deliverables and implementation before trying to complete the contractual paper works. Contractors may not have the enough experience, knowledge and will be available for short period compared to those in the field who daily interact. Also, since there will be the same initiative on national level, what are the purpose of this local initiative? Another lesson to learn is that such decision should come from people who are in field rather than from those who make sense on political level (Maughan 2010). In addition, technical barriers may occur, such as: architectures’ integration between Dubai initiative and UAE-NUMR.

Unifying electronic medical records across the country is a large-scale and complex technology that would involve different organizations. Although, there are many benefits of the unification, yet there are some challenges that might hinder the implementation. The followings are possible challenges and strategies to overcome:

- Infrastructure readiness: a proper evaluation of infrastructures to take place. This involves but not limited to, networking, connectivity, electricity, hardware and software availability.
- Legislation, standardization, governance and collaboration:
  - Establishing governance committee that involves representatives from each organization. Federal Law tends to be the legal influence on health information exchange. So there is a need for federal law to enable health information exchange across healthcare providers and set regulations and standards for this exchange.
  - Begoyan (2007) provided an overview about international standards for electronic medical records, such as: ISO, HL7 and Digital Imaging and Communication in Medicine (DICOM), however, still there are some incompatibilities between them as indicated by Bhartiya and Mehrotra (2014). For instance, two versions in HL7 (HL7 Version 2 and HL7 Version 3) are messaging protocols and focus on requirements demanded by a healthcare organization in communicating data in or outside its systems, yet these two versions lack a well-defined mapping between these versions which results in incompatibility.
  - Defining UAE patients data safety policy (same as HIPAA: Health Insurance Portability and Accountability Act) for all healthcare organizations to follow the guidelines of information access, exchange and rectification.
- Security: processes to be defined considering the following:
  - Access controls.
  - Authorization and authentications: Which functions and type of data a user can have access to it.
Also, verification of users’ identity. Healthcare professionals’ medical licenses to be linked with their access to the system.

Audit: conduct regular audit activities and investigate any malicious activity. Create audit log controls (Bhartiya & Mehrota 2014).

Disaster recovery management.

Cryptographic, for instance, digital time-stamping which cannot be modified.

- Privacy: some would argue that privacy is part of security. However, privacy can also be a challenge when authorized users access data. For instance, consent forms between healthcare providers and patients to be in place.

- Human and capital resources: evaluation of capital and human resources is essential before deployment as there will be changes in professionals’ roles, responsibilities and might require additional resources.

- Technical complexity:
  - Integration between existing systems and software.
  - Requires significant amount of coding.
  - Writing codes for electronic UAE-NUMR and telemedicine to allow interoperability between different organizations and people.
  - Involves integration between different applications, software and systems, such as: healthcare systems and Emirates Identity Authority to link patients’ medical records with their National ID.
  - Also, different departments within healthcare organizations, such as: radiology would require more bandwidth to exchange and store various types of images (e.g. 3D images).

- Ownership: since various organizations would be involved, there are some aspects that need to be addressed, such as: Who would own the data? How the copyright is maintained when third party vendors are involved (Bhartiya & Mehrotra, 2014)?

- Expertise availability: there will be a need for specialized experts in data mining field.

- Users’ acceptance (e.g. patients and healthcare providers). Most of the services would be automated, however, there are different age groups, backgrounds, education level...etc., who might not have the opportunity to access and utilize these services (e.g. telemedicine) and would require extra effort to make them use it, which would involve high risks of misuse.

Piloting this initiative before rolling-out on national level would be a practical strategy to avoid consequences as what happened to UK Universal Credit Project that was launched a few years ago and was criticized for the same since it was in the pilot phase (Williams 2013).
Conclusion

Users’ involvement to establish future visions for advanced and reasonable technologies need to be considered before developments take place. Having harmonization between standards in exchanging medical records is critical for interoperability’s future in health informatics across different boards. Although international standards for of interoperability in healthcare exist, still these standards need to be re-adjusted from time-to-time as healthcare field embracing inevitable changes. Also, defining standards can be done, but implementation of interoperability is complex, particularly for sophisticated technologies, such as electronic NUMR and telemedicine.

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Industrial Wireless Sensor Networks for Wellhead Monitoring and Control Applications - A Case Study

Fuad Al Attar, PhD in Computer Science student
The British University in Dubai

Abstract

The recent advances in Cyber Physical Systems (CPSs), Wireless Sensor Networks (WSN) and the Internet of Things (IoT) have gained high attention in the industrial sector. During the last few years, the concept was tailored to fulfill the stringent requirements of the industrial market in the form of the fourth industrial revolution or “Industry 4.0”. Most of the Oil & Gas customers in UAE and other GCC countries are gradually adopting the concept of industrial WSN in their Smart Fields as they realized the advantages of WSN over the conventional wired sensors’ approach. The objective of this study is to evaluate the employment of different industrial WSN standards in the Oil & Gas wellhead monitoring and control applications from cost, Quality of Service (QoS), scalability, safety and security perspectives.

Index Terms— Industrial Wireless Sensor Networks, WirelessHART, ISA100.11a, WIA-PA, WISA, Zigbee PRO, QoS, Scalability, Security, Safety.

Introduction

Un-manned Oil and Gas wellheads usually utilize reliable equipment so that they can operate for long times without shutdown, otherwise major profit losses may occur. In order to increase the lifetime of wellhead equipment, it is necessary to carry out regular maintenance activities in a timely manner. However, such maintenance activities are not really easy for old wellheads which are only equipped with basic overflow pressure alarms. Furthermore, it is almost impossible to send employees to check every well in person, thus there was a need for implementing “smart” Oil and Gas fields, in which data are collected automatically from various sites, then stored and analyzed.

Many Oil & Gas companies are nowadays utilizing the Smart Field technologies in order to improve recovery and raise production by responding quickly to any problem. In order to achieve such production improvement, Smart Fields use advanced technologies to obtain detailed data of oil and gas fields in order to better understand the pressure, temperature and flow of their oil and gas production process. Smart sensors are installed for each type of wellhead to report the necessary process data. These sensors are often connected to an intelligent Programmable Logic Controller (PLC) or a Remote Terminal Unit (RTU) which sends and receives data from the centralized Supervisory Control and Data Acquisition (SCADA) system or the Distributed Control System (DCS).
The Wellhead RTU system allows different end-user’s assets to better understand reservoir behavior and assist them in establishing improved reservoir models. They are also utilized in some cases to operate the local choke valve of the wellhead and to report Fire & Gas incidents. The configuration of the RTU system and the selection of the measurement instruments depend on the type of wellheads and the goal that the end-user wants to achieve from the wellhead monitoring process.

Wellhead monitoring process is a common use case for WSN. Wellheads may utilize either temporary or permanent wireless sensors to collect data during certain periods of time in order to check performance or troubleshoot certain problems. Using wireless technologies makes it easy to relocate the wireless equipment to another wellhead whenever needed. Furthermore, it is possible to retrofit existing geographically distributed wellheads with wireless sensors, and to transmit their data to SCADA/DCS centers located hundreds or thousands of kilometers away. A maintenance personnel can be sent to site as needed to handle detected problems (Sereiko and Werb, 2014)

**Wellhead Types**

Oil production can be achieved by three main methods: Primary Recovery, Secondary Recovery and Tertiary Recovery, which is also known as Enhanced Oil Recovery (EOR). Primary oil recovery can be achieved when hydrocarbons naturally rise to the surface, or when artificial lift devices, such as pump jacks, are used. Secondary oil recovery uses water and gas injection, displacing the oil and pushing it to the surface. According to the US Department of Energy, utilizing the first two methods of production (primary and secondary) can leave up to 75% of the oil in the well. However, the tertiary recovery method or EOR increases oil production. EOR is a more expensive method to use on a field; however it can increase production from a well to up to 75% recovery (Jaafar, M. et al, 2014).

In primary production, oil is recovered naturally from a producing well, however the method Enhanced Oil Recovery (EOR) improves the amount of oil recovered from a well through applying certain engineering technique and introducing fluids that reduce oil thickness and improve flow. These fluids may consist of gases that form homogeneous mixtures when added with oil (typically carbon dioxide), steam, air or oxygen, polymer solutions, surfactant-polymer formulations, etc. For example, Injection of carbon dioxide (CO2) into oil reservoirs for enhanced oil recovery has recently gained good attention in the Middle East region, and some pilot projects have been executed to determine the full economic potential of this injection method.
With regard to water injection, it is used in both onshore and offshore oil fields, and it is carried out by drilling injector wells into an oil reservoir and injecting water into that reservoir to push oil production. The injected water increases the pressure within the reservoir and moves the oil in place. There are a number of methods for deciding where to drill the water-injection well, which are usually drilled purposely to carry out this task, however it also possible to convert an oil producing well into a water-injection well

To facilitate oil or gas production, wellhead equipment shall be installed, whether the application is surface wellheads on land, jackups or offshore production platforms, or subsea wellheads. Wellheads serve as the termination point of casing and tubing strings. They connect the oil tubing and casting pipe to and Oil & Gas pipeline; they control pressure and provide access to the main bore of the casing or tubing or to the annulus, which is the space between any tubing/casing and the tubing/casing immediately surrounding it (Speer, 2006).
Producing surface wells that require pumps frequently do not have pressure containment requirement, however such requirement is applicable for other types of oil wells, gas wells, water injection wells, gas injection wells, etc. To fulfill the pressure containment requirement, an assembly of valves, spools, and fittings shall be used for the wellhead; this assembly is often called a “Xmas Tree” as it somehow looks like a Christmas tree; see Figure (2).

In summary, Oil & Gas wells can be categorized into the follow main types:

i- Oil Producers

a. Gravity Oil Wells (or Naturally Flowing Wells): which rely on reservoir pressure to lift production to surface

b. Artificial Lift Wells: Artificial Lifting is used when well conditions are insufficient to lift reservoir fluids to the surface at the required rate. There are many types of artificial lift wells based on the used lifting technique. Aliyev (2013) listed the following main lifting technique:

• Sucker Rod (walking beam/hydraulic)
• Electrical Submersible Pump (ESP)
• Gas Lift (continuous and intermittent)
• Intermittent gas lift with plunger
• Gas lift with continuous slug injection
• Hydraulic Pump (jet/piston)
• Progressive Cavity Pump (PCP)
• Plunger Lift

ii- Gas Producers

iii- Water Injectors

iv- EOR Wells (CO2 Injectors, Steam Injectors, etc)

Wellhead Monitoring

Due to applying stringent regulations, increasing energy demands worldwide, and decreasing oil reserves, Oil & Gas companies need to find ways to significantly enhance productivity and reduce costs. By utilizing Smart Oil and Gas Fields, the application of digital technology, combining in-field measurement devices, real-time data, simulation models, and advanced algorithms to maximize productivity by automating best practices (Lugo, 2014).
As the Smart Field concept has gained thrust within the oil and gas industry during the last few years, oil & gas operations are becoming more complex. However, most of end-users are now willing to live with this complexity after they observed the achieved benefits of enhanced quality and speed of decision making and execution. Such benefits are achieved by the access to real-time data and the use of analytical tools. The users of the Smart Fields technologies can monitor the performance of wells against the given targets in order to realize the discrepancy and report problems in a timely manner. As a result, production can be improved and downtimes can be significantly reduced.

To monitor an oil/gas field and to ensure equipment in remote site is functional, Oil & Gas companies shall first install field instruments/sensors and controllers. Installing these devices in pipes and wellheads allow companies to monitor, classify, quality check and filter data in the field. Moreover, companies can also control processes, taking into account all data received from the field in real-time (Lugo, 2014). In a Smart Field, the main measurement and control equipment are connected to a centralized system which is usually accessed by the operators, reservoir engineers, maintenance engineers, etc.

An automated flow control valve is usually installed for the wellhead in order to control the downstream (surface) pressure and production rate from the well. Pressure transmitters switches, temperature transmitter, flow transmitters, level transmitters switches and leak detectors are part of the measurement devices that can be used in a wellhead to measure the process variables of the production/injection process and to generate the necessary alarms/interlocks.

Figure (3): Some essential Oil & Gas smart fields’ sensors.
Adapted from (SOR INC, 2015)
For example, in Secondary and EOR Injection Wells, wellhead monitoring is necessary in order to check the ability of the reservoir to handle the injected material. Too high injection pressures may cause serious problems for the wellhead equipment and structure. Moreover, injecting above the fracture gradient of the reservoir will reduce the efficiency of injected materials and will increase the overhead cost of the production process. Therefore it is necessary to install level switches, level transmitters and pressure transmitters for monitoring the injection process.

Controlling the automated valve of a well remotely is also essential to maintain safety and integrity of that well. For example, it is necessary to shutdown the throttling valve located at the wellhead when sensing high line pressure through the pressure switch and/or transmitter.

The type of wellhead process measurement varies based on the type of the well and the used production method. Figure (4) shows a sample schematic diagram of measurement and control devices for a typical CO2 injection well.

![Figure (4): Schematic of a Typical CO2 Injection Process. Adapted from (Usher and Cerimele, 2012, P.117)](image)

**Remote Terminal Unit (RTU)**

For collecting data from site and receiving control instructions from the SCADA center, a RTU shall be installed at site for each wellhead, or each group of wellheads. Both Compact-type and Modular-type RTUs can be used.

Compacts RTU contain the power supply, CPU, digital and analog Input/Output (I/O) signal channels and communication ports. They usually come with different capacities in terms of I/O channels count, number/type of communication ports and functional capabilities. Using a compact RTU is very common for wellhead monitoring and control applications as the number of required I/O signals is very limited. Nevertheless a compact RTU usually consumes much lower power than a modular type, which makes it...
ideal for remote locations where power sources are expensive and very limited. Just to give an example of I/O requirements, I’ve developed the below Figure (5) to show the minimum RTU I/O requirements for a typical a CO2 Injection Wellhead application.

![Figure(5): A Typical CO2 Injection Wellhead RTU](image)

Some other wellhead applications require the employment of a Modular RTU which can be expanded to accept additional I/O channels, communication ports, etc. Furthermore, critical applications that require RTU redundancy shall use Modular RTU types as redundancy is not usually supported by compact RTUs.

**Wellhead RTU Requirements**

There are certain minimum requirements that shall be fulfilled by Oil & Gas Wellhead RTUs, specially these units which shall be installed in the harsh environment of the Gulf Cooperation Council (GCC) countries. The unavailability of regular power sources at many of the oil & gas wellhead locations, and the possible presence of flammable gases at some of these locations add extra challenges for the RTU manufacturers. As these RTUs are usually located at remote locations, they shall have very high Mean Time Between Failures (MTBF) so that they would not require routine maintenance.

During the last two decades, I’ve been personally working in many RTU projects for various Oil & Gas customers in this region. Each Oil & Gas company has its own specifications and requirements for its wellhead RTU systems. Most of the requirements follow good practices and raise the quality bar; however I often felt that some of the requirements of certain projects are either unnecessarily exaggerated or self-contradictory. For example, built-in radios are sometimes specified by customers
although fiber optic or WiMax networks are utilized for the project. They also specify the capability of carrying out some AGA (American Gas Association) flow calculations by the RTU even when there is no gas flow measurement in the project. Indeed, these additional features are good-to-have, but they unnecessarily increase the project’s cost and decrease the possible RTU options.

After I reviewed different customers’ specifications and participated in some value engineering workshops for Oil & Gas customers, I personally believe that the following minimum requirements are necessary and justified for wellhead RTUs in the GCC region:

- reliable operation at high temperature up to 70ºC
- very low power consumption (typically, compact RTU power consumption shall be less than 3 watts)
- accept both 12VDC and 24VDC power supply options.
- supports remote firmware upgrade
- supports data logging
- supports Report by Exception. i.e. it can initiate communication with master unit in case of certain events.
- supports remote diagnostics & troubleshooting
- supports remote configuration
- supports secured communication
- supports multiple industrial communication protocols for communication with 3rd party equipment (e.g. Modbus, IEC 60870-5-104, DNP3, etc).
- compact size.
- suitable for Zone 2 hazardous areas installation. This feature is required to ensure flexibility of installation work.
- integrated analog and digital I/O channels
- supports AGA gas flow calculations (only if the necessary measurement sensors are provided in the field)
- supports built-in radios (only if specific external communication modems/switches are not required)

The number of integrated I/O channels depends on the wellhead type. Table (1) shows the minimum I/O channels that shall be used for a wellhead RTU based on the handled process. These numbers may vary based on the actual installed measurement and control equipment.

It worth noting that Modbus communication protocol used to be the preferred RTU protocol for many endusers as it is supported by almost all vendors. However, I do not recommend using Modbus protocol for wellhead monitoring and control applications due to the following shortcomings:
It does not support time stamping of data values. This does not help in analyzing different data and events.

- It does not support Report by Exception feature; thus it cannot indicate a disturbance event. Master must always ask slave device for data, slave cannot initiate communications to master in case of certain events.

- It does not support sending buffered data.

- It is based on a fixed Poll-Response communication which increases the network’s traffic even in case of no new event. Master must always poll same data registers from each slave node.

- It does not satisfy basic security requirements.

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>DIGITAL INPUT</th>
<th>DIGITAL OUTPUT</th>
<th>ANALOG INPUT</th>
<th>ANALOG OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Injection Well</td>
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<td>0</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Oil Producer Well</td>
<td>2</td>
<td>0</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Gas Lift Well</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>PCP (Progressive Cavity Pump) Well</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ESP (Electrical Submersible Pump)</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>CO2 Injection Well</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>GBC (Gas Breakthrough controller) Well</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Gas Producer Well</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>

Table (1): Typical I/O count for a Wellhead RTU with conventional (wired) field instruments

**Power Requirements**

As most of the Oil & Gas wellheads are located in remote areas, providing the necessary electrical and hydraulic power can be a real challenge. In the GCC smart oil fields, solar power systems are the preferred power sources for wellhead monitoring and control systems.

Wellhead’s solar power system usually consists of three main components: (i) Solar panel, (ii) Charge regulator and (iii) Battery bank. The charge regulator protects the battery from being overcharged and eliminates reverse current from the batteries. Charge controller protects the solar system by disconnecting the batteries whenever there is high or low voltage. The battery bank stores the energy during the day for use at any time of day or night. The wellhead solar panels shall be designed to operate in harsh Offshore/Onshore GCC environment conditions.
Sensors & Actuators: Wired or Wireless?

Traditionally, wired sensors and actuators are used for digital oil & gas fields to send/receive data to/from the RTU system. Pressure transmitters, flow meter, temperature transducers and level meters are installed on the wellhead structure and piping to read the necessary process data. Typically, the analog/digital value of each sensor is separately transmitted through dedicated copper wires. The same is applicable for the controlled valve which is usually connected to the RTU analog and/or digital channels, depending on its control and measurement circuit.

This dedicated cabling work for field instruments makes the wiring work complicated and costly, especially when carrying out this installation work (excavation, cable trays, junction boxes, road crossings, labeling, wiring, etc) for hundreds of meters of cables at remote locations like most of the onshore and offshore wellheads.

In order to minimize the field wiring, the concept of fieldbus was introduced to the industrial market in the late 1980’s. With fieldbus, it is possible to connect together certain number of instruments and/or actuators to the industrial control system using a common cable. Many standards and protocols were developed by individual manufacturers and fieldbus organizations (e.g. AS-Interface, DeviceNet, Foundation Fieldbus, PROFIBUS PA, HART, etc). However, for wellhead monitoring applications, these fieldbuses are not very common as the number of field instruments is usually small. Thus there is much cost saving when replacing conventional signal wires by fieldbuses as most of the cost goes in the required installation materials and installation work (excavation, cable trays, etc).

I had been personally using and handling conventional wired instruments, wired fieldbus instruments and wireless instruments for various industrial applications, including wellhead monitoring and control. Many problems are common when using wired instruments; however wireless instruments are also not troublefree. Therefore it is always wise to study each case separately by evaluating the applicable advantages and disadvantages.

These are some of the common problems which conventional wired instruments may face:

- Complicated cable route (e.g. road crossing, concrete foundation, unreliable civil structure, etc)
- Expensive installation work due to long cable/cable-tray lengths, excavation, etc
- Weak digital/analog signal due to long cable route
- Interference due to using common trays for instrument cables and power cables.
Grounding problems (wrong grounding resistance, lose ground wiring, short-circuited ground wires, etc)

- Wrong input resistor
- Power supply problems (Overloaded power supply unit, short circuits, unstable voltage, etc)
- Corrosion of copper wires
- Interface due to improper cable shields
- Mechanical damage due to improper cable protection
- Moisture and/or Water/Oil in the conduit
- Wrong wire-labels
- Missing labels (Marshalling terminals, power terminals, I/O channels, etc)

In addition to most of the above-mentioned problems, the wired fieldbus instruments face some other issues such as:

- Wrong wire capacitance, which may cause sawtooth signal problems.
- Slow response time due to wrong network design, large number of nodes, etc

I prepared the below Figure (6) to demonstrate the necessary cabling for a typical oil producer wellhead monitoring and control RTU. Pressure transmitters monitor the upstream (tubing) pressure, downstream (surface) pressure and measure the Annulus (casing) pressure of the well. One temperature transmitter monitors the downstream temperature.

![Figure(6): Cabling for a Typical Oil Producer Wellhead RTU](image)

In order to resolve wiring and cabling issues, wireless instruments were introduced in the late 1980’s. However the industry was not ready to use wireless instruments during that period because of their high costs and bulky sizes. Fortunately the wireless sensor technology has genuinely been improved
during the last few years as the Cyber Physical Systems (CPSs) and Internet of Things (IoT) started. Nowadays, the sizes of the new wireless sensors are much smaller and their prices are very reasonable due to the advances in the electronics technologies. Compact wireless sensors with long battery life are part of the standard products of many manufacturers. As a result, many of the oil & gas companies decided to employ the WSN technologies in their wellhead monitoring and control applications. I prepared Figure (7) to demonstrate the reduction in required cabling for a typical oil producer wellhead monitoring and control RTU.

![Image](https://example.com/image)

**Figure(7): A typical Oil Producer Wellhead RTU with wireless instrumentation**

Having said that, I must also mention that - although wireless sensors/actuators do not face the above mentioned problems of wired instruments - they still have their own challenges to face, such as:

- Security attacks
- Data packets' loss due to weak radio signals
- Data packets' loss due to interference
- Weak transmission due to several radio signal reflection
- Unavailability of line of sight due to temporary or permanent physical obstruction (after system’s final handover to customer)
- Reliability for carrying safety-related control signals
- Ability of devices to be connected with other devices manufactured by different vendor
- Low data bandwidth
- Short battery life due to high data update rates

Competition between various industrial Wireless Sensor Networks (WSN) is on the level of addressing the above mentioned issues. Some of the WSN standards have already reached advance stage of solving these issues. Nevertheless some of the end-users are still willing to live with some of the unsolved WSN problems considering the great advantages of employing wireless sensors technology in their applications, such as:
- Exploitation of Micro-Electromechanical Systems (MEMS): MEMS devices integrated with computational power and communication capabilities offer a more robust design than attaching wires to small-sized devices (Paavola and Leiviska, 2010).
- Using wireless sensors for rotating and moving equipment,
- Reducing the safety risks by avoiding cable routes through dangerous areas - More endurance to lightning strikes.

Nechibvute and Mudzingwa (2013) listed some other benefits of WSN compared to wired sensor/actuator networks:

- Reduced Maintenance and Deployment Costs: Wireless sensor nodes eliminate cabling and trenching cost of deployment by up to 70%.

- High levels of Scalability and Flexibility: Additional wireless sensors/actuators can be installed at any location without running power supply and data communication cables. It may take you several days or weeks to install conventional wired devices, while you need a much shorter time to install wireless instruments.

- Improved Resource management in a control system: compared to most of wired fieldbus systems, WSN provides real-time measurement which makes it possible for the control system to dynamically control the process and monitor the process data in real-time.

- Improved Performance: Industrial WSNs allow high data transmission speed compared to most of the fieldbus wired systems. For example, the data rate of the wired HART (Highway Addressable Remote Transducer) protocol is 1.2 kbps, but the WirelessHart has a rate of 250 kbps. Moreover, it is possible for multiple wireless devices to act simultaneously, while this is not possible for most of the wired fieldbus devices.

Indeed, the most attracting benefit of WSN is the lower cost of installation and maintenance. Nowadays there is no dispute that installing wireless sensors provides significant cost saving for both Greenfield (i.e. new) and Brownfield (i.e. modifications) projects. The cost savings for Greenfield projects can be achieved due to many parameters, such as:

- Cancelled cost of power cables materials
- Cancelled cost of signal cables materials
- Cancelled cost of cable trays materials
- Cancelled cost of junction boxes materials
- Cancelled cost of conduits and pipes materials
- Cancelled cost of DC power supply, power distribution terminals, etc
- Cancelled cost of scaffolding materials for cabling work
- Cancelled cost of manpower for installing cables, junction boxes, cable ladders, etc
- Cancelled cost of preparation of wiring diagrams and loop drawings
- Cancelled cost of Analog/Digital Modules for the Industrial Control System.
- Cancelled cost of excavation work for cable routes
- Cancelled cost of road crossing work for cable route
- Cancelled cost of civil structure to carry cable trays.

In addition to all the above-mentioned cost savings, Brownfield projects can achieve the following through WSN:

- Cancelled cost of pulling new cables in the existing conduits, cable trays, etc
- Cancelled cost of carrying asset integrity study for modifying the existing structures
- Cancelled cost of making wall openings
- Cancelled cost of modifying the existing civil foundations
- Cancelled cost of modifying the existing marshalling and system panels
- Cancelled cost of modifying the hardware configuration of the Industrial Control System
- Cancelled cost of power supply adequacy studies
- Cancelled cost of additional power supply, modifications on the distribution panels, etc

Moreover, for offshore wellhead projects, another very important cost saving can be achieved by employing the WSN concept, that is the saving of structure’s cost due to the low weight of WSN installations. The cancelled weights of cables, stainless steel cable trays and stainless steel junction boxes will certainly reduce the overall weight of the offshore platform. This itself is a major saving as it reduces the cost of the platform’s structure.

**WSN Industrial Requirements**

In this section, we shall review the main features that shall be available in a wireless sensor/actuator so that it can be used in a wellhead monitoring and control application. Then we shall apply these requirements on the main industrial WSN standards:

- **IEEE 802.15.4 based standards:**
  - WirelessHART
  - ISA100.11a
  - WIA-PA
  - Zigbee PRO
IEEE 802.15.1 standards:
- WISA
- WSAN-FA

The main industrial prerequisites are related to the sensor itself and its battery, and their fitness for operation in harsh and hazardous environments. However, there are certain prerequisites that shall also be satisfied by the used WSN standard. These can be summarized as follows:

Quality of Service

“Process monitoring and control applications range from data sensing, measurement, record and diagnosis, to machine/equipment operation and emergency action. These operations are classified by the ISA100 committee into six different classes with increased priority” Zhao (2011, p.52). The below Table (2) lists all these six classes and gives a brief description for each class.

![Table (2): Different Classes of Applications as Defined by ISA](image)

These operations require certain Quality of Service (QoS) features that are not mandatory for normal computer networks, such as: “Real-time communications” and “High reliability”. For the real-time requirements, Christin, Mogre and Hollick (2010) specified the cyclic duration for different industrial automation applications as follows:

- Process automation data acquisition: greater than 10 ms
- Control machine tools: 1-10 msec
- Motion Control: 250 µsec to 1 msec
For the Low rate and high rate requirements, Nechibvute and Mudzingwa (2013) specified the range of update frequency for each type of industrial application as follows:

- **Monitoring and supervision:** 1-5 sec
- **Closed Loop Control:** 10-500 msec
- **Interlocking and Control:** 10-250 msec

With regard to “High Reliability”, it is required to minimize the packet loss in a WSN. Most of industrial applications need reliable transmission of each data packet in presence of radio interference (Nechibvute and Mudzingwa, 2013).

Wellhead monitoring and Control application can be given Class #3 based on the above mentioned ISA classification. Usually the shutdown and safety control of the valve are handled by the local shutdown panel and not by the RTU; this is the reason why lower ISA classes are not applicable. Nevertheless, in case of Emergency Shudown functionality is assigned to the RTU, then Class #0 requirements shall be applied, however none of the current IEEE 802.15.4 based standards can handle such critical class of control.

Christin, Mogre and Hollick (2010) concluded that “no officially released and open standard is currently able to fulfill the strong real-time requirements of the factory automation domain” (Christin, Mogre and Hollick, 2010, p.122). This conclusion was written in March, 2010, just few weeks before the announcement of WirelessHART as an international standard in April, 2010. Later, in 2014, ISA100.11a was also announced as international standard for Industrial Wireless Sensor Networks. Though both standards still do not satisfy the real-time requirements for some factory automation applications, they both provide acceptable real-time quality for the less-stringent industrial applications, like Process Automation (e.g. wellhead monitoring and control), ranging from Class #2 to Class #5 in the ISA table.

Zand, et al. (2012) indicated that ISA100.11a supports industrial applications from class 1 to 5, and that WirelessHART can support industrial applications from class 2 to 5. With regard to ZigBee Pro, it supports applications which require softer real-time.

WIA-PA and Zigbee PRO standards can also satisfy the required update frequency for a Wellhead Monitoring application; however, for Zigbee PRO, it has been concluded by Christin, Mogre and Hollick that “the frequency diversity proposed by the ZigBee standards is insufficient to fulfill the strong reliability requirements of industrial applications” (Christin, Mogre and Hollick, 2010, p.115). Nonetheless, WIA-PA (in the cluster/star level) is similar to the Zigbee PRO standard as it does not perform well when energy consumption is considered. WIA-PA (in the mesh level) shows a better energy performance as it utilizes the TSMP protocol to achieve low power and low bandwidth reliable communication (Zand, et al., 2012).
However, I do not recommend to utilize any of the IEEE 802.15.4 based standards (WirelessHART, ISA100.11a, WIA-PA and Zigbee PRO) for closed loop control of a wellhead. It might be argued that a high update rate of 250 msec by WirelessHART or ISA100.11a may satisfy the process control requirements of a wellhead, however applying the highest rates in a wellhead application is impractical as it will quickly consume the batteries’ energy. Therefore it is recommended to use these wireless standards only for monitoring the process variables and remotely operating the line valve of the wellhead. Moreover when the size of the wireless network increases, it is impractical to select the high update rate of 250 msec.

Practically, wireless sensor networks (WSNs) are currently being used in class 4–5 applications, in which low-power consumption is given priority over response time. These networks are not suitable for controlling high speed control loops as wireless sensors usually spend a large proportion of time in a low-power sleep state (Zand, et al., 2012).

The IEEE 802.15.1 Bluetooth-based standards, WISA and WSAN-FA are designed to provide update rates down to 10 ms, which much faster than any of the IEEE 802.15.4 based standards (Pimentel and Nickerso, 2013), and they can definitely satisfy the wellhead closed loop control requirements as they provide strict real-time guarantees. However they both consume high power, which makes them impractical for Process Automation and wellhead monitoring & control applications.

Moreover, given that WISA specification is proprietary (ABB), it puts the user into a single vendor situation. It is therefore concluded that WISA doesn’t support openness and interoperability (Christin, Mogre and Hollick, 2010).

Nechibvute and Mudzingwa (2013) specified the acceptable WSN battery life for different industrial applications as follows:

- Monitoring and supervision: 3 years
- Closed Loop Control: 5 years
- Interlocking and Control: 5 years

The battery life of a wireless sensor depends on its update rate. With the current market solutions, “a battery lifetime of 5-10 years can be achieved with update rates at 15 seconds or more. For the fastest applications with an update rate of 1 second, the battery lifetime is somewhere between 6 months to 1 year, depending on the manufacturer. The battery lifetime is also affected by ambient weather conditions, where low temperatures decreases battery capacity while higher temperatures increases the Capacity” (Petersen and Aakvaag, 2015, p.28). The battery for a wireless instrument shall be designed
so that it can be replaced at site. It shall also have the same hazardous area classification of the wireless instrument itself.

SAFETY

The main challenges for a safety application are the reliability and correctness of the communication network. Unlike control loops, rapid update is normally not the important factor. Safety applications need certain mechanisms to ensure that data packets arrive at the assigned destination within a defined timeout window. Most of safety systems require continuous monitoring of the relevant process signals. Safety instrumented systems (SIS) in the oil & gas industry shall comply with a certain Safety Integrity Levels (SIL) which are defined by the IEC 61508 standard. *There are four SIL levels (1-4), where SIL 4 is defined as the most dependable and SIL 1 as the least* (Petersen and Aakvaag, 2015).

Petersen and Aakvaag (2015) indicated that none of the wireless standard directly address the necessary Safety Integrity Level (SIL) certification. For example, due to the limitations in the current HART commands, it is currently impossible for WirelessHART to fully support SIL certified safety communication protocols, like PROFIsafe. However - although ISA100.11a standard does not directly support the necessary SIL certification - it is possible to achieve Safety Integrity Level No. 2 (SIL2) communication by carrying the PROFIsafe protocol over ISA100.11a wireless networks. This could be achieved because of the flexibility in the Application Layer of the ISA100.11a standard.

SECURITY

Gupta, Verma and Sangal (2013) detailed the main security requirements for a WSN. These can be summarized as follows:

- **Data confidentiality**: This ensures that all data messages remain confidential during the WSN communication process.
- **Data Integrity**: This ensures that all communicated data are protected from alteration.
- **Data Availability**: This ensures that data of the WSN are available whenever they are required by the application.
- **Data Authentication**: This ensures that the communication between nodes is authentic, which means that a fake node cannot be trusted in a WSN.
- **Data Freshness**: This ensures that no attacker can replay old messages within the WSN.
- **Self Organization**: This ensures that each node is self-organizing and self-healing.
- **Secure Management & Localization**: Secure management is required on base station level. Furthermore, sometimes it becomes necessary to locate each sensor node in a WSN in order to locate faults in the network.
• Time Synchronization: Any security mechanism for WSN shall be time-synchronized as most of the wireless sensor applications require time synchronization.

The following list is extracted from Petersen and Aakvaag (2015) to show various security issues that may affect a WSN:

- Accidental Association: Unintentional access to a WSN by a foreign device.
- Malicious Association: Access to a WSN by hackers.
- Identity Theft: Hacker which is able to pretend to be an authorized user by listening to credential traffic.
- Man-in-the-Middle Attacks: Hackers gaining access to a WSN with Malicious Association, and transparently monitor network traffic and/or provide false information and data to other network users.
- Denial of Service: A target device or gateway is flooded with bogus protocol messages.
- Network Injection: Accessing access points / gateways to introduce bogus network configuration commands.
- Byzantine Attack: Attack where an intruder reprograms sensors to send untrue readings to the control room.
- Radio Interference: Interference from other wireless networks operating in the same frequency bands.
- Noise: Negative influenced by industrial machines and equipment emitting electromagnetic radiation.
- Solar flares: They produce radiation across all wavelengths of the electromagnetic spectrum. They used to disturb radio communication and disable energy networks when targeting the Earth.

ZigBee PRO standard improved the security of the ZigBee 2006 version as it includes two new security modes: Standard Security mode and High Security mode. The later is more stringent and it is designed for industrial and critical applications, however its routing protocol needs to be improved as it does not include encryption in all parts of its key processes (Alcaraz and Lopez, 2013). Moreover, Zand, et al. (2012) indicated that the Zigbee PRO standard is not good enough for the industrial applications as it introduces high energy consumptions when applying the additional security features.

For WirelessHART, security is a mandatory feature. Alcaraz and Lopez (2013) explained that WirelessHART provides confidentiality at network-level and MAC-level. Nevertheless, Pimentel and Nickerson (2013) explained that WirelessHART provides an advantage over other protocols as it carries a proprietary protocol (HART), which is not based on widely known protocols. Accordingly, due to low availability of source codes and operational details of HART protocol, the WirelessHART could be more immune against attacks.
For ISA100.11a, Christin, Mogre and Hollick (2010) generally concluded that for ISA100.11a standard fulfills almost completely the identified security requirements as long as it operates in single-hop mode. Similar to WirelessHART standard, eavesdropping (unauthorized real-time interception) is almost impossible for ISA100.11a, information integrity is sufficiently ensured, probability of successful Sybil attacks node replication attacks is very limited, and there is sufficient protection against intermittent jamming. However Nixon (2012) raised a critical security concern against the ISA100.11a as it offers the Join Key (JK) and the Message Encryption as options. Offering these security measures as options is a security concern. Petersen and Aakvaag (2015) also agree with this conclusion as the concept of having optional security features may be a security threat in itself; and it can also be an issue when it comes to interoperability as different vendors may decide to implement different parts of the optional security options.

WISA and WSAN-FA are based on Bluetooth standard, which has strong and robust security features and it uses the national standard AES algorithm for encryption (Haque and Hossain, 2013).

**Scalability**

An industrial WSN needs to be scalable as the dynamic industrial market requires additional growth of production units and the number of their sensors/actuators from time to time.

Star, mesh and hybrid topologies are the typical WSN configurations; see below Figure (8). It shall be possible for a scalable WSN to increase the number of connected nodes in all applicable network topologies.

![Figure (8): WSN topologies: Star (a), mesh (b), and hybrid (c). Adapted from (Petersen and Aakvaag, 2015, p.12)](image)

Scalability of a WSN is also linked to its reliability since the challenge to build a reliable WSN is much bigger as the size of the network grows. The scalability depends mostly on the overhead of the network
which is caused by the additional communication packets that are required for controlling the communication process.

Zand, et al. (2012) put emphasis on the scalability issues that most of the industrial WSN standards face, including WirelessHART and WIA-PA. The problem is mainly caused by the centralized approach that these standards use to manage their resources. Such approach cannot handle the sudden changes that might occur in an industrial environment. However, Nixon (2012) explained that multiple access points can be provided for each WirelessHART local network. In case of increased data rates, you can add more access points. You may also use multiple gateways for large scale applications.

Scalability of the ZigBee PRO standard is generally good for wellhead monitoring applications. It can support more than 64,000 devices on a single WSN. Nevertheless the scalability feature of the ISA100.11a are generally acceptable as it uses the Internet Protocol version 6 (IPv6) which gives the standard a much larger address space than the address space of WirelessHART. ISA100.11a allows multiple subnets each with 30,000 of nodes (Zand, et al., 2012).

However, it is important to point out that the number of locally dedicated sensors for each wellhead is very limited, therefore scalability might not be a serious concern. Usually the local sensors of a wellhead are connected to the locally dedicated RTU system; see Figure (10). The wireless gateway in the left figure is connected directly only to the RTU which is equipped with a built-in radio. Whereas the wireless gateway in the right figure is connected to the both the RTU and the Wide Area Network (WAN), which is a WiMAX network in the shown example. In the latter case, it is possible to connect the WSN to a central Network Management Station, a Security Management Station and/or an Asset Management server which can access the diagnostic information of the wireless sensors.

Figure (9): A WirelessHART Mesh WSN
Even though the wireless sensors can be connected to the central SCADA network that may include hundreds or thousands of wellhead sites, each WSN network is usually terminated locally by passing the process information to the RTU; see Figure (11).

In case an end-user decides to connect multiple wellheads to a single WSN link/gateway, scalability would be a more important factor. However it is not normally feasible to connect many wellheads to a single WSN link/gateway as the number of adjacent wellheads inside the WSN range is usually small, even when we take the advantage of mesh topology. This should not be a problem for any of the discussed industrial WSNs. For example, WirelessHART is limited to about 30K devices per WirelessHART network (Nixon, 2012), and a typical WirelessHART or ISA100.11a Link/Gatewa...
connecting high density of devices to the same WSN gateway shall be studied carefully by the end-user as the network latency will go higher when the size of the network is increased.

Conclusions

A Wellhead monitoring and control application is a good example of efficient utilization of industrial wireless sensors technologies. Major cost savings and performance benefits can be achieved with WSN either in Greenfield or Brownfield wellhead Smart Field projects.

After reviewing the features of each industrial WSN standard and the wellhead application requirements, it is concluded that wireless sensors and actuators shall only be used for process monitoring and remote manual control of the wellhead equipment, but not for the fast closed loop control or critical process interlocks.

Zigbee PRO standard does not address all the industrial requirements for a wellhead monitoring and control application. It is also given a low rating on “power awareness” when compared to other standards like WirelessHART and ISA100.11a.

Both WISA and WSAN-FA standards utilize the Bluetooth communication techniques which consume higher power, and therefore they should not be used for a wellhead monitoring and control application. Another weakness of WISA is the lack of openness and interoperability as it is a proprietary (ABB) standard.

WIA-PA networks also consume high power when star topology is used. They also show some weakness in solving interference and multipath fading problems. Anyway WIA-PA products are mainly available in the Chinese market, and thus they do not have strong presence in the wellhead monitoring and control applications within the GCC countries.

WirelessHART sufficiently address the low power consumption, reliability, robustness and security requirements of wellhead monitoring and control applications. However, its application layer is limited to the HART protocol, which makes it unsuitable for handling SIL certified critical safety loops.

ISA100.11a also satisfies the low power consumption, reliability, robustness and security requirements of wellhead monitoring and control applications. Furthermore, its application layer allows devices to encapsulate foreign SIL certified communication protocols, which makes it feasible to use it for SIL2 safety control loops when it is customized to carry certified safety protocols. However, ISA100.11a offers some of its security measures as parameterized options, and this is a security concern by itself as the WSN can be subject to more security attacks in case some of these parameterized options are not
selected or wrongly configured. Nevertheless this parameterization flexibility of the ISA100.11a may lead to interoperability issues if different vendors decide to implement different features of the standard.

References


The Feasibility of Applying Savings by Design Policy
In Abu Dhabi-UAE

Muna Ali, PhD Architecture and Sustainable Built Environment student
The British University in Dubai

Abstract

United Arab Emirates (UAE) is characterized by high levels of electricity use worldwide. UAE building sector has the biggest share of electricity use representing the largest potential opportunity in terms of energy savings. However, the slow technological advancement in addition to relevant market barriers has led to underinvestment in energy efficient buildings. According to international experiences, such as that of California in United States of America (USA), well established building-related energy efficient policies proved great achievements in energy savings and greenhouse gases (GHGs) emissions reduction. Hence, this study objective is to suggest a previously established policy not yet applied in UAE and assess its feasibility.

For that purpose, the study proposed Savings by Design (SBD) program which is a bundle incentive that encourages achieving better energy performance than the mandated building codes in Californian nonresidential buildings. SBD program addresses many market barriers with particular focus on promoting energy-efficiency via innovative design strategies. RETScreen 4 software was utilized to quantify the feasibility of applying SBD in Abu Dhabi emirate/UAE. Three energy efficient scenarios (A), (B), and (C) of Abu Dhabi office buildings sector were modeled, attaining 10%, 30%, and 40% better energy performance than Abu Dhabi Pearl Building Rating System (PBRS) minimum requirements.

Results revealed that the three efficient scenarios (A), (B), and (C) are feasible in reducing GHG emissions 1.1%, 34%, and 45% respectively. The net present value (NPV) and internal rate of return (IRR) indicate the financial feasibility of the three scenarios. Scenarios order based on the IRR, case (A) is the most desirable one followed by (B) then (C) achieving 40.3%, 10.6%, and 5.8% respectively. Scenarios order based on the NPV, case (B) has the biggest NPV followed by (C) whereas (A) has the least by obtaining AED 4,015,495.00, 3,123,076.00, and 2,409,826.00 respectively.

Introduction

Problem statement

The major problem that this study intends to address the globally high levels of energy use by the building sector and its association with 35-40% CO₂ global emissions (Levine et al. 2012). Half of the GHGs emissions in UAE are attributed to electricity generation from fossil fuel. In UAE, the building sector presents the largest potential opportunity in terms of energy savings due to its consumption of the biggest
share of the country’s electricity (Figure 1) (UAE Ministry of Energy 2015). In 2010, UAE was ranked as attaining the highest ecological footprint reaching up-to 10.68 gha/person (UAE Ecological Footprint Initiative 2010).

![Figure 1: UAE electricity use in 2013](source: (UAE Ministry of Energy 2015, p. 59))

The high UAE electricity consumption is strongly associated with other three factors which are the rapid urbanization transition, severe climatic conditions and the energy subsidies (UAE Ministry of Energy 2015). Regarding the built environment, UAE has witnessed a great transition during the last 60 years from naturally ventilated houses to tightly sealed and air-conditioned ones (Yeatts et al. 2012). One of the significant features of this rapid transition is the blind adoption of foreign design techniques without verifying their feasibility when applied in UAE buildings. Subsequently, such isolated designs that highly depend on mechanical cooling and lighting resulted in the alarming energy consumption by the built environment. Although the UAE harsh and challenging climatic characteristics, many studies revealed the great potentialities of reducing building energy use by adopting passive design techniques (Al-Sallal et al. 2014, Taleb 2014).

Moreover, the role of inacting appropriate building-related environmental policies should not be ignored. It is a fact that buildings sector represents the maximum opportunity to minimizing CO₂ emissions. However, achieving this in building sector is challenging compared with the industrial and transportation sector. Rapid technological advancement and huge investments in other sectors facilitate adopting energy-efficiency methods. Conversely, the heterogeneous decision-makers in building sector developed market barriers that led to underinvestment in energy efficiency. The implementation of well-designed
building energy efficiency policies is considered as one of key strategies to overcome such barriers (Levine et al. 2012). UAE could greatly benefit from the advanced experience of some countries regarding such policies. However, similar to building design techniques, the blind adoption of others' policies designs without reviewing its feasibility and adaptability to the new context might also lead to unacceptable results.

**Research objective**

This study has two objectives. The first is to suggest a previously established building-related environmental policy at international level that is not yet applied in UAE. The second is to verify and measure the feasibility of implementing the proposed program in UAE in terms of energy and financial savings in addition to CO$_2$ emissions reduction. To achieve its objectives, this study was conducted in the following three phases.

i. First phase: Literature review
   a. Identifying UAE energy status and applied building-related environmental policies
   b. Identifying a country/state of significant related experience
   c. Identifying applied building-related environmental policies
   d. Selection and identification of a particular policy not yet applied in UAE.
   e. Suggesting future development of selected policy in UAE

ii. Second phase: Feasibility assessment
   a. Using RETScreen software to model the base case scenario representing the energy performance of current Abu Dhabi non-residential sector and additional three efficient cases adopting the selected policy.
   b. Demonstrating and discussing the analysis results.

iii. Third phase: Conclusions and recommendations.

**Rationale**

USA has leading experience in the establishment and implementation of building-related environmental policies. The worldwide adoption of USA building energy-efficiency policies practically exhibits their great success. For instance, U.S. Green Building Council declared that LEED building projects are about 72,500 in 150 countries (2015). According to the Alliance Commission on National Energy Efficiency Policy, California is considered as an energy-efficiency model at state level since 1970s. It was not the 1st state that mandated appliance efficiency standards, but it also succeeded in stabilizing electricity use per capita
since 1970s (2013). Compared with other U.S. states, electricity use per capita has increased by about 40% during the same period (Figure 2). Based on that, this study intended to benefit from that state significant experience by suggesting and appraising one of its established policies.

![California Electricity use (per capita)](image)

Source: (Natural Resources Defense Council 2013, p. 1)

Saving by Design (SBD) is a bundled incentive program that offer financial incentives for the owner and design team, design assistance in addition to energy design resources (EDR). SBD program focuses on achieving higher energy savings through cost-effective measures that ensures customers’ overall benefits. One of the reasons of selecting this program is that it reduces energy demand and promotes efficient energy use that minimizes the need for new power plants. That is of lower cost than energy generation, transmission, and distribution (U.S. Environmental Protection Agency (EPA) 2015). In USA, such type of policies are called energy-efficiency resource standards (EERS) which is similar to the renewable energy standards. To overcome market barriers, EERS provide incentives in form of direct payments or loans to encourage investing in energy efficient buildings (Levine et al. 2012).

The objectives of SBD as an EERS program is parallel with Abu Dhabi PBRS that set the demand reduction and enhancement of building energy efficiency as the foundation of its energy targets pyramid (Figure 3). The reason of this study focus on Abu Dhabi is that it is the only UAE emirate that sets mandatory and voluntary energy performance levels for the whole building by its adoption of PBRS. Such types of established rating systems are strongly linked with incentives programs. They are reliable methods that determine the energy efficiency levels and subsequently identifying the appropriate incentive for them (Farhar 2000).
Another reason of selecting SBD is related to the advantages of an incentive program when compared to building codes, which is already applied in Abu Dhabi. The SBD program, as a carrot policy, encourages people to exceed the set minimum energy efficiency requirements by building codes, as a stick policy. It also helps in overcoming three market barriers which are the high initial cost, split incentive, and the lack of information and training regarding energy efficiency techniques. Notably that the design of SBD program avoid the occurrence of the common disadvantage of incentive programs which is carpet baggers (Alsaleh & Mahroum 2014). The last reason of selecting SBD is that it is the only program that afford incentive to the design team which innovative design techniques.

Methods

This study is a quantitative one aiming to assess the feasibility of applying one of the international building-related environmental policies which is not yet applied in UAE by evaluating its financial and energy savings in addition to CO₂ emission reduction. To achieve that, the study utilized two methods which are literature review and RETScreen 4 software. The review is used to identify UAE energy status and applied building-related environmental policies; identify applied building-related environmental policies in a country/state of significant related experience; select a particular policy not yet applied in UAE; suggest future development paths when implementing the proposed policy in UAE. RETScreen 4 software was established by the Natural Resources Canada’s Canmet Energy Research Center in 1996 (Harder & Gibson 2011). It enables energy projects analysis and assists decision-makers in determining the financial and technical feasibility of energy efficiency, renewable energy and cogeneration projects.
Literature review

UAE general overview

UAE is located at 24 00 N and 54 00 E coordinates. UAE total area is 83,600 sq. m and 5,779,760 inhabitants growing at 2.58% rate. UAE has a high gross domestic product (GDP) per capita estimated as $ 66,300 ranked as the 13th worldwide (Central Intelligence Agency 2015). UAE has the 7th largest proven oil reserves worldwide and the 6th natural gas reserves. Abu Dhabi is the focal point of UAE’s oil and gas industry (International Business Publications 2015). The average economic growth of Abu Dhabi, whose office building sector is the focus of this study, is 6.1% while the annual average population growth is estimated as 5.2%. Abu Dhabi Office building supply is assumed as 3.22 M sq m (Gross Lease Area (GLA)) in 2014 (Abu Dhabi Islamic Bank Real Estate Services 2015) which is nearly to that estimated as 3.1 M sq m. During 2011-2014, the growth rate of Abu Dhabi office building ranged between 16 to 3.3% according to (Jones Lang Lasalle 2015) and between 15 to 3.1% according to (Abu Dhabi Islamic Bank Real Estate Services 2015). Vacancy rate decreased from 39% in 2013 to 25% in 2014 and expected to remain steady in 2015 (Jones Lang Lasalle 2015).

UAE building energy efficiency policies

UAE ratified the Kyoto Protocol in January 2005 and entered into force in February 2005. According to the protocol, UAE is a non-Annex 1 country and is not obliged to reduce its emissions. However, UAE is taking a number of steps to respond to critical environmental issues. For instance, energy efficiency is a major priority for UAE government representing the cheapest source of supply. According to UAE Vision 2021 strategy set a target of 15% reduction in CO2 emissions by 2021. Thus, the UAE has utilized several methods to cut demand. Abu Dhabi inaugurated mandated building codes in 2011 under the Estidama program while Dubai has also established the Green building codes in 2014. A set of mandatory requirements are also established by the Emirates Standardization & Metrology Authority (ESMA) for lighting and air conditioning (AC) units (UAE Ministry of Energy 2015).

Demand side management (DSM) in energy use is a major aspect of UAE Vision 2021 that target the country configuration based on innovative green principles. The program adopted a twofold approach that aims to enhance building energy efficiency and rectify their residents’ behaviors regarding energy conservation issues. Moreover, UAE government has also focused on educating energy consumers by providing school and customer programs sponsored by the Emirates Wildlife Society, Regulation and Supervision Bureau, and Environment-Agency Abu Dhabi. Energy efficiency targets by both green-economy and federal energy strategies are anticipated to obtain the highest influence on UAE’s energy profile. In 2014, a new department for energy conservation and energy efficiency was established. One of the major aims of that department was to establish database regarding energy use by different UAE
sectors which is crucially required to address lack of information as a market barrier (UAE Ministry of Energy 2015).

**Abu Dhabi Pearl building rating system**

Abu Dhabi emirate is the focus of this study. Prior to its selection as a host of the International Renewable Energy Agenda (IRENA) headquarters in 2008, Abu Dhabi announced its commitment to invest money and research in creating alternative energy programs as well as extending hands to assist developing nations (International Business Publications 2015). Abu Dhabi Vision 2030 strategy set 30% energy use reduction target by 2030. The establishment of Pearl building rating system (PBRS) in 2010 as part of the Estidama program is one of the tools to achieve that target. The PBRS aims to promote a development of sustainability throughout its lifecycle starting from design and including construction, maintenance and operation (UAE Ministry of Energy 2015).

Table 1: PBRS levels

Source: (Abu Dhabi Urban Planning Council (2010), p. 2)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Pearl Rating Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>All mandatory credits</td>
<td>1 Pearl</td>
</tr>
<tr>
<td>All mandatory credits + 60 credit points</td>
<td>2 Pearl</td>
</tr>
<tr>
<td>All mandatory credits + 85 credit points</td>
<td>3 Pearl</td>
</tr>
<tr>
<td>All mandatory credits + 115 credit points</td>
<td>4 Pearl</td>
</tr>
<tr>
<td>All mandatory credits + 140 credit points</td>
<td>5 Pearl</td>
</tr>
</tbody>
</table>

The energy efficiency of all building should be ranked following PBRS from 1 to 5 pearls. All building must comply with the minimum PBRS requirements identified as the one pearl rank while governmental buildings should comply with 2 pearl requirements (UAE Ministry of Energy 2015). The determination of the PBRS levels is calculated based on seven categories: (1) Integrated development process, (2) Natural systems, (3) Livable buildings, (5) Precious water, (5) Resourceful energy, (6) Stewarding material, and (7) Innovative practice. Within each category there are mandatory credits that should be met and optional credits that are awarded when meeting specified optional criteria. Higher Pearl ratings require compliance with those mandatory credits in addition to a specified number of extra credits (Table 1). The minimum acceptable requirements by PBRS in the resourceful category is that a building should achieve at least 12%

**California Saving by Design policy**

Most of energy efficient programs established in USA in the 1970s did not succeed in making consumers take energy-saving choices. Energy incentives programs such as energy efficiency mortgages (EEMs) and home energy rating system (HERS) were established in California since 1980s (Alliance Commission on National Energy Efficiency Policy 2013). Incentives programs were established to overcome barriers that hinder investing in building energy efficiency (Levine et al. 2012). However, before the Energy Policy Act (EPACT) 1992, the mortgage sector was unwilling to issue loans for upgrades without verifying their cost efficiency. Simultaneously, since HERS was a voluntary program, people are not encouraged enough to adopt it. After 1992, both of them witnessed widespread when HERS certificate was mandated as basic requirement for obtaining EEMs (Farhar 2000).

Incentive programs vary from simple direct payments for purchasing energy efficient products to more customized ones that might encompass financial and technical assistance. They might also target individual consumers, manufacturers, contractors or retailers (U.S. EPA 2015) (Figure 4). The major aim of SBD program is to encourage investment in high energy efficiency in new nonresidential buildings. What dignifies SBD is its being a bundle incentive that include: (1) the owner incentives reduce the initial cost of energy efficient buildings, (2) the design team incentives that encourage ambitious designers to innovate sustainable yet energy efficient design solutions, (3) provision of design assistance that helps in incorporating energy efficiency design strategies from preliminary design stages, (4) provision of energy design resources (EDR) i.e. training, analysis tools and in depth data regarding energy efficient technologies. (Savings by Design 2015).
In California, SBD is financed by five utility customers through the gas surcharge that imposed on gas customers’ bills to sponsor public welfare programs. SBD address the principal decision-makers in new buildings projects i.e. owners, developers, architects, engineers, designers, contractors, builders, and energy consultants. SBD methods provide detailed technical and financial assistance information that support owners and design teams to take well-versed decisions regarding their buildings’ energy efficiency levels. It encourages achieving better energy performance than the mandated on nonresidential Californian buildings reference to “2013 California Building Energy Efficiency Standards (BEES) (Title 24, Part 6)” (Savings by Design 2015).

SBD adopts two performance-based approaches to quantify the designed energy efficiency improvements: the whole building and the systems approaches. The whole building approach encourages the utilization of integrated design analyses through the whole building approach for large, complicated projects or those having innovative energy efficiency design features. In such projects, performance analysis of the whole building enhances the design team’s capability of optimizing the energy efficiency of the multiple and interacting building systems. This approach includes economic and parametric analyses in addition to the utilization of an approved energy simulation instrument. The Systems approach
promotes enhancement of energy efficiency of building’s systems. It is most suitable for less complicated projects. In such cases, the SBD representative suggests this straightforward approach to identify the probable energy efficient design alternatives. A simple performance-based simulation instrument is sufficient to rapidly quantify potential energy savings. Accordingly, the associated incentives will be calculated (Savings by Design 2015).

Owner and design team incentives are built on estimated annual energy savings of the project. The maximum incentive cap is 75% of the incremental cost of the improvements. Incentive calculations differ according to the two SBD approaches. The Whole Building Approach is more preferable method in achieving energy savings within SBD. That is due to the capability of the design team to incorporate many energy efficiency solutions when designing the integrated building systems. The incentive is awarded for buildings achieving 10% more savings than that required by Title 24 BEES. The incentives increase in a sliding range from $0.10 to $0.30 per annualized kWh savings for achieving 10 - 30% more savings than standards (Figure 5). Design team incentives are availed when the building design achieves 10% savings more than Title 24 BEES. It ranges from $0.033 - $0.10 per annualized kWh savings when savings exceed the standards within a range of 10 – 30%. In case of 40% more savings, a $0.13 per annualized kWh savings will be afforded (Figure 6).

Figure 5: Owner’s incentive/Whole building approach
Figure 6: Design team incentive/Whole building approach

Source: (Savings by Design 2015)

SBD program requires the following procedures:

- First, a project representative, i.e. owner, designer, etc. contacts a SBD representative.
- Second, a complete letter of interest in SBD program should be submitted. The utility is responsible for revising and approving letters of interest and design team applications.
- Third, a close coordination between the SBD representative, design team and owner to assure the feasibility of the design changes and establishment of the energy efficiency targets.
- Fourth, determination of which approach is applicable whether systems or whole building.
- The fifth step is the submission of required documents to the SBD representative.
- Sixth, after finalizing the design of the recommended enhancements, the incentive agreement will be issued by the SBD representative defining the proposed scheme details, incentive amounts, contract terms and conditions.
- Seventh is the owner signal on the agreement and its resubmission to the SBD representative. According to the Utility’s signature and indicated date, funds will be reserved for up to four years.
- Eighth, after the construction completion, the building representative must request for on-site inspection from the SBD representative.
- Ninth, the building representative should facilitate the on-site inspection and participate in evaluation when needed.
- The incentive will only be paid if the built project meets all the stated requirements. If not, adjustments will be done in the incentive according to the estimated energy efficiency performance. (Savings by Design 2015).
SBD implementation in new context

California SBD program is established in a way that enables it to tackle market barriers and failures that result in inefficient use of energy. SBD financial incentives help in overcoming two market barriers which are the high initial cost and split incentives commonly associated with buildings’ energy efficient improvements. Split incentives occur when the entity or individual responsible of paying energy bills and who benefit from future energy savings (tenant) is not the same entity/individual who provide energy efficient improvements (landlord). Affording direct payments to the owners addressed those barriers. Notably that SBD design also succeeded in avoiding the occurrence of carpet baggers whose aims are capturing temporary benefits (Alsaleh & Mahroum 2015). That is mainly because the incentive will only be paid if the built project meets all the stated requirements. If not, adjustments will be done (Savings by Design 2015).

The third barrier addressed by SBD program is the lack of information and training regarding energy efficiency techniques. Usually, information deficiency and/or imperfection leads to market failures characterized in the underinvestment in energy efficient improvements in buildings. The design assistance along with the EDR services help in decreasing the risk and uncertainty i.e. adopting a high-cost technique that can have uncertain future performance, prices, and irreversible results. Inaccurate information, i.e. regarding consumers’ preferences, can increase the perceived risk regarding energy efficient investment which will not only impede consumers but also suppliers from energy efficient investments. It also helps in lessening the transaction costs like that lost from consumers in searching, evaluating and obtaining energy-efficient mechanisms. For instance, estimating a building life cycle cost might be difficult. Such difficulties relative to energy efficient investments stand as a disadvantage compared with less efficient ones. Moreover, the direct coordination between the SBD and the design teams greatly helps in addressing economic and psychological behavioral impediments that hinder energy-efficient investment. This category of participants in building sector is very beneficial in terms of promoting more innovative design techniques that might boost buildings’ energy efficiency (U.S. EPA 2015).

However, importing SBD program into a different context such as UAE requires deliberate study in deciding how to adapt it to suit the new context economical, political, social, cultural, and environmental characteristics. Levine et al. (2012) declared some of the key considerations when establishing such a program is the assurance of attaining sufficient lead time and stakeholders’ engagement. Having adequate lead time that allows deliberate preparation for a new program is essentially important to create market certainty. It is also important in inaugurating a suitable program duration that makes the investment in its marketing valuable by all parties. In addition to that, especially when establishing an incentive program for the 1st time, there is a great need to involve other stakeholders in program selling and advertising its benefits to their clients and customers. Some of the best practices when establishing a new incentive program are:
Matching incentives to the market: This could be achieved by adjusting their amounts, timing and delivery methods. Attaining acceptable levels of flexibility that enable program supervisors to take suitable adjustments based on market needs will effectively yield more energy savings and promote the market transformation.

Education and outreach: The provision of sufficient fund plans and budgets which cover the education expenses that outreach all market participants and assure their understanding of the incentive rules.

Having targeted programs in specific sectors increase participation and savings when applying such programs.

Monitoring and assessment measures should be built on such programs. Flexibility is also required here to enable applying balanced rectifications and enhancements.

Policy designer should explore the potential objections and barriers to address them and remove them before program introduction.

Appropriate savings techniques should be adopted to guarantee that benefits exceed costs.

Incorporating specific methods that encourage lending and facilitate costs repayments by customers could help in achieving early success.

Minimizing the investor risk through government programs that offer on-bill finance and loan-loss reserves that motivate the private sector to invest in energy efficient projects.

Linking the finance with the building, that has specified energy efficient improvements, rather than the owner might minimize the perceived risk deterring owners from complying with agreed on enhancements.

Feasibility assessment

Modeling scenarios in RETScreen

RETScreen 4 software was utilized to assess the feasibility of a base case scenario representing the energy performance of Abu Dhabi nonresidential sector that is compliant with PBRS minimum requirements. Additional three efficient cases, with better energy performance to comply with SBD requirements, are also modeled. As illustrated in section (2.3), PBRS was recently mandated in 2010 and it represents a new experience not only at UAE level but at the whole Middle East level. Due to that, there is no record regarding the energy use by a prototype UAE non-residential building following PBRS requirements. To resolve such information deficiencies, a new department of energy conservation and energy efficiency was newly established in 2014. One of its major goals is develop database of energy use by different sectors allowing comparisons of green building design performance between different sectors and within the sector itself (UAE Ministry of Energy 2015).
The evaluation of a project compliance with the required PBRS standards is calculated not to a standard or prototype reference building but to its own compliance with ASHRAE/ASHRAE/IESNA 90.1 – 2007 as baseline building. The amount of energy performance improvement is measured by subtracting the performance of the proposed improved building from that of the building complying with ASHRAE/ASHRAE/IESNA 90.1 – 2007 (Abu Dhabi Urban Planning Council 2010). The study benefited from available data regarding the energy efficiency of prototype commercial building in different USA states (U.S. Department of Energy 2009). Abu Dhabi climate is classified by ASHRAE as 1B zone which is very hot and dry (Abu Dhabi Urban Planning Council 2010). Thus, the study selected Phoenix city that is a representative city for the nearest climate zone in USA which is hot and dry “2B” (American Society of Heating, Refrigerating, and Air Conditioning 2008 & U.S. Department of Energy 2009) (Table 2). Based on that the estimated energy use of a prototype non-residential building in similar climate is approximately 13.66 KWh/sf/yr. Moreover, reference to section (2.1), Abu Dhabi Office building supply is assumed as 3.22 M sq m. Regarding the growth rate of office buildings, the study adopted the least growth rate 3.1% in its calculations so as to estimate the minimum potential energy savings and CO₂ emissions reduction that might be achieved. Hence, the estimated annual growth in AD office building is (3.1% x 3.22 M sq m) that equals about 1,074,454 sq ft.

### Table 2: Energy use by different prototypes in Phoenix /Arizona

Source: (U.S. Department of Energy 2009, p. 19)

<table>
<thead>
<tr>
<th>Building Prototype</th>
<th>Location</th>
<th>Energy Use Intensity</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Electricity</strong></td>
<td><strong>Natural Gas</strong></td>
<td><strong>Electricity</strong></td>
<td><strong>Natural Gas</strong></td>
<td><strong>Savings 90.1-2007 vs. IECC 2006</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(kWh/sf/yr)</td>
<td>(kBtu/sf/yr)</td>
<td>(kWh/sf/yr)</td>
<td>(kBtu/sf/yr)</td>
<td>Energy</td>
</tr>
<tr>
<td>Nonresidential</td>
<td>Phoenix</td>
<td>13.12</td>
<td>2.45</td>
<td>12.95</td>
<td>2.43</td>
<td>1.3%</td>
</tr>
<tr>
<td>Residential</td>
<td>Phoenix</td>
<td>10.19</td>
<td>2.28</td>
<td>9.68</td>
<td>1.60</td>
<td>6.6%</td>
</tr>
<tr>
<td>Semiheated</td>
<td>Phoenix</td>
<td>4.22</td>
<td>4.12</td>
<td>4.22</td>
<td>3.96</td>
<td>0.8%</td>
</tr>
<tr>
<td>Nonresidential</td>
<td>Sierra Vista</td>
<td>11.75</td>
<td>3.13</td>
<td>11.52</td>
<td>3.08</td>
<td>2.0%</td>
</tr>
<tr>
<td>Residential</td>
<td>Sierra Vista</td>
<td>9.88</td>
<td>2.18</td>
<td>9.40</td>
<td>1.60</td>
<td>6.1%</td>
</tr>
<tr>
<td>Semiheated</td>
<td>Sierra Vista</td>
<td>4.33</td>
<td>4.32</td>
<td>4.33</td>
<td>4.17</td>
<td>0.8%</td>
</tr>
<tr>
<td>Nonresidential</td>
<td>Prescott</td>
<td>11.36</td>
<td>4.25</td>
<td>10.90</td>
<td>3.97</td>
<td>4.3%</td>
</tr>
<tr>
<td>Residential</td>
<td>Prescott</td>
<td>9.27</td>
<td>8.37</td>
<td>9.04</td>
<td>5.69</td>
<td>8.7%</td>
</tr>
<tr>
<td>Semiheated</td>
<td>Prescott</td>
<td>4.33</td>
<td>10.27</td>
<td>4.33</td>
<td>10.12</td>
<td>0.6%</td>
</tr>
<tr>
<td>Nonresidential</td>
<td>Flagstaff</td>
<td>10.85</td>
<td>5.36</td>
<td>10.56</td>
<td>4.88</td>
<td>3.5%</td>
</tr>
<tr>
<td>Residential</td>
<td>Flagstaff</td>
<td>8.73</td>
<td>12.67</td>
<td>8.73</td>
<td>10.28</td>
<td>5.7%</td>
</tr>
<tr>
<td>Semiheated</td>
<td>Flagstaff</td>
<td>4.35</td>
<td>15.39</td>
<td>4.34</td>
<td>15.29</td>
<td>0.4%</td>
</tr>
</tbody>
</table>
RETScreen 4 software is used to calculate the expected energy savings and the reduction in CO$_2$ emissions in both base case and other efficient scenarios motivated by SBD program. When modeling these study scenarios in RETScreen 4, heating value reference was assumed as lower heating value (LHV) since the higher heating value (HHV) is only utilized in North America (Natural Resources Canada 2009). Energy amount when combusting a fuel can be measured to include or exclude the released heat when the water vapor in the dissipated gases condenses. HHV includes that latent heat consumed for vaporization whereas LHV excludes it. Climate data region was selected as UAE while the location was Abu Dhabi International Airport. The project type is “user-defined” while analysis type is “Method 2”. Electricity price is assumed as 0.15 AED per each KWh reference to Abu Dhabi Regulation and Supervision Bureau (2015). The discount rate is 1.43143 as estimated by the Central Bank of UAE (2015). Concurrently with Abu Dhabi vision 2030, the project life is 15 years to determine the amount of contribution the application of SBD could achieve.

Since SBD program is only applicable on new buildings, the area in the three scenarios is similarly estimated as the potential growth in AD office building as 1,074,454 sq ft. Regarding the energy performance of the base case scenario is assumed to be compliant with PBRS minimum requirement by achieving 12% better energy performance than that of ASHRAE/ASHRAE/IESNA 90.1 – 2007 requirements. Efficient case (A), (B) and (C) is modeled to achieve 10, 30, and 40% better performance than mandatory PBRS requirements which are subsequently 22, 42, and 52% better than ASHRAE/ASHRAE/IESNA 90.1 – 2007 requirements. Based on previous assumptions; the annual energy use by base case, case (A), case (B), and case (C) are 12,915,785, 11,448,082, 8,512,676, and 7,044,973 KWh respectively. The incentive value as prescribed by the Californian SBD in section (2.4) is calculated as part of the costs in all scenarios. Subsequently, the incentive amount is 543,050.00, 4,843,419.00, and 8,688,801.00 for case (A), (B), and (C) respectively. Table (3) demonstrates the major assumptions used to model the base case and efficient cases scenarios in RETScreen.

<table>
<thead>
<tr>
<th>Table 3: Major scenarios assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area (sq f)</strong></td>
</tr>
<tr>
<td>-------------------------------------</td>
</tr>
<tr>
<td>1,074,453</td>
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<tr>
<td><strong>Annual Energy use (KWh)</strong></td>
</tr>
<tr>
<td>-------------------------------------</td>
</tr>
<tr>
<td><strong>PBRS Compliance</strong></td>
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<tr>
<td>-------------------------------------</td>
</tr>
<tr>
<td><strong>Incentive value (AED)</strong></td>
</tr>
</tbody>
</table>


## Results

Based on the above data and when comparing the base case with the efficient case (A) assuming that the whole new office building is exceeding PBRS requirements by 10%, RETScreen analysis demonstrated the following results:

- Net GHG by the base case is 77,213 whereas it is 68,439 tCO₂/yr resulting in 8,774 tCO₂/yr reduction. By 2030 about 13,161 tCO₂ will be reduced which is 1.1% less CO₂ emissions than the base case scenario.
- The net present value (NPV) of this case is 2,409,826 AED. The difference between the present value of incoming and outgoing cash flows. NPV is commonly used as an indicator of a project’s feasibility. A project is assumed as feasible, which is applicable in this case, when (NPV > 0) (Devi et al. 2014). The annual life cycle savings is 179,669 AED/yr.
- Benefit-Cost ratio (BCR) is 5.44. BCR is the ratio between the benefits and costs and it is a measure of the feasibility of a particular investment (Soeleman et al. 2014). For instance, BCR of this case indicates that the benefits of this case exceed the costs by more than five times during the calculated 15 years. The internal rate of return (IRR) is estimated to be 40.3%. IRR is the discount rate required to make the net present value of benefits equal the costs (Wagner 2012). The higher IRR indicates the higher profitability and desirability of an investment.
- Simple payback period (PBP) is 2.5 years (Figure 7). It is the required time to return the invested amount of money in an asset by the incoming cash flow generated by the investment (Glossner et al. 2015). The less payback period is, the more attractive the investment.
When comparing the base case with the efficient case (B) assuming that the whole new office building is exceeding PBRS requirements by 30%, RETScreen analysis demonstrated the following results:

- Net GHG by the case (B) is 5,089 tCO₂/yr resulting in 2,632 tCO₂/yr reduction than base case. By 2030 about 39,484 tCO₂ will be reduced which is 34% less CO₂ emissions than the base case scenario.
- Net present value (NPV) is 4,015,495 AED. The annual life cycle savings is 299,371 AED/yr.
- Benefit-Cost ratio (BCR) is 1.83. The internal rate of return (IRR) is estimated as 10.6%.
- Simple payback period is 7.3 years (Figure 8).
When comparing the base case with the efficient case (C) assuming that the whole new office building is exceeding PBRS requirements by 40%, RETScreen analysis demonstrated the following results:

- Net GHG by the case (C) is 4,211 tCO2/yr resulting in 3,510 tCO2/yr reduction than base case. By 2030 about 52,645 tCO2 will be reduced which is 45% less CO2 emissions than the base case scenario.
- NPV is 3,123,076 AED. The annual life cycle savings is 232,838 AED/yr.
- Benefit-Cost ratio (BCR) is 1.36. The internal rate of return (IRR) is estimated as 5.8%.
- Simple payback period is 9.9 years (Figure 9).
Conclusions and recommendations

UAE building sector represents the largest potential opportunity in terms of attaining high energy savings and GHGs emissions reduction. However, achieving this in building sector is challenging due to the slow technological advancement and common market barriers leading to energy efficiency underinvestment in this sector. The implementation of well-designed building energy efficiency policies is considered as one of the key strategies to overcome such barriers. UAE could considerably benefit from the advanced international experience such as California/USA leading experience in establishing its own building-related energy efficiency policies.

The significantly poor design of UAE buildings in terms of their integration with UAE local environment is another market failure that should be addressed. UAE alarming levels of electricity use is strongly associated with the rapid transition in UAE built environment from naturally ventilated buildings to tightly sealed mechanically-cooled ones. One of the major deficiencies of that transition is the blind adoption of foreign building design techniques. This reinforces the potential role of policies such as SBD program that address prevailing market barriers with more focus on design issues.
SBD is a bundle incentive that promotes achieving better energy performance levels in nonresidential buildings than that mandated by building codes. SBD help in overcoming the high initial cost and split incentives by affording financial incentives to buildings’ owners. Affording financial incentive to the design teams also helps in developing innovative energy efficient strategies. Moreover, the provision of design assistance in addition to energy design resources addresses the lack of information and training regarding energy efficiency techniques. Usually, insufficient information leads to market failures characterized in the underinvestment in energy efficient improvements in buildings.

Based on RETScreen analysis results, the three efficient scenarios described in section (3) proved their feasibility in reducing GHG emissions. The NPV, BCR, and IRR indicate the financial feasibility of the three efficient scenarios. Ordering these scenarios based on the IRR, case (A) is the most desirable one followed by case (B) then (C) achieving 40.3%, 10.6%, and 5.8% respectively. Ordering scenarios based on the NPV, case (B) has the biggest NPV followed by case (C) whereas case (A) has the least by obtaining AED 4,015,495.00, 3,123,076.00, and 2,409,826.00 respectively. Regarding the GHG emission reduction, case (C) achieved the highest reduction followed by case (B) then case (A) by attaining 45%, 34%, and 1.1% reduction. PBP is only 2.5 years for case (A) while it is 7.3 by case (B) and 9.9 years by case (C).

It is important to note that, in real life conditions, it is not expected that all new commercial buildings are going to achieve similar energy performance. That might subsequently lead to the availability of the three types of incentives in varying degrees. However, similar to building design techniques, the blind adoption of others’ policies designs without reviewing their feasibility and adaptability to the new context might also lead to unacceptable results. For instance, when importing this program to UAE context, the incentive amounts should be restudied and adapted to suit with UAE economic, political, social, and cultural characteristics.

One of the essential considerations when setting the incentive values is identifying the program target in terms of the expected GHG reduction and its financial resources. Setting a specific target might greatly help in determining the most cost-efficient program which is the one that achieve the target with the least cost. On the other hand, the financial resources might greatly dominate the targeted GHG reduction. Moreover, benefiting from the best practices and issues illustrated in section (2.5) such as having sufficient lead time, matching incentives to the market, and stakeholders’ involvement; might immensely help in developing a successful policy.
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Exploring the role of Lean methodology as a tool for performance improvement in healthcare projects: an ethnographic case study in U.A.E

Ala’a Abuhejleh, PhD Project Management student
The British University in Dubai

Paul Gardiner, SKEMA Business School
Professor of Project Management

Samer Ellahham
Chief Quality Officer at SKMC

Purpose

This extended abstract is provided as a contribution to the 2nd Doctoral Research Conference of the British University in Dubai (BUiD). The position paper reported in this abstract explores the value and role of Lean methodology in healthcare projects. The objective of the research is to review the topic of Lean healthcare with the intention of recognizing its merits and limitations. The research also gives an overview of the supporters and opponents of Lean methodology in hospital projects. It is mainly to reply to the criticism surrounding the application of Lean in hospital projects. The research identifies, through an ethnographic case study, the position of the researchers supporting the continuous application of Lean performance improvement in the context of project management within healthcare sector. This study aims to encourage researchers and healthcare leaders to rethink the role of Lean healthcare and work on innovative ways of streamlining healthcare projects to address its challenges appropriately.

Design/ methodology/ approach

The research is supported by a real example of a public hospital in the UAE which has succeeded in applying Lean, and by evidence based on a review of the literature of peer-reviewed publications to respond to the criticism of the opponents.

Sheikh Khalifa Medical City (SKMC) in Abu Dhabi, UAE was selected as a vivid example that has implemented Lean and succeeded in improving its system quality and reliability, and the data were collected using a qualitative ethnographic approach. This study uses ethnographic research to show how the third researcher, Chief Quality Officer and Senior Cardiologist Consultant at a large public hospital, spent his first three years on the job setting theory into practice.

Ethnography- studies the daily experiences of people and extends our understanding of the social developments within establishments. This study is constructed on the personal experiences of the third researcher (auto-ethnography) to provide an insider’s point of view. Data collection from autoethnographic narratives has been validated.
Our position is that Lean is a feasible, practical, beneficial and transformational methodology in healthcare in general and in hospital projects specifically. Nevertheless, these merits must be balanced against existing criticism. The opponents of Lean in healthcare, mainly those who are in the practical field are criticizing it from several different aspects. The major areas of criticism that this research has focused on using evidence from the literature to respond to them are: Lean is for manufacturing not for a service industry such as healthcare, difficulty to accept Lean Japanese jargon, Lean might lead to staff lay-off or outsourcing, and the high cost of Lean training.

**Findings**

In this study, we found out through an ethnographic case study that hospitals which invest in Lean ended up driving value to the patients and decreasing unproductive work. The findings highlight the following benefits of Lean in healthcare projects:

- Lean performance improvement provides value to patients and their families
- Lean improves patients and caregivers satisfaction
- Lean can eliminate errors and provide optimal care to patients at the best possible cost when implemented effectively
- Lean can enhance process flow and improve throughput
- Lean methodology is applicable and valuable management tool in hospital projects

We proceed with a debate related to Lean methodology and its applicability to healthcare projects. The major points of criticism and our responses follow.

In response to the criticism that Lean is for manufacturing not for a service industry such as healthcare we posit a change of mindset. This can give people a goal in their working lives and the ability to change attitudes. With a change in the mindset, the people start to judge Lean in a different way and are more prepared to participate in the improvement initiatives of the organization. In reply to the criticism of difficulty to accept Lean jargon we posit that some jargon is always necessary but by having an attitude of learning from others and being open to their culture is healthy and can make you smarter. In regards to argument that Lean leads to lay-offs we posit that people is the true essence of Lean. Lean leads to happier employees based on respect and a new approach of thinking which needs behavioral change for many people to break down the “silo mentality” and to think wisely. Subsequently, this will lead to improve staff satisfaction, communication and team work. In response to who argue that Lean training is expensive we posit that the right training based on our own knowledge and needs is cost-effective and avoids waste and excessive cost that can result from over use of consultants.
Research implications/ limitations

The research results suggested several actions and solutions drawn from the above discussion as critical success factors of Lean implementation in hospital projects:

- Lean implementation must be an integral part of the hospital’s long term strategy
- Develop leaders and people who understand and follow the Lean philosophy – build capability
- Develop a clear link between hospital goals, key objectives and Lean activities
- Seek true participation by all - people actually working in the process must be involved
- Value must be defined by the patient
- Select a few priority projects to work on first
- Build a culture to prevent problems and waste rather than to simply inspect and fix
- Standardize tasks and processes
- Use time as the best overall measure

This has an important implication for healthcare organizations to move forward with a change in mindset.

The limitation of this study is due to the time limit; this research was conducted through an autoethnographic account of one individual’s (the third researcher’s) learning experience in implementing Lean at a single hospital, so it is not possible to generalize the results, probably it will not reflect other leaders experience and other hospitals.

In addition, we call for further research to strengthen the position outlined in this study.

Originality/value

This research illustrates the potential link between high reliability healthcare and Lean methodology in hospitals to stimulate further discussion and enable more evidence-based decision making for the researchers and policy makers about adopting Lean as a performance improvement strategy. To the best of our knowledge this is the first study in the UAE calling for the application of Lean in hospital projects by linking academia, business and industry through research and is supported by a review of evidence on both sides of the argument.

This research shows the value of an auto-ethnographic view on Lean management learning as a tool for performance improvement in healthcare projects. The information gained through this study is supported by the third researcher’s experiences in fulfilling his role as a healthcare leader. This may service the reader exploring his/her own role in the field of healthcare leadership.
Critical Success Factors for the implementation of industry certificate projects in universities

Noha Tarek Amer, PhD Project Management student
The British university in Dubai

Purpose

Industry certificate projects are recently increasing in universities. A lot of companies such as Cisco, HP, SAP, Oracle...etc. are introducing their certificate programs to universities. In these programs, students apply and get selected based on their qualifications. The selected students then get exposed to the relevant industry practices where they eventually get certified if they pass the exam. These programs require a lot of resources from industries, supporting departments from universities, and students. This study attempts to examine the critical success factors that impact the success of industry certificate projects in universities.

The aims of the study are as follows:

1- What is the definition of an industry certificate project success as defined by the industry?
2- What is the definition of an industry certificate project success as defined by the supporting department in the university?
3- What is the definition of an industry certificate project success as defined by the students?
4- What factors should be considered in order to achieve success as defined by the industry, the supporting department in the university, and the enrolled students?

Design/ Methodology/ Approach

The main research methodology to achieve the aims of this research is a case study of the SAP program in the American University of Sharjah. The SAP program runs once every year where selected students are taught two certificates and are then allowed to do a self-study certificate. SAP then supports students in finding an internship in a relevant field. Students are highly encouraged to apply for this program as it makes them stand out with their industry certificates and experiences compared to their graduating peers. However, the implementation of this program is not easy as there are typical conflicts that happen between the three involved stakeholders, SAP, AUS, and the students.

This case study will reflect on the experience of SAP, the supporting department in the American University of Sharjah, and the enrolled students in order to develop three different theoretical frameworks suited for the industry, supporting department in the university, and the students. Data collection will be conducted using interviews with SAP personnel and the supporting department in the university. Data will also be collected from students using focus groups of 4-5 students at a time.
Findings

Success is measured differently for these three stakeholders. For instance, industries define success of these programs as more marketability for them. Universities define success of these programs as more students enrolled in their offered majors. Students define success of these programs as landing a job after graduation. Therefore, the study will provide a definition of success for industry certificates projects in universities, as defined by the three concerned stakeholders: the industry, the supporting department in the university, and the students.

The study will also provide a list of success factors that increase the likelihood of success as defined by the industry, the supporting department in the university, and the students.

These outcomes will be mainly achieved through the proposal of three theoretical frameworks suited for the three concerned stakeholders: industries, supporting department in the university, and the students.

Research Limitations/ Implications

The main research limitation is that it will be limited to one case study. The results of the case study will be three different theoretical frameworks suits to the different concerned stakeholders: industry, supporting departments in universities, and students. For future research opportunities, the three frameworks will be verified using interviews with industries, supporting departments in universities, and a questionnaire to students. Therefore, the questionnaire will provide more general results.

Practical Implications

Industry and university collaboration is very important as it bridges the gap between what is taught in universities and what is applied in the industry. This study will help three different stakeholders in the implementation of industry certificate programs in universities and utilize their resources in an efficient way. The frameworks will provide industries, supporting departments in universities, and students with factors to consider when they endure in the implementation of industry certificate projects.

Social Implications

Industry certificates in universities are very important for industries, supporting departments in universities, and students. It helps industries in marketing their products and improving their output and network. These projects also help supporting departments in universities by attracting more students to their major. Also, these projects help students by exposing them to the industry and exposing them to networking opportunities with industry experts.

This research shall improve the quality of life and overall efficiency for the three concerned stakeholders: industry, supporting departments in universities, and the students.
**Originality/Value**

There is previous research on what impacts the success of specific programs in universities. However, these programs are long term and exhibit different characteristics than industry certificates, which are short term. Moreover, previous research does not consider a holistic view from all the concerned stakeholders in these industry certification endeavours. Therefore, this research will provide a list of guiding factors to industries, supporting departments in universities, and students, when they undertake and enroll in industry certificate projects.

**References**


Adaptation of Retrofit Strategies for Mass Housing Renewal and Urban Development in order to meet the Demands of Energy Consumption, Occupants’ Behaviour and their Cross-Cultural Influences in Northern Cyprus

Bertug Ozarisoy, PhD Student
Welsh School of Architecture, Cardiff University

Abstract

This research paper investigates the pattern interpretation of the occupants’ behaviour and their cross-cultural influences on the energy efficiency of buildings assessment during the implementation of retrofit strategies on the mass housing estates in the Turkish Republic of Northern Cyprus (T.R.N.C.). The research is conducted by ethnographic methods that includes observations, semi-structured interviews and focus group discussions. The expected results point out the need for control mechanisms in the mass housing sector to promote and support the adoption of retrofit strategies and minimise non-controlled refurbishment activities, in line with diagnostic information of the selected mass housing estates. Conclusion, limitations and future research direction were also discussed.

Keywords: construction process, energy-efficiency, retrofitting.
Detection of accident via sensors installed in roads

Maitha Ateeq Al-Hameli, PhD Architecture and Sustainable Built Environment student
The British University in Dubai

Introduction

In today’s scenario we witness a lot of road accidents in our daily life. It is the most unwanted things to happen to road travellers and drivers. The main and basic unfortunate reason is that we don’t learn from our last or past mistakes on while driving on roads. Almost everyone is using vehicle to make his/him life easier, but most of them are quite well aware about the safety measures and general road rules, which we have to follow during driving. Some of the main common reason behind the road accident and crashes are listed below:

- Red light jumping
- Drunken driving
- Distraction to driver
- Over speeding
- Avoiding safety gears by road users like seat belts and Helmets.
- Overtaking in wrong manner.

Sometimes weather is also responsible for road accidents due to Fog, Snow, Heavy rainfall, Hail storms and wind storms. A large number of people all over the world suffer death injury due to lack of communication system on road, which causes delay of help on road or highways.

Purpose

I would like to assist investigation under the challenges faced during roads accidents and carelessness of the drivers while driving the vehicles in the daylight or night. This abstract has been prepared after performing various surveys. To detect vehicle accidents and reporting about them to the health care Centre is a cumbersome task as there is no such technology or system available for the cause and till the time the ambulance reached, the victim already dies. The major objective of this dissertation is to prepare and implement a system that will immediately make call to the health Centre via a GPS so that thousands of lived can be saved during road accidents. For the same purpose, Wireless sensor network (WSN) is installed underneath the roads or on the roads depending upon the type of sensors. The aim is to control the traffic and avoiding unnecessary road accidents, traffic intersections and to intimate ambulance unit.
for immediate help via wireless sensors. Basically three units are involved in the implementation of the system:

- Vehicle Unit
- Traffic Unit
- Ambulance Unit

Research methodology/approach

A research has been conducted in order to find out the facts to implement such system. The rooted survey has been done in order to understand that how the sensors are installed, how they are going to work, how the traffic will be managed and what procedure is applied to send the messages or alert to the health Centre. Lot of theory work has been done in order to understand the concepts of GPS, GSM and wireless sensor networks. The work has undergone to find out the type of sensors and which type of sensor is suitable for the vehicle accident detection. The theoretical approach has been applied to get acquainted with Traffic unit, Vehicle unit and Ambulance unit/healthcare unit. What cost has been made for the fully fledged implementation of this system is a major issue. Although the implementation of such system is purely a practical approach but to get through this practical implementation, theoretical background needs to be clear. The working of such system is tested under various phases to make sure whether it is working perfectly fine or not. The data is collected from various sources like published research papers and journals. Once all the data has been gathered the empirical approach is applied for the implementation of the system.

Findings

This study will provide a useful tool to control the traffic on roads and provides an efficient way to deal with accidents in case of emergency where an individual may die on the spot if not reached to the healthcare Centre immediately. While studying the case study it has been found that several factors are involved to detect vehicle accidents on roads and some of them are:

- Average speed of traffic
- Traffic volume
- Road surface
- Road Gradient
- Composition of Traffic
- Driving Condition
• Current weather condition etc.

Research limitations

The main limitation of this research is the access of relevant resources as the feasibility of the solution is very high but implementation is difficult to achieve as various parameters needs to be taken care of while implementing and testing the system. Various areas have been left uncovered as the topic is a bit vast and challenging. This research paper does not discuss about detecting road accidents and contacting control rooms via smart phones. This research paper is basically based upon the wireless sensor networks and sensors which are installed underground and detect an incident or accident based upon the characteristic sound.

This research paper also does not discuss about detecting road vehicle accidents via intelligent traffic light system in which the emergency vehicles are automatically detected via sound signals and the traffic management system allows them to go without stopping. Other similar areas of research also deals with the sensor systems installed in the vehicles in which the controller is able to identify the location of accident spot.

This research paper also does not consider carbon monoxide detection by the sensors installed within vehicles. Such sensors are able to detect the air pollution and thus avoid the situation of dizziness or drunk drivers.

Originality/value

The quality work has been done from start to end. All the statistics that has been collected are from the standards tools and techniques. Questionnaires are performed to get the feedback from the developers as well as from the end users. The software and sensors that is installed is of high quality and standard as the health of drivers are taken into consideration. The implementation of this system is purely original as several such systems has been made for security and safety purposes to prevent road incidents or to inform the ambulance unit but the sensor based roads are not yet have been implemented as of now. This is an initiative to bring into notice a practical/Embedded System that can help to resolve the problems faced during vehicle accidents and ambulance arrival on the accident location. The system is really helpful from the safety point of view and proves to be an ideal solution in the cities where the traffic is at its peak. This system is so valuable to the general masses as well to the government of India.
Conclusion

The conclusion of this abstract is to implement a system that will help in detecting vehicle accidents on roads by installing sensors in roads or on roads and to send an alert about the accident occurrence via GPS or GSM which in turns send the message to control unit that is health centre.

References


Multivariable control system for controlling Air gap of Maglev Train Suspension System

Ibrahim A. Nassir, MSc Systems Engineering student
The British University in Dubai

Abstract

This paper presents the control of multivariable systems which are subjected to variable conditions such as changes in the input reference and to the external load, the area of application is to design a controller by implementing recent methodology least effort for controlling the clearance in the suspension system of (maglev train) within allowable limits, this paper will emphasize this technique and enabling comparable transient and disturbance rejection characteristics against results obtained by classical control theories, such as inverse Nyquist array and optimal control theory, an approximation allowed on transfer function to waive affection of double integrator appears in the characteristic equation. Air gap simulated to evaluate the effectiveness of the designed controller to maintain the air gap within the allowable limit, the results illustrate that the presented design can result in a satisfactory and better dynamic performance, especially promoting the reliability of the suspension control system in practical engineering application. MATLAB-SIMULINK software used for simulation of system model.

Key words: levitation (MAGLEV) train, air gap, multivariable, control, least-effort, INA, optimal, MATLAB/SIMULINK

Purpose

The main aim of this work is to study the application of recent control technique (least effort technique), to design a centralized control system for levitation (MAGLEV) train, in order to control the air gap of the electromagnetic suspension system. Evaluating the proposed controller in comparison to previous designs.

Design / Methodology / Approach:

The study conducted based on the recent technique (least effort) to design controller for multivariable system, the least effort regulating technique was introduced by (Prof. R. Whalley, and M Ebrahimi, 1999), the main steps of this procedure were, closed loop strategy, inner loop analysis, optimization, disturbance rejection analysis and stability of the combined system, the study describe that this technique gain superior performance and disturbance rejection, it also provide simpler controller than those presented by the classical control methods, it is aiming to minimize the performance index, inner loop analysis was adopted, and will be investigated to demonstrate system performance, afterward at the end design stage, the external loop constructed to achieve robustness requirements with acceptable perturbation.
Introduction

A magnetically levitated vehicle (Maglev) is a railway multivariable systems which are subjected to variable conditions such as changes in the input reference and to the external load, it is modelled as single mass system flies over a rigid guideway. The model considers that the vehicle must be actively controlled in order to overcome instability of the electromagnetic levitation system. The air gap can be defined as the space (clearance) splits the fixed guideway from lifting magnets, it must be controlled at certain limit in order to avoid any direct contact between these two parts. The control unit of levitation system contain of electromagnetics, gap sensing device, and separated controlling systems, Fig (1), Fig (2), Fig (3), as such all mechanical and electrical components to be included in the simulation of the model. In previous research controller designed by different control strategies to overcome the complicated coupling between control loops, the adopted methods were inverse Nyquist array, internal model control, inverse based decoupling control. The model reduction method was adopted by previous researchers, due to high order and complexity of controller, also an approximation was allowed in the reduced model in order to avoid influence of double integrator appears in the system characteristic equation. There are several studies conducted on designing of controllers of the electromagnetic levitation system, [4,5,6,7] , in addition to, There are numerous studies for modeling and simulation of the maglev train systems conducted by using commercial software like, ADAMS, Matlab-Simulink and Simpac.

Findings

Results

System showing better performance and faster response with new control technique (least effort) than that obtained by controller designed by classical methodology, for air gap1 (G1) fig (1)-fig (9), the system required 0.18 second to reach steady state and lifting air gap from 0 to 10 mm, while required 0.35 second in the previous control system to lift the air gap from 9 – 10.5 mm. For air gap2(G2), the time required to increasing the air gap from 0 to 4mm is about 0.01seconed and settling time to steady state at 1 mm about 0.17sec, while in the previous the required time was about 0.3 second.

From the results can conclude that the system responses obtained from the new technique (least effort) seems to be more stable and well performed, this guarantee the flexibility of design strategy. The transient response improved by designing the inner loop, while the interaction in the outputs has been reduced by designing the outer loop, and then better disturbance recovery enhanced.

Research Limitations / Implications

I would suggest for future research to do a research’s on modeling and simulation different railway systems, there were some limitation or restrictions for this study such as the availability of laboratories for practical practices in addition to non-availability of the maglev systems, limitation of the related references.
Practical Implications

The results illustrate that the presented design can result in a satisfactory and better dynamic performance, especially promoting the reliability of the suspension control system for the maglev train in practical engineering application, and integrity of railway systems.

Originality / Value

The main outcome of this study is it the first time applying the (least effort) design technique on the railway systems, this adding value to the recent technique (least effort) to design controller for multivariable system, was introduced by (Prof. R. Whalley, and M Ebrahimi, 1999).

System schematic:

![Lateral view of the CMS04 low speed maglev vehicle](image1)

![Schematic of the module suspension control system](image2)
Fig (4); the force diagram of one levitation module in lateral [1]

**System parameters:**

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<tr>
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</tbody>
</table>

Table (1): Parameters of the module suspension control system [1]
Open loop system Simulation results:

Fig (5); Open loop system response following step input at reference 1
Closed loop system Simulation results:

Fig (6); least effort controller-system response- air gap G1 following step input at reference $r_1 = 1$ With vary feedback values

Fig (7); least effort controller-system response- air gap G2 following step input at reference
\( r_1 = 1 \) With vary feedback values

![Graph showing system response for \( r_1 = 1 \) with varying feedback values.]

Fig (8); least effort controller-system response- air gap G1 following step input at reference

\( r_1 = 10 \) With vary feedback values

![Graph showing system response for \( r_1 = 10 \) with varying feedback values.]

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Fig (9); least effort controller-system response- air gap G2 following step input at reference $r_1 = 10$ With vary feedback values

Fig (10); least effort controller-system disturbance rejection response- air gap G2 following step input at reference $r_1 = r_2 = 0$, with disturbance1=1, and vary feedback values

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Investigating Project Managers’ Learning Motivation for Project Management Technical Competence Development: An Adult Learner Approach

Jimoh Kareem, PhD Candidate
Skema Business School, Lille, France.

Abstract

Public and private sector organisations all over the world execute projects for pursuing their strategic business goals. Only adequately competent project managers can help organisations deliver projects successfully. Project managers with sufficient project management (PM) technical competence are, however not easy to find.

Although project managers’ PM technical competence can be improved by learning and education through the sponsorship by employers and other organisations; to ensure sustainable PM technical competence development, project managers will have to take personal responsibilities for their PM technical competence development.

Through the lens of adult education principle and self determination theory (SDT), this deductive quantitative study will investigate: barriers to; project managers’ learning motivation for; and project managers’ preferred learning options for; developing PM technical competence.

When completed, it is predicted that this study will: identify the main barriers to project managers’ participation in PM technical competence development; reveal the project managers’ learning motivation profile based on the SDT; and identify preferred learning options for PM technical competence development by project managers.

Key words: project management, technical competence development, adult learning
Introduction

It is a widely held belief among employers of human labour that when a competent worker is engaged to perform a given task, the task will be performed effectively. The measure of effective task performance is rated in terms of performance of such task the first time in the shortest possible span of time and the successful and satisfactory outcome of the task performance. This anecdotal view also applies to the field of project management (PM).

Project managers with the right depth and breadth of PM technical competence are expected to be able to perform PM roles effectively, which should be able to lead to successful delivery of projects, since the competence of project managers is an important factor for the successful delivery of projects (Crawford, 2000).

Competence is developed through learning and education (Ashleigh, Ojiako, Chipulu, & Wang, 2012). It is therefore important to pay necessary attention to the project managers’ participation in learning activities for their PM technical competence development (Bartunek, 2014).

This research is therefore aimed investigating project manager’s learning motivation using an adult learning motivation approach. It will: look at the key factors preventing project managers from participating in PM technical competence development activities; determine project managers’ learning motivation profile based on self determination motivation continuum; and identify the learning options preferred by project managers for their PM technical competence development.

Background

In a recent study conducted by the Project Management Institute (PMI®), it was found that two-thirds of organisations find it very difficult to get project managers with sufficient PM technical skills for hire, yet 90% of organisations believe that PM skills are teachable (PMI, 2013a). The reasons why employers of project managers find it very difficult to get and hire project managers with adequate PM technical skills may be because of any of three reasons.

One of the possible reasons could be that there are no sufficient project managers within the overall PM human resource pool from which employers can hire. This pertains to dearth in number of project managers. A second possible reason could be that, although there are many project managers, the PM technical competence of (some of) the existing pool of project managers is not at the right level for the project managers to be hired by the organisations. A third possible reason could be a combination of the shortage of project managers in terms of numbers and low PM technical competence level of some of the existing project managers.
In terms of responsibility taking, there are four options as to who may be responsible for the development of the PM technical competence of project managers. One option is for the employers of project managers to take full responsibility for the development of PM technical competence of project managers employed by them. Employers will only want to spend on training of employees in areas that are specific and directly related to the performance or tasks within their organization (Green, 2011). Such skills developed with the assistance of employers are therefore likely going to be context-specific and will not give rise to reflective project managers that can adapt to changing PM roles required of project managers (Crawford, Morris, Thomas, & Winter, 2006) because of the unique nature of projects (PMI, 2013b).

A second option is for other organisations who are not the employers of project managers to take responsibility for the development of the PM technical competence of project managers. This refers to situations where scholarship awarding organisations sponsor project managers on PM training courses. This seldom occurs and when it happens, the number of project managers who can benefit from such sponsorship is very limited, compared to the number of project managers who need to develop their PM technical competence. This approach will therefore serve very limited purpose in addressing the problem of dearth of project managers with adequate PM technical competence.

A third option in terms of responsibility for the development of project managers' PM technical competence is for the project managers themselves to take personal responsibility for their PM technical competence development. This approach enlists the participation of project managers in taking ownership of the sponsorship their PM technical competence development. This will therefore offer a sustainable solution to the challenge of insufficient project managers with relevant PM technical competence.

A fourth option for developing project managers’ PM technical competence is a combination of any two or more of the three earlier options.

This study approaches the development of project managers’ PM technical competence from the point of view of project managers’ taking personal responsibility for their PM technical competence development. This approach is adopted because it is believed that it is the approach that will provide the most comprehensive panacea and sustainable solution to the problem, by producing project managers in sufficient numbers with the required level of PM technical competence.
Literature Search

Projects Financial Commitments

Organisations across various industries deploy projects as means for pursuing and achieving organisational objectives (Maylor, 2001). Projects also serve as strategic tools for moving organisations forward (Gina, 2009) and for ensuring their continuous existence as going concerns (Ramazani & Jergeas, 2015).

All over the world, both public and private sector organisations, expend significant amount of financial resources on the planning and execution of projects. It is estimated that out of the world's United States (US) $50 trillion Gross Domestic Product (GDP), one-fifth is devoted to capital formation, which comprises mainly of projects (Turner, Huemann, Anbari, & Bredillet, 2010). It is also estimated that between 2014 and 2025, about US $78 trillion will be expended on infrastructure projects globally (Oxford Economics, 2014).

Regionally, each of the Gulf Cooperation Council (GCC) countries is currently undergoing infrastructural transformation. This is made possible through the various and numerous projects being undertaken by each of the six countries making up the Council. The Middle East Economic Digest (MEED) put the monetary value of various planned and ongoing major projects in the GCC in 2015 at more than US $172 billion (MEED, 2014). These projects span the process, construction, transportation, utilities, tourism, information and technology, and manufacturing industries. These projects will require project managers with the right level of competence to manage them for successful delivery.

The Project Manager

The project manager is the person formally appointed and saddled with the accountability to deliver a project in order to achieve predefined objectives, using given set of limited resources (Jha & Iyer, 2006). The individual go by different job titles on various projects. However, a project manager is better defined in terms of the roles performed rather than the title ascribed to the role (Walker, 2002). A project manager, in the context of this research, is therefore the individual charged with the responsibility to oversee, monitor, and take overall responsibility for the successful delivery of the entire project from inception to completion (Lock, 2001).

Projects being temporary endeavours aimed at creating unique products, services, and satisfactory results (PMI, 2013b); will require project managers imbued with diverse and appropriate level of PM technical competence to make them function as reflective practitioners (Crawford et al., 2006) towards addressing novel project situations.
Competence

Competence derives from the Latin word "competentia" (IPMA, 2006). The terms “competence” and “competency” are found to be used interchangeably in the literature. Both terms have their roots in law and clinical psychology. In the two fields, the terms are used to refer to individual’s capacity to perform specific functions and take care of oneself. The two terms have since found usage in education, vocation, and other fields (Shippmann et al., 2000).

There are various definitions of the terms competence and competency in use by different scholars. In the general management literature, where the terms first found popular usage before their use in PM, competency refers to the underlying characteristics of an individual, that are, causally related to the effective or superior job performance of that individual in a given role (Boyatzis, 1982; Spencer & Spencer, 1993). Being "causally related" means that, a change in one leads to a change in the other (Spencer & Spencer, 1993). Competence refers to a “complex ability that... [is]...closely related to performance in real-life situations” (Hartig, Klieme, & Leutner 2008, p. v). Within the PM domain, competence is defined as the capability to manage projects professionally, by applying PM best practices with respect to the design of the PM process, and the application of PM methods (Gareis & Huemann, 1999).

In an attempt to distinguish between competence and competency, Dillon and Taylor (2015) define competence as “the required knowledge, attitudes, and skills required to perform a job effectively”, and define competency from a performance-based perspective as, “the ability to demonstrate appropriate behaviours in the application of relevant knowledge and skills in order to achieve effective performance in the work context” (p.91).

From the foregoing, it will therefore seem that competence consists of a cluster of knowledge, skills, and attributes that enable an individual to perform a given task satisfactorily when the performance is measured against a standard of acceptable level of accomplishment. A distinction between competency and competence seem to also be that the former refers to set performance levels in standards and frameworks for specific job roles, while the latter is demonstrated when appropriate level of knowledge, skills, and attributes are applied to the performance of a given task to achieve a predefined satisfactory level of achievement.
Classification of Competence

Katz (1955) identifies technical skills, human skills, and conceptual skills as important for the performance of managerial role. He describes possession of technical skill as the demonstration of understanding of, and proficiency in methods, processes, procedures, or techniques used in a particular trade; human skill as the ability to relate with members of a team so as to rally the team’s support towards achievement set objectives; and conceptual skill as one that enables a manager to carry out his role, while recognising the impact of his actions and inactions on the overall organisation.

The PMI® (2007) identifies three classes of competence, which are knowledge competence, performance competence, and personal competence. Knowledge competence is made up of the knowledge possessed by a project manager about the application of PM processes, tools, and techniques for the performance of project activities. Performance competence relates to how a project manager applies PM knowledge to the performance of project activities. Personal competence relates to the behaviour of a project manager while carrying out project activities within a project environment.

The PMI® also recently identifies PM skillset and termed them the new triple constraints of PM skills (PM talent triangle), which consists of PM technical skills, leadership skills, and strategic and business management skills (PMI®, 2013c). PM technical skillset broadly tallies with Katz’s (1955) description of technical skills. Project leadership competence refers to the knowledge, skills, and attributes deployed by a project manager for organising and rallying support of project team members towards achieving project objectives (Müller & Turner, 2010). Strategic and business management skill seem to relate to what Katz (1955) describe as conceptual skills.

Both the IPMA (2006) and Association for Project Management (APM) (2009) classify PM competence into technical competence, behavioural competence, and contextual competence. They also identify forty-six and forty-seven sub-competences respectively, under the three major competence categories.

Based on general management and PM literature, competence can therefore be broadly classified into technical or functional competence; behavioural, human or social competence; cognitive competence; and strategic, business, conceptual or meta-competence (Brière, Proulx, Flores, & Laporte, 2015; Winterton, Parker, McCracken, Dodds, & Henderson, 2000; Cheetham & Chivers, 1998; Shenhar & Thamhain, 1994).

The concept of competence applies at organisational level in form of core competence (Prahalad & Hamel, 1990), team or group level, and at individual level (Bredillet, 2008; Loufrani-Fedida & Missonier, 2015). This study looks at competence at individual level.
Project Management Technical Competence

PM is defined as the “application of knowledge, skills, tools, and techniques to project activities to meet the project requirements” (PMI® 2013b, p. 5). PM technical competence can therefore be described as the application of PM knowledge, skills, tools, and techniques to project activities to meet the project requirements. PM technical competence encompasses a grasp of, and the ability to be able to apply relevant PM techniques to address any novel project challenges (Stickney & Johnston, 1983).

Although a project manager needs appropriate dose of leadership and strategic and business skills as depicted in PMI’s new PM talent triangle (PMI® 2013c) apart from PM technical skills, the argument of this paper is that PM technical competence is the core skill that project managers should be well grounded in. A project manager with adequate level and breadth of PM technical competence would therefore be able to manage any project, irrespective of the technical or business context in which such project is being executed (Hartman, 2008). This, of course, will be done by employing the services of other auxiliary skills that may also be required on each project from time to time.

To sum this section, the competence of project managers can be developed (Crawford et al., 2006) to the level where they can effectively perform their PM roles on various projects. The development of competence is achievable through learning and education (Ashleigh et al., 2012; Alam, Gale, Brown, & Kidd, 2008), and, only individuals who are adequately motivated will be able to summon the courage to participate in learning and educational activities for the development of their competence (Song, 2000; Maurer & Tarulli, 1994). This therefore emphasises the role of motivation in engaging in learning for competence development.

Motivation

Motivation refers to the reason why people do what they do (Brophy, 2004). It is distinct from goal, which refers to the quality and direction of action taken in a given situation (Thrash & Elliot, 2001). Motivation is the driving force that makes people desire to act in a particular manner and gears them to taking action towards what they want to achieve (Buehl & Alexander, 2005).

There are various theories of motivation postulated by different scholars. Examples of such motivation theories include Maslow’s Hierarchy of Needs, Herzberg’s Motivation / Hygiene (two) Factors theory, McGregor’s X-Y theory, McClelland’s Need for Assessment theory, Weiner’s Goal theory, and Bandura’s Social Cognitive theory. Each of these motivation theories explain reasons for engaging in different actions. One motivation theory that relates to learning and education is the Self Determination Theory (SDT) (Deci & Ryan, 1985, 1991).
**Self Determination Theory**

SDT is a motivation theory that posits that there are different types of motivation, which vary according to the level of self-determination of behaviour involved. A self-determined behaviour is a behaviour that is freely endorsed by the individual (Deci & Ryan, 2000; Ryan & Deci, 2000). From SDT standpoint, motivation is classified into intrinsic, extrinsic, and amotivation components, with all the motivation types believed to exist in a continuum. Extrinsic motivation, which is regarded as regulated and controlled behaviour, is further classified into external regulated, introjected regulated, identified regulated, integrated regulated motivation, depending on the extent of internalisation of the behaviour and the degree of autonomy of the individual. An internalised behaviour is one in which the individual freely engages without any external prod (Schafer, 1968). To be autonomous is to “behave with a sense of volition, willingness, and congruence” and “to fully endorse and concur with the behaviour one is engaged in” (Deci & Ryan, 2012, p. 85).

External regulated motivation refers to an individual’s engaging in a behaviour because of expected reward or to avoid punishment. Introjected regulated motivation refers to engaging in a behaviour in order to avoid guilt, anxiety, or in order to enhance one’s ego or due to self pride motive. Identified regulated motivation involves engaging in certain behaviours deemed to be important, even if they are not interesting to the individual. Integrated regulated motivation refers to engaging in activities which is fully assimilated to the individual’s sense of self (Ryan & Deci, 2000).

The features of the forms of extrinsically motivated behaviour are summarised in Table 1.

**Table 1: Features of Forms of Extrinsically Motivated Behaviour**

<table>
<thead>
<tr>
<th>Type of Regulation</th>
<th>Degree of Self-Regulation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>External</td>
<td>Very low</td>
<td>Behaviour controlled by demands or contingencies external to the person.</td>
</tr>
<tr>
<td>Introjected</td>
<td>Moderately low</td>
<td>Behaviour controlled by demands or contingencies internal to the person such as self esteem contingencies.</td>
</tr>
<tr>
<td>Identified</td>
<td>Moderately high</td>
<td>Behaviour chosen because the person identifies with the importance of the activity.</td>
</tr>
<tr>
<td>Integrated</td>
<td>Very high</td>
<td>Behaviour experienced as “wholly free” because the regulation has been integrated with the person’s sense of self.</td>
</tr>
</tbody>
</table>

Source: Deci, Ryan, & Williams, 1996, p. 168.
Intrinsic motivation is an autonomous behavior which is displayed when an individual engages in a given behaviour because of genuine interest in, and love for the activity. Amotivation occurs when an individual behaves in a manner, without any interest in the activity being carried out, or even out of coercion (Deci & Ryan, 2000).

This study is aimed at identifying the motivation profile of project managers regarding their participation in PM technical competence development activities.

Learning

Project managers’ PM competence can be developed through learning and education (Ashleigh et al., 2012; Alam et al., 2008). Learning can be defined from either a process or product perspective. From a process perspective, learning is seen as a process through which behaviour changes as a result of experience, and when viewed from a product perspective, learning refers to a change in behaviour (Merriam & Caffarella, 1999). Both definitions, however, suggest that the ultimate objective of learning is to engender desired behaviour. The acquisition of desired behaviour leads to improved competence (Crouse, Doyle, & Young, 2011), which invariably leads to improved performance (Bennet & Bennet, 2008).

If PM technical competence can be developed (Crawford et al., 2006) through learning and education (Ashleigh et al., 2012; Alam et al., 2008), yet about two-thirds of organisations find it difficult to find project managers for hire (PMI, 2013a), it is therefore important to investigate the reason for this scenario. This gives rise to the research question:

What are the main barriers preventing project managers from participating in PM technical competence development?

Generally, learning takes any of the forms of individual and collective learning; exploratory and exploitative learning; and intuitive and sensing learning (Wang & Chugh, 2014). In the project environment, learning can be within projects and between projects (Dutton, Turner and Lee-Kelley, 2014; Kotnour, 2000).

Project managers’ learning may not, however, be approached from the usual pedagogical point of view. This is because most of the learning by project managers is undertaken after obtaining basic education, usually after obtaining bachelor’s degree (Turner, Keegan, & Crawford, 2000). Project managers are therefore adults who are responsible for themselves and would be able to determine the direction of their
PM technical competence development, depending on the personal goal set by them, for engaging in learning activities (Knowles, Holton, & Swanson, 1998).

**Adult Learning**

The definition of an adult can be viewed from any of biological, legal, or social and psychological perspectives (Merriam & Brockett, 2007). Biologically, there are certain physical features which are associated with the attainment of adulthood. From a legal perspective, the laws in various countries stipulate the age at which individuals are considered as adults. The norms in different localities also set the socially agreed criteria for identifying an adult. An adult is therefore one regarded as adult in the society where they belong (UNESCO, 1997).

Adult education refers to all spectrum of learning undertaken by adults to improve their cognitive abilities, develop their knowledge, and enhance their technical and professional competence, in the course of their career (UNESCO, 1997). Project managers can therefore be regarded as adult learners. One factor that has been found to engender participation in adult education is learner motivation (Cross, 1981; Galvin, 2003; OECD 2003).

**Adult Learning Motivation**

Studies on the factors militating against adults’ participation in continuous education have identified lack of motivation, lack of time, lack of money, and lack of employer support (Cross, 1981; Galvin, 2003; OECD 2003). There are also some adults who lack outright interest in education, without any particular reason (Ahl, 2006; Cross, 1981). For such adults, no amount of encouragement will make them imbibe education.

Projects managers being adults, this paper posits that the factors adduced to by adults for non-participation in education should also be applicable to project managers’ non-participation in PM technical competence development. This is therefore the basis of the research question:

**To what extent are the types of adult learner motivation within the self determination theory relevant to project managers’ motivation to engage in PM technical competence development?**

**Forms of Adult Learning**

Adult learning can take any of the form of formal, non-formal, or informal learning (Coombs & Ahmed, 1974). Formal learning usually takes place in established academic institutions, is structured and
systematic, and lead to the award of certificates and diplomas after completion (Coombs & Ahmed, 1974; Colardyn & Bjornavold, 2004).

Informal learning refers to learning that takes place outside academic institutions. They are usually unstructured and unsystematic, but they account for a sizeable portion of learning by adults (Coombs & Ahmed, 1974). They sometime take place while the learner is oblivious of the occurrence of learning (Marsick & Watkins, 2001). Non-formal learning refers to other forms of structured learning that takes place in learning institutions that are regulated by relevant authorities, as is done with formal learning (Werquin, 2010).

Project managers’ learning for PM technical competence development will therefore be in form of any or a combination of formal, informal and non-formal learning. This leads to the research question:

**What are the major options of adult learner competence development which are relevant to project managers’ PM technical competence development?**

**Methodology**

Research is a systematic form of inquiry with clear objective and aimed at discovering new idea, providing new insight into existing problem, or raising further questions regarding a phenomenon (Naoum, 2007).

The terms research methodology and research method are often used interchangeably by scholars. Research methodology refers to a researcher’s theoretical tendency and research approach (Hussey & Hussey, 1997), while research method refers to the techniques used in obtaining and analysing research data (Saunders, Lewis & Thornhill, 2009).

There are three main research methods in use in the social and behavioural science field, which are qualitative research, quantitative research, and mixed-method research (Teddlie & Tashakkori, 2009). Qualitative research involves the formulation of propositions, collection and analysis of narrative data, with the aim of understanding the phenomenon under study (Strauss & Corbin, 1994). Quantitative research is concerned with the formulation and testing of hypotheses regarding a phenomenon with the aim of generalising the finding of the research (Jackson, 2008). It relates to “the gathering, analysis, interpretation, and presentation of numerical information” (Teddlie & Tashakkori 2009, p. 346). Mixed method research involves a combination of the features of qualitative and quantitative in a single research or series of research (Creswell & Plano Clark, 2007).
There are various forms of qualitative and quantitative research approaches. Examples of forms of qualitative research approach are case study research, grounded theory, and ethnographic studies. Examples of forms of quantitative research approach are desk research, experimentation, and survey research (Fellows & Liu, 1997). The current research is a quantitative survey research, which involves the formulation of hypotheses regarding main barriers to project managers’ participation in PM technical competence development; project managers’ motivation to engage in PM technical competence development; and project managers’ preferred learning option for PM technical competence development.

Research Philosophy

Birks (2014) define philosophy as “a view of the world encompassing the questions and mechanisms for finding answers that inform that view” (p.18). This definition is akin to that of research paradigm, which is regarded as “universally recognised scientific achievements that for a time provide model problems and solutions to a community of practitioners” (Kuhn 1962, p. viii). Research philosophy therefore refers to a researcher’s system of belief and assumptions regarding the development of knowledge (epistemology) and the nature of knowledge (ontology) being developed (Saunders et al., 2009).

There are two extreme ends of epistemology within which other epistemological views can be situated, which are positivist view and interpretivist view (Bryman, 2001). The positivist approach is predicated on the assumption that reality exists outside and independent of the researcher (Chia, 2002). All that a researcher needs to do is to seek the reality of the phenomenon being investigated. This approach involves the taking of objective view and formulating hypothesis, with the aim of verifying, modifying or falsifying existing scientific laws, theories, principles, or models (Thompson, 1995).

On the other hand, interpretivist epistemology is based on the assumption that reality is subjective and socially constructed, taking account of the context and circumstances surrounding the phenomenon being studied in deriving inference regarding such phenomenon (Remenyi, Williams, Money, & Swartz, 1998). The implication of holding the view that reality is subjective is that there could be multiple realities, depending on the views taking by each researcher (Guba & Lincoln, 1997).

Other epistemological views that fall between the two extremes of positivism and interpretivism are post-positivism and pragmatism. The post-positivists believe that it is difficult to attain the ultimate reality or truth, and therefore study a phenomenon taking account of existing facts and the context in which the phenomenon exists (Crossan, 2003). Pragmatism is an epistemological view that considers the research question as uppermost, and the researcher could therefore adopt the sampling and data analysis method most suitable for addressing the research question (Powell, 2001).
It is important for a researcher to ensure coherence between the research philosophy, research method, and techniques adopted for the conduct of the research (Saunders et al., 2009). This research is therefore a quantitative survey research based on deductive ontology and a post-positivist epistemology.

**Expected Research Outcome**

This research is expected to highlight the main reasons why project managers do not seem to be willing to participate in PM technical competence development. It is expected that the reasons for project managers’ non-participation in PM technical competence development will range from lack of time to spare and spend on PM technical competence development; lack of personal funds to commit to participating in PM technical competence development activities; lack of inner drive to summon the courage to engage in PM technical competence development; or not even ascribing any importance to the development of their PM technical competence.

The research will also indicate the learning motivation profile of project managers within the SDT motivation continuum. It is predicted that many of the project managers will display autonomous behavioural profile by revealing moderate to high level of intrinsic motivation and identified regulated motivation and low level of introjected regulated motivation, external regulated motivation, and amotivation on the SDT motivation continuum. It is also predicted that some of the project managers will display a level of controlled behavioural profile by exhibiting low level of intrinsic motivation and identified regulated motivation and moderate to high level of introjected regulated motivation, external regulated motivation, and amotivation. The research may also result in project managers with a combination of high level of both autonomous and controlled behaviour.

The research is also predicted to identify the type of learning preferred by project managers for developing their PM technical competence development among formal, non-formal, and informal forms of learning. Since the project managers are already working, it is predicted that many of the project managers will report informal learning option as their preferred method for developing their PM technical competence. It is also likely that some of the project managers will report preference for formal learning while others will report preference for non-formal learning for their PM technical competence development. It is also predicted that some of the project managers will report a combination of informal and either formal or non-formal learning options for the development of their PM technical competence.
Limitation

This research is aimed at investigating project managers’ learning motivation for PM technical competence; it is not investigating project managers’ PM technical competence, nor is it investigating the performance of project managers with adequate PM technical competence.

Conclusion

Majority, if not all employers of human labour, will prefer engaging competent individuals for the performance of organisational tasks, and this is the same for employers of project managers. Only adequately competent project managers can help deliver projects successfully. There are not so many of such competent project managers for hire.

PM competence has been broadly categorised into technical or functional competence; human or managerial competence; and conceptual or meta-competence. While all these competence categories are important and useful, PM technical competence is considered the foundation upon which a project manager may need to build other competences.

A project manager with adequate level of PM technical competence should be able to successfully perform his PM role, while leveraging on and seeking support of other auxiliary roles, when needed.

Projects are unique by nature and project managers will therefore need to continue to learn from time to time, depending on the nature of challenges faced on different projects. Project managers will therefore need to be self-motivated to continuously engage in learning for their PM technical competence development. They will also need to scale through barriers against their participation in PM technical competence development activities, by identifying their preferred learning option for PM technical competence development.
References


Success of the Projects with High Public Usage: The Role of Benefits in Global TOD Initiatives

Egor Krivosheya, Moscow School of Management SKOLKOVO
Evgeny Plaksenkov, Moscow School of Management SKOLKOVO

Abstract

This article evaluates the role of benefits for the financial and management decisions in the projects with the aim at high public usage. Using fsQCA method on the sample of 20 transitoriented development (TOD) project launch cases worldwide, this article finds significant, robust evidence in favor of benefit importance for the project success. Results show that the benefit diversity is a necessary condition for the project funding and welfare improvement success, while the small number of minimal benefits among all stakeholders necessarily leads to funding and welfare implications inefficiencies. The lack of benefit diversity is also necessary for small welfare improvement. Results imply that the focus on benefits during different project management stages is detrimental for project success and propose a mechanism for implementing benefits in capital budgeting, valuation and other financial decisions.

Keywords: Transit-oriented development; benefits; project success; financial modelling; capital budgeting
The Financial risk management in the Governmental projects in Dubai

Alia Marjan, PhD Project Management student
The British University in Dubai

Abstract

This study aims at achieving some theoretical purposes related to the understanding of financial risks associated with projects sponsored and funded by governments, and practical purposes related to the financial risk management of projects sponsored and funded by the Government of Dubai. On the theoretical level, this study will address the existing gap in the literature which can be identified on some levels. First, there is the gap between the conventional framework and more recent developments in the understanding of financial risks associated with projects. The conventional framework perceives financial risk as a specific risk that is narrowly defined and restricted to specific areas such as the availability of financial resources, the allocation of financial resources, and disruptions in the flow of financial resources. In contrast, the comprehensive approach does not perceive financial risk as a variable in itself, but as a construct that constitutes of multiple variables and that is interrelated with other risk variables. These developments in the study of financial risk must be reflected in the concept of comprehensive financial risk management which addresses financial risk from several perspectives, not only from the conventional perspective that strictly focuses on the availability or disruption of finances. On the practical level, this study aims at achieving two important goals. The first is to map comprehensively the financial risk management and control systems, structures and mechanisms adopted by the relevant authorities in Government of Dubai. This is followed by the analysis of the strengths and weaknesses of these systems, structures and mechanisms by benchmarking against comparative systems adopted by some other government involved in financing mega projects.

This study aims at answering the following primary research questions:

- What are the types of financial risks that face the implementation of government projects in Dubai?
- To what extent is the current financial risk management system adopted by the government of Dubai for its sponsored projects in line with international best practices?
- What is the impact of financial risks on government projects in Dubai?
- How can the risk management department in Dubai identify financial risks related to government projects?
- What are the appropriate controls and mechanisms that the government of Dubai should apply to mitigate financial risks associate with government projects during the implementation stage?
Tonnquist (2009) warns that project implementation process encounters a series of challenges that the project management team must be aware of, and determine how to deal with them adequately. Government officials responsible for such Projects, Programs, and Portfolio Management (PPPM) must be aware that they are dealing with projects that face risks. Therefore, that if these risks are not handled appropriately, a project may fail to achieve its objectives. According to Nagarajan (2005), one of the main reasons that lead to ineffective project delivery is an inefficient analysis of risk factors that are involved in the project. Various risks are associated with project implementation including political risks, financial risks and project performance or appraisal risks (Mullaly 2006). Financial risks have major impacts on the success of projects, especially those that require heavy financial investment. Bonaime, Hankins and Harford (2014) define financial risks as any risks that refer to the volatility of variable returns, resulting in the deviation of actual results from expected outcomes. Arena and Arnaboldi (2013) classify financial risks into two categories, namely internal risks that emerge within the firm and which may be related to the financial capabilities or limitations of the firm undertaking the project, and external financial risks which may be related to the environment in which the project is being executed, such as inflation or the rise in the costs of materials. On the other hand, Grimsey & Lewis (2002) classify financial risks associated with projects as volatility related to two distinct types of risks, namely those involved in the development phase such as capital costs and the costs of design, and those related to the operational phase of a project such as the stream of revenues and recurrent costs such as wages, asset operations, maintenance and insurance. Alternatively, Xenidis and Angelidis (2005) define financial risk as any risk that emerges from a financial or economic source, and which is related to the funding of a project and the commercial, competition, loans, and demand issues of a project. While the financial risk may constitute one element of the wide array of risks that often face projects, financial risk is often one of the major reasons for the failure of projects, especially those projects characterized as mega-projects (Field & Keller, 1998). Accordingly, it is not surprising that the study of financial risk and the concept of financial risk management has received unusual attention in recent years. It is also not surprising that the definition of financial risk still lacks consensus, especially in the context of projects, a fact that is attributed to the variety of sources of financial risk and the different types of financial risks that may be country-specific and/or project specific (Xendixi & Angelidis, 2005).

From the literature review, an initial conceptual framework built to have a road map to examine the impact of financial risks on the government projects in Dubai and the management of these financial risks.

The researcher chooses the qualitative method as a research approach; the data collection is done through investigating the case study in the selected government organization which implements mega projects in Dubai and conducting semi-structured interviews with staff who their jobs are pertaining to the projects and risk management. The study concludes that it is important to identify various constraints that may have a direct impact on the success of the project and define the best approach that can be used to deal with them. This research has demonstrated that the impact of financial risks on the government projects in Dubai can be very devastating, especially when measures are not taken to control them in time. Projects may face financial risks because of some reasons. One of the main reason that may cause
financial risks within a project is the changing economic environment within the country. Issues such as inflation always have the effect of increasing the cost of undertaking a given project. Such inflation increases the price of both labor and materials needed for the normal operations. Another possible cause of financial risks in government projects can be a source of funding. The main source of funding for government projects come from public coffers. The government may fail to avail the needed liquid and material assets to the project team members in good time. This would delay such projects, making it difficult to achieve the originally planned objectives at the right time. When these financial risks are not mitigated in good time, there can be a series of consequences that may be faced in the project. Some projects have completely stalled in the past due to financial risks they faced during their implementation. Based on the findings, the researcher recommends the necessary improvements or corrections to ensure that the financial risk management system adopted by the Government of Dubai is aligned with international best practices.

References


Approaches to Learning Adopted by Students of Architecture – A Classification

Ashok Ganapathy Iyer, PhD Student, 
Welsh School of Architecture, Cardiff University, UK

Abstract

The paper explores the ongoing PhD research work being done to classify the students’ approaches to learning in architectural education through an international perspective. The research hypothesis, the qualitative methodology used for the research; phenomenographic research and approaches to learning are reviewed in detail. The results of the pilot study conducted to understand the phenomenographic approach is discussed with reference to earlier studies in higher and university education. The paper attempts to present ‘the way forward,’ by initiating a discussion within the research community on the research journey adopted in the search of this classification.

Introduction

The research has looked into the nature of students’ approaches to learning in the architecture program through their experiences in the core coursework of architectural design, presented within the larger research context of architectural education. What are the approaches to learning being adopted by the students of architecture in the coursework of architectural design, has led to another exploratory question; how theory introduced in the first year architectural design coursework impacts on their learning approaches in the subsequent years? The above research hypothesis has been further reinforced by the research question; why do approaches to learning evolve in the architectural design coursework from the first to the final year? The basis to look at learning approaches in architectural education is due to the significant research gap in this field in comparison to the relative clarity within research in other disciplines. The aim is to classify the learning approaches adopted by students of architecture in their design coursework, with the vehicle for this classification being explored through theory introduced in early-stage curriculum and its impact on the learning approaches in the subsequent years. The main objective of the research is to identify the approaches to learning adopted by students of architecture in their design project work by looking at theory introduced in the students’ first year core coursework of architectural design and using that as a vehicle to evaluate their learning approaches in subsequent years. The research has endeavored to classify these learning approaches to understand how they actually manifest themselves in architectural education. The identified research methodology; phenomenography has been used to categorize the students’ approaches to learning in the early-stage curriculum and subsequent years of their architectural program. The research outcome will be presented as categories of approaches to learning presented through an outcome space.
Literature Review

Approaches to learning with reference to students in higher education have been expressed in terms of surface and deep approaches (Marton and Säljö 1976). The surface to deep approaches to learning within the research in higher education has been variably studied in multitude of disciplines. Students’ approaches to learning are directly correlative to their prior experiences of studying and understanding the key concepts of the subject matter, which is vital to the subsequent approaches to studying and learning outcomes (Prosser and Trigwell 1999). Thus research into the approaches to learning has been an endeavor towards reflecting on the student’s experience within the domain of higher and university education.

Teaching and Learning in Higher Education – 3-P & Phenomenographic Model

Research into the teaching and learning in higher education has evolved in the past century with a series of theories being put forward by various schools of thought following quantitative, qualitative and mixed methodologies. This journey includes the schism that has developed within the research of higher education at the university where the researcher and teacher are required to holistically look at learning and teaching as a living eco-system (Schon 1987) with the introduction of various theories of learning from the implicit-theories-in-use to the explicit theories or formal theories of student learning; which includes the classroom-based theories of learning, the institutional model, and the phenomenographic model (Biggs 1994). A distinctive differentiation of the classroom-based theories of learning and the institutional model where the student’s characteristics with reference to the teaching context and the approaches to learning, thus taken in achieving the learning outcome is seen through the 3-P Model or the Presage – Process – Product classroom teaching model and the phenomenographic model where the learning is seen through the perspective of the learner i.e. the student (Biggs 1994). The emphasis is to the use of the phenomenographic approach in the understanding of learning and teaching through the students’ prior experiences and their prior understanding as the key towards looking at the learning approaches, they take in their education and learning outcomes (Prosser and Trigwell 1999).

3-P Model and the Phenomenographic Approach

The 3-P or the Presage – Process – Product classroom teaching model is based on the model that was derived from Dunkin and Biddle (1974) and the present version by Biggs (1987-93) was visualized as a dynamic system within an educational event with a mutual interaction between the students’ approaches to learning forming an important part within factors such as prior knowledge, their ability and preferred approaches to learning; the teaching context which includes factors such as objectives of teaching and assessment coupled with institutional procedures and environment; on-task approaches to learning or learning - focused activities, and learning outcomes from a quantitative and qualitative basis (Biggs, Kember, and Leung 2001). The Study Process Questionnaire (SPQ) (Biggs 1987) and Approaches to Study Inventory (ASI) (Entwistle & Ramsden, 1983) have been used as the quality indicators for the 3-
P model and studied from an individual constructivist, social constructivist, or a cognitivist perspective with the three perspectives taking a dualistic viewpoint wherein the individual and the world are seen as independent entities and the process of knowledge is studied accordingly. Trigwell & Prosser have argued for a constitutionalist perspective using the phenomenographic approach to reflect on the relational nature of teaching and learning and re-conceptualize the 3-P model to study their conceptions. Theoretically using the phenomenographic approach, they have pointed at a major task of teaching for the teacher in creating teaching and learning situations in similar ways in which students would experience the teaching and learning content that the teacher has designed (Keith and Michael 1997; Trigwell and Prosser 1997). Trigwell et al. (2005) have also used the phenomenographic approach by developing the structural component using the elements of the Structure of the Observed Outcome (SOLO) Taxonomy (Biggs & Collis, 1982) and pointed at qualitatively different ways in which university teachers’ experiences change in their understanding of the subject matter, they have taught (Keith et al. 2005). This brings us back towards understanding phenomenography as a research approach and how can the phenomenographic perspective be used in understanding the learning approaches within the architectural design coursework.

The students of architecture are introduced to various theoretical constructs in the coursework of architectural design as a part of their architectural curriculum. The study has looked at the theory introduced within architectural design coursework in the students’ first year as the research vehicle to evaluate their learning approaches in subsequent years. The vehicle of the introductory theory-based model of looking at their design coursework is the most appropriate way of classifying the students’ learning approaches instead of history and theory or technology; as architectural design plays a central role in the design studio through the years of their architectural education. The academic context has been explored from a historic background of literature review with the focus on approaches to learning in architectural education (Iyer 2015). This review has explored facets of students’ learning approaches in the coursework of architectural design (Roberts 2006; Webster 2001, 2004), the design studio (Schon 1985); in addition to the historic and prevailing schools of thought with reference to the architectural curriculums (Bax 1991; Gulgonen and Laisney 1982; Littmann 2000). The learning approaches shall be categorized using a phenomenographic study. The physical domain of the research has been taken from an international perspective by looking at the design curricula with reference to the architectural programs at four schools of architecture including one each from United Kingdom and India; with two from the United States of America (Iyer 2014-15).

Research Methodology

The focus of the research is to explore the approaches to learning of architecture students using the qualitative research methodology of Phenomenography. Phenomenography has been defined by Marton (1992) as “the empirical study of the limited number of qualitatively different ways in which we could experience, conceptualize, understand, etc. various phenomena in and aspects of the world around us. These differing experiences, understanding, etc. are characterized in terms of categories of
descriptions, logically related to each other, and forming hierarchies in relation to the given criteria. Such an ordered set of categories of description is called the outcome space of the phenomenon or concepts in question” (Drew, Bailey, and Shreeve 2001). Using this research methodology, the researcher can put together a “range of different ways in which people understand and experience the same thing” and “is interested primarily in surfacing variation of experience and understanding” (Cousin 2009). “Each phenomenon in our world can be seen and understood in only a limited number of distinctively different ways” and this understanding can be correlated by defining it “as the experiential relations between an individual and a phenomenon” (Marton 1992).

Phenomenography helps the researcher in mapping the experiences of the research participants based on their understandings of the phenomenon. It reflects these understandings within a limited range or categories of description, helping further in building an outcome space for the said phenomenon and the final analysis. The approaches to teaching and learning in various fields of higher education and in creative fields within design education have been studied using Phenomenography. With an emphasis on design education, literature review on phenomenography points at further research that needs to be undertaken in the design curricula for architectural education (Bailey 2002; Drew, Bailey, and Shreeve 2001; Trigwell 2002).

Pilot Study & Results using the Phenomenographic Approach

The pilot study looked into the architecture students’ evolution in their learning approaches by comparing the first year and fourth year of the program; charting the variation and exploring the reasons this evolution. The study was aimed to understand phenomenography as a methodology in identifying learning approaches from a qualitative perspective. A sample of thirty-nine students in two colleges of architecture in India participated in this study.

The semi-structured interviews undertaken using phenomenography; focused on the students’ approaches to learning in the architectural design coursework of first and fourth year with the design project as the learning context. The study was done on the lines of earlier phenomenographic studies to understand the variation in the approaches to learning of fashion design students based in various institutions in the United Kingdom (Bailey 2002; Drew, Bailey, & Shreeve, 2001).

A sample of first year and fourth year students from two schools of architecture were interviewed to understand the approaches to learning with reference to their architectural design course work. A semi-structured interview using the phenomenographic approach was designed and ethical approval for the interview questions was obtained. The interviews were conducted for a sample of ten students of each year, chosen randomly from the year’s population for the selected schools of architecture. A qualitative analysis of the students’ responses to categorize the approaches using phenomenography was undertaken and used for the final study. A paper was published in a peer-reviewed journal, outlining the full project (Iyer and Roberts 2014).
<table>
<thead>
<tr>
<th>Approach</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Approach A</td>
<td>Series of steps taken from the introduction of the design problem to the completion of the final solution with emphasis on presenting a good output and preparing a good portfolio.</td>
</tr>
<tr>
<td>Approach B</td>
<td>Trying to understand or experience architecture using the experiences of the faculty as a scaffold or reflecting on their instructions to present the learning outcome.</td>
</tr>
<tr>
<td>Approach C</td>
<td>Evolving perceptions of architecture by adopting a series of steps within the process of design which is based on a product-focused outcome.</td>
</tr>
<tr>
<td>Approach D</td>
<td>Evolving the perceptions of architecture through the process of design which is based on a process-focused outcome.</td>
</tr>
<tr>
<td>Approach E</td>
<td>Conceptualizing the thought process and using it in the evolution of architecture based on in-depth experiences directly correlative to perceptual psychology within the students’ experiences.</td>
</tr>
<tr>
<td>Approach F</td>
<td>Students’ reflecting into the conceptual and abstract focus towards design based on an innately creative and experiential level of understanding architecture.</td>
</tr>
</tbody>
</table>
Table 2 - The Focus on Approach to Learning (based on Bailey, 2002) (Bailey 2002; Iyer and Roberts 2014)

<table>
<thead>
<tr>
<th>Deep</th>
<th>Surface</th>
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</thead>
<tbody>
<tr>
<td>Text – based</td>
<td>Meaning of Text</td>
</tr>
<tr>
<td>Practice – based (Fashion Design)</td>
<td>Visualization of concepts</td>
</tr>
<tr>
<td>Practice – based (Architectural Design)</td>
<td>Visualization of conceptual &amp; abstract focus</td>
</tr>
</tbody>
</table>

Table 3 – The Act of Learning Intention (based on Bailey, 2002) (Bailey 2002; Iyer and Roberts 2014)

<table>
<thead>
<tr>
<th>Deep</th>
<th>Surface</th>
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<tbody>
<tr>
<td>Text – based</td>
<td>To understand</td>
</tr>
<tr>
<td>Practice – based (Fashion Design)</td>
<td>To develop one’s own conceptions</td>
</tr>
<tr>
<td>Practice – based (Architectural Design)</td>
<td>To develop one’s own conceptions of architecture based on creative and experiential level of understanding</td>
</tr>
</tbody>
</table>
Table 4 – Approaches to Learning activities (based on Bailey, 2002) (Bailey 2002; Iyer and Roberts 2014)

<table>
<thead>
<tr>
<th>Deep</th>
<th>Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text – based</td>
<td>Organizing and integrating content</td>
</tr>
<tr>
<td>Practice – based (Fashion Design)</td>
<td>Relating fashion to own life world</td>
</tr>
<tr>
<td>Practice – based (Architectural Design)</td>
<td>Conceptual and abstract focus based on creative &amp; experiential level of understanding architecture</td>
</tr>
</tbody>
</table>

Analysis

The pilot study titled ‘A phenomenographic study in understanding the design students’ approaches to learning the coursework of architectural design’ and its publication has given a clear direction to the final study of my on-going PhD studies (Iyer and Roberts 2014).

The pilot study using the phenomenographic and identified learning approaches adopted by the students of the first year and fourth year of the architecture program as per Table 1 that reflects a variation between product-focused to process-focused and in the direction of concept-focused approaches. Table 2 to 4 has presented a comparison between the dimensions of learning approaches within practice-based learning contexts of architectural design and fashion design; in reference to the
text-based learning context by Marton & Saljo (1976). Table 2 represents the depth in the learning approaches within the architectural design coursework in comparison to fashion design; in the overall framework of deep and surface approaches of text-based learning context. Table 3, presents architectural education in the macro to the micro realm which far exceeds the boundaries of fashion design education in the practice-based learning context. Table 4 is a comparison of the categories of approaches derived from the current study to the earlier studies done on fashion design. Table 1 to 4 represent a new dimension to the practice-based learning context of architecture education and my ongoing work within the international context dwells into the entire cross-section of the five years of the architecture program.

The identified categories of approaches adopted by first and fourth year architecture students is connected to how the concepts of deep and surface approaches to learning manifest themselves in architectural education pointing towards a more complex set of learning approaches than just a simple deep and surface division (Iyer and Roberts 2014). It also raises a further question on do the categorized approaches form different points on a continuum between deep and surface, or are some in a different dimension. The literature review on students’ learning approaches in architectural education has provided further pointers from the surface to the deep dimension, through years of training and reflective practice in architectural education (Iyer 2015).

Discussion

The approaches to learning in higher education were reviewed by focusing on deep and surface approaches to learning adopted by the students’ cohort and the various student learning models that have been used to map these approaches. The review furthured looked at learning and teaching models with an emphasis on the qualitative research methodology – ‘Phenomenography;’ and a differentiation of the ‘phenomenographic approach’ from ‘phenomenological approach’ or ‘Phenomenology.’ The students’ experiences of their approaches to learning with specific emphasis to learning outcomes; as foreseen by them and the teachers’ community were also reviewed using phenomenography. The students’ approaches to learning in architectural education were reviewed using the vehicle of theory introduced in the early-stage of the architectural curriculum within the coursework of architectural design. The review further looked at the manifestation of the approaches to learning in subsequent years of the architecture program and studies conducted using phenomenography which has helped in formulating the research methodology for the proposed research. The review also presented a general overview of the physical domain of this research on architectural education with specific reference to the four schools of architecture and the introductory theory coursework of architectural design in the early-stage of the architectural curriculums in these schools. A paper has been published in a peer-reviewed journal and through research funding, I attended an international conference on early-stage curriculum which is outlined in this literature review (Iyer 2015).
Implications & the Way Forward

For the final data collection, a sample of the first year and advanced years students were interviewed to understand and classify the conception of approaches to learning in architectural education. This was done through a series of semi-structured interviews to explore the learning experiences of the students’ cohort using phenomenography by charting the theory introduced in the early-stage of the architectural curriculum on the advanced level architectural design coursework in the subsequent years of the architecture programs at two schools of Architecture in United Kingdom and India. A semi-structured interview was prepared for the students’ cohort to get an in-depth perspective on the approaches to learning and eventual outcomes using phenomenography (qualitative method). Ethical approval was obtained from the Research Ethics Committee – Welsh School of Architecture (WSA), Cardiff University for the interview and questions. As a part of the phenomenographic study, semi-structured interviews were conducted using the learning context of the design project work done in the architectural design coursework. This was done with reference to the two schools of architecture as the physical domain of the research. The interview was piloted on a small sample of first and senior students with the data being used to refine the questions. Semi-structured interviews were conducted on a sample of ten to fifteen students for each year from the first year to the final year, chosen randomly from the year’s population and the design faculty from the selected schools of architecture. The interim qualitative analysis of the students’ responses to categorize the same using phenomenography involved data collection through semi-structured interviews with the students on a one-to-one basis. These interviews were recorded and transcribed as per the guidelines set up by the Research Ethics Committee, WSA. The transcribed data from the students’ cross-section of each school were codified manually and using NVivo; a qualitative and data analysis software. The transcripts went through a series of iterations where the experiences of the students with reference to the set phenomena within the research question were codified and de-contextualized from the original experience. These went through further iterations and were presented as categories of description with reference to the approaches to learning for each year of the architecture program for various Schools. These categories of description were then placed within an outcome space for qualitative interpretations in the form of a conclusive discussion with reference to the research question.

The data collection done at one school was analyzed using the phenomenographic approach and this interim qualitative analysis was assessed by identifying the categories of learning approaches. These interim findings were presented in a Research Seminar to get the viewpoint of experts at WSA in February 2014. Based on the interim review, the current analysis was further strengthened by a Focus-Group Discussion with a group of 6 to 8 students from each year for two schools which focused on four broad areas.

1. Theory introduced in early-stage of the architectural curriculum and its relevance in the architectural design studio
2. Role of tutors and critique in the architectural design studio
3. The design process adopted by the students in the architectural design studio
4. The philosophy of the school and its relevance in the architectural design studio

On the similar lines, data collection through semi-structured interviews were conducted at two more schools of Architecture in the United States of America. The final analysis of the categories of description, outcome space and focus group discussions is being conducted manually and using NVivo to determine approaches of learning adopted by students with a focus on the coursework of architectural design in the architecture program.

Acknowledgements

I take this opportunity to thank the Research and Development Program, Manipal University – Dubai for the research grant given in 2014 that partly supported by data collection at the two schools of architecture in the United States of America and attending NCBDS – 2015 in Houston, Texas.

References


Effect of the supporting electrolyte concentration on energy consumption and defluoridation of drinking water in the electrocoagulation (EC) method

*Khalid S. Hashim, PhD student, Department of Civil Engineering, School of the Built Environment, Liverpool John Moores University, UK. Babylon University, Department of Environmental Engineering, Iraq.*

Andy Shaw
School of the Built Environment, Liverpool John Moores University, UK.

*Rafid Alkhaddar
School of the Built Environment, Liverpool John Moores University, UK.*

Montserrat Ortoneda Pedrola
School of the Built Environment, Liverpool John Moores University, UK.

*David Phipps
School of the Built Environment, Liverpool John Moores University, UK.*

Abstract

Electrocoagulation (EC) is of growing interest due to its ability to treat a variety of pollutants from both water and wastewater. However, wider uses of this method are limited by several operational parameters such as electrolysis time, current density, and electrode materials. Therefore, many studies have been devoted to investigating the influence of these operating parameters on the removal of different pollutants.

In this context, the effects of the supporting electrolyte concentration (SEC) on energy consumption and defluoridation of drinking water by EC have been explored in this study. A new reactor was used to investigate the effects of SEC on both energy consumption and fluoride removal from drinking water. The obtained results demonstrated that the influence of SEC varied between significant (on energy consumption) and slight (on fluoride removal). It was found that adding SEC to increase water conductivity from 0.2 to 1 mS.cm\(^{-1}\) significantly reduced the energy consumption from 3.7 to 0.79 kW.h/m\(^3\) and reasonably increased fluoride removal efficiency from 90.2 to 98.3%.

**Keywords** — Iron removal, energy consumption, water temperature, flow column, electrocoagulation.
Introduction

The increasing interest of electronics market on semiconductor materials use has resulted in the production of large amounts of fluoride-containing wastewaters (Maleki et al., 2015, and Melidis, 2015), as the semiconductor industries use large quantities of hydrofluoric acid (Hu et al., 2003). The absence of fluoride in drinking water causes dental cavities, but its presence with concentration more than 1.5 mg/L causes bone diseases (Hu et al., 2003, and Zhang et al., 2015). Therefore, the maximum permissible concentration of fluoride has been limited, by the WHO, to 1.2 mg/L (Tezcan et al., 2013). Several methods have been practiced to reduce the concentration of this element in drinking water to the permissible limit, such as using bone char or calcite (Yang et al., 1999, and Hu et al., 2007), Donnan dialysis (Hichour et al., 1999), calcium precipitation (Maleki et al., 2015), adsorption onto hydroxyapatite (HAP) (Melidis, 2015), and electrocoagulation (EC) (Mameri et al., 2001, Zuo et al., 2008, Emamjomeh and Sivakumar, 2009, and Tezcan et al., 2013). The EC method is growing in interest because it does not require chemical additives, is easy to run, and produces less sludge (Mollah et al., 2001; Zhu et al., 2007; and Emamjomeh and Sivakumar, 2009). Although the EC method has been effectively used to treat several contaminants, its mechanisms and aluminium speciation are very complex and are not clearly understood (Mollah et al., 2001, and Zhao et al., 2009). Therefore, some investigations have commenced to understand the interaction between the key parameters that influence the performance of the EC method. For instance, it was reported that some co-existing anions constrain the localized corrosion of aluminium electrodes which in turn reduces the defluoridation rate (Hu et al., 2003). The impact of pH variation on energy consumption and phosphate removal using iron electrodes was analysed by (Irdemez et al., 2006). Subsequently, The influence of current density on phosphate remediation using either iron or aluminium electrodes was studied in another study by Irdemez et al. (2006).

Therefore, SEC has been selected for investigation in this paper as it governs the water conductivity by providing the required ionic species to facilitate the passage of a current (Rout and Sharma, 2011; and Matias et al, 2015), and consequently it affects energy consumption (Tezcan et al., 2013), water temperature (Ricordel et al, 2014), and pollutant removal efficiency (Attour et al., 2014; and Zhang et al., 2015). A new EC reactor (FCER) was used in this study to explore the influence of the SEC on the performance of the EC method in terms of energy consumption and defluoridation of drinking water. The FCER, which relies on the concept of flow columns, showed high performance in terms of water mixing and controlling the temperature of the water being treated (Hashim et al., 2015).
Experimental Materials

For each run the desired quantities of sodium fluoride salt (NaF) and sodium chloride salt (NaCl) were dissolved in deionized water to prepare a stock of synthetic water. The initial pH value of the prepared stock kept at 6 using of hydrochloric acid solution (30%). This initial pH value was selected as it is the most favourable value to achieve the best removal of fluoride from drinking water using EC method with aluminium electrodes (Zuo et al., 2008; and Tezcan et al., 2013). The conductivity of water samples adjusted to 0.2, 0.32, 0.64, and 1 mS.cm\(^{-1}\) using NaCl. All the required chemicals were supplied by Sigma-Aldrich and used as supplied. Electrolysing processes commenced at room temperature (20 ±10°C).

Analytical methods

Fluoride concentration was measured using a Hach-Lange spectrophotometer (Model: DR 2800). Water conductivity, temperature, and conductivity were measured using a meter supplied by Hanna company (Model: HI 98130). The required current density was calculated from current values provided using a rectifier (HQ Power; 0–30 V). Initial water temperature was maintained at the room temperature using a water bath (Nickel-Electro: Clifton).

EC reactor

The electrocoagulation process was commenced using a new cylindrical electrocoagulation reactor (flow column EC reactor-FCER) (figure 1). The design of the FCER is basically relies on the innovative use of a perforated-plate flow column. Hashim et al. (2015) mentioned more details about this rector.

Experimental procedure

The electrolysing process of 20 minutes at each run commenced by immersion the aluminium electrodes in a 1000 mL water sample, which initially contained 10 mg/L of fluoride at pH of 6, the gap between electrodes kept at 3 mm. A constant current density of 1 mA/cm\(^2\) was driven using a rectifier. 5 mL samples were collected from the reactor at5 minute intervals, in order to determine the influence the SEC on the performance of the FCER. The accumulated impurities on the electrodes were removed using hydrochloric acid and deionised water at the end of each run.

The removal efficiency was estimated using the following equation:
\[ \text{RE\%} = \left( \frac{C_0 - C}{C_0} \right) \times 100\% \] (1)

Where, \( C_0 \) and \( C \) are the influent and effluent concentrations of fluoride, in mg/L, respectively. While the energy consumption was measured using the following equation (Tezcan et al., 2013):

\[ E = \frac{(I \times V \times t)}{(\text{Vol.})} \] (2)

Where \( E \) is the electrical energy consumption (kW.h/m3), \( I \) is the current (A), \( V \) is the potential (V), \( t \) is the time (h), and \( \text{Vol.} \) is the volume of solution (m3).

**Results and discussion**

**Effect of SEC on removal efficiency**

The impact of the SEC on the fluoride removal was explored at different conductivities (0.2, 0.32, 0.64, and 1 mS.cm\(^{-1}\)) at initial pH of 6, initial water temperature of 20 ± 1°C, and a constant current density of 1 mA/cm\(^2\). It was found that the fluoride removal efficiency increased for 20 min of electrolyzing, from 90.2 to 98.3 % as the water conductivity increased from 0.2 to 1 mS.cm\(^{-1}\) respectively.

**Effect of SEC on energy consumption**

Energy consumption is a key parameter in any electrochemical process as it determines the cost of treatment (Tezcan et al., 2013). This parameter is inversely related to the conductivity of the solution, and in consequence is affected by the SEC (Durango-Usuga et al., 2010; and Kobya et al., 2011). In order to investigate the impact of SEC on energy consumption, water samples with conductivities of 0.2, 0.32, 0.64, and 1 mS.cm\(^{-1}\) were electrolysed at current density of 1 mA/cm\(^2\), and initial pH of 6 for 20 min. The average energy consumption was calculated using Eq. 2. The results, shown in Figure 3, showed an inverse relationship between the SEC and energy consumption, where the energy consumption decreased from 3.7 to 2.05, 1.11, and 0.79 kW.h/m3 as the SEC increased to achieve water conductivity of 0.2, 0.32, 0.64, and 1 mS.cm\(^{-1}\) respectively.

According to the results obtained from the experimental work, a relationship between the removal efficiency and energy consumption can be developed using SPSS-23 software, as shown in Figure 4. This relationship is expressed by the following formula:
\beta = \frac{101.01 \times R}{(2.94 + R)} \quad (3)

where \( \beta \) and \( R \) represent the predicted fluoride removal per kW.hr and the actual removal respectively. Applying this model to the experimental data confirmed high reproducibility, where the maximum difference between the actual data points and the predicted ones was less than 0.2%. Therefore, it can be said that this model is an effective tool to reproduce the performance of the FCER in terms of SEC, energy consumption, and fluoride removal.

This increment in fluoride removal and the reduction in energy consumption due to the addition of NaCl might be explained as a result of increasing the ionic species that facilitate the passage of the current. However, although SEC enhanced the defluoridation process and energy consumption, using higher additions of SEC (NaCl) is still controversial due to the possible generation of environmentally unwanted by-products such as organochlorine species (Durango-Usuga et al., 2010; and Tezcan et al., 2013). Thus, basing on these considerations, as it mentioned before, it might be reasonable to maintain water conductivity within the range of 0.32 - 0.64 mS.cm⁻¹ during the defluoridation of drinking water using EC technique (aluminium electrodes).
Conclusion

The influence of SEC on fluoride removal in the electrocoagulation method has been explored in terms of fluoride removal efficiency and energy consumption. The results obtained demonstrate that SEC addition can significantly reduce the energy consumption and slightly enhance fluoride removal efficiency. Where, it was found that increasing the SEC to maintain the conductivity between 0.32 and 0.64 mS.cm\(^{-1}\) clearly reduced the energy consumption and modestly enhanced the removal efficiency. Thus, in this project, water conductivity within the range of 0.32 to 0.64 mS.cm\(^{-1}\) is the optimum value to achieve the highest fluoride removal efficiency.

Figure 3: Influence of SEC on energy consumption

Figure 4: Experimental and predicted removals per energy consumption unit using the suggested model.
This work is a part of validation procedures of an advanced EC unit; this unit designed to remove the complex pollutants from drinking water within short time and low operating cost.

References


The Linear Elastic Analysis of Cold Mix Asphalt by Using Finite Element Modeling

Hayder K. Shanbara, PhD student, Department of Civil Engineering, Liverpool John Moores University, UK
Al-Muthanna University, College of Engineering, Al-Muthanna, Iraq.

Anmar Dulaimi
Liverpool John Moores University, UK
Kerbala University, Kerbala, Iraq.

Felicite Ruddock, Programme Leader, Department of Civil Engineering, Liverpool John Moores University, UK

William Atherton, Programme Manager, Department of Civil Engineering, Liverpool John Moores University, UK

Abstract

In this research the linear elastic behavior of asphalt mixtures was investigated by using finite element analysis, which pavement construction engineers have tried to adapt for pavement analysis. A three-dimensional (3D) finite element (FE) model of a novel developed fast-curing cold asphalt concrete binder course (CACB) mixture has been examined in this study. This developed mixture has a waste fly ash (WFA) and another waste material (LJMU-A2) as an activator to make a new binary blended cement (BBC) filler and has used this new filler as a substitute for conventional mineral filler. A commercial FE analysis package named ABAQUS/standard has been used to establish the FE model in which model dimensions, meshing strategies and element types are taken to achieve a desired degree of accuracy and convergence of the developed model. Also in this developed model, a four-layer pavement structure under static loading of 0.7 MPa has been utilized. Several conventional and modified flexible pavements have been analyzed in this model using Multi-layer System Theory. The horizontal deflection distribution along the top of the pavement’s surface layer has been investigated in two directions (the direction of traffic flow and perpendicular on it). The results demonstrate the capability of the model in simulating the effect of WFA and LJMU-A2 on vertical surface deflection (rutting) of cold asphalt mixtures.

Keywords: Finite element analysis, linear elastic behavior, cold asphalt mix, ABAQUS.
Introduction

Asphalt mixtures are a complex heterogeneous material consisting of coarse and fine aggregates, bitumen, filler, air voids and possibly additives. Resulting failure of such material under applied load depends on several circumstances that happen at the aggregate – emulsion level. Modifications and additives are widely used in asphalt pavement mixtures, and this makes the behaviour more complicated by developing some ageing impacts such as chemical oxidation, binder microcracking and hardening (Martin, 2002). Using of waste material to improve the performance of asphalt mixtures is one of the economical approaches (Arabani et al., 2014). Cold mix asphalt mixture is normally prepared and applied at ambient temperature where no heating is necessary. These mixtures are known to show weak early strength and long curing time due to the presence of water (Thanaya, 2003b, Oruc et al., 2007). Cement has been used widely to enhance the mentioned drawbacks of cold mix asphalt (Needham, 1996, Oruc et al., 2006, Al-Hdabi et al., 2014). However cement industry is responsible for 5% of CO₂ emission (O’Rourke et al., 2009).

Three dimensional (3D) finite element (FE) modelling is highly presented as the best method to solving certain essential problems about flexible road pavements performance (Sukumaran et al., 2004), but the time required and slow and long processing to model and analyse pavement structures are restraining the utilize of these analysis.

The objective of this study is to explain finite element modelling strategies that can be utilized for analysing pavement structures and the possibility of predicting asphalt pavement failure behaviour. The aim of this research is to find a less computationally intensive model, which keeps the accuracy of an infinitely integrated model. To accomplish this task, finite element analyses have been carried out using ABAQUS software in which model dimensions, meshing strategies and element types are taken to achieve a desired degree of accuracy and convergence of the developed model.

The material model used for the pavement structure is a linear elastic model. To adapt the infinite elements, mesh dimensions and memory constraints are performed which decrease computation time with a reduced overall model size. In addition, the symmetrical 3D model is discovered by demonstrating the ability to predict pavement responses for symmetrically loaded conditions.

The final goal of the present work is to develop a working model for asphalt road pavement able to predict flexible road pavement failures which caused by static load conditions.
Cold Mix Asphalt

Cold mix asphalt is defined as bituminous materials which are prepared at ambient temperature by emulsifying the asphalt in water before blending with the aggregates. It has been considered an inferior mix compared to hot mix asphalt for the last several years, mainly in terms of its mechanical properties, extended curing period required to achieve an optimal performance and its weak early life strength (Thanaya et al., 2009). Many different parameters affect cold mix asphalt properties, such as: aggregates source, curing time and condition, emulsion selection and initial emulsion content, optimum pre-wetting water content and optimum moisture content at compaction and residual asphalt content.

In fact, there is not any mix design method which is universally accepted for cold asphalt mixtures. Therefore, Marshall Method is the most well-known method for emulsified asphalt aggregate design.

Generally, cold mix asphalt is still limited to road pavement layers, i.e. it is applicable to base layer with low volume traffic loads or used as a surface layer for low to medium traffic volume roads. Ibrahim and Thom (1997) reported that a 40 mm hot mix asphalt layer has to be overlaid with cold mix asphalt for heavy traffic volume roads.

Nowadays, as a result of mixing techniques and emulsion technology improvements, cold mix asphalt could be produced even with dense gradation. This compares with open graded mixtures which were the only mixtures used several years ago. Ibrahim and Thom (1997) also stated that a cold mix asphalt may comprise bituminous emulsion mixed with continuous or gap graded aggregate gradation with added water. Studies were conducted by Chevron Research Company in California, concluded that full curing time of cold bitumen emulsion mixtures on site may occur between two months to two years depending on weather condition (Thanaya, 2007).

Comparison between Hot and Cold Mix Asphalt

Many studies have been conducted to evaluate the performance of cold mix asphalt, and it has been claimed that there are obvious variations between cold and hot mix asphalt. The main difference is that the emulsion and aggregates are mixed together at ambient temperature without heating in terms of cold mix, and at high temperature (138°C - 160°C) to mix the binder and aggregates in terms of hot mix. Munyagi (2006) showed that all results from cold mix asphalt tests in term of indirect tensile strength test were very low compared to 800kPa which is the minimum value of hot mix asphalt specification. These mixes have shown inferior properties, for instance, low mechanical properties and strength in their earlier life, high permeability compared with hot mixes and their lower stability (Oruc et al., 2007, Read and Whiteoak, 2003, Thanaya et al., 2009). Whilst hot mixes gain their ultimate strength and properties after a very short time. However, many ecological and financial characteristics might be acquired when cold mix asphalt is used instead of conventional hot mix.
Use of Additives in Cold Mix Asphalt

Modified Asphalt mixtures are predominantly used for high loads, heavy traffic volume and severe environment conditions (Tang and Haddock, 2006). Additives are used in cold asphalt mixes to accelerate curing and initial strength in early life. Waste or by-product industrial materials have been used in road pavements manufacturing as alternative materials which is considered acceptable and has become more important. These materials have cementitious or pozzolanic characteristics, for example, Ground Granulated Blastfurnace Slag (GGBS), fly ash, silica fume and rice husk.

(Brown and Needham, 2000) studied adding cement to cold mix and they concluded that addition of Ordinary Portland Cement (OPC) improved mechanical characteristics (stiffness modulus, permanent deformation resistance and fatigue strength) of emulsified mixtures. Pulverised fly ash has been investigated by Thanaya (2003a), to improve the performance of cold bituminous emulsion mixtures. She concluded that the usage of this substance can enhance mixtures properties. Al-Busaltan et al. (2012) carried out a study on adding (LJMU-FA1) to cold graded emulsified asphalt mixtures; he discovered that addition of this material will improve the stiffness modulus, permanent deformation resistance and water sensitivity, especially if more than 50% of filler is replaced with (LJMU-FA1).

Ellis et al. (2004) conducted a research on Ground Granulated Blastfurnace Slag (GGBS). The results showed that the mixtures strength and stiffness improved when GGBS had been added in damp conditions.

Chávez-Valencia et al. (2007) evaluated the effect of using polyvinyl to increase the compressive strength of cold mix asphalt. Polyvinyl acetate was added to the emulsion and the compressive strength was increased by 31% compare to the traditional cold mix. Khalid and Eta (1997) studied the impact of polymers on emulsified bitumen macadam performance. They utilized cationic emulsion with Ethlene Vinyl Acetate (EVA) and Styrene-Butadiene-Styrene (SBS) with two different aggregate gradations (dense graded base course and close graded surface course). Their results show a noticeable advantage in the cases of stiffness modulus and permanent deformation.

Methods and Experimental

Materials

The aggregate used in this research was graded using the British Standard specifications BS EN 13108-1 AC-20 (European Committee for Standardization, 2006) as illustrated in Figure 1. Cationic slow-setting bitumen emulsion (C60B5) with 60% of residual bitumen content was utilized in the production of the specimens. The bitumen properties of were controlled according to the British Standard specifications.
Two types of filler have been used in this study, traditional limestone dust mineral filler and waste fly ash (WFA). In addition, the (LJMU-A2) waste material has been used in this study and it was provided through the waste material of an industrial production company. This waste material was added to the WFA with different percentages (1% to 4%) of dry aggregate weight to develop a new cold asphalt concrete binder (CACB) course. The chemical analysis by XRF of all the fillers is revealed in Table 1. It can be clearly seen from this table that the composition of the WFA was 70.417% of CaO and 26.003% silicon oxide while LJMU-A2 contained 35.452% silicon oxide and 44.167% aluminium oxide.

### Table 1: XRF results (%)

<table>
<thead>
<tr>
<th>Properties</th>
<th>CaO</th>
<th>Al₂O₃</th>
<th>SiO₂</th>
<th>Fe₂O₃</th>
<th>MgO</th>
<th>K₂O</th>
<th>SO₃</th>
<th>Na₂O</th>
<th>TiO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>WFA</td>
<td>70.4</td>
<td>2.6</td>
<td>26.0</td>
<td>0</td>
<td>2.9</td>
<td>0.3</td>
<td>0.4</td>
<td>1.9</td>
<td>0.5</td>
</tr>
<tr>
<td>LJMU-A2</td>
<td>0.0</td>
<td>44.2</td>
<td>35.5</td>
<td>0.4</td>
<td>0.7</td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LD</td>
<td>76.3</td>
<td>0</td>
<td>16.7</td>
<td>0</td>
<td>0.9</td>
<td>0.3</td>
<td>0.1</td>
<td>2.3</td>
<td>0.2</td>
</tr>
</tbody>
</table>

**Indirect tensile stiffness modulus test (ITSM)**

The process of curing for all samples was to keep it in the mould for 24 hours at room temperature (20 °C) after which time the sample was extruded and kept at room temperature until testing took place at
different age 3 days to determine the stiffness modulus. The test was performed at 20 °C following the BS EN 12697-26:2004 (European Committee for Standardization, 2012a) using HYD 25 Cooper Research Technology apparatus as can be seen in Figure 2.

![HYD 25 Cooper Research Technology apparatus](image)

**Figure 2: ITSM Apparatus machine**

**Results and Discussion**

After designing of the conventional and modified (with WFA) cold mixtures and the traditional hot mixtures, stiffness modulus test was carried out at 3 days curing time as shown in figure 3. The test was performed on cylindrical samples following the BS EN 12697-26 (European Committee for Standardization, 2012b) as shown in Figure 3.

![Graph of ITSM vs WFA percentage](image)
In addition, (LJMU-A2) which is a high aluminosilicate waste material, was incorporated to perform as supplementary cementitious material and also to work as an activator in four different percentages in the range from 1% to 4% by dry aggregate weight as a substitution to the WFA. The results of ITSM tests presented in Figure 4 and the maximum ITSM value is 3730 MPa when 1.5% of LJMU-A2 was replaced with WFA to be binary blended cement (BBC) filler which is a 1.5% LJMU-A2 and 4.5% WFA.

Finite Element Model

*Model geometry and boundary condition*

The mesh consists of four layers of the pavement structure as shown in Figure 5, and perfectly bonding has been assumed between each two layers. The pavement cross-section consists of asphalt layer, granular base, granular subbase and subgrade. The thickness of each layer is as follows: 10 cm asphalt layer, 15 cm granular base layer, 20 cm granular subbase layer and 30 cm, which forms the subgrade. Boundary conditions are employed to all edges or faces of the structural pavement geometric model to control displacement in the horizontal direction on the vertical edge which is perpendicular to the layer surface. The last layer (subgrade) modelling has been assumed to be fixed with no displacement in
horizontal and vertical directions representing a very stiff layer (encastrate). The geometric model is symmetrical on x and y axes, therefore, one quarter of the model has been taken and the load is applied as shown in Figure 6.

Figure 5: Flexible pavement cross-section

Figure 6: Boundary condition and load application
**Material Properties**

The flexible pavement material has been separated into three groups: asphalt mixtures, granular materials, and cohesive soils. All these groups have been modelled as elastic materials. This is an elastic model in which these materials have been assumed to behave as elastic materials for low stress levels. Also, all the material models require elastic material properties that include the requirement of the elastic modulus and Poisson’s ratio. The elastic material properties are shown in Table 2 (Junior et al., 2005).

<table>
<thead>
<tr>
<th>Layer</th>
<th>Modulus of Elasticity (E) (MPa)</th>
<th>Poisson’s ratio</th>
<th>Density (kg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt mixture</td>
<td>variable</td>
<td>0.4</td>
<td>2200</td>
</tr>
<tr>
<td>Granular base</td>
<td>200</td>
<td>0.35</td>
<td>2000</td>
</tr>
<tr>
<td>Granular subbase</td>
<td>100</td>
<td>0.35</td>
<td>1800</td>
</tr>
<tr>
<td>Subgrade</td>
<td>50</td>
<td>0.3</td>
<td>1700</td>
</tr>
</tbody>
</table>

**Meshing and Element Definition**

The most important and significant variable in estimating accurate stress and strain in the flexible pavement is the degree of mesh refinement. The finest mesh is required under the loads to improve the level of accuracy. In order to determine a suitable element size to ensure a desired degree of accuracy and convergence for the developed model, several meshing iterations have been tried to reach the best and most accurate mesh size as shown in Figures 7 and 8. The final mesh, which is presented in Figure 9, has 79248 nodes and 46800 three-dimensional elements.

![Figure 7: Mesh convergence of the finest area](image-url)
Model Analysis

Rahman et al. (2011) states that tyre imprint area has to be a rectangular area which is more suitable than circular or ellipsoid tyre imprint areas. Also, this study shows that the tyre pressure is uniform distributed over the contact area. The tyre imprint pressure load, which is applied directly on the finite elements underneath the wheel path, is performed as 0.7 MPa (100 psi) which is to a single axial wheel load (40 kN)
divided by the contact tyre footprint area (58000 mm²). The pavement response under the static load is shown in Figure 10.

Figure 10: Pavement response after applied a static load

In this study, deflection under the wheel path and the areas around it is a function of the static load application. Decrease in the amount of deflection of the developed cold mixtures is significantly greater than the deflection on the surface of the conventional mixtures as shown in Figure 11.
Vertical Deformation resistance

The cold mix resistance to vertical deformation with a binary blended cement (BBC) filler, which is a 1.5% LJMU-A2 and 4.5% WFA was determined using the three dimensional (3D) finite element (FE) analysis. It has been clearly seen that the 6% of waste fly ash as a full replacement to the ordinary lime stone dust filler and binary blended cement had the expected effect on the vertical deformation resistance. The mixtures with such materials exhibited a small surface deflection during loading condition, while the deflection was the deepest if the mixtures are used as a conventional cold mix. The results show that the mixtures with BBC and 6% WFA are approximately performed as hot mix asphalt with 40/60 pen asphalt binder grade, whereas have a better performance compare to the 100/150 pen. The poor resistance of the conventional cold mix to vertical deformation, which can cause the rutting phenomenon, is because of the low stiffness modulus of such mixtures. Stiffness modulus of cold mixtures has been developed by using BBC and WFA, therefore, these mixtures have been improved to resist the vertical deflection.
Conclusion

In this research, the use of the three-dimensional (3D) finite element (FE) analysis in estimating pavement’s damages was discussed. The processes of choosing and optimizing the suitable meshes are investigated. The process for implementing a finite element model which considers the linear elastic material behaviour, pavement boundary and load geometry were described.

In particular, the following items were concluded:

- According to obtained results, the model provided can properly predict damage behaviour in asphalt mixture in pavements of various types of material.
- Results show that the LJMU-A2 has positive effects on mechanical behaviour of asphalt mixtures.
- The ordinary cold mixtures exhibited less resistance to the vertical deformation than improved mixtures with BBC and WFA.
- The cold mixtures with BBC and WFA offered better resistance to vertical deformation than the 100/150 pen hot mixtures under same conditions.

Acknowledgments

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Characterisation of Soft Soil Microstructure Stabilised With Binary Blending Using Two Waste Fly Ashes

Hassnen M Jafer, Postgraduate Research Student, School of the Built Environment, Liverpool John Moores University, UK
University of Babylon, College of Engineering, Civil Engineering Department, Babylon, Iraq.

W Atherton
Liverpool John Moores University, School of the Built Environment

Abstract

This paper represents an investigation on the microstructures of soil stabilised with binary blending using two different types of waste materials’ fly ashes. The microanalysis was conducted in order to realise the obtained improvement in the strength of stabilised soil. The soil used in this study was an intermediate plasticity silty clayey soil with medium organic matter content. FA1 was optimised in previous study dependant on the unconfined compression strength (UCS) test conducted on specimens of soil treated with various percentages of FA1. The optimum percentage of FA1 was 12% of the dry weight of the soil. In this study, UCS test was conducted on specimens of soft soil treated with 12% of binder produced by binary blending of FA1 and FA2 with different proportions and the specimens were kept for curing of different periods (3, 7, 14, and 28 days) prior to be subjected to UCS test. Scanning electronic microscopy (SEM) test was employed to investigate the mechanism of strength improvement in the most remarkable soil-binder mixture. The results showed a significant development in stabilised soil strength especially by using the binary blending mixtures. Moreover, remarkable bond building sequences and sequent changes in the microstructures of the stabilised soil due to the chemical reaction of the added fly ashes were observed through SEM test.

Introduction

Self-cementing property for some of waste materials, and pozzolanic property for others have been motivating the researchers to conduct laboratory experimental works to produce new cementitious materials since the mid-nineties of the last century [1]. Moreover, many researchers have adopted binary, ternary and even quaternary blending systems to produce new cementitious materials from different types of waste materials and fly ashes. They used [2 – 5].

However, so many researchers have concentrated their experimental works to study the improved properties of stabilised soil, but there are a rare number of researchers investigated the mechanism of how this improvements happened. Therefore, this study elucidate the changes in the microstructures in stabilised soils using cementitious materials to provide a clear understanding about the hydration kinetics
taken place in the microstructures of soil stabilised by binary blending using two different fly ashes. Scanning electronic microscopy test (SEM) was employed in this study to observe the changes in microstructures of the soil specimens treated with unary and binary mixtures of the fly ashes used in this study after subjected to different periods of curing (3, 7, and 28 days). Additionally, the optimum binary blending paste was also investigated by SEM for the same periods of curing to observe the hydration reactions and the formation of ettringite and cementitious product.

Materials and methods

Soft Soil:
An intermediate plasticity silty clay soil was used in this study. The soil samples were extracted from a shallow depth ranged between 300 – 500mm below the ground level from the riverbank of the River Alt in High Town which is located to the north of Liverpool city centre in the United Kingdom. The main properties of the soil used in this study are illustrated in table 1.

Table 1: Main properties of the soft soil used in this study.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMC %</td>
<td>52.14</td>
</tr>
<tr>
<td>LL %</td>
<td>44</td>
</tr>
<tr>
<td>PI</td>
<td>20.22</td>
</tr>
<tr>
<td>Sand %</td>
<td>13.08</td>
</tr>
<tr>
<td>Silt %</td>
<td>43.92</td>
</tr>
<tr>
<td>Clay %</td>
<td>43.00</td>
</tr>
<tr>
<td>Specific Gravity (Gs)</td>
<td>2.57</td>
</tr>
<tr>
<td>MDD g/cm³</td>
<td>1.57</td>
</tr>
<tr>
<td>OMC %</td>
<td>23</td>
</tr>
<tr>
<td>pH</td>
<td>7.78</td>
</tr>
<tr>
<td>Organic Matter Content %</td>
<td>7.95</td>
</tr>
<tr>
<td>UCS of compacted soil (kPa)</td>
<td>202</td>
</tr>
</tbody>
</table>

\( g/cm^3 = \text{gram/cubic centimetre, kPa = kilopascal.} \)

Fly Ashes:
The fly ashes employed in this study were two different types of waste materials produced from incineration processes in local power plants used different types of fuel. The first fly ash (FA1) has high calcium content while the other fly ash (FA2) has significant amount of pozzolanic compounds (silica dioxide (SiO2), Aluminium oxide (Al2O3) and iron oxide (Fe2O3)).
Methods and samples preparation:

Several specimens of soil treated by 12% of binary blending with different proportions of FA1 and FA2 were prepared for UCS test with standard dimensions of 38mm in diameter and 76mm in height. The specimens were subjected to different periods of curing 3, 7, 14, and 28 days under a degree of temperature about 20°C and 100% humidity using humidity cabinet prior to the application of UCS test. Unconfined compressive strength test was carried out according to BS 1377-7:1990 [6]. Table 2 illustrates the mixing procedure of FA1 and FA2 percentages which were added by 12% of the dry weight of the stabilised soil in this study.

Table 2: Mixing proportion of FA1 and FA2

<table>
<thead>
<tr>
<th>No.</th>
<th>Mixture ID</th>
<th>FA1 %</th>
<th>FA2 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Virgin soil</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>U</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>BM1</td>
<td>10.5</td>
<td>1.5</td>
</tr>
<tr>
<td>4</td>
<td>BM2</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>BM3</td>
<td>7.5</td>
<td>4.5</td>
</tr>
<tr>
<td>6</td>
<td>BM4</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

Results and Discussion

Unconfined Compressive Strength (UCS) Test:
The results of UCS test for the soil treated with different types of binary mixtures are shown in figure 1. The results indicated that there was a significant improvement in the strength of the stabilised soil with the use of binary blending. However, the results indicated that BM2 was the optimum mixture which provided highest value of UCS.

Figure 1: Effect of binary blending on UCS of stabilised soil in different curing periods.
Figure 2: SEM test images for (a) untreated soil, and (b), (c), and (d) Soil treated with 12% BM2 with age of curing of 3, 7, and 28 days respectively.

Scanning Electronic Microscopy (SEM) Test:

Specimens of compacted untreated soil and soil stabilised with 12% of BM2 were prepared for SEM test. The soil treated with BM2 were subject to different periods of curing (3, 7, and 28 days) prior to be subjected to SEM test to investigate the sequent changes happened in microstructures of the treated soil throughout the time of curing. Figure 2 (a to d) shows the SEM images for untreated soil and 3, 7, 28 days ages of soil treated with 12% of BM2 consequently. It can be seen that there were clear changes in the microstructures over the time of curing; these changes are characterised by the creation of calcium silicate hydrate compound (C-S-H) in addition to the needle shape particles (ettringite) which happened due to the hydration reaction happened after mixing BM2 grains with water.
Conclusions

- Results of UCS test indicated that the use FA2 in the binary mixture was very effective to enhance the soil strength in comparison to that for soil treated with FA1 only. The results revealed that the optimum binary mixture was BM2 which combined from mixing 9% FA1 and 3% FA2 by the dry weigh of treated soil.
- Binary blending of FA1 and FA2 (BM2) was found very effective as a binder in soil stabilisation. The soil strength in this study was increased significantly from 200kPa for untreated soil to 924kPa for the soil treated with 12% of BM2 with 28 days of curing; this improvement represents more than 4.5 times of UCS for compacted origin soil.
- Furthermore, it could be concluded that C-S-H and ettringite, which were produced due to the hydration reaction processes, contributed to the achieved strength development of the soil stabilised with binary mixture.

References


Analysis of the Lateral Response of a Reinforced Concrete Pile Penetrated In Sand Soil Using Finite Element

Ameer A. Jebur, PhD student, Department of Civil Engineering, Liverpool John Moores University, UK

William. Atherton, Department of Civil Engineering, Liverpool John Moores University, UK

Rafid M. AL khaddar, Department of Civil Engineering, Liverpool John Moores University, UK

Edward. Loffill, Department of Civil Engineering, Liverpool John Moores University, UK

Abstract

Pile foundations are slender elements, underneath a major structure, frequently used for many decades as load carrying and load transferring systems from shallow inadequate subsurface soil layers to deep and stiff bearing strata with high degree of efficiency. Moreover, the laterally loaded response of concrete reinforced piles penetrated in sandy soil is normally analyzed using Winkler Model (beam on elastic foundation), in which the sand–pile interaction is simulated by highly nonlinear p–y curves. The present study presents the result of numerical analyses of the behaviour of reinforced concrete squared model piles (400mm) diameter with embedment depth-to-diameter ratio (L/d) of (20) penetrated in a calibrated chamber of pre prepared dense sand relative density (D_r,%). The model piles subjected under lateral loading system. The study revealed that the sand specimen shear strength parameters and the model pile dimension are the most significant parameters influencing the pile behaviour and its capacity

Key Words: Reinforced Concrete Pile; Slenderness Ratio; Soil-Pile Interaction; Winkler Model; Shear Strength Parameters.

Introduction

Pile foundations are slender elements, underneath superstructures, frequently used for many decades as load carrying elements, (Miyasaka et al., 2008; Manandhar and Yasufuku, 2013; Karim et al., 2014; Alkroosh et al., 2015; Jebur et al., 2016). Illustrations of major structures where the utilize of pile foundations are common place are sky scrapers, bridges, transmission towers and offshore platforms, jetties and geotechnical structures. These superstructures should be designed to resist moments and lateral loads as a result of wind waves and earthquakes. Moreover, there are some geotechnical structures
such as, oil production platforms, earth retaining structures and deep open excavations where the response of piles is to resist and transfer lateral applied loads to the deep strata (Ensoft, 2005; Fellenius and Tech, 2008; Elhakim et al., 2014; Ebrahimian et al., 2015; Faizi et al., 2015). Salgado (2008) reported that the whole or a part of the deep foundation may be laterally moved when a it is under to the lateral load, as a consequence, rotation and/or bending moments will be induced in the structural element. The precise prediction of the interaction between the soil-pile is a typical problem a pile foundation is subjected via lateral loading. However, it is necessary for geotechnical engineers to peer in mend in terms of pile design and analysis to determine the stresses-strain distribution and the deflections that are resulted in the structural element and the contacting mass specimen in the lateral effective zone. It has been accepted in the field of geotechnical engineering that the model of the Beam-on-Winkler-Elastic-Foundation often referred to as the “p-y” behaviour, is accepted methods to precise predict the response of horizontally loaded piles (Kim and Jeong, 2011); (Ni et al., 2014). The main concept of the Winkler model (1867) is to represent the soil layer with a series of unlimited number of elastic springs. It is worth mentioning that the spring elasticity is the same as the soil subgrade reaction($k_h$). Poulos (1971) was the first researcher who investigated and developed a practical procedure for pile foundation under the action of lateral loading conditions of free and fixed head. It has been assumed that the contacted soil media is as plastic-elastic. In this research, finite element code (FEC) is optimised to analyse to simulate the reinforced concrete model pile subjected via lateral loading application. The lateral pile deflection, the soil-pile interaction, the shear and moment soil profiles distributions with depth were accurately determined.

**The Numeric Model**

In this paper, finite element is used for running a series of the model of the soil-pile interaction. The main application of this novel method is that some of the few model input parameters are used that can be easily determined by running simples experimental test in such small time as mentioned in the next paragraphs. It is important that the input parameters is determined precisely to exact determine the sand-pile interface in the sand effective depth. To model the behaviour of the soil an elastic-plastic approach is taken along with the application of Mohr-Coulomb failure criterion and a schematic diagram of the concept of the p-y curves for laterally and axially loaded piles and the numerical model of the soil pile interaction are explained in Figures 1 and 2 respectively.
Figure 1: Soil-pile interaction of a pile model subjected via lateral loading according to the $p$-$y$ curves approach, improved after (Ensoft, 2005)

Figure 1: Model of the reinforced concrete pile subjected to combined loads
Experimental Works

Few laboratory tests has been conducted on adopted sand. Following the procedure of the unified soil classification system (USCS) the sand specimen used in this study can be classified as a SP. Figure 3. Shows the sieve analysis test of the sand bed that has been adopted in proposed model. Furthermore, the result of the direct shear test is presented in Figure 4. Moreover, the scanning electronic microscopy (SEM) for the sand sample is depicts in Figure 5. It can be seen from the SEM that the sand shape is sub-rounded. The main physical and chemical properties are also attached in the Table, 1.

Figure 3: Sand specimen particle size distribution.

Figure 4: Sand-sand direct shear box test results
Figure 5: Scanning electronic microscopy, SEM

<table>
<thead>
<tr>
<th>Soil Property</th>
<th>Value</th>
<th>ASTM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient of Uniformity, Cu</td>
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<td>D 2487</td>
</tr>
<tr>
<td>Specific Gravity, Gs</td>
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<td>D 891</td>
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<tr>
<td>Coefficient of Curvature, Cc</td>
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<tr>
<td>Effective Grain Size, D_{10} (mm)</td>
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<td>D 6913</td>
</tr>
<tr>
<td>Moisture Content, Mc (%)</td>
<td>&lt; 0.3 %</td>
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<tr>
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<td>Sand Classification, (USCS)</td>
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Silicon dioxide, SiO₂ > 96%  C 114
Aluminium oxide, Al₂O₃ Max 2%  C 114
Sodium oxide, Na₂O 0.32%  C 114
Calcium oxide, CaO 0.87%  C 114
Ferric oxide, Fe₂O₃ 0.27%  C 114
Potassium oxide, K₂O 0.85%  C 114
Magnesium oxide, MgO 0.23%  C 114
Loss of ignition, LOI (%) 0.21  C 114
Angle of internal friction, φ 37.5°  D 7891
Soil-pile interface friction, δ 26.0°  D 7891

**Loading Status**

Rectangular reinforced concrete model pile is adopted in this numerical modelling, considering slenderness ratio (lc/d) for simulation the response of long/rigid piles, as explained in the Table 2. During the numerical analysis, the static lateral loads are applied at the concrete pile tip plus a free additional length of about 20 mm to overcome the temporary contact of the applied load with the soil surface. Additionally, to avoid the boundary effect of the soil container walls Robinsky and Morrison (1964) have been stressed that the minimum influence zone of the sand container varies between (3-5 times pile diameters used in this research is 400 mm) and depends on soil stress history and the method of pile advancing. In the present research, the extent of the sand bed is up to10 pile diameter from the centre of the test pile. The concrete pile material properties were approved from (Gere and Timoshenko, 1997).

**Table 2: Properties of the model input parameters for the proposed pile model.**

<table>
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<tr>
<th>Test ID</th>
<th>Poisson's Ratio, υ</th>
<th>Applied Loads, kN</th>
<th>Sand Mass Relative Density, Dr %</th>
<th>Modulus of Elasticity, Ec, MPa</th>
<th>Test Depth (cm)</th>
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<td>800</td>
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</tbody>
</table>
Results and Discussion

The results of the numerical modelling of the sand-pile-sand interaction are presented below. The model pile was under the action of lateral loading. The results of the resistance of the ground (sand), the load-displacement curve, the shear force profile and a consequence moment distribution are also reported as shown below. It can be seen that the soil-pile interaction is highly non-linear.

The results of the numerical analysis for the influence of shear forces profiles on model pile head deflection is illustrated in Figure 6. It can be seen that the maximum pile head deflection for a rigid model pile having slenderness’ ratio (l/d = 20) is about 38cm for the lateral applied load of 600KN. In addition, for the pile head deflection subjected via 400KN is about 0.18cm. In sharp contrast to that, just 5cm and 2cm deflections have been occurred for a lateral load of 200KN and 100KN respectively in the direction of the applied load. It can be seen that for all applied loads, the model piles start to bent at about 4m depth from the direction of the applied loads. Regarding the shear profile, it can be noticed that the maximum shear occurred is about -620KN as a result of the applied 600KN. While, the shear distributions for the rest of the applied load decreased significantly from -400KN to about -100KN for applied load ranged from 400 to 100KN respectively.
The profile of the moment and the net ground reaction within the sand depth for the reinforced concrete pile also been presented. Figure 8. Shows the maximum moment convinced in a reinforced concrete model pile is about 1500Nm under 600$k_n$ at a sand depth of about 3.8m. while for 400$k_n$ applied load, the maximum moment noticed at depth of about 880Nm at a depth of about 3m in the effective penetrated zone. Furthermore, the moment induced for the 300$k_n$ and 200$k_n$ the moment profiles are 560Nm and 300Nm respectively. The moment occurred for the applied load 100$k_n$ is just 90Nm. Moreover, the net ground reaction profile against the distribution of the model pile-soil interaction depth is presented in Figure 9. As illustrated, the maximum ground resistance is about 650 $Kn/m^2$ induced at depth of about 4.3m from the point of the applied load. For both 400$k_n$ and 300$k_n$ the ground resistance are 400$k_n/m^2$ and 280$k_n/m^2$ occurred at depths of 3.2m and 2.7m respectively. the net ground reaction reached value of about 125$k_n/m^2$and 70$k_n/m^2$for the applied loads of 200$k_n$and 100$k_n$ respectively. in the reverse direction of the lateral load along lower zone of the effective profile depth, the peak ground resistance occurred at depth of about 6.2m reached a value of about -450$k_n/m^2$. 

**Figure 6: Displacement versus pile depth.**  **Figure 7: Shear force versus pile depth.**
Conclusion

A finite element code has been developed and optimized to simulate the sand-pile-sand interaction by means of numerical modelling and has the ability to predict the high non-linearly between the soil-pile interaction. The model pile that has been adopted in this research is a reinforced concrete pile with dimensions of (0.4 * 0.4)m with 8m long. The lateral applied loads were ranged from (0, 100, 200, 300, 400 and 600)\(\tilde{K}n\). Furthermore, the pile penetrated in a properly scaled down chamber to avoid the stress-strain distribution issues. The proposed method of analysis adopted in this research takes advantage of a proper constitutive numerical model for the major influence input parameters that affect the analysis such as, the properties of the sand specimen and the model reinforced concrete piles. Good agreements have been gained when compared the results of the numerical model with other researcher documented in the literature. Generally, the effective profiles of the model pile-soil interface shear forces, bending moments and ground reactions were occurred at soil depth of around 4m from the point of the applied load. Furthermore, the forces induced from the lateral independent horizontal load are a function of the lateral earth pressure coefficient (k), slenderness ratio (lc/d) as well as the sand mass relative density.
Moreover, it is noticed that at specific certain depth "critical pile depth" the increment values in the moment distribution, shear profile and pile head deflection start to be marginally changed. The critical depth for this model pile and sand bed is determined to be at around at 5m.

ACKNOWLEDGEMENTS

The first author would like to express his gratitude to Dr. William Atherton and Prof. Rafid AL khaddar for their help and support during this research.

References


The Relationship between Operating Condition and Sludge Wasting of an Aerobic Suspension Sequencing Batch Reactor (ASSBR) Treating Phenolic Wastewater

Ali W. Alattabi, PhD student, Department of Civil Engineering, Liverpool John Moores University, UK

Clare B. Harris, PhD Student, Department of Civil Engineering
Liverpool John Moores University, UK

Rafid M. Alkhaddar, PhD Student, Department of Civil Engineering
Liverpool John Moores University, UK

Ali Alzeyadi PhD Student, Department of Civil Engineering
Liverpool John Moores University, UK

Abstract

Petroleum refinery wastewater (PRW) can be considered as one of the most significant sources of aquatic environmental pollution. It consists of oil and grease along with many other toxic organic pollutants. In recent years, a new technique has been implemented using different types of membranes and sequencing batch reactors (SBRs) to treat PRW. SBR is a fill-and-draw type sludge system which operates in time instead of space. Many researchers have optimised SBRs’ operating conditions to obtain maximum removal of undesired wastewater pollutants. This technique has gained more importance mainly because of its essential flexibility in cycle time. It can handle shock loads, requires less area for operation and is easy to operate. However, bulking sludge or discharging floating or settled sludge during the draw or decant phases occur with some SBR configurations, which is a problem in the SBR system. The main aim of this study is to develop an innovative design for the SBR, optimising the process variables to result in a more robust and efficient process. Several experimental tests will be developed to determine the removal percentages of chemical oxygen demand (COD), biochemical oxygen demand (BOD), phenol and nitrogen compounds from synthetic PRW. Furthermore, the dissolved oxygen (DO), pH, temperature and oxidation-reduction potential (ORP) of the SBR system will be monitored online to ensure that there is a good environment for the microorganisms to biodegrade the organic matter effectively.

Keywords: Hydraulic retention time, Petroleum refinery wastewater, Phenol, Sequencing batch reactor.

Introduction

Petroleum refinery wastewater (PRW) is a refractory wastewater containing organic and inorganic constituents, and complex aromatics [1]. Crude oil consists of suspended solids, organic and inorganic compounds containing salts, and water-soluble metals. To remove contaminants, crude oil undergoes a
desalting process using large quantities of water; however, the desalting process might cause plugging, corrosion and fouling of equipment [2]. In general, compounds in PRW consist of dispersed and dissolved oil, and dissolved formation minerals [3], [4]. Oil is a mixture of hydrocarbons such as BTEX, polycyclic aromatic hydrocarbons (PAHs) and phenol [2], while dissolved formation minerals are inorganic compounds, which consist of anions and cations including heavy metals [2]-[5].

The traditional treatment methods for refinery wastewater are physicochemical, mechanical and biological [6]. One of the alternatives to the conventional activated sludge process is a sequencing batch reactor (SBR). The SBR is an activated sludge process (ASP) wastewater treatment technology. It has been successfully used in the treatment of both industrial and municipal wastewater [7]. In addition, the SBR is a fill-and-draw type sludge system which operates in time instead of space. In a single tank, the SBR performs equalisation, neutralisation, biological treatments and secondary sedimentation via a timed control sequence [8]. The USEPA state that the SBR operation system has five basic operating modes – Fill, React, Settle, Draw and Idle [9]. Mainly due to its unique single tank design and ease of use in industry, the uptake of SBR technology has increased over recent years. Many researchers have optimised its operating conditions to obtain maximum removal of undesired wastewater compounds. The difference between the SBR system and a conventional activated sludge system is that the SBR includes all treatment units in a single tank, while, in the latter, these units require separate basins.

Hydraulic retention time (HRT) is one of the most significant parameters in biological treatment as it can affect the degree of treatment of the important pollution parameters. Leong et al. [10] stated that, via SBR, complete phenol removal has been reached with a 12-hour cycle. In addition, Thakur, Deo Mall and Srivastava [11] studied the effect of HRT and filling time on simultaneous biodegradation of phenol, resorcinol and catechol. The results showed that an increase in HRT from 0.625 d to 1.25 d caused an increase in the COD, phenol, resorcinol and catechol removal efficiencies.

Moreover, Thakur, Srivastava and Mall [12] used SBR to reduce the organic matter present in petroleum refinery wastewater; a variation of HRT (0.56-3.33d) was used under instantaneous fill mode, and the results showed that the removal efficiency of COD and TOC was 77% and 79% respectively. Furthermore, in another study [13], SBR with periodic HRT showed better performance than SBR with long HRT.

The aim of this study is to determine the relationship between HRT and sludge characteristics in the modified SBR system by studying different HRTs (8, 12, 18 and 24 hrs) and determine its impact on sludge characteristics and effluent quality.

**Materials and methods**

**Experimental set-up of SBR**

In this research, four identical reactors will be used in the SBR system, R1, R2, R3 and R4. Each has a 5L capacity. All of the reactors will be filled with 3-4L of synthetic wastewater containing undesirable chemicals, and 1-2L of bacteria (biomass) will be added to each reactor for biological wastewater treatment. The treatment reactors will be equipped with four electronic sensors (probes) to measure the
parameters of pH, dissolved oxygen (DO), temperature and oxidation-reduction potential (ORP). The configuration of one of the four SBR reactors used in this research is shown in Fig. 1.

The system will operate within (8-24) hours HRT, and the samples will be taken and analysed from the treatment reactors (R1, R2, R3 and R4) for influent and effluent respectively.

Synthetic wastewater

The synthetic wastewater contains a mixture of chemicals, as shown in Table 1. The wastewater will be changed daily for each reactor with the mentioned concentrations. It is expected that the added chemicals will have a strong effect and lead to changes in the water quality. The bacteria will start their activities when the aeration and chemicals are available.

The bacteria (biomass) are a mixed culture of sewage-activated sludge, which will be brought from Liverpool Wastewater Treatment Works, Sandon Docks, Liverpool, UK.

Research methodology

The flow shown in Fig. 2 describes the methodology of sampling and testing water quality parameters. It will start by taking the sample from the reactors after adding the synthetic wastewater and analysing phenol, BOD, COD, ammonia-nitrogen (NH$_3$-N), nitrate-nitrogen (NO$_3$-N) and nitrite-nitrogen (NO$_2$-N). After adding the synthetic wastewater to the treatment reactors, the LabVIEW software will start to record the DO, pH, temperature and ORP data and save it to the computer. After completing the treatment of each reactor, an effluent sample should be taken and analysed again to find the removal rates of phenol, BOD, COD, NH$_3$-N, NO$_3$-N and NO$_2$-N, and to find the sludge volume index (SVI) and mixed liquor suspended solid (MLSS) to study the sludge characteristics and to evaluate the SBR system.
Fig. 1 The configuration of R1, one of the identical laboratory SBRs (R1, R2, R3 and R4)
Expected results

This research project expects to save the operation costs and improve the sludge characteristics as well as to enhance the effluent quality by finding the relationship between the operating conditions and sludge characteristics, and its impact on the treatment efficiency of PRW.
Acknowledgement

The financial support from the Ministry of Higher Education and Scientific Research, Iraq, and University of Wasit for the first author is highly appreciated.

References


The Impact of Business Intelligence on Organization Performance

David Kantro, PhD Project Management student
The British University in Dubai

Abstract

In today's global settings, corporations have improved significantly their decision-making process and their overall performance. We went from an era of undocumented processes with an emphasis on extensive use of manual labor to a more effective one.

During the last decade, the World Wide Web or the Internet of things has transformed organizations' landscapes. Although we can arguably state that today's business environment presents more challenges than ever before, many organizations make the best of these situations by leveraging big data. Business intelligence allows organizations to conduct a scan of their political, economical, social and technological environment. It also allows them to effectively gather historical or new data in order to assess their strengths, weaknesses, opportunities, and threats or past experiences. This process either conscious or unconscious is the key to business success to many organizations.

Introduction

We live in an ever-changing world, where literally everything seems to get done faster and on a bigger scale. This approach to business or mode of operation is mainly due to the macro constraints presented by the environment in which we live in today as a society. One of management's core competencies is to be able to think on their feet and make important decisions to obtain unrealistic outcomes, in a short timeframe, with fewer resources.

The fact that we are not going back to the slow-paced environment when we had the possibility to squander huge amounts of resources in order to find solutions to global issues, has led many entities to look closely at technics or mechanisms susceptible to enhance decision-making. For many organizations, in various industries, scattered around the world, data mining and business intelligence seem like the descriptive, predictive, and prescriptive tool to effectively deal with business challenges.

In this study, we analyze the impact that using business intelligence has on project success rate, organization's budget management, and the diversity of international stakeholders that a given company may have.

A thorough analysis and some hypothesis show that improvements either in project success rate, industry overall improvement, budget management, return on investment, shareholders satisfaction, employees' engagement, or motivation, are all subject to recent changes (globalization, internet of things, knowledge sharing mechanisms, etc). This is why it is important to find automated ways of providing consistent outcomes regardless of market fluctuations.
Research Problem

Everything around us is changing to accommodate the principles of this new era. From electronics to food, literally every business sector is being impacted or has been profoundly transformed to meet the requirements of today’s business environment and clients’ requirements. The acceleration of IT in general was possible due to the World Wide Web. This paradigm shift has improved significantly our life. With GPS enabled devices, we can easily find places. We are even leading towards some incredible technologies such artificial intelligence.

Any project manager in any industry goals is to look for resource optimization to get the best outcome.

Industry best practices are hard to find therefore hard to share.

This leads companies to make the same costly mistakes year after year.

Every time a new project takes place, the feasibility studies done hardly make use of proven past experiences to help formulate the new projects. This is a real problem that requires the attention of academia and industry leaders.

As stated in the introduction, do we have enough evidence to conclude that business intelligence is the solution to solve organization performance issues?

Literature Review

Business Intelligence

Business intelligence (BI), as a professional discipline, prescribes organizational and technological interventions aimed at providing timely, accurate information to the right people, at the right times, to enable and improve business decision-making (Watson, 2009)\textsuperscript{2}

Business Intelligence (BI) Success and the Role of BI Capabilities


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As stated in the definition of BI, business intelligence in most cases is used in the decision making process. From the fundamental basics of collecting raw data from multiple sources to making the best decision based on available information.

This may sound simple to execute but the rate of failure due to uneducated and poor decision made, shows the complexity to implement business intelligence in organizations.

(Isik; Jones; Sidorova, 2011) mention that business intelligence has become a priority for many organizations to improve their decision making process, but final outcomes have somewhat left room to state that most organizations still lack the proper knowledge to fully capitalize on business intelligence features and benefits.

The Role of Organizational Absorptive Capacity in Strategic Use of Business Intelligence to Support Integrated Management Control Systems


The ability for an organization to strategically gather new external information will greatly determine the success rate of business intelligence system.

What happened in the past is management setting out to accomplish a task, and made use of any available resources in order to reach their goals. The process of identifying, sharing and implementing any new findings was top management driven. (Elbashir; Collier; Sutton, 2011)

From a normal observer, business intelligence system is like another tool to provide core management control capability and leverage companies’ database. So it may use top down approach like all other systems, but the fundamentals of business intelligence suggests that leveraging it, is driven from the bottom up. (Elbashir; Collier; Sutton, 2011)

Business intelligence in risk management: Some recent progresses

Wu, Desheng Dash; Chen, Shu-Heng; Olson, David L, 2014

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Risk management is an important part of every organization’s operations. Most projects outcomes are dictated by how risk is managed within the organization. Although risk may have different meanings depending on the context in which we use it, in most cases it implies threat. One of the attributes of business intelligence is its ability to include inherent risks in the decision making process.

Several risks factors (human capita, financial, geographic, etc.) can be factored in the decision making process by using business intelligence\(^4\). (Wu and al, 2014)

What we tend to see when we add or eliminate a given risk factor to a project, is that the final project success rate changes accordingly, leading management to consider or revisit their decision.

**Research hypotheses**

**Research hypothesis 1:** Using of business intelligence generally improves project success rate

**Research hypothesis 2:** Using of business intelligence generally increases international stakeholders

**Research questions**

a) Is there a significant change in project success rate following the use of business intelligence?

b) Is there a significant change in organizations’ international stakeholders following the use of business intelligence?

**Methodology**

\(^4\) Wu, Desheng Dash; Chen, Shu-Heng; Olson, David L. 2014

Business intelligence in risk management: Some recent progresses

Information Sciences, Vol.256, pp.1-7
In order to effectively find solutions to our research problem, we did use different methodologies. This approach helped to gather relevant data applicable to our case. The information gathered was of a qualitative and quantitative nature.

The quantitative method provided a more objective discussion with participants. It did facilitate the establishment of a sample size and various variables that were used to determine correlation between independent and dependent variables.

The qualitative method approach did allow us to gather more measureable information. The information gathered was analyzed using Excel and SPSS.

**Data Type**

The type of data that we collected during our research played a huge role in the results and final outcomes of our study. They are but not limited to the followings:

- Time and space in various projects
- Industry and project data (Agriculture, Healthcare, IT, Transport)
- Government regulations data
- Organization’s financial statements
- Private sector data
- Business registration data
- Industries’ barriers to entry data
- Industry best practices data
- Management behavior data
- Geographic location data
- Employees’ performance data

The goal of the data collected was to provide solutions to our research problem.

**Data collection methods**

1. **Interviews**
   A series of interview were conducted in Dubai and Abu Dhabi. Participants were given a questionnaire beforehand. The purpose of the interview was to collect quantitative and qualitative information about business intelligence, more precisely information pertinent to our research problem.

2. **Direct observations**
   We did analyze behavior of participants in their work environment. The goal of this research method was to see how participants use business intelligence on a daily basis. It also helped draw a correlation between organization overall performance and business intelligence.
3. Literature review
In order to have a holistic view about business intelligence and analyze relevant findings on the subject, we do some literature reviews. This approach provided insights about scholars’ views and also the etymology of business intelligence. It also led to a discussion, and as a result of the discussion, we were able to pinpoint some key elements to further advance our study.

4. Case studies
Many case studies were done to figure out the impact of business intelligence. In order to answer our research problem, we had to analyze various case studies. The findings served as premises to make a recommendation and to raise more questions regarding the link between business intelligence and organization’s performance.

Data Analysis

a) Frequencies - Univariate statistics
We surveyed 26 participants from various industries

Assumption 1: Comparing project success rate before and after using business intelligence
After year 2000, literally every organization was familiar with business intelligence processes. Enterprises had many available resources to leverage big data. So the increase we notice in the graph above shows that project success rate can be attributed to the use of business intelligence.

b) Paired sample t test

We surveyed 26 participants from various industries. Measurements per participant are scale variables.

**Research hypothesis 1: Use of business intelligence generally improves project success rate**

We surveyed 26 participants from various industries. Measurements per participant are scale variables. Independent variable: use of business intelligence. Dependent variables:

- Project success rate before year 2000
- Project success rate after year 2000

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<tr>
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<tr>
<td>Upper</td>
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</tbody>
</table>

**Interpretation:** In this analysis p<0.05. Therefore we reject the null hypothesis. In conclusion, using business intelligence does affect project success rate. Also an analysis of the mean shows a consistent increase in project success rate after year. This is evidence that business intelligence, big data and the Internet of things do in general improve business operations.
Research hypothesis 2: Use of business intelligence generally increases the number of international stakeholders

We surveyed 26 participants from various industries.

Measurements per participant are scale variables.

Independent variable: use of business intelligence

Dependent variables:

- International stakeholders before year 2000
- International stakeholders after year 2000

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<thead>
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**Paired Samples Test**

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</table>

**Interpretation:** In this analysis p<0.05. Therefore we reject the null hypothesis. In conclusion, using business intelligence does affect the number of organizations’ international stakeholders. Also an analysis of the mean shows an increase in international stakeholders after using business intelligence. This is evidence that business intelligence, big data and the Internet of things do accelerate globalization.

**Findings and Discussion**

A general analysis conducted on the following main variables (pre and post year 2000 project success rate and pre and post year 2000 international stakeholders) shows that business intelligence has transformed most industries.

In most cases, there is a strong correlation between the use of business intelligence and organization overall performance.

The survey shows that for instance project success rate have increased since Internet and leveraging big data has become ubiquitous. Same remarks were made for budget management and the diversity of stakeholders a company may have.
Before the popularization of Internet and business intelligence, organizations had fewer resources to be fully effective in their operations.

**Conclusions and Recommendations**

Using business intelligence does offer valuable information on a given organization strengths, weaknesses, opportunities and threats. It also provides a descriptive figure of an organization’s environment whether it is political, economical, social and technological. Having these types of information is key to success in many ways. In fact, we see more organizations, especially in the medical sector, capitalizing on the benefits of business intelligence to find cure and improve current treatment processes.

**References**


Quantitative Analysis on Knowledge Sharing Motivators & Demotivators Inside SIEMENS Middle East

Fuad Al Attar, PhD Computer Science student
The British University in Dubai

Abstract

Enabling the transfer of experiences and knowledge inside organizations has been always a crucial task for management. However, the willingness of individuals to share their knowledge inside an organization is the main factor for success or failure of any knowledge sharing process. In this research work, I evaluate the main factors that influence an employee’s willingness to transfer his/her tacit knowledge to other employees inside an organization. Nonetheless I examine through quantitative methods the effectiveness of Nonaka’ socialization, externalization and internalization techniques on sharing knowledge. The findings are applied on Siemens Middle East company in order to further assess the effectiveness of its used knowledge sharing techniques.

Keywords: Knowledge Sharing, Knowledge Transfer, Barriers, Demotivators, Enablers, Motivators

Introduction

Getting the most out of knowledge assets and resources is the main purpose of knowledge management systems. It’s indeed very important for organizations to develop and maintain certain level of knowledge through such management systems in order to survive in the business competition.

Although many people recognize only codified/articulated knowledge - which can be found inside books and documents - there is another important class of knowledge that is difficult to find in a documented form. Such class of knowledge is called “Tacit Knowing” or “Tacit Knowledge”. Polanyi (1966) gave several examples on this class of knowledge, such as our ability to identify the face of a human-being amongst many other humans. Normally we cannot describe how we could make such identification.

Many companies depend much on this kind of knowledge which cannot be easily codified or put in catalogues, manuals and procedure documents. This is the reason why sharing such knowledge between employees is a real challenge. Many techniques and tools were proposed for handling both types of knowledge (codified/explicit and non-codified/tacit). These techniques focus mainly on transferring both explicit and tacit knowledge between people, by either keeping the knowledge in its original form (i.e. tacit-to-tacit or explicit-to-explicit) or by converting it to other form (i.e. explicit-to-tacit or tacit-to-explicit). Indeed the tacit-to-explicit transformation is the most complicated as it’s not always feasible. Special proficiency is usually required for carrying out such knowledge conversion process.
Sarayreh, Mardawi and Dmour (2013) explained that one of the most famous Knowledge Management (KM) models which deal with both tacit and explicit knowledge types is the Socialization, Externalization, Combination and Internalization (SECI) Model or what’s known as Nonaka’s KM Model, which is shown in Figure (1). This model was jointly developed in 1995 by both Nonaka and Takeuchi who believed that knowledge invention and creation processes are spiral/coiled course of interactions between tacit and explicit knowledge. These interactions develop new knowledge inside companies and organizations.

As the simplest and best way of transferring tacit knowledge from one individual to another is by keeping it in its original tacit form, focus is always made on learning-by-watching and learning-by-doing techniques. However, such mentoring processes are totally dependent on the willingness of the mentor/expert employee to transfer his/her tacit knowledge to other employees.

By identifying the barriers/demotivators and enablers/motivators of Knowledge Sharing (KS), management can enhance the performance of the KS processes. As a result of such enhancement, the overall KM process can successfully achieve its purposes.

With reference to report of The Know Network (2015), Siemens company was recognized on 17-Nov-15 as the first winner in converting organizational knowledge into value. It would be therefore beneficial for the Middle East organizations to review the KM tools and techniques which are utilized by Siemens to activate the KS processes. However, in order to ensure that the special business environment of the Middle East is considered in the study, Siemens Middle East company was covered by this research.

**Research Objectives and Methodology**

The main objective of this research work is to answer the following combination of descriptive, relational and causal questions:

- What are the most preferred methods by employees for sharing tacit knowledge inside organizations?
What are the main KS barriers/demotivators that face organizations in the Middle East?

What are the factors that can have impact on an employee’s willingness to transfer tacit knowledge to his/her colleagues? Do gender, years of experience and duration of employment have any impact? Can job security and trust really enhance such willingness?

Do Socialization (meetings & group activities), Internalization (training) and Externalization (INTRANET) have impact on the effectiveness of knowledge sharing tools and procedures?

Do the good KS practices by Siemens Middle East really have genuine positive impact on the overall KS performance of the company?

I have used a mixed method approach in this research work. First, I went through a qualitative exploration and investigation through addressing main KS concepts and earlier studies, and then I used my own experience and direct observations in the field of managing KS inside organizations. Last but not least, I designed a survey questionnaire to test my hypothesis about the factors that affect the willingness of employees to share knowledge.

Literature Review

Documenting and sharing tacit knowledge is very important for companies and organizations so that they would not require to fix the same issues which they had experienced before. Nevertheless, as Stover (2004) indicated, it’s important to codify the organizational knowledge so that it can be reused for developing and creating new knowledge.

Haslinda and Sarinah, (2009) indicated that the simple Nonaka’s model may give an impression that the process of transferring knowledge is simple, however the fact is that such process is not really simple, and it can get very complicated when there is lack of willingness by individuals to share their knowledge.

Stover (2004) mentioned that the first barrier in KS is the nature of the tacit knowledge itself as it’s usually complicated and personal. As a result, it’s difficult to communicate tacit knowledge to others. According to Tounkara (2013), it’s important for companies to apply the recommended KM engineering procedures and techniques for identifying and codifying knowledge. Of course there will be a need for assigning specialized personnel to carry out such task as these skills need special type of education and experience.

The difficulty of acquiring and developing such skills is a challenge for management. Frost (2014) focused on the barrier related to lack of knowledge engineering skills and abilities, such as tactical abilities, commerce ability, logic-building abilities, communication abilities and IT abilities.
Ngulube (2003) mentioned additional barrier which can be faced after transferring knowledge successfully. This barrier is the possible obsolescence of documented knowledge due to changes of facts, technologies, etc. In order to resolve this issue, the company shall activate the internalization processes of Nonaka’s KM model. Discussions and interactions between employees during the internalization processes can make sure that the obsolete knowledge is detected then updated. Moreover, by activating the socialization activities during the next round of Nonaka’s KM process, the effect of obsolete knowledge can be minimized.

The barrier of unrealistic work load and lack of time for activities of KS is another important barrier which had been mentioned by Kosonen and Blomqvist (2013). Such issue would certainly have impact on the employee’s willingness to transfer or even to receive knowledge. Kibean Kwanya (2015) mentioned the barrier of lack of sufficient financial resources to support KS activities and processes. This causes absence of required IT and communication tools. Frost (2014) focused on the importance of correct financial planning for the organization’s budget in order to ensure that KM resources are taken into account.

Sheng (2013) referred to the barrier of lack of absorption abilities by the trainees. It’s recommended that companies shall frequently evaluate the absorption abilities of their employees who are active in the KS process.

The fear of losing job is another KS barrier. Keyes (2008) indicated that some employees may mistakenly conclude that they will be replaced by other employees if they share their knowledge. Keyes (2008) also referred to office politics which can be also a KS barrier. Such politics may cause lack of cooperation for transferring knowledge from one employee to another. Lack of trust and respect is indeed part of the KS barriers as people tend to voluntarily share their knowledge when there is an environment of trust.

Kosonen and Blomqvist (2013) mentioned the barrier of cultural diversity inside the work place. This can be a serious issue when employees fail to build and maintain reasonable relationships with people from other cultures.

Szulanski (1996) mentioned the problem of lack of incentives/rewards by management to encourage the KS activities.

The difficulty of locating the people who may have the required knowledge is also a problem that some employees may face. Keyes (2008) indicated that many employees do not know whom to ask for the
required knowledge when needed. This regularly happens in large organizations. The problem can also be caused by the lack of KS assets and tools, either due to lack of financial support as mentioned above, or lack of proper planning and management skills. Keyes (2008) further summarized the main KS barriers in one chart, which is shown in Figure (2).

![Figure (2): Main KS Barriers. Source (Keyes 2008)](image)

Survey Questionnaire

The survey questionnaire is an essential element in my research work. I designed the questionnaire in a certain way so that I can assess the relationship between the following variables:

- **Dependent Variable (1): Personal Willingness to Share Knowledge.** Independent Variables: Gender, Total years of experience and Total years of employment
- **Dependent Variable (2): Organization’s Willingness to Share Knowledge.** Independent Variables: Job Security and Trust.
- **Dependent Variable (3): Effectiveness of Knowledge Sharing Tools and Procedures.** Independent Variables: Socialization (meetings & group activities), Internalization (training) and Externalization (INTRANET).

The questions were also designed in a way that facilitates analyzing the knowledge sharing performance at Siemens Middle East, especially for the following KS factors:

- Socialization at Siemens
- Externalization at Siemens
- General willingness to share knowledge at Siemens
- Personal willingness to share knowledge at Siemens
Furthermore, I asked the participants to indicate the KS barriers that some of their colleagues are facing in their current organization. The purpose of this question is to identify the barriers which are commonly faced by employees and the dimension of each barrier through analyzing its frequency. The following KS barriers were presented for the participants to assess:

- Lack of time Barrier
- Lack of job security
- Lack of trust & respect
- Cultural & language barriers
- Lack of KS tools and assets
- Improper utilization of KS tools
- Lack of incentives
- Competition between employees
- The culture of “I know everything”
- The culture of shame to ask
- Inability to locate the correct knowledge source
- Far distance between work locations
- Lack of cross-division communications
- Different gender barrier
- Lack of Lessons-Learned sessions

I used the SurveyMonkey website to publish my survey questionnaire. First, I internally circulated the questionnaire to my colleagues at Siemens Middle East company, then I published the link of the survey at my LinkedIn account.

When I got almost equal participation from Siemens and non-Siemens employees on 7th of April 2016, I decided to conclude the survey. The duration of the survey was three days, and the total number of participants was 87 persons (44 Siemens employees and 43 non-Siemens employees).

Figure (3): Survey Results: Percentages of Siemens employees and other employees
In order to check if there is dependency between variables, I used the SPSS software to calculate the correlation coefficients. As most of the collected data is either Nominal or Ordinal data, I selected the Spearman Correlation Coefficient for my tests.

Then Regression was calculated through SPSS to check the significance of relationship between independent variables and dependent variables. I relied mostly on the Chi-square analysis as most of my data is either Nominal or Ordinal type. Although T-Test and ANOVA test are not very appropriate for my categorical variables, I decided to apply them as well just for verifying my Chi-square results.

**My Observations at Siemens**

Siemens had won 13-time European MAKE prizes so far. This includes six prizes of Overall European MAKE Winner (The Know Network, 2015). Through my own personal observations inside Siemens Middle East, I noticed many good motivators for the KS process and a good employment of Nonaka’s KM techniques, which include socialization, externalization, combination and internalization activities. Most of my observations about KS practices at Siemens are positive, however I’ve had few negative observations as there is a good room for improvement in some KS-related aspects, which I’ll also address in this section.

At Siemens Middle East, Socialization is activated by sharing knowledge between employees through personal meetings and virtual tools like Intranet chatting, forums, etc. Throughout this socialization process, an employee receives knowledge from different experts in the organization.

The offices in Siemens Middle East follows the open-office structure in which closed offices are avoided as much as possible. The purpose of following such design is to remove physical barriers between employees so that knowledge transfer through personal interactions can be made much easier.

For project and service engineers, Siemens created a web-tool named Techno-Web. It’s a communication podium where employees can gain experience from the available experts and technical materials at the web-tool.

Weekly, monthly, quarterly and annual team-events are always part of Siemens business calendar. Some of these events are purely social, like birthday gatherings, sports, etc, while the nature of other events is more business-focused, like technical workshops, sales workshops, business conferences, etc.

Frequent Lunch-and-Learn sessions are conducted by Siemens for its own employees, solution partners and customers in order to keep them updated about the latest products and services. Furthermore, the middle managers are always encouraged to dedicate special workshops that can be attended by certain
teams. These workshops address specialized topics for product sales, procurement, accounting, project execution, etc. Brainstorming and learned lessons are essential parts of the agendas of such workshops.

Although I observed many other good socialization practices inside Siemens divisions (Digital Factory Division, Process Industries & Drives Division, etc), I noticed that there is a need for more cross-division interactions. With regard to Externalization (converting tacit knowledge to explicit knowledge), I noticed that Siemens could build an excellent library for various fields of necessary business knowledge. It should be simple for each employee to find ready-made documents, procedures, manuals, catalogues, product updates, best engineering practices, etc. Moreover, Siemens engineers are always urged to submit site visit reports about their maintenance and project activities. Moreover, Sales people can easily submit their customer visit reports through the online customer relation management (CRM) tool, which is called Philos. However, I noticed that some Sales personnel are either not aware about this feature or they do not use it regularly.

For the knowledge Combination process, I believe that Siemens had also made an excellent progress so far as there is a good amount of combined-knowledge for each employee. It is not easy to go through all these tools and assets as the codified material is really massive; however a simple example is the interactive electronic CA01 catalog which combines all essential data on Siemens products. It also includes simple design and customization tools which choose the required hardware and/or software items once the user provides the design input. Preparing preliminary design documents, functional design documents and budgetary techno-commercial proposals is made simple with the CA01 tool.

The web-based CRM software (Philos) is available for most of Siemens Sales personnel. They use this tool to update the status of their sales opportunities, organize their customer visits, plan the customer-satisfaction surveys, etc. Nevertheless, delegating a sales task to other colleagues and assigning the work-team for certain opportunities are also possible through the same tool.

However, I observed that few of the very helpful attributes of Philos are not used properly by some sales personnel, either because they are not aware about that feature or they simply did not realize its great benefits. I also noticed that there are some other CRM tools which are used by the local teams in addition to Philos. Although these tools are providing additional help, like logging the customer’s cases and enquiries, I believe that it will be more helpful if all CRM tools are combined into one software for all users.

A special sales intelligence software called “Global-Footprint” is available for sales personnel to track the installed Siemens equipment. This web-based software uses GoogleEarth to show the location of
Siemens products, the names of customers and the details of the installed equipment. Indeed this is an excellent tool for the service sales specialists to locate their customers and plan their visits, however I noticed that some of the available installed-base data is old and could be obsolete as the customer may have already replaced the installed product. The local management is aware about such an issue, and there are genuine efforts to update the installed-base data by carrying out site surveys and offering free service reports to the customers who provide latest information about their installed Siemens equipment.

Internalization process at Siemens is established to ensure that any recently-created knowledge is transferred to the relevant employees in the company. The process includes training, learning-by-watching and learning-by-doing sessions. Nevertheless, Siemens web-based E-Learning is a very useful tool for all types of employee who can simply take online training sessions on any subject (sales, finance, engineering, etc) from any location at anytime. Special Live Meeting sessions are also available using the same online E-Learning tool.

Survey Results

In this section, I shall briefly summarize my findings after I analyzed the results of the conducted survey. Here, I summarize the main information about the participants of the survey, then I test and analyze the relationships between variables.

Participants

As I mentioned earlier, I could manage getting almost equal participants from Siemens and non-Siemens employees by distributing the survey questionnaire first to my Siemens colleagues then publishing the survey online for other participants.

My goal was to get more than 30 participants from Siemens and equal number from non-Siemens employees. I was glad when I could finally get 44 participants from Siemens and 43 from non-Siemens as this helps my research approach. However, I still wish that I could get higher number of participants from certain categories of respondents as I could not properly test and conclude some of the relations due to the low number of respondents in that category.

For example, I could only get 13 Female participants, which reduces the value of my render-related analysis.

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>14.9 %</td>
<td>13</td>
</tr>
<tr>
<td>Male</td>
<td>85.1 %</td>
<td>74</td>
</tr>
</tbody>
</table>

Table (1) Survey Summary: genders of Respondents
Likewise, I could only get few participants from non-Arab countries and few from single-culture companies. This is the reason why I could not assess the difference related to these variables, which could have been considered a bonus for my research work. However, my aim was to get more than 30 participants from non-Arab countries and more than 30 from multi-culture companies so that I can compare the results with those of Siemens Middle East. I was glad to get 82 participants from multi-culture companies including 81 participants from Arab countries.

<table>
<thead>
<tr>
<th>Multiple cultures</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>94.3 %</td>
<td>82</td>
</tr>
<tr>
<td>Not really, Majority are from same culture</td>
<td>3.4 %</td>
<td>3</td>
</tr>
<tr>
<td>No</td>
<td>2.3 %</td>
<td>2</td>
</tr>
<tr>
<td>answered question</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>skipped question</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Arab Country</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>93.1 %</td>
<td>81</td>
</tr>
<tr>
<td>No</td>
<td>6.9 %</td>
<td>6</td>
</tr>
<tr>
<td>answered question</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>skipped question</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Table (2) Survey Summary: Percentages of participants from Multi-culture companies and Arab countries

With regard to the years of experience, I noticed that most of the participants are senior people with more than 10 years of total work experience. I could only get few junior participants, thus I could not get strong analysis results for this variable.
Table (3) Survey Summary: Total work experience of respondents

However, I could successfully get a better number of participants who have had either less than 1 year or less than 5 years of employment duration at their current organization.

Table (4) Survey Summary: employment’s durations of respondents

Main KS Demotivators

The answers to the Question No. 17 of the survey questionnaire are very interesting. The question is (*In your opinion, why could some employees in your current organization face knowledge-sharing problems?*) and the answers sorted based on their frequencies are as follows:

- Lack of time (66.7 %)
- Lack of incentives (49.4 %)
- Cultural & language barriers (43.7 %)
- Lack of cross-division communications (43.7 %)
- Lack of Lessons-Learned sessions (41.4 %)
- Lack of trust & respect (34.5 %)
- Lack of job security (33.3 %)
- Competition between employees (28.7 %)
- The culture of “I know everything” (27.6 %)
- The culture of shame to ask (26.4 %)
- Improper utilization of KS tools (16.1 %)
- Far distance between work locations (13.8 %)
- Lack of KS tools and assets (11.5 %)
- Inability to locate the correct knowledge source (9.2 %)
- The barrier of “different gender” (8.0 %)
- Other barriers (4.6 %)

The barrier of the Lack of Time has had the highest ranking 2/3 of the respondents, which shows that the insufficient time to run-through the knowledge sharing practices is a very important demotivator for
the KS process. It deserves noting that many of the respondents who gave good ranking for the knowledge sharing tools inside their organization, they listed the lack of time as a main barrier.

Regardless of the efforts and the investment that an organization spends on KS practices, it makes sense that such practices would not give the awaited results unless the employees are given the time slot for practicing the KS process and using the available KS tools.

This barrier can be overcome when KS becomes part of the management’s workload plans for the employees. Nevertheless Time-Management skills for each individual play important role in this process.

The second barrier in the respondent’s ranking was the Lack of Incentives and Rewards. Although some employees can be self-motivated to share their knowledge as their main motivation is their personal values, some other employees would only focus on their incentivized tasks and their key performance indicators (KPIs). Unless the KS practices are part of these KPIs, some employees will be very reluctant to spend the necessary time and efforts to transfer their knowledge to other employees.

The barrier which ranked third in the respondent’s answers was the Cultural and Language Barrier. This is indeed very important because countries like UAE have had very diversified cultures. For example, according to the BQ-Magazine (2016), south Asians alone comprise almost 55% of the nationalities in UAE, and even those do not share the same culture.

These mixtures of nationalities, cultures and religions need special tacit-knowledge transfer skills and techniques as the subject can become very critical. I believe that activating the socialization process can reduce the negative impact of diversified cultures on the KS process.

The barrier of Insufficient Communication between Different Divisions was ranked fourth in the survey’s results. This shows that the management’s KS plan shall be prepared by the top management of the organization, and not only by the heads of divisions. This can ensure that the channels and doors between divisions are kept open for KS, otherwise the whole practice will be subject to the preferences and priorities of each individual division’s manager.

The barrier of Lack of Lessons-Learned Sessions got the fifth position in the respondent’s ranking. From my own experience in both Operations and Sales Departments, I believe that these sessions play major role by creating new knowledge inside the organization and sharing the knowledge with the largest possible number of employees during a short time. It is recommended to conduct such sessions upon completion of main projects or sales bids. Bids’ Win-Loss Analysis Sessions are also included in this category.

Lack of Trust & Respect barrier was given the rank six in the survey’s results. Some managers may use conflict of interest between different employees when they try to maintain a good internal auditing for different business functions. However, over-using such techniques may cause serious mistrust problems between employees, especially when there is a multi-cultural work environment in the organization.
Job security is an obvious KS barrier; I’m therefore surprised that it was pushed to the seventh rank. I was also surprised that the barrier of Competition between Employees got the eighth rank. However, with a percentage close to 1/3 of the respondents, both of these two barriers are still very important. Management shall ensure that a comfortable working environment is created and that a reasonable feeling of job security is present.

The culture of “I know everything” and “It’s shame to Ask” are ranked 9th and 10th respectively. Such culture is not only linked to the individuals as it can be a general phenomenon. Management needs to promote the concept of KS as a usual daily activity in order to overcome such reluctance to ask for knowledge.

The improper utilization of KS tools was ranked 11th in the survey’s results. High number of KS tools can be a positive indication that management gives sufficient attention to the KS processes; however such high number of tools may confuse the individuals who did not get proper induction and familiarization session for utilizing these tools. As a result, the utilization of these tools will not genuinely improve the KS process.

Far distance between work locations was listed as a barrier by almost 14% of the respondents. If we logically correlate this with the result of the Question No. 6 that the personal meetings are the preferred communication method for KS, then it’s fair to conclude that the geographical barrier can have negative impact on the efficiency of KS.

Although the impact of such barrier can be minimized by providing proper communication tools (e.g. Video conferencing, Live Meetings, etc), these tools cannot fully eliminate the barrier. This is clear from the results of the survey as more than 40% of respondents who selected this barrier are from Siemens where good amount of communication tools is available for employees. If such communication tools and assets are not available, then the KS process will be extremely difficult. I noticed that more than 11% of the respondents listed the missing tools as a barrier in their organizations.

The barrier of inability to locate the person who has had the required knowledge is also listed by some respondents. It’s therefore important for management to publicize the competency register of each employee so that individuals can locate the person who got the knowledge that they need to receive.

The barrier of different gender is ranked last in the predefined-barrier-list, however 8% is not really a percentage that can be neglected especially when considering the fact that the numbers of working females in some organizations in the Middle East are too low.

Preferred KS Communication

As expected, the respondent’s answers for the question related to their most-preferred method for sharing knowledge is meetings/workshops which supports Nonaka’s recommendation about face-to-face meetings in order to get best results from the socialization process.
Summary of the respondent’s answers is as follows:

- Meetings/workshops (77.0 %)
- Emails (12.6 %)
- Other (social events and one-to-one interviews) (3.4 %)
- Telephone (2.3 %)
- Intranet (2.3 %)
- Special Software Tools (2.3 %)

Factors for Personal Willingness to Share Knowledge

The answers to Question No. 8 - which is related to respondent’s willingness to share knowledge – indicate that majority of respondents showed good willingness to share knowledge.

The below Figure (6) shows the Histogram of the collected data (Variable: My KN Willingness) with a Mean/average value of 5.49 (considering 6 as the top ranking). Both Mode and Median values are 6, which shows slight skewness to the left in the Histogram.

![Figure (6): Histogram of respondent’s willingness to share knowledge](image)

I’ve checked both the correlation and the regression between this dependent variable and the independent variables of: Gender, Years of experience, Duration of Employment in order to check the presence and the strength of relation between these variables.

As the data is Categorical (Ordinal/Nominal), the main applied tests are Spearman Correlation and Chi-Square tests. Nevertheless, as explained earlier, I’ve also applied t-test/ANOVA for verification purposes whenever I found it necessary.

The summary of the tests’ results is as follows:
Gender

Figure (7) shows the Histogram of the collected gender data (Question No. 1), from all respondents.

![Histogram of gender variable](image)

By reviewing the collected gender data, it’s noticed that 85% of Females showed good and very good willingness to share their knowledge, compared to 86% of Males showed the same. The difference is too small which indicates no relation with gender. The same is also confirmed when applying the following relationships’ tests:

- Correlation coefficient is very weak (0.017)
- Chi-Square Tests showed no significance (sig. value 0.500)
- T-Test showed no significance (sig. value 0.451)

It is therefore concluded that there is no relationship between the genders of respondents and their willingness to share knowledge with others.

Years of Experience

Most of the participated respondents are not junior employees (90.8% are with more than 5 years of experience and 72.4% are with more than 10 years of experience). Nevertheless the results of the carried out tests are as follows:

- Correlation coefficient is weak (0.153)
- Chi-Square Tests showed no significance (sig. value 0.078)

Accordingly, it’s conclude that there is no significant relationship between a respondent’s total work experience and his/her willingness to share knowledge with others.

Years of Employment
The collected data about the respondents’ employment duration with their current employers is summarized as follows:

- Less than 1 year (17.2 %)
- 1 - 5 years (40.2 %)
- 5 -10 years (27.6 %)
- More than 10 years (14.9 %)

The statistical test results are as follows:

- Correlation coefficient is very weak (0.024)
- Chi-Square Tests showed no significance (sig. value 0.267)

This shows no significant relationship between the duration of employment and the willingness to share knowledge.

Factors for Organization’s Willingness to Share Knowledge

The answers to Question No. 7 reflect the general willingness of the organization’s employees to share their knowledge.

The question is (Do you agree that most employees in your current organization are willing to share their knowledge with their colleagues?). Summary of the respondents’ answers is as follows:

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>14.9 %</td>
<td>13</td>
</tr>
<tr>
<td>Agree</td>
<td>40.2 %</td>
<td>35</td>
</tr>
<tr>
<td>Neither/Neither agree nor disagree</td>
<td>28.7 %</td>
<td>25</td>
</tr>
<tr>
<td>Disagree</td>
<td>16.1 %</td>
<td>14</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>0.0 %</td>
<td>0</td>
</tr>
</tbody>
</table>

Table (5) Survey Summary: Organization’s willingness to share knowledge

Where the highest rate is 5 (Strongly agree), and the lowest rate is 1 (Strongly disagree).

Figure (8) shows that the distribution of the data is almost normal with a Mean value of 3.54.
In order to test the relation between this variable (organization’s willingness to share knowledge) and other variables, I checked both the correlation and the regression between this dependent variable and the independent variables of: Job Security and Trust.

Since my collected data is Categorical (Ordinal/Nominal), I applied the Spearman Correlation and Chi-Square tests. However, I’ve also applied t-test/ANOVA for verification purposes whenever I found it necessary. The tests’ results are summarized in the following sub-sections:

**Job Security**

As expected, test results show significant relationship between Job Security and the Organization’s willingness to share knowledge. The concluded test results are:

- Correlation coefficient is Moderate (0.390)
- Chi-Square Tests showed significance (sig. value 0.005)
- ANOVA test showed significance (sig. value 0.000)

This confirms that Job Security has had genuine impact on the willingness of most employees of an organization to share their knowledge with their colleagues.

**Trust**

Moreover, test results show significant relationship between Trust and the Organization’s willingness to share knowledge. The concluded test results are:

- Correlation coefficient is Moderate (0.454)
- Chi-Square Tests showed significance (sig. value 0.005)
- ANOVA test showed significance (sig. value 0.000)
This confirms that both Trust and Respect have had genuine impact on the willingness of most employees of an organization to share their knowledge with their colleagues.

Efficient KS Motivators

Figure (9) shows the distribution of collected data related to Question No. 11 (Do you agree that there are enough meetings, workshops or social activities in your organization to help sharing knowledge between employees?). The summary of the respondents’ answers is as follows:

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>14.9%</td>
<td>13</td>
</tr>
<tr>
<td>Agree</td>
<td>36.6%</td>
<td>32</td>
</tr>
<tr>
<td>Neutral/Neither agree nor disagree</td>
<td>24.4%</td>
<td>21</td>
</tr>
<tr>
<td>Disagree</td>
<td>18.4%</td>
<td>16</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>5.7%</td>
<td>5</td>
</tr>
</tbody>
</table>

Table (6) Percentages of participants from Multi-culture companies and Arab countries

Figure (9): Histogram of Effectiveness of knowledge sharing tools

Where the highest rate is 5 (Strongly agree), and the lowest rate is 1 (Strongly disagree). For testing the relation between the variable (Efficient KN Tools) and other variables, I checked the correlation and the regression between this dependent variable and the independent variables of: Socialization, Internalization and Externalization.

Since the respondents’ data type is Categorical (Ordinal/Nominal), I applied the Spearman Correlation and Chi-Square tests. T-test/ANOVA tests were also applied for verification whenever I found it necessary. The tests’ results are summarized in the following sub-sections:

Socialization (Meetings & Group Activities)
Significant relationship was noticed when testing the relationship between the Efficient KN Tools and the rating of Socialization. Summary of results is shown below:

- Correlation coefficient is Strong (0.554)
- Chi-Square Tests showed significance (sig. value 0.000)
- ANOVA test showed significance (sig. value 0.000)

This confirms that Socialization does have an impact on the effectiveness of knowledge sharing tools inside organizations.

**Internalization (Training)**

Relationship between the Efficient KN Tools and the rating of Internalization was tested, and the results are summarized as follows:

- Correlation coefficient is Moderate (0.391)
- Chi-Square Tests showed no significance (sig. value 0.081), (however, 19 cells have expected count less than 5. The minimum expected count is 11).
- ANOVA test showed significance (sig. value 0.000)

This indicates that Internalization has had an impact on the effectiveness of knowledge sharing tools inside organizations.

**Externalization (INTRANET)**

Relationship between the efficiency of KS tools and the rating of Externalization was tested, and the results are summarized as follows:

- Correlation coefficient is Moderate (0.429)
- Chi-Square Tests showed significance (sig. value 0.001)
- ANOVA test showed significance (sig. value 0.000)

This confirms that Internalization has had an impact on the effectiveness of knowledge sharing tools inside organizations. Nevertheless, an ANOVA test was carried out for the combined Externalization, Socialization & Internalization (Training) variables also showed significant relationship with the efficiency of KS tools.
Siemens KS Performance

I compared the answers of Siemens respondents with the remaining respondents in order to assess the general KS performance at Siemens company. In order to test the relation between this variable (Employee of Siemens) and other variables, I checked both the correlation and the regression between this dependent variable and the independent variables of: Socialization, Externalization, Internalization, General KS Willingness and Personal KS Willingness. As the respondent’s data is Categorical (Ordinal/Nominal), I applied the Spearman Correlation and Chi-Square tests. I’ve also applied t-test/ANOVA for verification whenever necessary. The tests’ results are summarized in the following subsections:

Socialization at Siemens

The correlation test results show there is a relationship between Siemens and the ratings of the Socialization process. However the statistical tests show that such relationship is not really significant.

- Correlation coefficient is Weak (0.194)
- Chi-Square Tests showed no significance (sig. value 0.48)
- T-Test test showed significance (sig. value 0.069)

Externalization (INTRANET& CRM) and Internalization (Training) at Siemens

With regard to the question (How do you rate your organization’s internal training program?), the answers show the following:

- Excellent or Good Training (SIEMENS) 61.4%
- Excellent or Good Training (Non-SIEMENS) 41.80%

![Figure (10): Survey results on rating of Internal Training](image)

This indicates that Siemens respondents are generally more satisfied about their internal training program than the other respondents.
With regard to the question *(How often you use a CRM tool for sharing knowledge with other employees in your organization?)*, the answers show the following:

- 55% Use CRM regularly/sometimes (SIEMENS)
- 37% Use CRM regularly/sometimes (Non-SIEMENS)

![Figure (11): Survey results on regular use of CRM tool](image)

This indicates that Siemens respondents are using the CRM tool to share knowledge more often than the other respondents.

With regard to the question *(How do you rate your organization’s INTRANET as a method for transferring knowledge to employees?)*, the answers show the following:

- Excellent or Good INTRANET (SIEMENS) 72.7%
- Excellent or Good INTRANET (Non-SIEMENS) 48.80%

![Figure (12): Survey results on rating of INTRANET](image)

This indicates that Siemens respondents are more satisfied about the INTRANET tools than the other respondents.

The relationship between the dependent variable (Siemens Employee) and the independent variable of Externalization was tested and the results were as follows:

- Correlation coefficient is Moderate (0.320)
- Chi-Square Tests showed significance (sig. value 0.001)
ANOVA test showed significance (sig. value 0.001)

**General KS Willingness at Siemens**

With regard to the question *(Do you agree that most employees in your current organization are willing to share their knowledge with their colleagues?)*, the results show the following:

- 65.9% of Siemens employees agreed
- 44.2% of non-Siemens employees agreed

![Figure (13): Survey results on general KS willingness](image)

This indicates that Siemens employees are generally more satisfied about the KS environment in their organization.

I tested the relationship between the independent variable (Siemens Employee) and the dependent variable (General KS Willingness), and the results were as follows:

- Correlation coefficient is significant but still Weak (0.227)
- ANOVA test showed significance (sig. value 0.034)
- T-Test test showed significance (sig. value 0.034)

This indicates the significance of Siemens’ good KS performance when compared to other organizations whose employees participated in the survey questionnaire.

**Personal KS Willingness at Siemens**

With regard to the question *(Who are the employees in your organization that you are ready to share with them your own work-knowledge?)*, the answers show the following:

- All employees (by SIEMENS) 77.3%
- All employees (by Non-SIEMENS) 53.5%
Figure (14): Survey results on respondent’s willingness to share knowledge

This indicates that Siemens respondents are generally more willing to share their knowledge with their colleagues when compared to other respondents.

I tested the relationship between the independent variable (Siemens Employee) and the dependent variable (General KS Willingness), and the results were as follows:

- Correlation coefficient is significant but still Weak (0.280)
- Chi-Square Tests showed significance (sig. value 0.047)
- T-Test test showed significance (sig. value 0.005)
- ANOVA test showed significance (sig. value 0.005)

This indicates that Siemens has succeeded in motivating its employees to share their knowledge more than other organizations.

Conclusions

The conclusions of my personal observations and the conducted survey are summarized as follows:

- The most preferred method by employees for sharing tacit knowledge inside organizations is personal meetings/workshops. Therefore companies need to focus on increasing the socialization activities for their employees in order to motivate the KS processes.

- The main KS barriers/demotivators that face organizations in the Middle East are concluded in this research. Nevertheless a priority rating has been given to each barrier based on the results of the survey. The top five KS barriers are: Lack of time, Lack of incentives, Cultural & language barriers, Lack of cross-division communications and Lack of Lessons-Learned sessions.

- The main factors that can have impact on the willingness of most employees to transfer tacit knowledge to their colleagues are Job Security and Trust. Nevertheless, the statistical tests concluded that there is no
relationship between employees’ willingness to share knowledge and their genders, years of experience or duration of employment.

- Socialization (meetings & group activities), Internalization (training) and Externalization (INTRANET) do have genuine impact on the effectiveness of knowledge sharing tools and procedures.

- The statistical tests confirmed that the KS performance by Siemens Middle East is generally good when compared to the obtained results from other employees. This indicates that the good KS practices which I personally observed inside Siemens do have genuine impact on the effectiveness of the KS process.

References


Strategic Implementation of quality in SMART Government in Dubai

Hoor Riadh, PhD Student in Project management,
The British University in Dubai

Abstract

Those united Middle Easterner emirates (UAE) legislature need encountered different legitimate progressions ensuing of the Unit might have been fabricated up clinched alongside 1970. To these progress endeavors, the and only state power need been central to installment An society for organization progress Furthermore proficient course of action execution through different instruments. Of late, the dream of the state power will fulfill individuals' happiness need been an essential figure reconfiguring a standout amongst these instruments - legislature.

The specific focuses from claiming this paper to make a speculative review of existing composing looking into open organization quality, open organization improvement Also smart legislature will recommend a structure for dialog and to break down the legitimate components impinging on the determination of the sharp legislature show, to portray the segments of the model in the UAE, to overview those status for execution in the UAE and tn assess the issues Also prospects of the splendid movement.

Majority of the data Also information to this paper were assembled starting with assistant wellsprings. The two-year change head out (June 2012-May 2014) need shown astonishing achievement done wording An smooth birch move from administration with administration Also in this manner those country need situated new concentrates will finish in the center from claiming Right away and 2018. A chance to be that Likewise it may, there have been two foremost worries in the approach level:

Introduction

The Dubai E-government (DEG) is a test of how An spearheading thought is, no doubt converted under truth since the ruler from claiming Dubai need maintained that Dubai e-government ought on witness those new type from claiming clever legislature. It may be an exhaustive technique to help the Dubai administration see its destinations about turning under those fundamental focal point purpose of the new economy through those change and creative employments from claiming innovation, for an exhaustive framework from claiming amassed administrations to those correspondence division that urge business development with murder defers and bottlenecks. The electronic correspondence achievements clinched alongside Dubai settled on Emulating the dispatch of the e-government augment to 2001 would those delayed consequence from claiming joint endeavors Eventually Tom's perusing constantly on Dubai administration divisions (DEG, 2009).

Likewise an alternate "biological community" that merits an additional approach. Their see may be kept tabs for city-based organization will intensify points of interest and minimize disservices.
Hey keep up that open organization ought to a chance to be depicted Toward an open Also clever legislature What's more it ought with take advantage for information Also correspondence improvement (ICT) Concerning illustration a standout amongst those skilled units. Those inventors however caution that those execution from claiming this "astute" open organization will be a mind boggling errand that obliges a multidisciplinary approach (Jiménez et al., 2014). Provoked Toward this resounding view, our examination begins with a chase down a speculative expand on sharp administration and Subsequently it may be seen as profitable on make those talk further with conceptualize the Acquaintanceship between eGovernment, splendid government, headway and open organization caliber.

This movement will similarly set the UAE toward equal level with forefront countries Also mirror those Combative objective of Dubai with rank during a helter skater overall level for headway for everyone inhabitant in the country. (Alrazoqi Furthermore Silva, 2011). The Dubai administration means with make An subjective hop On administrations provided for on kin by and large every last one of over undertakings ought a chance to be evaluated Likewise a few for them need aid done Furthermore functioned the place the rest are in the fabricating stage or even now unborn.

Research problem statement

Starting with an organization purpose of view, Al-Koura fights eGovernment as a clear fundamental duty on oversee empowering the operation for administration and the coursing library about authoritative information Furthermore administrations for an amazing goal about stretched plan for open administrations on subjects in a proficient also useful best approach (Al-Koura, 2014).

There need aid Different issues in the UAE to advanced mobile legislature that would had a tendency to in the investigation composing Furthermore which provides for a couple plans that those Dubai legislature Might Think as of. As for every Alseheri et al. (2011), execution of majority of the data boxes Also reprocessing about central registers bring gotten sure response from inhabitants however these new functionalities would imparted to those A large portion part in the extend of open association workers, same time unforcedness regarding this subject "around locals is low which camwood again off their utilization Toward those Generally speaking populace.

These tests hint at what guideline issues might again off alternately bottleneck those use of the Dubai advanced mobile administration project and the change get ready likewise. These sorts about issues require augment organization methodologies alternately managing significant ventures strategies with complete it deliberately with avoid those same oversights Dubai legislature aggravated same time executing the Dubai E-government system.

Research aim and objective

The aims and objectives of this research are:

- To review of e-Government and its part in upsetting existing administrative frameworks.
- To contends that all together for e-Government activities to really succeed, we have to create open trust and certainty to advance dissemination and interest.
Research justification

Those examination may be finished so as will discover the key usage from claiming caliber clinched alongside advanced mobile legislature to Dubai.

In the past few years, various countries of the globe offered watchful attention with making methodologies Furthermore strategies around the climbing ticket from claiming e-Government. In regards execution and activity, a couple countries have picked up speedier ground over others and conceivably succeeded previously, delivering fancied effects. The united Middle Easterner emirates (UAE), through incessant vitality What's more movement starting with its pioneers What's more for An transform force for best act reception, bring refined more foremost Also speedier effects (Rahman, et. Al., 2013). The coupling of quality organization thoughts, legislature execution perfect models also flawlessness models drove regularly to an assignment from claiming eGovernment in the UAE when the new century rolled in.

Research hypothesis

The research hypothesis is:

Hypothesis 1 (H1): Leadership, organizational culture and communication affect the SMART idea of e-government in UAE.

Smart Government in Dubai (dependent variable) and Leadership, Communication & Organizational Culture (independent variables)

Not in the least similar to various different making countries around those GCC, need Dubai showed up should a chance to be to a more excellent degree An central focus perspective that pulls On people starting with made Furthermore making countries should help alternately considerably find An vocation. This permits the investigator should need An a greater amount grounded see for Bedouin power style Also their impact with respect to execution, Similarly as it starts starting with separate nationalities and ability in the extent.

Research Questions

1. What sort of crucial organization model is A large portion suitable, selecting from the critical models that would use Likewise and only e-government and keen legislature (that need aid distinguish underneath in the composing overview segment)?
2. What sort of activity Also organization style may be needed for advanced mobile administration?
3. How the thing that sort hierarchic society meets expectations best for advanced mobile legislature business settings what's more entryway you quit offering on that one makes this society?
4. What sort of correspondence styles might worth of effort best for advanced mobile legislature work places Furthermore their clients?
Methodology

Research Design

As the purpose of the study are to review of eGovernment and its part in upsetting existing administrative frameworks and to contend that all together for eGovernment activities to really succeed, we have to create open trust and certainty to advance dissemination and interest.

Sampling

For this, the 100 Reponses were generated through the set of 35 questions in which different questions were asked from the different people that what they think about the SMART idea in UEA. Many different responses were generated.

Research instrument

Notwithstanding those reality that gatherings and focus get-togethers will provide for an incredible arrangement of the majority of the data obliged for the postulation, they will must make supplemented with record examination for methodology articulations Also reports from the national UAE administration and the Dubai legislature. The record examination will take a gander at those political and legitimate issues previously, critical enactment, administration and office system documents and arrangements. The most recent paper will discuss what topics in the report card substance will make inspected that would critical of the productive gathering about e-government in the political, social What's more managerial setting of the UAE. The file examination will take a gander at substance that could a chance to be associated with those reason, rules What's more hones from claiming keen government, both Similarly as much as its use for reflecting formal real What's more technique necessities Also its comparability with those traditions Furthermore estimations of the UAE socially Furthermore socially. Those examination will similarly take a gander at majority of the data on the Choice for e-government slants in the UAE Also natives' inclinations previously, using it in unique visits furthermore printed duplicate paper fill in.

Regardless record examination, recognitions will a chance to be carried of Dubai keen legislature division's use assembly that also incorporates a personal satisfaction director that might make profitable to providing for information around how activity and organization are by any means drilled, What’s more also information on the progressive society and the correspondence styles that need aid being used. The most recent paper will recognize those amounts from claiming hours again a foreordained timeframe, Furthermore those errands that will make viewed and the sort issues What's more topics that notes will a chance to be taken from claiming.
Data analysis

The data that is collected is then factual investigation is performed by utilizing distinctive measurable measures that aided in testing the examination speculation and decided the relationship between the variables. These factual measures are reliability analysis, correlation analysis, regression analysis, one-sample t-test, ANOVA, Chi-Square and frequency distribution of demographic information. All these tests are performed using SPSS. More detail about each analysis is given in the results and discussion chapter.

Results and Discussion

Reliability Analysis

This test is a standout amongst the most imperative tests to be directed in breaking down information for the truth it tests the nonappearance of mistake when the test is managed. It is pointer of how dependable or mistakes free are our estimations. The components with Cronbach Alpha of more than 0.60 are viewed as solid (Gleam & Gleam, 2003).

From the results, the following values of Cronbach Alpha are identified:

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cronbach Alpha Values</th>
<th>Number of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart Government</td>
<td>0.7</td>
<td>8</td>
</tr>
<tr>
<td>Leadership, Culture</td>
<td>0.8</td>
<td>13</td>
</tr>
<tr>
<td>Communication</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Demographic Analysis

The demographic aspects studied in this research are gender, age, local authorities in which employees work, designation, experience and satisfaction toward e-services. The descriptive statistics of the demographic are shown as below:

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Q1_Gender</th>
<th>Q2_Age</th>
<th>Q3_Local_Authorities</th>
<th>Q4_Designation</th>
<th>Q5_Experience</th>
<th>Q6_Satisfaction_e-service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.44</td>
<td>2.60</td>
<td>3.01</td>
<td>2.96</td>
<td>1.96</td>
<td>1.83</td>
</tr>
<tr>
<td>Median</td>
<td>1.00</td>
<td>2.00</td>
<td>3.00</td>
<td>3.00</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Mode</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>.499</td>
<td>1.206</td>
<td>1.105</td>
<td>1.180</td>
<td>1.127</td>
<td>.378</td>
</tr>
<tr>
<td>---------------</td>
<td>------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>Variance</td>
<td>.249</td>
<td>1.455</td>
<td>1.222</td>
<td>1.392</td>
<td>1.271</td>
<td>.143</td>
</tr>
</tbody>
</table>

Of total 100 participants, 44% were female while 56 were male, who are working in the local authorities in the Dubai e-government.

Of total 100 participants, 20% were belongs from the age group between 18 and 25 years; 31% belongs from the ages between 26 and 30 years; 27% belongs from the ages between 31 and 34 years; 13% belongs from the ages between 36 and 40 years; while remaining 9% were ages more than 40 years.
Of total 100 participants, 5% were belongs from Dubai Electricity and Water Authority; 32% were belongs from Dubai Health Authority; 33% were belongs from Dubai Courts; 17% were belongs from Dubai Municipality; and remaining 13% were belongs from other authorities.

Of total 100 participants, 9% are working at managerial level; 29% are working as advisors. 34% are working as supervisors; 13% are working as were CEO/COO and BOD; while remaining 15% are working at other work positions in Dubai e-government.
Of total 100 participants, 49% have been working since less than 1 year; 22% have been working between 1 and 5 years; 13% have been working between 6 and 10 years; while remaining 16% have been working since more than 10 years.

Of total 100 employees, 83% said that they are not satisfied with the e-services provided by the authority in Dubai, while remaining 17% have shown satisfaction toward e-services of their authorities.
Correlation analysis

The correlation analysis inspects the relationship between the study variables by the utilization of connection investigation. Besides, with regards to translate the estimation of relationship, following rules are considered:

- Correlation estimation of 1 or near 1 implies an impeccable relationship;
- Negative estimation of 1 or near 1 implies a flawlessly negative relationship; and
- Correlation estimation of 0 means there is no relationship

By using SPSS, the following correlation has been identified between independent and dependent variables of the study:

<table>
<thead>
<tr>
<th></th>
<th>Smart Govnt</th>
<th>Cul_Lead_Comm_Average</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pearson Correlation</strong></td>
<td>1</td>
<td>-.156</td>
</tr>
<tr>
<td><strong>Sig. (2-tailed)</strong></td>
<td>.122</td>
<td></td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

The findings revealed the negative and weak relationship between SMART e-Government of Dubai (dependent variable) and communication, organizational culture and leadership (independent variables) at the significance level of 5% as it shows the value of correlation coefficient as -0.156.

T-Test Analysis

One-sample t-test results shown below determined and compared the mean of both independent and dependent variables. The results revealed that the p-value of Dubai Smart Government and communication, leadership and organizational culture is 0.000 that is less than 0.005, which indicates the significant difference between the mean values of two variables is statistically significant.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart Govern</td>
<td>100</td>
<td>2.53875</td>
<td>.780260</td>
<td>.078026</td>
</tr>
<tr>
<td>Cul_Lead_Comm_Average</td>
<td>100</td>
<td>3.521538</td>
<td>.7584781</td>
<td>.0758478</td>
</tr>
</tbody>
</table>
One-Sample Test

<table>
<thead>
<tr>
<th></th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart Govern</td>
<td>32.537</td>
<td>99</td>
<td>.000</td>
<td>2.538750</td>
<td>Lower: 2.38393, Upper: 2.69357</td>
</tr>
<tr>
<td>Cul_Lead_Comm_Average</td>
<td>46.429</td>
<td>99</td>
<td>.000</td>
<td>3.5215385</td>
<td>Lower: 3.371040, Upper: 3.672037</td>
</tr>
</tbody>
</table>

Chi-Square Analysis

The following results obtained from the Chi-Square test revealed the relationship between two categorical variables of the population. Thus, it is interpreted from the results that the value of Pearson Chi-Square is 802.092 cannot be rejected because the p-value is greater than 0.005. Therefore, the null hypothesis of the study is accepted and it can be said that leadership, communication and organizational culture affects the Dubai Smart Government as the results also revealed the negative relationship between the variables.

Chi-Square Tests

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>802.092a</td>
<td>714</td>
<td>.012</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>316.812</td>
<td>714</td>
<td>1.000</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>2.397</td>
<td>1</td>
<td>.122</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. 770 cells (100.0%) have expected count less than 5. The minimum expected count is .01.

ANOVA

ANOVA is utilized to evaluate contrasts in normal estimations of a dependent variable under the impact of free variables controlled, considering the impact of uncontrolled autonomous variables. However, the following results revealed that the unexplained variance in the data is 35.990 out of the total 60.272. Besides, the P-value, which should be less than 0.05 for accepting the hypothesis, is greater than 0.005, which means that null hypothesis is accepted because the model is not statistically significant. Finally, the F-value is indicated as 1.290, which is enough to accept the null hypothesis.
Hence, it can be interpreted that the organizational culture, leadership, and communication affects the Dubai Smart Government.

ANOVA

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>24.282</td>
<td>34</td>
<td>.714</td>
<td>1.290</td>
<td>.187</td>
</tr>
<tr>
<td>Within Groups</td>
<td>35.990</td>
<td>65</td>
<td>.554</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>60.272</td>
<td>99</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Regression Analysis

The linear regression has been performed to test the hypothesis. In the results, Model Summary explains the overall relation between dependent and independent variables. The results revealed that there is negative and weak relationship between the study variables as it shows the $R$ as 0.156 or 15.6%. Besides, $R^2$ value represented as 0.24, which indicates that the communication, leadership and organizational culture explains only 24% of the variability of the dependent variable i.e. Dubai Smart Government.

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.156a</td>
<td>.024</td>
<td>.014</td>
<td>.774677</td>
</tr>
</tbody>
</table>

As discussed before, the results of ANOVA in regression also revealed the similar outcomes. Since, the residual value of unexplained variances is 58.812 out of the total 60.272, while the $p$-value is also greater than 0.05, which means that the null hypothesis is accepted.

ANOVA

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.459</td>
<td>1</td>
<td>1.459</td>
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</table>

a. Dependent Variable: AVERAGE
b. Predictors: (Constant), Cul_Lead_Comm_Average
Finally, the coefficient represents the contribution of each variable in the model. In the following coefficient table, it is shown the ‘B’ value as -0.160, which indicates that there is a negative relationship between variables. Furthermore, the table shows the t-test of each ‘b’ value is less significant, which means that predictor do not make significant contribution to the model as it is greater than 0.05. Based on the results, it can be concluded that communication, leadership and organizational culture are not the significant predictors of Dubai Smart Government.

### Coefficients

<table>
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<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
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a. Dependent Variable: AVERAGE

### Conclusion

This paper highlighted the main issues of Dubai e-government and SMART government strategic implementation. As discussed above, electronic government become a trend around the world, and the Dubai government decided to join this trend without really studying the implementation strategy that would work best and serve its own and its clients’ interests. In order to ease the process of adoption among citizens and employees issues like privacy, individual security and transparency are the main issues that bottleneck the process of the virtual government implementation and adoption. Since, the results obtained from the study revealed that these issues are usually take place due to the ineffective communication, organizational culture and leadership practices.

The best solutions that will work for the above issues which slow down the adoption process is to put a strategic plan in place for implementation such as the Reiss et al. (2006) model which could apply to the SMART government project in Dubai, of course in a professional way and with a suitable team to carry out the strategy. Client trust can only come after a reliable service is operating. Also the quality of government should set a higher standard, requiring a strategic implementation process that will raise the bar of quality management and managing large programs among other Emirates in the UAE, where Dubai will stand out as an example for the rest to follow or be inspired by.

Nevertheless, there is still enough time before 2020 to conduct more research and to organize suitable strategies to make sure that this large scale program will deliver its services properly and will serve the overarching goal of SMART government.
Reference


Gas Turbine Propulsion For Heavy Vehicles

Eyad Megdadi, MSc Systems Engineering student
The British University in Dubai

R. Whalley, Head of the MSc in Systems Engineering Programme
The British University in Dubai

M. K. Ebrahimi
Loughborough University of Technology, UK

Abstract

The regulation of gas turbine, power propulsion systems, for heavy vehicles, is considered. Multivariable control to restrict the gas generator speed and power turbine, gas temperature, by closed loop, fuel pump voltage changes and power turbine, guide vane nozzle angle, actuator adjustments, is proposed. A novel feedback strategy which minimizes the control system energy dissipation confining actuator activity and hence the fuel flow and nozzle angle movement, is employed. Closed loop, output interaction, cross coupling, is constrained together with the achievement of specified, steady state and dynamic performance conditions by minimizing a control energy, performance functional. An alternative approach based on H infinity control methods is presented, for purpose of comparison. Computation of the responses, disturbance suppression, transient and the control energy dissipated by these procedures, is provided. The advantages of the techniques incorporated are contrasted and recommendation are formulated.

Keywords: automotive, gas turbine, regulation, response, characteristics.

Introduction

Gas turbine engines are very reliable, have unrivalled power-weight ratio properties and excellent mechanical efficiency characteristics [1]. The use of these power units for aviation, maritime and industrial applications [2] has also been successful particularly where constant speed, full load performance is required.

Gas turbine power systems for automobiles have also been investigated [3]. The Rover car company, gas turbine entry for the Le Mans 24 hour race, was successfully completed in 1950 [4] [5] with an adapted, gas turbine powered saloon, demonstrating thereby the reliability, compactness and power-weight advantages of these prime movers.

However, the transition from aircraft, ship propulsion and industrial power plant to automotive, gas turbine drives was not an overwhelming success. Immediate problems with the increasing fuel consumption experienced, under part load, varying disturbance and idling conditions and rising fuel costs were instrumental in arresting, automotive gas turbine developments [6].
There were in addition environmental concerns, regulation problems and safety aspects to consider. These difficulties manifested themselves in terms of the transient loss of power [7] following load changes owing to incomplete combustion. Related atmospheric pollution anxieties and the problems arising from the high temperature, exhaust emissions, exacerbated these concerns.

As with all turbine applications, compressor surge and fuel flow limitations also required closed loop regulation. However, dedicated controls were used to address these problems although increasing complexity, costs and maintenance requirements.

Nevertheless, the impressive performance of gas turbines, under full load conditions remained, with comparability approaching that of diesel engine performance. This and, the unrivalled reliability, compactness and power-weight advantages of these power systems, continued to attract attention. Advocates of turbine drives speculated that gas turbine traction, for the long haul [8], [9], commercial vehicles traversing North America, Australia and Asia, for example, would be attractive. These journeys were often conducted under virtual full load, constant speed conditions enabling the high load performance, reliability and power-weight advantages of these units to be realized. A refit by replacement policy was also envisaged, as with aircraft, ship and industrial units enabling scheduled servicing following specified, operational duty cycles.

Innovation which introduced gas turbine-electric propulsion, as shown in the arrangement of figure 1, was also proposed [10]. This eliminated the high speed gearing problem which together with heat recovery using the exhaust gases simultaneously lowers the exhaust gas temperature whilst improving cycle efficiency.

![Figure 1: Arrangement of commercial Vehicle Gas Turbine- Electric Drive](image)

With this advancement, gas turbine, heavy duty vehicles could dispense with the need for, the heavy diesel engine, propeller shafts, universal couplings, gears, flywheels and clutches benefiting thereby from the lower mass—-inertia, cost and complexity associated with these components. Additionally, the noise, vibration and judder arising from the use of diesel engines and mechanical transmissions would be avoided improving driver experience, minimizing fatigue and enhancing the safety aspects, associated with long distance, road transportation.
Gas turbine-electric drives also provide substantial improvements over earlier traction systems, for commercial vehicle applications. However, the control problem remains with the requirement for gas generator speed limitations and inter-turbine, gas temperature restrictions, by fuel pump motor and power turbine nozzle actuator, voltage variations.

However, as the analytical model herein indicates, the system outputs of the gas generator turbine speed and the power turbine gas temperature, are coupled. This requires closed loop monitoring and feedback control to confine this interaction enabling the achievement of specified, closed loop response reactions.

The general system arrangement is as shown in figure 2, where the principal assemblies are indicated together with specific function details.

![Gas Turbine-Electric Power System Arrangement](image)

**Figure 2:** Gas Turbine-Electric Power System Arrangement

### Systems Description

The non-linear model derived in [11] and employed in [12], yields the linearized, transfer function matrix, given by equation 2.1, for an automotive, gas turbine drive. This model is in respect of 80-100% of the gas generator speed and 85-100% of the engine, power generation capacity providing thereby an appropriate, high performance, analytical description for the unit. The two independent inputs are the percentage (% $f_p$ ) fuel pump, motor voltage and the percentage guide vane, nozzle actuator voltage (% $n_a$).

Hence, the model input vector is, $u(s) = (%f_p, %n_a)^T$ and $\delta(s) = (\delta_1(s), \delta_2(s))^T$ is the load disturbance vector.
The outputs to be controlled are the percentage changes in the gas generator, turbine speed \( \% \omega \) and the percentage change in the power turbine, inlet gas temperature \( \% T \), so that \( y(s) = \left( \%T(s), \%\omega(s) \right)^T \) is the model output vector where:

\[
y(s) = G(s)u(s) + \delta(s)
\]

and \( G(s) \) is system transfer function, matrix model given by:

\[
G(s) = \begin{bmatrix}
\frac{0.967 \times 10^6}{s + 40.0} & -8.1248(s + 3.27) \\
8.82 \times 10^6(s + 31.42) & (s + 0.95) \\
(s + 1.55)(s + 40)(s + 187.4) & 50.20 \\
(s + 1.55)
\end{bmatrix}
\]

In response to unit, step input changes the output variations are given by the transients, shown in figure 3 for a 1% change in the fuel pump, motor voltage. Figure 4 shows the percentage output changes again for the gas generator turbine speed and the power turbine gas temperature, \( \% \omega \) and \( \% T \), respectively, following a 1% change in the guide vane, nozzle actuator unit.

**Figure 3:** % Output Changes Following a 1% Change in Fuel Pump Motor Voltage % \( f_p \)
As these graphs illustrate, there is substantial output coupling when exercising either of the inputs. In the first case, following a change in the fuel flow of 1% the steady state gas generator, turbine speed rises by approximately 1.9% in 1 sec. and the power turbine gas temperature increases by 2.4%. Otherwise, a nozzle guide vane actuator change of 1% produces a decrease in the power turbine, gas temperature of 20% and a steady increase in the gas generator, turbine speed of 25% in 1 sec.

These open loop responses indicate that there is a substantial regulation problem arising from the suppression of the output interactions alone. Equally, variations in the fuel flow result in sluggish speed response, dynamic changes, whilst nozzle angle increases produce power turbine gas temperature increases and again slow speed variations.

The objective here is to obtain rapid, monotonic, closed loop reference, automotive speed responses with “small”, acceptable changes in the power turbine, gas temperature. Equally, an input on the alternative, closed loop, reference input should result in a change in the power turbine, gas temperature, with “small” changes in the gas generator, turbine speed.

In principle, of course the availability of two or more independent inputs provides the opportunity for enhanced, closed loop performance. However, realizing this tempting prospect is largely dependent on the regulation strategy invoked, as demonstrated herein.
Closed Looped Controller Design

The closed loop control strategy, outlined in [13], aims to secure specified steady state, reference – set point and disturbance suppression characteristics, for this automotive gas turbine, via the use of an outer loop and an inner loop pre-compensator configuration. The inner loop will be employed to achieve prescribed dynamic and disturbance recovery rates, for the system, via the use of the control law:

\[ u(s) = k(s)[\dot{x}(s) - h(s)y(s)] + P(r(s) - Fy(s)) \]  \hspace{1cm} (3.1)

where in equation 3.1, \( k(s)[\dot{x}(s) - h(s)y(s)] \) is the inner loop component and \( P(r(s) - Fy(s)) \) details the outer loop reference input, feedback and compensator contribution for regulation purposes.

Combining \( u(s) \) in equation 3.1 with equation 2.1 yields:

\[ y(s) = (I_m + G(s)K(s)H(s))^{-1}GK(r(s) + \delta(s)) \]  \hspace{1cm} (3.2)

The procedure for the determination of the \( k(s) \) and \( h(s) \) vectors are detailed in [14].

Inner Loop Design

The description for the gas turbine power system, for heavy duty vehicles, in percentage terms is given by equation 2.1 where a factorization of \( G(s) \) of the form:

\[ G(s) = L(s) \frac{A(s)}{d(s)} R(s) \]  \hspace{1cm} (4.1)

may be established, where in equation 4.1

\[ L(s) = \begin{bmatrix} 1 & 0 \\ 0 & \frac{1}{(s+1.55)(s+187.4)} \end{bmatrix}, \quad R(s) = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \]

\[ A(s) = \begin{bmatrix} 0.967(s + 0.95) \times 10^6 & -8.1248(s + 3.27) \\ 8.82(s + 31.42) \times 10^6 & 50.20(s + 187.4) \end{bmatrix} \]  \hspace{1cm} (4.2)

If:

\[ k(s) = \begin{bmatrix} \frac{s+40.0}{s+400.0} & 0 \\ 0 & \frac{1}{s+400.0} \end{bmatrix} \begin{bmatrix} k_1 \\ k_2 \end{bmatrix} \]  \hspace{1cm} (4.3)

and:

\[ h(s) = [h_1, h_2] \begin{bmatrix} \frac{s+0.95}{(s+1.55)(s+187.4)} & 0 \\ 0 & 1 \end{bmatrix} \]  \hspace{1cm} (4.4)

Then for the inner loop:

\[ y(s) = (I_m + G(s)k(s) >> h(s))^{-1}G(s)k(s)\dot{x}(s) \]  \hspace{1cm} (4.5)
and the Characteristic Equation for the inner loop becomes:
\[
det(I_m + G(s)k(s) > < h(s)) = 1 + < h(s)G(s)k(s) >.
\] (4.6)

Consequently, equation 4.6 can be written as:
\[
-1 = \frac{b(s)}{(s+1.55)(s+400)(s+187.4)}
\] (4.7)

**Figure 5:** Root locus of \(-1 = b_0(s + 1.55)/(s + 1.55)(s + 400)(s + 187.4)\)

where in equation 4.6 the controller generated zero of \(b(s) = b_0(s + 1.55)\) has been selected to achieve a desired, closed loop pole pattern. In this case, with \(b_0 = 1.09 \times 10^4\) the closed loop poles would reside at \(-294 \pm 6.81 \times 10^{-6}i\), as indicated by figure 5.

Consequently, the inner product of equation 4.6 becomes:
\[
< hA(s)k >= [1 \ s] \begin{bmatrix} 0.95 \times 10^6 & -26.568 \\ 0.967 \times 10^6 & -8.1248 \end{bmatrix} \begin{bmatrix} 277.1244 \times 10^6 \\ 8.82 \times 10^6 \end{bmatrix}, [9407.48 \ 50.20] \begin{bmatrix} k_1 h_1 \\ k_2 h_1 \\ k_1 h_2 \\ k_2 h_2 \end{bmatrix}
\] (4.8)

With \(k_2 = nk_1\) equation 4.8 reduced to:
\[
< hA(s)k >= k_1[1 \ s] \begin{bmatrix} 0.95 \times 10^6 & -26.568 \\ 0.967 \times 10^6 & -8.1248 \end{bmatrix} \begin{bmatrix} 277.1244 \times 10^6 \\ 8.82 \times 10^6 \end{bmatrix} + [9407.48 \ 50.20] \begin{bmatrix} h_1 \\ h_2 \end{bmatrix}
\] (4.9)

Equation 4.9 can be written as;
< hA(s)k >= Q(n)(h_1, h_2)^T \tag{4.10}

with \(k_1 = 1\):

\[
Q(n) = \begin{bmatrix}
0.95 \times 10^6 & -26.568 \\
0.967 \times 10^6 & 8.1248 \\
277.1244 \times 10^6 & 8.82 \times 10^6 \\
9407.48 & 50.20
\end{bmatrix} n
\]

Then from equations 4.9 and 4.6:

\[
Q(n)(h_1, h_2)^T = b_0(1.55, 1)^T \tag{4.11}
\]

An optimization analysis based on minimising the control energy which for arbitrary changes in the outputs results in:

\[
E(t) = \int_{t=0}^{t=\infty} \left( \sum_{i=1}^{m} k_i^2 \sum_{j=1}^{m} h_i^2 \right) dt
\]

Requiring that the performance index function \([15]\):

\[
J(n) = (1 + n^2)b^T(Q^{-1})^TQ^{-1}b \tag{4.12}
\]

achieves an extremum value. This occurs when:

\[
\frac{\partial J(n)}{\partial n} = 0.
\]

Expanding equation 4.12 following the substitution of \(b\) and \(Q(n)\) yields:

\[
J(n) = N(n)/D(n)
\]

where:

\[
N(n) = (1 + n^2)(1.09 \times 10^4(1.55, 1))
\]

* \[
\begin{bmatrix}
(50.2 + 8.82 \times 10^6)^2 & -(9424.5n - 2.772 \times 10^8)(8.125n - 9.67 \times 10^5) \\
-(9424.5n - 2.772 \times 10^8)(8.125n - 9.67 \times 10^5) & (918000 - 26.5638n)^2
\end{bmatrix}
\]

* \((1.09 \times 10^4(1.55, 1))^T\)

and:

\[
D(n) = (517.0n^2 - 4.8445 \times 10^7n - 1.7865 \times 10^{12})^2
\]
Here the extremum of $J(n)$ occur when $\partial J(n)/\partial n = 0$ where:

$$J(n) = \frac{N(n)}{D(n)}$$

and

$$\partial J(n)/\partial n = \left(\frac{1}{D(n)}\right)\left(\partial N(n)/\partial n\right) + \left(\frac{N(n)}{D(n)}\right)b = 0$$

The zeros of $\partial J(n)/\partial n$ are located at:

$$n = -0.00000747416067, -28923.67853549, -28173.19705 \pm 4527.32241i$$

The real zeros of $\partial J(n)/\partial n$ are:

$$n = -7.4741 \times 10^{-6}, -28923.6785$$

The graph of $J(n)$ indicates that the absolute minimum occurs when $n = -7.47416067$. Hence $k$ and $h$ are given by:

$$k = \begin{bmatrix} 1 \\ -7.47416067 \times 10^{-6} \end{bmatrix}$$

and:

$$h(s) = \frac{Q(n)^{-1}}{k_1} b.$$  

With $n = -7.47416067 \times 10^{-6}$ and $b_0 = 1.09 \times 10^4$ yields:

$$h = \begin{bmatrix} 1.7646 \times 10^{-2} \\ -1.9116 \times 10^{-5} \end{bmatrix}$$

completing the inner loop design.
Outer Loop Design

The outer loop evaluation process requires that a constant, pre compensator matrix \( P \), should be established where:

\[
P = \left( G(0)^{-1} + K(0) \right) S_s \ast \left( I - F \ast S_s \right)^{-1}.
\]

with

\[
G(0) = \begin{bmatrix} 24175 & -27.9664 \\ 23851.3788 & 32.387 \end{bmatrix},
\]

\[
y(0) = S_s r(0) \quad \text{where} \quad S_s = \begin{bmatrix} 1 \\ 0.1 \\ 1 \end{bmatrix}
\]

and \( F = \begin{bmatrix} f_{11} & 0 \\ 0 & f_{22} \end{bmatrix}, \) \( F \) selected where \( 0 < f_{ii} < 1, \ i = 1, 2 \), for closed loop stability.

The pre compensator matrix \( P \) becomes:

\[
P = \begin{bmatrix} 3.6730e-01 & 7.3323e-02 \\ -2.7277e-01 & 2.7833e-01 \end{bmatrix}
\]

Simulation

The closed loop system for analytical purposes is shown in figure 7. Normally, only reference input \( r_2(s) \) would be used to provide the acceleration change required, by the vehicle driver. Reference input \( r_1(s) \) would be set to a constant value depending on the power turbine gas temperature limitation. Consequently, only a single input would need to be driver adjusted, with the nozzle, guide vane angle variations arising from feedback changes alone.

\[\text{Figure 7: block diagram representation of closed loop system}\]
An investigate of the system response by applying a unit step input on $r_1(s)$ and then on $r_2(s)$ of figure 7 will be investigated. These are shown in figure 8 and 9 indicating that a fast response with minimum output interaction reaching the required angular, steady state speed after 0.25 sec., for $f = 0.95$, for example.

**Figure 8:** System response for a unit step change at $r_1(s)$

**Figure 9:** System response for a unit step change at $r_2(s)$
Implementation of the Least Effort Controller

It is elementary to convert the inner and outer loop structure shown in figure 7 to the conventional pre and feedback compensator configuration given in [16] if this is required. Comparing the closed loop structure for the least effort controller, with the conventional arrangement results in, from equation 3.2:

\[ y(s) = (I_m + G(s)k(s)) >< h(s) + PF^{-1}G(s)Pr(s) \]  

(7.1)

and from [16]:

\[ y(s) = (I_m + G(s)K(s)H(s))^{-1}G(s)k(s)r(s) \]  

(7.2)

Comparing equation (7.1) and (7.2), evidently:

\[ K(s) = P \]

and:

\[ K(s)H(s) = k(s) >< h(s) + PF. \]

Consequently:

\[ H(s) = P^{-1}k(s) >< h(s) + F. \]

Hence, for this system for \( F = \text{Diag}(0.95, 0.95) \) with

\[ k(s) = \begin{bmatrix} s+40.0 & 0 \\ 0 & \frac{1}{s+400.0} \end{bmatrix} \begin{bmatrix} k_1 \\ k_2 \end{bmatrix} \]

and:

\[ h(s) = [h_1, h_2] \begin{bmatrix} s+0.95 \\ \frac{s+1.55(s+187.4)}{s+400.0} \\ 0 \\ 1 \end{bmatrix} \]

then:

\[ P = K = \begin{bmatrix} 1.0886e-01 & 1.0004e-01 \\ -6.6171e-02 & 9.0722e-02 \end{bmatrix} \]

and:

\[ H(s) = \begin{bmatrix} 1.0886e-01 & 1.0004e-01 \\ -6.6171e-02 & -6.6171e-02 \end{bmatrix}^{-1} \begin{bmatrix} s+40.0 \\ s+400.0 \\ 0 \\ s+400.0 \end{bmatrix} \begin{bmatrix} k_1 \\ k_2 \end{bmatrix} \begin{bmatrix} s+0.95 \\ \frac{s+1.55(s+187.4)}{s+400.0} \\ 0 \\ 1 \end{bmatrix} + F \]

Figure (10) gives the conventional triple, \( K(s), H(s), G(s) \) structure which results in an algebraically equivalent model, for implementation purposes.
To investigate the system’s ability to reject disturbances a unit step on $\delta_1(s)$ and then on $\delta_2(s)$ of figure (7), will be applied.

Figure 11: System response for a negative unit step at $\delta_1(s)$
Figure 12: System response for a negative unit step at $\delta_2(s)$

The high disturbance rejection behaviour of the system is shown in figures 11 and 12 following a unit step disturbance on $\delta_1(s)$ and then on $\delta_2(s)$, of the block diagram of figure 7.

**Alternative Design (H Infinity Control)**

The H infinity control strategy employs the feedback control structure of figure 13.

![Feedback control structure typical](image)

The controller equation is:

$$F_c = \begin{bmatrix} A_f & -ZL \\ \vdots & \vdots & \vdots \\ F & \vdots & 0 \end{bmatrix}$$  \hspace{1cm} (8.1)

where:

$$A_f = A + \gamma^{-2}B_1B_1^TX + B_2F + ZL \gamma C_2$$

$$F = -B_2^TX, L = -Y \gamma C_2^T, Z = (I - \gamma^{-2}YX)^{-1}$$

In general, the robust control problem uses the configuration shown in figure 14.
The plant model can be represented as:

\[
\begin{bmatrix}
\dot{x}(s) \\
y_1(s) \\
y_2(s)
\end{bmatrix} = P(s) \begin{bmatrix}
x(s) \\
u_1(s) \\
u_2(s)
\end{bmatrix}
\]

where in equation (8.2) \(x(s), y(s)\) and \(u(s)\) are the state, output and input vectors, respectively, and:

\[
P(s) = \begin{bmatrix}
A & B_1 & B_2 \\
C_1 & D_{11} & D_{12} \\
C_2 & D_{21} & D_{22}
\end{bmatrix}
\]

The state space and output equations given by:

\[
\dot{x}(s) = Ax(s) + [B_1 \quad B_2] \begin{bmatrix} u_1(s) \\ u_2(s) \end{bmatrix}, \quad \begin{bmatrix} y_1(s) \\ y_2(s) \end{bmatrix} = \begin{bmatrix} C_1 \\ C_2 \end{bmatrix} x(s) + \begin{bmatrix} D_{11} & D_{12} \\ D_{21} & D_{22} \end{bmatrix} \begin{bmatrix} u_1(s) \\ u_2(s) \end{bmatrix}
\]

The transfer function related \(y_1(s)\) and \(u_1(s)\) is:

\[
T_{y_1u_1}(s) = P_{11}(s) + P_{12}(s)[I - F(s)P_{22}(s)]^{-1}F(s)P_{21}(s)
\]

For \(H_\infty\) robust standard control: \(\|T(s)y_1u_1\|_\infty < 1\), and for optimal \(H_\infty\) control: \(\min_{F(s)} \|T(s)y_1u_1\|_\infty\) must be selected, see for example [17].

From figure 15, it is required to choose the weighting functions \(W_1(s), W_2(s)\) and \(W_3(s)\) which can be considered as filters.

In general the plant model can be related to the three weighting function by:
\[
P(s) = \begin{bmatrix}
W_1(s) & -W_1(s)G(s) \\
0 & W_2(s) \\
0 & W_3(s)G(s) \\
I & -G(s)
\end{bmatrix}
\]

So that:

\[
T_{y1u1} = \begin{bmatrix}
W_1(s)S(s) \\
W_2(s)F(s)S(s) \\
W_3(s)T(s)
\end{bmatrix}
\]

Then the \( F(s) \) function can be obtained from:

\[
S(s) = [I + F(s)G(s)]^{-1}
\]

where \( S(s) \) is the sensitivity function.

A complementary sensitivity transfer function defined as:

\[
T(s) = I - S(s) = F(s)G(s)[I + F(s)G(s)]^{-1}
\]

By choosing weighting function for gas turbine model of:

\[
W_1(s) = \begin{bmatrix}
100 & 0 \\
0 & \frac{1}{s+1}
\end{bmatrix},
\]

\[
W_2(s) = \begin{bmatrix}
10^{-5} & 0 \\
0 & 10^{-5}
\end{bmatrix}, \text{(to avoid any singularity problems)}.
\]

and:

\[
W_3(s) = \begin{bmatrix}
\frac{s}{1000} & 0 \\
0 & \frac{s}{2000}
\end{bmatrix},
\]

Then, as shown in [18] by applying the Matlab function “augtf” to obtain the \( \gamma \) variable of the system transfer function, and “hinfopt” Matlab function to obtain \( H_{\infty} \) optimal following interaction was used to obtain \( \gamma_{min} \):

\[<\text{H-Infinity Optimal Control Synthesis}>]

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<td>4</td>
<td>0.7500e-01</td>
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<td>7</td>
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Iteration no. 9 is your best answer under the tolerance: 0.0100.
Table 1: The Matlab results of the H-infinity optimal control synthesis.

Selecting $= 7.7734 \times 10^{-1}$, then $F_c(s)$ is:

$$F_c(s) = \begin{bmatrix} F_{11}(s) & F_{12}(s) \\ F_{21}(s) & F_{22}(s) \end{bmatrix}$$

(8.6)

where:

$$F_{11}(s) = \frac{1.6826 (s + 3259) (s + 187.4) (s + 40)^2 (s + 1.55) (s + 1) (s + 0.9439)}{(s + 2.14e04) (s + 253.9) (s + 84.55) (s + 40) (s + 1.55) (s + 1.396) (s + 1) (s + 0.5)}$$

$$F_{12}(s) = \frac{21.449 (s + 187.4) (s + 40)^2 (s - 14.98) (s + 1.55) (s + 0.8405) (s + 0.5)}{(s + 2.14e04) (s + 253.9) (s + 84.55) (s + 40) (s + 1.55) (s + 1.396) (s + 1) (s + 0.5)}$$

$$F_{21}(s) = \frac{245.87 (s - 2.534e04) (s + 245.2) (s + 40) (s + 20.69) (s + 1.55) (s + 1) (s + 0.95)}{(s + 2.14e04) (s + 253.9) (s + 84.55) (s + 40) (s + 1.55) (s + 1.396) (s + 1) (s + 0.5)}$$

$$F_{22}(s) = \frac{8217 (s + 405.2) (s + 206.6) (s + 40) (s + 4.784) (s + 1.55) (s + 0.95) (s + 0.5)}{(s + 2.14e04) (s + 253.9) (s + 84.55) (s + 40) (s + 1.55) (s + 1.396) (s + 1) (s + 0.5)}$$

H-Infinty Controller Simulation

To investigate of the system response by applying a unit step input on $r_1(s)$ and then on $r_2(s)$, using the Matlab Code. Following the inclusion of the control algorithms of equation (8.6) can be determined from the computed response transients.

![System response for a unit step change at $r_1(s)$](image_url)
Figures 16 and 17 show a fast system responses but with high interaction between outputs 1 and 2 for input $r_2(s)$, step changes. The controller is also very complicated with non-minimum phase characteristics. This indicates that the closed loop system would exhibit poor integrity properties.

**Control Energy Dissipation Comparison**

The control energy which for, white noise changes in the disturbances, $\delta_1(s)$ and $\delta_2(s)$ inputs is given by:

$$E(t) = \int_{t=0}^{t=1} (u_1(t)^2 + u_2(t)^2) dt$$

(10.1)
Figure 18: Control energy dissipation by least effort and H infinity controllers.

Figure 18 showing the considerable level of energy dissipated by the h infinity controller. The difference in the energy required by the two controllers would be devoted to the generation of heat, noise and wear following increased actuator activity.

Conclusions

This investigation examined the employment of gas turbine–electric propulsion, for heavy duty, long distance, road transportation vehicles.

On full load, gas turbine drives exhibit fuel efficiency characteristics, similar to diesel engine, power units whilst providing superior reliability, compactness and power-weight ratio properties. These power units eliminate the need for heavy diesel engine, gears, clutches, propeller shafts, flywheels and universal couplings minimizing mass-inertia loading effects. Mechanical driveline noise, vibrations and hence driver fatigue would also be reduced by this innovation contributing thereby to enhanced operating conditions.

The potential for gas turbine–electric, so called series drives, depends crucially, on the closed loop regulation strategy adopted and the robustness and reliability of the system technology employed. Essentially, this means that the use of high gain actuator and comparator feedback strategies should be avoided with the incorporation of proven, accurate, efficient transducers, electronics and actuators.
As demonstrated, the targeted, closed loop performance of gas turbine powered road vehicles, should replicate conventional vehicle drives with rapid, smooth, monotonic speed variations following air-fuel, accelerator actuation. The control loops are required to suppress open loop, output interaction, following reference input variations resulting in, desired speed or power turbine temperature changes.

The closed loop, feedback performance of the power unit considered, arises from the employment of the least effort, regulator design method. This approach requires output feedback alone and low gains to achieve the closed loop performance, detailed in section (6). In achieving the absolute minimum, energy dissipation required for regulation purposes whilst attaining the required transient performance, steady state accuracy and the disturbance recovery characteristics provided in section (6), where with the passive, low gain elements employed, robustness is guaranteed.

Finally, the low gain, pre and past compensators, for implementation purposes, determined in section 7, results in the suppression of the effects of disturbances, as shown by the well behaved response characteristics, of figures 8 and 9. Figures 11 and 12 provide evidence that the system’s recovery following disturbances, is pleasing, with a maximum disturbance effect, rejection performance of 90% and 92%, following temperature and speed loading, respectively.

The performance of the alternative, H infinity controller provides rapid responses characteristics but with transient interaction. The control algorithms required are of high order and would require complicated analogue or digital implementation to achieve the required feedback signals it is also evident that changes in the system performance, owing to drift, aging and wear would cause problems arising from the sensitivity of the high order, polynomial shaping functions involved.

Additionally, following repeated variation in the performance index, the closed loop speed response although fast exhibits non-minimum phase characteristics. The control effort dissipated by the H infinity controller is also much higher than that shown by the least effort regulator. This indicates that this would result in the generation of heat, wear and noise whilst attracting more refit, availability and reliability costs following increased actuator activity.

There is therefore little to commend the H infinity controller option, for this application, in comparison to the frugal, least effort control strategy, investigated here in.

As a consequence of the attainment of these results, further application studies are anticipated.
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Study of influent transfer inside filter media packed in a laboratory up-flow filtration regime

Ali Alzeyadi, PhD student, Civil Engineering Department, Liverpool John Moores University, UK
Al Qadissiya University, Al Qadissiya, Iraq

Edward Loffill, Senior Lecturer, Civil Engineering Department
Liverpool John Moores University, UK

Rafid Alkhaddar, Head of the Department of Civil Engineering
Liverpool John Moores University, UK

Abstract

Recently, many filtration systems were developed for use in different removal processes. The superior operational aspects of up-flow, continuous and granular media filters led the researchers to develop the media filters for the removal of impurities from wastewater. The evaluation of the hydraulic characteristics of the filter media in filtration regime leads to an understanding of the reaction between the influent and filter media structure. This will help to determine the optimum influent flow rate and residence time that should be taken into consideration in system design. The residence time distribution (RTD) is defined as the process of the distribution of different atoms which get out of the reactor with respect to time. In this paper, the RTD experiments were conducted to analyse the hydraulic behaviour for the influents inside the up-flow filter rigs. Sand and granite were used as the filter media. A red drain dye was injected into the filtration regimes at different flow rates (0.4, 0.8 and 1.2 l/min) to simulate the behaviour of the effluents inside both the selected filter media. The distribution of the tracer inside the sand looked better than that in granite over time. High amounts of the tracer left the granite over time intervals at flow rates of 0.4 l/min compared to the flow rates of 0.8 and 1.2 l/min. Better tracer distribution was observed inside the granite at flow rate 0.4 l/min. On the other hand, the tracer shows an outstanding retention time in the sand over all flow rates in comparison with granite. In this experiment, the determination of the optimum flow rate, which increases the chance of contact between the wastewater impurities and the packed filter materials, provides a good overview for modelling the scale of filter configurations with respect to the hydraulic characteristics of the selected filter media.

Keywords: Residence time distribution, filter media, filtration regime, sand, granite, flow rate.

Introduction

The outstanding features of wastewater treatment are characterised as a stable, low cost and effective procedure to obtain an acceptable water quality for discharge into the aquatic environment without any adverse effects (Bernardez et al., 2008). Currently, the use of active filter media to retain pollutants from wastewater has been considered for use in wastewater treatment facilities (Herrmann et al., 2013, Hu et al., 2007, Alzeyadi et al., 2015). In the active filter media technology, media selection is one of the essential factors that should be considered in the designing and operation of filtration systems to achieve the required effluent quality according to the global legislations of water bodies’ protection.
The influence of the influent retention time (RT) on contaminant removal have to identify; RT is also referred to as the influent-to-media contact time (Lyngsie, 2013). In general, the reactors are treated ideally: mixed and plug-flow patterns. Unfortunately, in the real world, they are observed to behave differently from the expected behavioural pattern. Hence, to describe the non-ideal reactors, the residence time distribution (RTD) function $E(t)$ is used. The RTD is measured experimentally by injecting an inert species, called tracer, into the reactor at a specific time and then by determining the tracer concentration, $C$, in the effluent stream over time (Levenspiel, 1999, S., 2006). RTD refers to the mixing characteristics in a reactor, and the RTD experiment has extensively used to investigate the behaviours of the flow rate in a reactor. The method analyses the flow properties and predicts the performance of a reactor by developing a mathematical flow model (Nemade et al., 2010). Alkhaddar et al. (2001) also stated that the RTD represents an outstanding method of measuring the efficiency of a reactor. Loffill (2011) has illustrated that the interaction time between the substances that act as filter media and influent to be treated is one of the significant parameters in the filtration process.

Many factors influence the mechanism of the particle transportation, and some of these factors operate simultaneously. It is, therefore, appropriate and beneficial to inspect these factors individually (Zamani and Maini, 2009). In the bed filtration process, the particles are taken away over the flow of a solution inside the filter media. In this process, the particles follow the fluid streamlines, and most of them are removed from the flow without even any contact with the grain surface. However, the particles are transported across the streamlines through the media particles in such a manner that they reach the immediate vicinity of a grain surface. This may result in an attachment relying on the nature of the particle-surface interactions. The deposition process constitutes of transport and attachment. moreover, the attachment of the particles to previously deposited particles can happen according to the interaction nature between the suspended particles and only happens when the particles are colloidally unstable. If the deposited particles are again entrained in the flow, then a detachment mechanism is followed (McDowell-Boyer et al., 1986, Tien, 1989, Schramm, 1996, Elimelech et al., 1998).

The aim of the study was to characterise the flow dynamics via the measurement of RTD of the aqueous phase in the lab-scale up-flow filter using a red drain dye (RDD) as the tracer. RTD experiments were carried out in the same mode of operation and at different flow rates.

**Materials and Methods**

**Experimental set-up**

In the present study, lab-scale filters were set up. Each reactor set-up consist of a cylinder with a diameter of 0.1 m and height 0.8 m and had an up-flow configuration. RTD was measured by shot 50 ml of tracer (RDD of 2g/L concentration) into the path of influent stream that pumped to the filters via submersible pumps at time $t = 0$. The tracer concentration, $C$, in the effluent stream was measured as a function of time. All the experiments were performed at steady flow state (inlet flow rate = outlet flow rate). The pulse injection method was applied in this experiment. A syringe as a single shot at the flow stream inlet performed the process of injection. The process of samples collection was performed in a way of collected from the outlet of the filter column over regular periods. The data was collected at three different flow rates: 0.4, 0.8 and 1.2 l/min. For each flow rate, the concentration and amount of tracer remained the same. The HACH LANGE DR 2800 spectrophotometer was used to measure the
out tracer concentration. The device measures the RDD absorption amount at wavelength $\lambda = 525$ nm. Afterward, they RDD concentration is determined from calibration curve, which prepared previously for standard RDD concentration.

**Tracer selection**

A tracer can be any material used to investigate the physical movement of fluids over the environmental systems; it could be either pathways of surface water or those in the subsurface. Tracers are moved via the same physical pathways and at the same rate as the particles flow in the fluid paths. The tracers are categorized as inert or conservative species. Tracers can be selected according to their feasibility to assist us to realize the chemical characteristics of a substance in stream paths. ‘A specific tracer can be chosen based upon the parameters an investigation aims to study. There is no ‘ideal’ tracer, and therefore choice of tracer will depend upon the ultimate objectives of a tracer test’ (Ward et al., 1998). The types of the tracer can be classified according to their nature and source. Such the environmental tracers, they are substances coming from a particular environment and their features allow using them as tracers. They are categorized into two subclasses: natural environmental tracers and anthropogenic environmental tracers. Both natural and anthropogenic environmental tracers are exploited in a same way. Natural environmental tracers result from naturally occurring processes. An example is the use of radon-$^{222}$ (Ellins et al., 1990, Ellins et al., 1991, Cecil and Green, 2000). Second tracer’s type is the artificial tracers; they are intentionally discharged into the nature during the study of tracer. ‘These may be conservative, to track the movement of surface or subsurface waters, or non-conservative, to study the effects of and potential for sorption, biodegradation and storage within a stream or aquifer system’ (Berryman, 2007). Various substances are available to be selected as artificial tracers, and the selection of appropriate tracer must be depending on the specific data required from an investigation. An optimum tracer should have the following characteristics: chemically inert, soluble in the mixture and easily detectable (De Souza Jr. and Lorenz, 2014a). Therefore, RDD was selected as the injectable tracer.

**Injection methods**

There are two methods of injecting the tracer: pulse input and step input (Levenspiel, 1999, De Souza Jr. and Lorenz, 2014b) as illustrated in Figure 1. In this study, the pulse input method was used as it permits for simple interpretation because all the substances enter the reactor at the same time. In the pulse input method, the tracer amount is rapidly injected in a single shot into the path of the fluids that flow into the reactor. The exit concentration is then identified as a function of time. In the RTD analysis, the derived effluent concentration–time curve is indicated to as the C curve. The tracer material across system boundaries can be analysed according to the injection method. For the pulse injection, we chose an increment of time $\Delta t$ that was sufficiently small than the concentration of tracer, $C (t)$, exiting between time $t$ and $\Delta t$ was essentially the same. Then the quantity of tracer material, $\Delta N$, leaving the reactor between time $t$ and $t + \Delta t$ was stated as follows:

$$\Delta N = C (t) \cdot v \Delta t$$  \hspace{1cm} (1)

Where $v$ is represents the effluent volumetric flow rate. $\Delta N$ is the quantity of substance spent between $t$ and $t + \Delta t$ in the reactor.
Measurement of the RTD

The distribution of residence time is referred to the substance exit age. Hence, dividing equation 1 by the total quantity of injected tracer, we obtained:

$$\frac{\Delta N}{N_0} = \frac{V}{N_0} \frac{C(t)}{N_0} \Delta t$$  \hspace{1cm} (2)

This equation 2 is a mathematical expression for the fraction of the substance that has a residence time in the reactor between time $t$ and $t + \Delta t$. For a pulse injection, we define:

$$E(t) = \frac{V}{N_0} \frac{C(t)}{N_0}$$  \hspace{1cm} (3)

Further, the value of $E(t)$ can be substituted in equation (2) as follows:

$$\frac{\Delta N}{N_0} = E(t) \Delta T$$  \hspace{1cm} (4)

where $E(t)$ refers to the RTD function. It illustrates in a quantitative way the time taken by various fluid elements to flow through the reactor. Re-arrange the previous equations in the differential form, we get:

$$dN = V C(t) \, dt$$  \hspace{1cm} (5)

On integrating, we obtain the below equation 6:

$$N_0 = \int_{0}^{\infty} V C(t) \, dt$$  \hspace{1cm} (6)

The volumetric flow rate $v$ is constant. Therefore, we can express on the $E(t)$ as follows:
\[ E(t) = \frac{C(t)}{\int_0^\infty C(t)dt} \] (7)

The area under the C curve is represent the integral in the denominator. The distribution of residence times is characterized by an external RTD or an exit age distribution, \( E(t) \). The function \( E(t) \) has the units of time as shown in equation (7). Another important parameter is the residence time \( t \) that refers to the time taken by the certain amount of molecules to remain within a unit volume. The ideal mean residence time (MRT) for a flow rate \( Q \) into a fixed volume reactor \( V \) is given as follows:

\[ \tau = \frac{V}{Q} \] (8)

The MRT of the reactor was determined from the RTD curve. The first moments of the normalised RTD curve gives the equation for MRT as follows:

\[ MRT = \int_0^\infty tE(t)dt \] (9)

The MRT is calculated by taking the time \( t \) at which 50% of the total integral value recorded has passed (Levenspiel, 1999).

Packing filter media

The surface characteristics of the filter media can have a significant effect on the influent residence time. In the present study, sand and granite were used as the filter media due to its feasible physical characteristics, such as porosity and surface area.

Results and Discussion

The experimental findings were analysed according to the moment method to determine the optimum flow rate for good influent dispersion during their transfer through the selected packed materials. Equation 7 was applied to obtain the RTD curves as illustrated in the Figures 2(a-c). The depth of the packed materials in the filter rigs is a key factor in the study of the hydraulic behaviour of the influent inside the wastewater treatment facilities. The depth of both the packed materials was found to be 27 cm. In Figures 2b and 2c, the tracer totally passed through the sand during 175 and 125 sec for flow rate 0.8 and 1.2 l/min, respectively. Comparatively, the tracer needed approximately 420 sec to pass through the filter media completely when the flow rate was 0.4 l/min. On the other hand, large quantities of the tracer exited from the granite in a short time at all flow rates of 0.4, 0.8 and 1.2 l/min as presented in Figures 2.a, 2.b, and 2.c, respectively. The tracer material flowed through granite at a time interval of 50–100 sec for flow rates 0.8 and 1.2 l/min in comparison with the previous flow rate of 0.4 l/min in which a better dye concentration distribution was observed over time. The exit age of the tracer at flow rate 0.4 l/min was 220 sec as illustrated in Figure 2.a. The tracer distribution inside the sand at flow rates 0.8 and 1.2 l/min were approximately same to the tracer distribution inside the granite at the flow rate of 0.4 l/min.
In general, the results revealed that the tracer distribution along the sand is better than granite at all flow rates. Good dispersion could be achieved at low flow rates for granite. The outstanding tracer distribution was achieved for sand at the lowest flow rate as shown in Figure 2.a, in which the tracer spent 420 sec inside the sand for total recovery. Accordingly, the flow rate of the tracer through the granite with more than 0.4 l/min flow rate was inadmissible because of the large quantity of substance exit from the filter rigs in a very short time. The rest of the flow rates for both the packed materials indicated a good tracer concentration distribution over the time.

(a) 

(b)
Figure 2: The residence time distribution curves for sand and granite at different flow rates: (a) 0.4 l/min; (b) 0.8 l/min; (c) 1.2 l/min.

One of the major objectives of the paper was to determine the interaction time between the entering solution and the packed filter media. All curves of RTD are presented in Figures 2(a-c), the position of the peaks for the tracer that passed across the granite are appeared early in all the flow rates which implemented compared with the position of the peak for the tracer in the sand. With the increasing flow rate, the time of peak appearance reduced between the sand and granite. Fazolo et al. (2006) stated that the long tails present in the RTD curves referred to the dead zones or stagnations. In the present study, the RDD tracer was injected into the water path. Therefore, the influent did not include any solid particles that would create a dead zone. No long tails appeared in the RTD curves as shown in Figure 2, and the entire tracer was recovered.
According to the analytical method, Equation 8 presents the moment of the MRT. This equation will allow to gain a numerical value for the MRT that will help in comparing the retention time inside the filter materials. Therefore, the results suggested that the chance of tracer reacting with sand was more than that for granite. In addition, the surface reactivity of the filter media should be taken into account due to its significance in determining the impurities removed and the contact time.

Conclusion

The findings of our study revealed that the tracer showed good dispersion over granite at low flow rates. On the other hand, the tracer showed an outstanding retention time in the sand over all flow rates as compared to granite. The performance of impurities removal using sand as packed media in the up-flow filters was better than that of the granite. This was because of the maintenance of the good pattern of the influent retention time and dispersion even with increased flow rate. However, further studies should focus on surface reactivity of the filter media as they play an significant role in the removal of the contaminant and the contact time.

Acknowledgement

It is indeed a great opportunity on the part of the authors to thank the Iraqi Ministry of Higher Education and Scientific Research, Al Qadissiya University for their financial support for the research. The authors would also like to acknowledge with gratitude the technical team of the labs of Henry Cotton in the Liverpool John Moores University for their assistance in this work. The authors would particularly like to thank Mr. Feegan M. for his help in the construction of the filter rigs.

Nomenclature

RTD     residence time distribution 
RT     retention time 
E(t)     residence time distribution function 
C     tracer concentration 
ʎ     wavelength 
RDD     red drain tracing dye 
t     time
\( \Delta t \) time increment

\( \Delta N \) amount of tracer material

\( N_0 \) total amount of material that injected into the reactor

\( v \) effluent volumetric flow rate

\( \tau \) theoretical mean residence time

\( V \) tank volume

\( Q \) steady flow rate

MRT mean residence time

PFRs plug flow reactors

CSTRs Continuous stirred-tank reactor

References


Project Adherence to the Planned Duration and its Relationship with Projects Critical Success Factors

Nawal Rashed Al Hassani, PhD Project Management student
The British University in Dubai

Abstract

Despite the fact of the huge investment on the software development projects, yet the level of business satisfaction was always low. Big portions of the software development projects fail to deliver on time, and within the budget. Therefore it’s becoming crucial to understand those factors that influence the success of the projects.

Introduction

Despite the fact of the huge investment on the software development projects, yet the level of business satisfaction was always low. Big portions of the software development projects fail to deliver on time, and within the budget. Therefore it’s becoming crucial to understand what are those factors that influence the success of the projects. If the organizations are able to understand the most important factors, then the success of the projects will be easily achievable. In this study we will attempt to examine candidate critical success factors in an organization in Abu Dhabi. A quantitative methodology will be followed to analyze real data of real life project implementations.

Research Problem

The research question of this study is:
Do project success factors and project characteristics influence the performance of the project and the adherence to the planned project duration?

Aim of the Research

The aim of this research is to study if there is any relationship between the success of the project from the perspective of adherence to the original planned duration, and the Project Critical Success Factors (CSFs) including, the quality of testing activities, the effectiveness of the provided trainings, the time spent on planning activities, the time spent on software design activities, and the size of the team.
Research Objectives

It’s important to organizations to understand how they can achieve better performance for their projects. The factors that impact the success of the projects can be different. In this research we will attempt to find out the relationship between the software projects success, in terms of achieving the planned project duration or time, with other aspects that could be success factors affecting the level of success. The research will be done based on real data from an organizing in Abu Dhabi. Abu Dhabi Tourism Authority was established to oversee and develop the tourism sector in Abu Dhabi. It has big portfolio of projects. Many of the projects are software development or technical enhancement projects. The authority agreed to provide the details related to some projects which were implemented from the period of 2011 to 2014. The Authority follows a defined project management framework for IT projects. There are defined processes and template. The phases of the software development projects starting from initiation, design and planning, implementation, monitoring and closure has been followed since 2010. The data provided for 15 projects which all fall under the software development category. The Authority has external customers and many of the developed software have external users. Each project has also external stakeholders engaged due to the nature of work. The adherence to the timeline and schedule is a very important aspect to the organization to better manage the expectations of external customers and protect the image of the Authority. The research will include analysis of the data provided, and based on the analysis we will develop set of recommendations that will help the organization to improve the level of project success and achieving projects deadlines.

Research Questions

- How does the effectiveness of quality and testing influence the project adherence to the planned project duration?
- How does the effectiveness of training influence the project adherence to the planned project duration?
- How do the project type and the Project team size influence the project adherence to the planned project duration?
- How does the number of days spent on planning influence the project adherence to the planned project duration?
- How does the number of days spent on design influence the project adherence to the planned project duration?

Literature Review and Hypotheses
The following section will explore the current literature about the success factors related to the software engineering or software development projects.

Software Development Projects

Projects are used to drive change and as a tool of innovations in organizations. Projects utilize significant resources. (Sauser, Reilly & Shenhar, 2009). Software development project (SD project) is a compound activity within the limitations of time, human resources and budget, in an effort to produce new or improved computer code which will add value to the business and its existing processes. (Wysocki, 2006)

Many software development projects are not being delivered within the time or budget and hence they fail to bring value to the organization (PMI’s Pulse report, 2013).

Literature indicates that 37% of information technology projects faced challenges and the risk to fail. (Standish Group, 2010). The failure rate of IT projects is too high; it’s not justifiable for business based on the schedule, cost and quality goals. The projects face issues and problems which results in unachieved scheduled, budget and quality. (Cook-Davies, 2002).

Literature argues that there are many proposed reasons for the failure of Software Development projects and in different context. Many studies highlighted that the selection of improper project management methodology causes the failure of Software development projects. (Murad & Cavana, 2012). Nelson (2005) mentioned that any successful project is in need of using a project methodology.

However, software development projects are still failing despite the existence of project management methodologies such as PMI, PRINCE2, and Agile which promote good practices (Standish Group, 2012). Literature suggests that having different methodologies and alternatives made it difficult to project managers to select a proper methodology. For example, 20 percent of all projects do have the features of traditional projects, however studies found that project managers continue to use the traditional methodologies and apply them on the projects although it might not work. Sheffield and Lemetayer(2013) stated that agile methodologies can ensure better user satisfaction and faster development time, but still the methodology is less understood. (Sheffield & Lemetayer, 2013). Software Development projects suffer from low rate of success and the failure rate is high (Standish Group, 2012). It was found that 86% of all the software development projects that followed traditional methods were unsuccessful. The success rate was very low at the level of 14% only, 57% of the projects were under challenges, 29% considered completely failed SD projects projects.(Standish group,2012)

Project Success

The Standish Group study has identified three primary constraints that determine the project success: time, scope and cost. As per Kerzner (2009), the project success is the completion of the project within the determined time, cost and performance.
Following that, there were updated definition of project success to include the perception of the quality of the software product, and the completion of the project.

Standish group (2004) found that the failure rate was 71% for information technology projects that depend on the traditional critical success factors. The Time, cost, performance, and requirements are considered essential critical success factors (Nelson, 2005). Many project management studies stated that the success of the projects in the IT field depends on a wide range of critical success factors. Therefore it’s not easy to standardize or quantify the CSFs with the same level across all the projects.

Up to date, the critical success factors for IT projects have been associated with concerns about user support, the leadership, project planning, top management support, and team dynamics (Ahimbisibwe, 2015)

**Critical Success Factors**

Critical Success Factors (CSFs) are defined as “those factors that are necessary to meet the desired deliverables of the customer on a project”. (Somers and Nelson, 2001)

According to Rockart, Critical success factors (CSF) are very common in the field of information systems. There are many definitions for the CSFs. They are the key areas that should be going right in order for the project implementation to be successful.

However, the software development projects have different characteristics; due to the software itself, which has implications on the complexity, invisibility of the software, conformity, and costs. (Nasir & Sahibuddin, 2011). Furthermore, software development projects have distinctive characteristics such as the computer code management which make SD projects different than other projects and even SD project being different than each other’s. For example specific characteristics of software development projects are copyrights, backup requirements, version control, and matters related to testing like the testing methodology, the tester characteristics and logs. In addition to time, budget, and releases. (Ahimbisibwe, 2015)

The projects of software development involve multiple stakeholders such as clients, senior managers, IT managers, supplier senior managers, system architects, testers, project team members and third party contractors. Each stakeholder has different agenda and interests in the project, they also have different priorities and this might influence the success of the project (Lacity & Willcocks, 2000).

As per literature, cost, scope and time are considered the primary critical success factors of the projects. Moreover, the success factors include quality, suitability, and the time of the user acceptance. (Hirshfield, 2010). Good project management involves utilization of quality, strategy, user involvement, communication, business requirements, the analysis of implementation, and allocation of dedicated resources. (Legris & Collerette, 2006). The Information Technology Project will fail if those additional success factors are not implemented or applied in process of the project management. (Ahimbisibwe, 2015)
Studies showed that there is a significant and positive relationship between project success and the use of quality plan, effective communication, and user involvement in agile projects. In waterfall methodology projects the project success is positively associated with the use of quality plan and the effective communication. (Ahimbisibwe, 2015) Chow & Cao’s (2008) found that the important CSFs were project management process, team environment, customer involvement, a right delivery strategy, qualified team, and proper practice of agile approach.

The study that was conducted by Misra et al’s (2009) found that 9 CSFs can be considered significant to the project success, which are: training and learning, customer satisfaction, collaboration with customer collaboration, decision taking time, commitment of customer, the culture of the corporate, control activities, and personal characteristics. However, the study did not support the hypothesis of team size, informal planning, negotiation, team competence and team distribution to have significance with project success.

The education and training has a positive impact on achieving successful implementation of agile projects. (Ahimbisibwe, 2015) Jun et al (2011) stated that there is significance between product performance and project uncertainty. In addition planning and controlling, internal integration and participation of users was also found to have impact on product performance.

Sudhakar (2012) has conducted a comprehensive literature review to identify the candidate critical success factors for the software development projects. He found that there was a total of 35 candidate CSFs. The CSFs were categorized in 7 areas, and the following categories were identified to be significant candidate CSFs that impact the success of software projects: organizational and environmental, team category, technical and communication.

In a study conducted by Haijdiab et al. (2012) they examined agile projects in the government entity in United Arab Emirates (UAE). It was found that among many factors, the lack of top management to invest in the project was a challenge to failure of the projects. They found that the move from plan based software project to agile based project required careful planning and dedication of resources. Agile method was more suitable in small size projects, low critical and that require small team and few change culture. (Haijdiab et al. 2012)

Critical success factors which are important to the software projects include, strong commitment of top management, clear objectives, skills of project managers, skills and experience of project team, realistic and detailed project schedule, and clear achievable requirements.

Communication has a role in the implementation of agile software development project. Amler(2005) identified effective communication to be among the important success factors for agile methodologies (Ambler, 2005).

Effective communication between developers, management, support, customers, and business areas, is an important characteristic of agile. (Doherty, 2011)
Another study found that the most important factors are realistic estimation of time and budget, project management skills, the methodology applied by the project manager, clear unchanged requirement. (Nasir & Sahibuddin, 2011)

90% of the entities that could deliver projects successfully in consistent manner had used a methodology for project management (KPMG report, 2012). 73% of the successful projects had provided training to the project team and stakeholders on the use of the tool and the methodologies (PMI Pulse report 2013).

Since the combination of the project characteristics can vary significantly across projects, the importance of specific CSFs will therefore be affected. The influence of CSFs on project success criteria may be modified according to fundamental characteristics of software development projects (Wysocki, 2009). This might be the reason behind the variation of candidate CSFs identified by different researches in the literature till today.

Conceptual Framework

The following figure no. 1, shows the theoretical framework of the hypothesizes of this study:

Hypothesis 1 (H1): There is a statistically significant positive relationship between the project success (adherence to the planned project duration) and effectiveness of quality and testing activities of the project.

Hypothesis 2 (H2): The effectiveness of training will have a positive relationship with project success.

Hypothesis 3 (H3): The project type and the Project team size will have a relationship with the Project success.

Hypothesis 4 (H4): The number of days spent on planning will have a relationship to the Project Success.

Hypothesis 5 (H5): The number of days spent on design will have a relationship to the project success.

Figure 1: Theoretical Framework of the study
Research Methodology

In this research the author is examining the statistical relationship between project success and critical success factors including effectiveness of quality and testing activities, effectiveness of training, the time spent on planning phase, the time spent on design phase, the project type, and the team size. A quantitative research design was used (Saunders et al., 2012). According to Saunders et al. (2012) quantitative research includes control in order to ensure validity. The following sections will elaborate on the sample data and the measures used to collect it.

Sample

This research is exploring the statistical relationship between project success in terms of adherence to planned duration and critical success factors. The research was conducted in an organization in United Arab Emirates, which is Abu Dhabi Tourism Authority (ADTA). The data collected from the records of the Authority, as the organization has a project management framework and applied processes. The data extracted from the records in coordination with the projects managers of the organization to ensure full understanding of the data and the context. During the research and the data gathering in particular, ethical aspects were taken into account such as informed consent, confidentiality of data and anonymity of projects and team members identities. (Saunders et al., 2012). For insurance of informed consent, the senior management in the organization were informed and requested to support this study. The purpose and approach of the study was shared with the authority and the senior management instruction to the team members to participate in providing the data was required. To ensure confidentiality of data and anonymity of team members who worked in the projects, the project names were changed to be unrecognizable, i.e. project1, projet2 etc. There was no request for the name of the project team members and only the project team size was requested.
Data collected

At ADTA, the project management process includes many processes that cover different areas of the project, such as the monitoring and control process, quality process, post implementation process, and learning and development. The project managers monitor the performance of the project using a template that includes matrices. This template is a live document and is being used by the project managers throughout the project life cycle.

Using the existing records and templates, we were able to collect data about 15 software development projects. The gathered details of each project included: project type, performance index (which is an indication of the percentage of adherence to the original project planned duration), the size of the project team, the time spent on planning phase, the time spent in design phase, the effectiveness of the quality and testing activities (scale of 5, very poor to excellent and the project is being rated by the project manager upon closing), the effectiveness of the training (scale of 5 and the project is being rated by the project manager upon closing). Only those templates which found completed and filled with the required data were selected. The uncompleted templates were eliminated.

Dependent and Independent Variables

In this study, the dependent variable will be adherence to planned project duration. It represents the project success from time perspective. There are multiple independent variables that the study will attempt to examine their relationship and influence on the identified dependent variable. The independent variables will include: the size of the project team, the time spent on planning phase, the time spent in design phase, the effectiveness of the quality and testing activities, and the effectiveness of the training.

Data Analysis, Findings and Discussion

In this section data analysis will be displayed. The supporting tool which was used for this study was Statistical Package for Social Sciences (SPSS). The results generated by using the tool will be discussed and will also be reviewed based on the discussion from the literature.

Descriptive Statistics

In this section we will describe the distribution of the projects in regards of some characteristics. This will include discussing the type of projects, adherence to the project planned duration, the size of the project team, how much time is spent in planning phase, how much time is spent in design phase, levels of effectiveness of quality and testing activities, level of effectiveness of trainings provided. The examined sample was (15) projects. The descriptive statistics showed that the majority of the projects
are developed in-house, (47%) of the projects. (13%) of the projects were managed, and the same percentage was recognized for the other types of the projects. In regards to the project team size, most of the projects had project team of (5) members, with the percentage of (46.7%) of the total projects. Two projects had team of (10) members and the rest had team of less than (5) members. In regards to the effectiveness of the quality and testing activity, only (13%) of the projects were rated as having excellent quality and testing activities. (47 %) of the projects were rated as Good, (20%) of the projects were rated for having average and poor quality and testing activities, none of the projects were rated to have very poor quality and testing. For the effectiveness of the training, the majority of the projects were rated as having Good effectiveness of training, (40%) of the total projects. (27%) were rated to be average, and (26%) were rated to be poor and very poor.

Hypothesis Testing

In the following section, the researchers will conduct correlation test and regression analysis to provide statistical evidence that will either support or reject the hypothesis proposed earlier.

Correlation Test

Using the SPSS, we applied the Pearson correlation test, in order to understand if there is any correlation between the dependent and independent variables. According to (Foster, 2001) the value should be less than 0.01 for significance. In the below table 1, the results of the test are displayed, it’s clear that there is a relationship between the adherence to the planned duration (ProjPerfIndex) and the Training rate at significant levels of 0.003. The relationship is positive therefore an increase in the rate of the training effectiveness will lead to increase in the project adherence to the planned duration. This supports the hypothesis H2. The test also revealed that there is no relationship between the project adherence to the planned duration and effectiveness of the quality and testing activities, hence the hypothesis H1 is rejected according to the results that showed significance levels of 0.039 which is more than 0.01. The hypothesis H3, H4, and H5 are also rejected since the results show that there is no significance between the project adherence to planned duration and the project type or team size, time spend on planning and time spent on design phase.

<table>
<thead>
<tr>
<th></th>
<th>ProjPerfIndex</th>
<th>ProjTeamSize</th>
<th>ProjectType</th>
<th>PlanningTime</th>
<th>DesignTime</th>
<th>QualityRate</th>
<th>TrainingRate</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProjPerfIndex</td>
<td>1</td>
<td>-.002</td>
<td>.019</td>
<td>-.410</td>
<td>-.376</td>
<td>.537</td>
<td>.712†</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.933</td>
<td>.957</td>
<td>.129</td>
<td>.167</td>
<td>.039</td>
<td>.083</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 1: Results of Correlation test
Regression Analysis

We used the regression analysis in order to predict the value of project adherence to the planned duration based on the value of the training effectiveness rate, since we found that in the correlation coefficient test that there was a significant relationship between the two variables.

In the below table2, we conducted the analysis using SPSS. The test showed that R2 and adjusted R2 values of 0.507 and 0.469 respectively. This indicates that around 5% of variance in the project adherence to the planned duration could be influenced by the effectiveness of the training provided during the project lifecycle.

![Model Summary](image)

Table 2: The Regression results

The table below shows the F-ratio is 13.380 , which is significant at p < .001. This indicates that the regression model is well predicting the adherence to the planned duration.(Saunders et al., 2012;Field, 2009).

![Coefficients](image)

Table 3:F ratio

Discussion

The conducted test proofed that there is a positive relationship between the project adherence to the planned duration and the effectiveness of training. This supports the literature. The study that was conducted by Misra et al’s (2009) found that 9 critical success factors can be considered significant to the project success, and one of them was training and learning. In addition the study did not support the hypothesis of team size, which was also the result of the test conducted in this study, as the tests did not show any relationship between projects adherence to planned duration (which indicates the success of the project), and the size of the project team.
The education and training have positive influence on successful implementation of agile projects (Ahimbisibwe, 2015). As mentioned in the PMI report, 73% of the successful projects had provided training to the stakeholders on the use of the tool and training on the methodologies (PMI Pulse report 2013, p.8).

**Conclusion**

The study showed that there is a positive relationship between the adherence to the planned duration and the effective training provided to the project team and stakeholders. In addition, it was evidenced that there is no relationship between the adherence to the planned duration and the effectiveness of quality and testing, the project team size, time spent in planning and time spent on design activities. Accordingly, we will provide some recommendations based on the findings.

Based on the findings, it is recommended that the project managers pay attention to the training and learning aspects. They should assess the needs of training or skills development in the initial phase of the project. A training plan must be developed to increase or leverage the skills and awareness level of the project stakeholders. The training must consider any aspect of the project that might impact the success of the project and the ability of the project team to achieve the project objectives. All stakeholders must be considered, either from the technical team, business team or the client.

This study was conducted based on the data from one organization. There is an opportunity that a similar study is conducted on multiple government entities. The sample in this study was small due to the fact that it’s collected from real records of one organization, however conducting the study on a larger number of organizations will help in having a more appropriate data sample and projects details from different organizations, which will then be more helpful toward generalizing the results of the study.
References


The Effect of High Calcium Fly Ash Fineness on the Stiffness Modulus of a New Cold Asphalt Concrete for Binder Course Mixture

Anmar Dulaimi, PhD student, Department of Civil Engineering, Liverpool John Moores University, UK

Hassan Al Nageim, Professor of Structural Engineering, Liverpool Centre for Materials Technology Department of Civil Engineering, Liverpool John Moores University, Liverpool, United Kingdom

Kerbala University, Kerbala, Iraq

Felicite Ruddock Programme Leader, School of Built Environment, Liverpool John Moores University, Liverpool, United Kingdom

Linda Seton Reader, School of Pharmacy and Biomolecular Science, Liverpool John Moores University, Liverpool, United Kingdom

Abstract

In this study, two grades of high calcium fly ash (HCFA) were examined for use as supplementary cementitious materials (SCM) in cold asphalt concrete bituminous emulsion for binder course mixture (CACBC). The two grades of HCFA that have been used vary in particle size distribution and in chemical structure. Also, this research presents a laboratory study for physical activation of the HCFA by low energy intensive agitation with low grinding duration. This was applied taking sustainability in consideration and to avoid agglomeration. The influence of grinding fineness of HCFA on the development of the indirect stiffness modulus test (ITSM) of CACBC was studied. The two grades of HCFA were added to CACBC as a substitution to the commercial limestone filler.

According to the investigation, the ITSM of mixtures comprising fine HCFA was greater than that of coarser HCFA at early ages due to the cementitious activity of HCFA improving with high fineness. Moreover, it was found that grinding the fine HCFA is more positive to the ITSM development.

Keywords: Binder course, cold mix asphalt, grinding, high calcium fly ash and stiffness modulus.

Introduction

Cold bituminous emulsion mixtures (CBEMs) are a technology that is produced and placed at normal temperature. It has benefits including environmentally friendliness, low cost, energy efficiency and safety. However, CBEMs have shown lower features such as low early-life strength and high porosity related with hot mix asphalt (Needham, 1996; Oruc et al., 2007).

Many attempts have been considered to develop the performance of cold mix asphalt by several researchers in terms of cement addition (Head, 1974; Oruc et al., 2007), rapid setting cement (Thanaya et al., 2009; Fang et al., 2015), fibres (Bueno et al., 2003; Ferrotti et al., 2014) and polymers (Khalid and
On the other hand, utilizing waste materials in cold mix asphalt such as the application of fly ash as a filler substitution material will decrease the environmental impact and improve the mechanical properties of these mixtures (Al-Busaltan et al., 2012; Al-Hdabi et al., 2014; Dulaimi et al., 2015). Accordingly, these materials bring economic, technical and ecological advantages. Cold asphalt mixtures have characteristics that make them favoured to hot asphalt mixtures. One of these features is the energy consumption which is lower than the hot asphalt mixture as there is no heating for the huge aggregates quantities and also there is no heating for the asphalt emulsion when mixing with the aggregates (Gómez-Mejide and Pérez, 2014). In addition, there are other benefits in terms of ecological impact, economic costs or providing a good environment for the workers.

In the concrete sector, there has been a considerable amount of research associated with fly ash performance and many studies have been conducted into the influence of fly ash fineness by grinding in order to improve the pozzolanic action (Chindaprasirt et al., 2007; Sadique et al., 2013; Xu et al., 2015). In addition, Felekoğlu et al. (2009) demonstrated that by grinding fly ash, strength gain associated with pozzolanic activity will be enhanced because of the improved surface area. As a result, increased numbers of particle and improved surface area will increase the requirement of water by grinding.

According to the advantages of cold mix asphalt and to improve the economic and characteristics of such mixture, two sorts of high calcium fly ash were incorporate in these mixtures as a filler replacement. No research has been found which investigated the effect of the grinding fineness of HCFA and also the application of differing particle size distributions on ITSM of the CBEMs. Therefore, this research aimed at modify the HCFA fineness by grinding and the cementitious action of finely HCFA was assessed through the ITSM to produce a new cold asphalt concrete for binder course mixture (CACBC). Furthermore, the influence of HCFA fineness on ITSM was also examined. The new CACBC was comparable to the traditional hot asphalt concrete AC 20 mm binder course after 3 days which will assist to remove the restriction forced by road authorities for using of such CBEMs.

Materials

- **Aggregate**: The aggregate utilized in this research is granite from Carnsew Quarry at Mabe in the UK. Gradation of aggregate is specified in Figure 1 and the characteristics have been tabulated in Table 1. The aggregate was dried, subjected to sieve analysis accomplished following BS EN 933-1 (European Committee for Standardization, 2012a). The aggregate structure allowed a curve to be determined following EN 13108-1 (European Committee for Standardization, 2006).

Asphalt concrete for binder courses was used in this study, which are continuously graded mixtures and a prominent type of mixture in use as binder course and base in road pavement in the UK where its strength is derived from the interlock of coated aggregates which provides the principal mechanism for the material to transmit load.

- **Bitumen emulsion and asphalt**: slow-setting cationic bitumen emulsion (C60BS) was chosen for CACBC to guarantee high adhesion between aggregate particles (Thanaya, 2003). Whereas,
100/150 and 40/60 pen grades bituminous binder were chosen for soft and hard hot mix asphalt.

- **Filler**: four types of filler were utilized namely, limestone mineral filler, a commercially available Portland cement type CEM-II/A/LL 42.5-N which is provided from Hanson (UK) and two grades of HCFA which were created by combustion between 850°C and 1100°C in a power generation plant using a fluidised bed combustion (FBC) system and was categorized into two grades, fine high calcium fly ash (HCFA1) and coarse high calcium fly ash (HCFA2). It should be noted that there is no major variation in the chemical structure of both grades of HCFA.

### Table 1: Aggregate properties

<table>
<thead>
<tr>
<th>Material</th>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate (coarse)</td>
<td>Water absorption, %</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>Apparent particle density, Mg/m$^3$</td>
<td>2.67</td>
</tr>
<tr>
<td></td>
<td>Bulk particle density, Mg/m$^3$</td>
<td>2.62</td>
</tr>
<tr>
<td></td>
<td>Water absorption, %</td>
<td>1.7</td>
</tr>
<tr>
<td>Aggregate (fine)</td>
<td>Apparent particle density, Mg/ m$^3$</td>
<td>2.65</td>
</tr>
<tr>
<td></td>
<td>Bulk particle density, Mg/ m$^3$</td>
<td>2.54</td>
</tr>
<tr>
<td>Limestone filler</td>
<td>Density, Mg/ m$^3$</td>
<td>2.57</td>
</tr>
</tbody>
</table>
The chemical composition of OPC, limestone filler (LD) and the two grades of HCFA has been tabulated in Table 2. It can be seen that both fine high calcium fly ash (HCFA1) and coarse high calcium fly ash (HCFA2) have approximately the same amount of CaO, however HCFA1 has more SiO$_2$, Al$_2$O$_3$ and MgO than HCFA2.

Table 2: XRF analysis, %.

<table>
<thead>
<tr>
<th>Properties</th>
<th>CaO</th>
<th>SiO$_2$</th>
<th>Al$_2$O$_3$</th>
<th>MgO</th>
<th>Fe$_2$O$_3$</th>
<th>SO$_3$</th>
<th>K$_2$O</th>
<th>TiO$_2$</th>
<th>Na$_2$O</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCFA1</td>
<td>70.417</td>
<td>26.003</td>
<td>2.552</td>
<td>2.988</td>
<td>0</td>
<td>0.357</td>
<td>0.279</td>
<td>0.497</td>
<td>1.918</td>
</tr>
<tr>
<td>HCFA2</td>
<td>70.276</td>
<td>24.671</td>
<td>2.209</td>
<td>2.721</td>
<td>0</td>
<td>0.342</td>
<td>0.335</td>
<td>0.534</td>
<td>1.811</td>
</tr>
<tr>
<td>OPC</td>
<td>67.002</td>
<td>28.614</td>
<td>2.615</td>
<td>1.688</td>
<td>1.874</td>
<td>2.78</td>
<td>0.778</td>
<td>0.414</td>
<td>1.647</td>
</tr>
<tr>
<td>LD</td>
<td>76.36</td>
<td>16.703</td>
<td>0</td>
<td>0.981</td>
<td>0</td>
<td>0.096</td>
<td>0.348</td>
<td>0.185</td>
<td>2.258</td>
</tr>
</tbody>
</table>

Sample preparation

The preparation of CACBC samples in this study follows the technique implemented by the Asphalt Institute, (Marshall Method for Emulsified Asphalt Aggregate Cold Mixture Design (Asphalt Institute, 1989)) for designing CACBC mixtures. Several pre-wetting water contents were studied to find the lowest proportion which will confirm satisfactory coating. Additionally, indirect tensile stiffness modulus
(ITSM) tests were employed to choose the optimum emulsion content. The mixture density test was adopted to decide the optimum total liquid content at compaction. According to this process, pre-wetting water content, optimum total liquid content at compaction and optimum residual bitumen content were 3.5%, 14% and 6.3%, respectively.

The ingredients were mixed together in a Hobart mixer. Aggregate with the filler and the pre-wetting water content were added and mixed for 1 minute at low speed. Later, the slow setting bitumen emulsion was introduced slowly during the following 30 second of mixing, and the mixing was continued for the next 2 min at the same speed. Furthermore, the specimens were mixed and placed in the mould, and next they were straight subjected to compaction with 100 blows of the Marshall hammer, 50 on each side of the samples by using a standard Marshall Hammer. The specimens were left initially in the moulds for 24 hours before being extruded to avoid disintegration of specimens. After that, all the samples were cured at room temperature and subjected to the indirect tensile stiffness modulus test (ITSM) at 3 days age.

To study the influence of HCFA and for comparison purposes, samples of control mixtures using traditional limestone filler (without adding any HCFA) was also prepared as well as mixtures treated with OPC as a filler replacement. In addition, two grades of asphalt concrete hot mix namely, 100/150 pen and 40/60 pen, were prepared.

On the other hand, HCFA was ground using a mortar and pestle (373 W motor with 2.5 litre bowl capacity). The grinding time is the important factor. In this research, the grinding time was chosen as 12.5 minutes which gives approximately the same particle size distribution as that of the used OPC (which will be discussed later in detail). HCFA fineness was estimated to increase with this grinding time.

**Method**

1. **Indirect tensile stiffness modulus (ITSM):**

The indirect tensile stiffness modulus (ITSM) test was performed at the age of 3 days following a standard procedure in BS EN 12697-26 (European Committee for Standardization, 2012b), using Cooper Research Technology HYD 25 testing machine as presented in Figure 2.

The ITSM was carried out at a temperature of 20 °C with a load target rise time of 124±4 ms while the horizontal deformation was 5 μm. All the samples were conditioned for at least four hours before conducting the test. The mixtures compaction was fixed at 50 blows per face for all the cold and the hot asphalt concrete binder course mixtures.
2. Particle size distribution (PSD) of filler materials:
Particle size distribution of the fillers was assessed by utilizing a laser diffraction particle size analyzer (Beckmen Coulter) in liquid mode as shown in Figure 3. It uses reverse Fourier optics combined in a patented fibre optic spatial filter system and a binocular lens system.
Results and Discussion

**Influence of distribution particle size on ITSM**

In order to describe the fineness and particle structure of the two grades of HCFA and compare them with the traditional limestone filler (LD) and with the commercial Ordinary Portland Cement (OPC), a laser diffraction particle size analyser was employed. The test results of the two grades of HCFA as well as OPC and LD are depicted in Figure 4. The PSD of HCFA1 and HCFA2 have coarser grain size distribution than the control LD and OPC where HCFA1 has finer particle than HCFA2 although they have the same coarser particles in 0–1 µm range as shown in Figure 4.

The ITSM development of CACBC with the two grades of HCFA incorporated is presented in Figure 5. Substantial enhancement can be seen on ITSM development from samples made from the fine HCFA1. The incorporation of the fine HCFA1 resulted in a very good strength improvement and shows noticeable ITSM at early ages as compared to the OPC samples as well as the LD specimens. At early ages (3 days), the ITSM of HCFA1 mixtures were higher than that of the control mixtures i.e. standard mixtures with limestone filler (around 13 times) and about (9%) more than the 100/150-pen hot asphalt concrete binder course mixtures. This enhancement is due to the fineness of HCFA1. However, it is still lower than the mixtures treated with OPC by around (31%).
The reduction in particle size means that the pozzolanic reaction, which is usually a slow process, is sped up. Furthermore, accelerating the process of hydration depends on the size of particles of HCFA where it is difficult for the water to access to the heart of the large HCFA particles. On the other hand, mixtures treated with HCFA2 displayed ITSM values less than the HCFA1 and OPC samples by about (12%) and (40%) respectively. ITSM was considerably lower than the others where the large size of the particles of HCFA2 specimens did not allow full hydration leading to heart particle weakness and as a result low stiffness modulus.

![Figure 4: Particle size distribution of filler materials](image-url)
Effect of HCFA1 fineness on ITSM

In this research, low energy intensive dry agitation using a mortar and pestle as shown in Figure 6 (1 horsepower motor with 2.5 litre bowl capability) with small time of grinding was applied taking sustainability into consideration and to prevent the particles agglomeration, as agglomeration is harmful for the nature and ground product activity (Juhasz and Opoczky, 1990). Rodrigues et al. (1999) stated that grinding generates greater surface area, however the phenomena of agglomeration that is usually connected with extended grinding time, in reverse affects the pozzolanic action.

Accordingly, the second stage was grinding of HCFA1 at 12.5 minutes to explore the fineness of HCFA1 on the ITSM development. Many attempts have been made to reach approximately the same particle size as that of OPC. It can be seen from Figure 7 that when grinding time was 12.5 minutes, the fineness of HCFA1 improved considerably compared with untreated HCFA1. The fineness of HCFA1 is approximately the same of OPC except the range 14-47 µm where it is a little more fine than OPC. However, in the range from 1.5 to 0 µm, the OPC has more fine particles than HCFA-12.5 min. Table 6 illustrated the physical particle characterizations of the 12.5 min ground HCFA1, HCFA1, HCFA2, OPC, LD. It can be seen that 12.5 min ground HCFA1 has the lowest d10, d50 and d90 among the control fillers except d90 of the OPC which is lower than HCFA1-12.5 min.
Figure 6: Mortar and pestle
Figure 7: Particle size distribution after grinding

Table 6: Physical particle characterizations

<table>
<thead>
<tr>
<th>Material</th>
<th>Median, µm</th>
<th>d10, µm</th>
<th>d90, µm</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD</td>
<td>24.2</td>
<td>1.45</td>
<td>96.5</td>
</tr>
<tr>
<td>OPC</td>
<td>11.9</td>
<td>1.66</td>
<td>41.1</td>
</tr>
<tr>
<td>HCFA1-12.5 min</td>
<td>11.77</td>
<td>1.59</td>
<td>35.4</td>
</tr>
<tr>
<td>HCFA1</td>
<td>41.2</td>
<td>2.99</td>
<td>119</td>
</tr>
<tr>
<td>HCFA2</td>
<td>97.58</td>
<td>4.61</td>
<td>323.1</td>
</tr>
</tbody>
</table>

Figure 8 shows the test results of ITSM of HCFA1-12.5 minute grinding and control mixtures. It can be observed that the mixtures incorporating HCFA1-12.5 minute grinding did achieve a significant increase in ITSM. For the ground HCFA1, maximum ITSM of (3181 MPa) happens at the mixture including HCFA1
grinding for 12.5 minute at the age of 3 days, which is remarkably improved at all ages and it is around 36% greater than that the mixtures with untreated HCFA1. This is due to the high fineness of HCFA1-12.5 minute (as can be observed in Figure 7 and Table 6) that displays good cementitious characteristics and packing effect. In addition, grinding partially breaks the structure of the material, which in turn facilitates the easier reaction with other substances.

Peris Mora et al. (1993) established that increasing of the fineness of fly ash could decrease interior friction in fresh mortar. According to this phenomenon, termed “lubricant effect”, the workability of HCFA mixtures in this research should be able to improve. Furthermore, it can be reported that process of grinding not only rises the specific surface area by decreasing the size of particle but also achieves morphological amendment and improved particle size distribution.

![Figure 8: ITSM results after 3 days](image)

**Conclusions**

- This study examined the probability of improving ITSM of CACBC mixtures by changing the particle size and fineness of HCFA. It can be said that HCFA activity is governed by the particle size distribution, the fine HCFA shows excellent performance while coarser HCFA does not exhibit a good performance in ITSM when used.

- Mechanical grinding can considerably affect the fineness of the HCFA. The HCFA fineness is improved with an increase in period of grinding to 12.5 minutes, which is a consequence of the influence of grinding on decrease of the size of particle.
• Fineness of HCFA1 could be increased by mechanical grinding which also improve cementing activity of HCFA1. It was found that the ITSM depended on the fineness of HCFA. The results of ITSM of the CACBC mixtures display that the optimum cementing active HCFA can be achieved by a low duration of grinding (12.5 minute).

• Small intensive grinding was very active to improve the reactivity of HCFA1.

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