Diffusion of ICT Innovations in UAE Public Schools and The Role of Stakeholder Engagement

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by

WALEED AHMED HASSAN AL-ALI

A thesis submitted to the Faculty of Engineering and IT in fulfilment of the requirements for the degree of

DOCTOR OF PROJECT MANAGEMENT

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Abstract

ICT innovations played a vital role in driving last century developments characterised as the digital revolution introducing unprecedented opportunities across different life sectors. This digital revolution is expected to further evolve to encompass the fourth industrial revolution that was characterized by a fusion of technology. Internationally there is consensus on the need for a paradigm shift in education reforms to meet these future developments where it is fundamentally believed that ICT innovations will play vital role in redefining learning and the overall educational experience. The traditional model of education is losing its former binding character as ICT extended learning opportunities and access to knowledge is not bounded by time, place or pace.

The challenge is that introducing ICT innovations into traditional schools requires high investments and considered complex process due to the complexities around changes related to education. To achieve the enhanced educational objectives, the literature emphasised that diffusing ICT into schools shall not be considered an abstract technology deployment rather than an educational change process that shall be effectively planned and managed.

This research attempts to fill this gap by focusing on an actual ICT innovation diffusion project that is taking place in UAE public schools. The first objective is to understand the ICT innovations diffusion in education. The second objective is to extract from literature main dimensions to explore the ICT innovations diffusion process and status in UAE public schools. Third objective is to explore the status of the ICT innovations diffusion in UAE public schools. Fourth objective is to explore the process of the ICT innovations diffusion in UAE public schools. The fifth objective is to study the interactions between the stakeholders over the ICT innovation diffusion project lifecycle activities. Finally, the sixth research objective is to develop a framework to support effective diffusion of ICT innovations in UAE public schools that address the changing stakeholder dynamics over project lifecycle.

This explorative research adopted qualitative research methods to gain insights into the process and status of ICT diffusion in UAE public schools. A list six constructs composed of 26 dimensions were identified by combining literature from innovation theory, stakeholder theory, technology acceptance and project management. These dimensions

were used to develop the research framework and guide the explorative study based on the semi-structured interviews. a total of 55 interviews conducted with stakeholders from different levels, from MoE, local education authority, MBRSLP, schools and suppliers related to this project in UAE. The review examined four years of ICT innovations deployment phases in UAE public schools and the findings were analysed using Dependency Structure Matrix (DSM), heat maps, and Social Network Analysis (SNA) techniques.

The research contributed to the body of knowledge by developing and an understanding for the phenomenon of ICT innovation diffusion project in UAE public school. The research provided rich findings extracted through qualitative investigation providing details on the process and status of the ICT in UAE public schools. In addition, the research provided a contribution the theory by developing a holistic approach based on framework composed of 26 dimensions to explore the process and status of ICT innovation diffusion in UAE public schools. Another contribution to theory is the use of DSM, heat maps and SNA techniques for data analysis within project management which support the viability of these new techniques in research. Moreover, the research findings provided contribution to practice specific to the UAE project and some conclusions applicable to similar projects beyond UAE.

On the other hand, no research without limitations, this research has some limitations including the geographical limitation in UAE schools as Abu Dhabi schools were not since they are not falling under the federal MoE of UAE, parents and students were excluded from interviews although they are considered a key stakeholder educationally and in the context of ICT in education, and successful ICT diffusion was not linked to academic performance.

موجز البحث

لعبت ابتكارات تكنولوجيا المعلومات والاتصالات دورا حيويا في دفع التطورات التي شهدها القرن الماضي والتي وصفت بأنها ثورة رقمية تقدم فرصا غير مسبوقة في مختلف قطاعات الحياة، ومن المتوقع أن تتطور هذه الثورة الرقمية لما يسمى بالثورة الصناعية الرابعة التي تتسم بدمج موسع للتكنولوجيا، من جانب آخر وعلى الصعيد الدولي هناك توافق في الآراء حول الحاجة إلى نقلة نوعية في إصلاحات التعليم لمواكبة هذه التطورات المستقبلية حيث يعتقد أساسا أن الابتكارات في مجال تكنولوجيا المعلومات والاتصالات سوف تلعب دورا حيويا في إعادة تعريف عملية التعلم والتجربة التعليمية ككل، إن النموذج التقليدي للتعليم بدأ يفقد طابعه التقليدي الملزم حيث أن ابتكارات تكنولوجيا المعلومات والاتصالات وسعت فرص التعلم بشكل كبير حيث صار االوصول الى المعرفة والتحصيل العلمي لا يحده زمان أو مكان أو وتيرة.

ويتمثل التحدي في أن إدخال ونشر ابتكارات تكنولوجيا المعلومات والاتصالات في المدارس التقليدية يتطلب استثمارات عالية ويعتبر عملية معقدة نظراً للتعقيدات المرتبطة بعملية التغيير والإصلاح للتعليم، ولتحقيق الأهداف التعليمية المعززة أكدت الدراسات أن إدخال ونشر تكنولوجيا المعلومات والاتصالات في المدارس يحب أن لا يكون مشروع تكنولوجيا مجردا وبدلا من ذلك أن يعتبر عملية تغيير تعليمي يجب التخطيط لها وإدارتها بفعالية.

ويعمل هذا البحث على سد هذه الفجوة من خلال التركيز على مشروع نشر ابتكارات تكنولوجيا المعلومات والاتصالات الفعلي الذي يجري في المدارس الحكومية في دولة الإمارات العربية المتحدة، والهدف الأول هو فهم عملية نشر ابتكارات تكنولوجيا المعلومات والاتصالات في التعليم، والهدف الثاني هو استخلاص الأبعاد والعوامل الرئيسية لاستكشاف عملية نشر ابتكارات تكنولوجيا المعلومات والاتصالات ووضعها في المدارس الحكومية في دولة الإمارات العربية المتحدة، والهدف الثالث هو استكشاف حالة نشر ابتكارات تكنولوجيا المعلومات والاتصالات في المدارس الحكومية في دولة الإمارات العربية المتحدة، والهدف الرابع هو استكشاف عملية نشر ابتكارات تكنولوجيا المعلومات والاتصالات في المدارس الحكومية في دولة الإمارات العربية المتحدة، والهدف الخامس هو دراسة التفاعلات بين أصحاب المصلحة عبر أنشطة دورة حياة مشروع نشر ابتكارات تكنولوجيا المعلومات والاتصالات في مدارس الامارات، وأخيرا، يتمثل الهدف البحثي السادس في وضع إطار لدعم النشر الفعال لابتكارات تكنولوجيا المعلومات والاتصالات في المدارس الحكومية في دولة الامارات العربية المتحدة التي تعالج ديناميكيات أصحاب المصلحة المتغيرة على مدى دورة حياة المشروع.

واعتمد هذا البحث الاستكشافي طرق بحث نوعية للتعرف على عملية ووضع نشر تكنولوجيا المعلومات والاتصالات في المدارس الحكومية في دولة الإمارات العربية المتحدة، وقد تم تحديد قائمة من ستة محاور مكونة من ستة وعشرين عاملا من خلال الجمع بين الأدب من نظرية الابتكار، ونظرية أصحاب المصلحة، وقبول التكنولوجيا وإدارة المشاريع، وقد استخدمت هذه الأبعاد لتطوير إطار البحث وتوجيه الدراسة الاستكشافية على أساس المقابلات شبه المنظمة، حيث أجري ما مجموعه خمسة وخمسون مقابلة مع أصحاب المصلحة من مختلف المستويات، من

وزارة التربية والتعليم، والسلطة التعليمية المحلية، و برنلمج التعلم الذكي والمدارس والموردين المرتبطين بالمشروع، وقامت الدراسة باستعراض أربع سنوات من مراحل مشروع نشر ابتكارات تكنولوجيا المعلومات والاتصالات في المدارس الحكومية في الإمارات العربية المتحدة، وتم تحليل النتائج باستخدام تقنيات مصفوفة هيكل التبعية (DSM) وخرائط الحرارة وتقنيات تحليل الشبكات الاجتماعية (SNA).

ساهم البحث في مجموعة المعرفة من خلال تطوير وفهم لظاهرة مشروع نشر التكارات تكنولوجيا المعلومات والاتصالات في المدارس الحكومية في دولة الإمارات العربية المتحدة، وقد وفر البحث نتائج غنية مستخلصة من خلال تحقيق نوعي يقدم تفاصيل عن عملية ووضع مشروع نشر ابتكارات تكنولوجيا المعلومات والاتصالات في المدارس الحكومية في دولة الإمارات العربية المتحدة، وبالإضافة إلى ذلك، قدم البحث مساهمة نظرية من خلال وضع نهج شامل على أساس إطار يتألف من ستة وعشرون عاملا لاستكشاف عملية ووضع مشاريع نشر ابتكارات تكنولوجيا المعلومات والاتصالات في المدارس الحكومية في الإمارات العربية المتحدة، وثمة مساهمة أخرى في الجانب النظري هي استخدام تقنيات مصفوفة هيكل التبعية (DSM) وخرائط الحرارة وتقنيات تحليل الشبكات الاجتماعية (SNA) ضمن نطاق إدارة المشاريع والتي تدعم فاعلية هذه التقنيات الجديدة في البحث، وعلاوة على ذلك، قدمت نتائج البحث مساهمة في الجانب التطبيقي والممارسات وتحديدا لمشروع نشر ابتكارات تكنولوجيا المعلومات والاتصالات في المدارس حيث أن بعض االاستنتاجات يمكن الاستفادة منها في مشاريع مماثلة خارج نطاق دولة اإلمارات العربية المتحدة.

من ناحية أخرى، لا يوجد بحث دون قصور، هذا البحث لديه بعض القيود بما في ذلك التقييد الجغرافي في مدارس الإمارات العربية المتحدة حيث أن مدارس لإمارة أبو ظبي لم تكن ضمن البحث لأنها لا تقع بشكل مباشر ضمن وزارة التربية والتعليم في دولة الإمارات العربية المتحدة، كذلك تم استبعاد أولياء الأمور والطلاب من المقابلات على الرغم من أنهم يعتبرون من أصحاب المصلحة الرئيسيين تعليميا، وفي سياق تكنولوجيا المعلومات والاتصالات في التعليم والنجاح في نشر ابتكارات تكنولوجيا المعلومات والاتصالات لم يتم ربطها بالأداء الأكاديمي والتحصيل الدراسي.

Dedication

To all those who strive for progress and development of themselves their country you can achieve your dreams, just set a target and work toward it until you get there.

PhD journey was a challenge that I decided to take on with all the other commitments I already had with family, friends, work, and personal business. I took this challenge for several reasons, first was a personal challenge for myself, second to make my family proud of me and set an example to them that you can achieve your dreams.

My deepest apperceptions and sincere gratitude to my **Mother** and **Father**, to my brothers and sisters, to my beloved family for their support and encouragement. Special thanks to my lovely wife **Kholoud**, my three beautiful kids **Khalid**, **Hamdan** and **AlReem**, thank you for all the sacrifices you made and patience you had when I was away from you working on my PhD journey. To my friends and all those whom I love I send a special dedication.

For all of you, one by one, thank so much for your support, encouragement and deep prayers, which were the main factors that kept me going to reach my goal.
May Allah Bless You All.

Acknowledgment

First and foremost, all praise is for Allah, The Almighty, The Exalted, to whom we seek His guidance.

A special thanks to my supervisors, Professor Halim Boussabaine and Dr. Khalid Al Marri for their guidance, continuous encouragement and support. I appreciate all their efforts.

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Thanks to my university colleagues for their discussions, suggestions, criticism and encouragement.

Thanks to all interviewees who accepted to participate in this study and gave their valuable time and contribution. Thanks to every person and institution that helped me to conduct this study, directly or indirectly. Everyone's contribution is counted and appreciated.

My sincere appreciation and heartfelt thanks go to my parents, family, friends and work colleague who have encouraged me in the toughest times of this journey. Every one of them had their own way of advising and guiding me. Thank you for being there to support me.

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Abbreviations

DOI	Diffusion Of Innovation
DSM	Dependency Structure Matrix
ICT	Information Communication Technology
ITU	International Telecommunication Union
MBRSLP	Mohammed Bin Rashid Smart Learning Programme
MoE	Ministry of Education
OECD	Organisation for Economic Co-operation and Development
RAK	Ras Al Khaimah
UAQ	Umm Al-Quwain
UN	United Nations Educational, Scientific and Cultural Organization
UNESCO	United Nations Educational, Scientific and Cultural Organization

CHAPTER 1. INTRODUCTION

1.0 Introduction

This introduction chapter starts by providing background information related to the context of the research, which will build a better understanding of the need for the research. After doing so, the research questions, aims and objectives are presented, and then the research value and contribution to the body of knowledge will be delineated. Lastly, a brief overview of the research and thesis structure is outlined.

1.1 Research Context

In this section, background information to the research context will be provided to ensure a better understanding of the research problem. First, the evolution of ICT usage in education will be previewed. Secondly, background on the UAE education system and the use of ICT in schools will be provided.

1.1.1 Evolution of ICT Use in Education

Information and communication technologies (ICT) play a vital role in driving developments across different life sectors; ICT has been considered the main driver for what is called the third industrial revolution, where the first used water and steam power, and the second used electric power for mass production. According to Klaus Schwab, founder and executive chairman of the World Economic Forum (WEF):

> *“A Fourth Industrial Revolution is building on the Third, the digital revolution that has been occurring since the middle of the last century. It is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres “*(Schwab, 2017).

According to the OECD (Organisation for Economic Co-operation and Development), over the last forty years ICT has rapidly developed and has profoundly influenced almost every aspect of human life, and education plays a key role in ensuring that everyone can obtain the benefits of this technology-rich world (OECD, 2014).

Because of these massive developments in the field of ICT, traditional education has witnessed an important paradigm shift. According to Brown (2015):

> *"The overwhelming progress made in the field of information and communication technologies (ICT) and technology-enhanced learning (TEL) is changing our educational practice - the way in which we teach, learn, and do research. The traditional model of education is losing its previously binding character, not only in the case of residential face-to-face institutions, but very much so also for distance learning institutions. Time, place, and pace do not play a dominating role as they did in the past ".*

In this era, information and knowledge are no longer limited to libraries, books, or individual people such as teachers or experts. The amount of information and knowledge openly available is increasing on a daily basis, and ICT empowers access to such resources regardless of where one is in the world (Barber et al., 2013; Brown, 2015). Accordingly, ICT use in education has witnessed rapid development and increased acceptance from both general education and higher education sectors, which has led to an increased interest in this area of knowledge from both academia and industry (Groff, 2013; OECD, 2014; Bayne, 2015; Zhu, 2015; Zhang et al., 2016). According to IDC (2015):

> *"The IT spending forecast in the higher education sector in the Asia/Pacific region, excluding Japan's (APEJ) higher education sector, will increase from US$8.7 billion in 2015 to US$10.4 billion in 2019".*

In addition, according to EdTechXGlobal (2016):

> *"Education technology is becoming a global phenomenon, and as distribution and platforms scale internationally, the market is projected to grow at 17.0% per annum, to $252bn by 2020"*.

The huge investments and growing market of ICT in education present a clear indication of the rise of ICT innovation adoption in order to support teaching and learning practices and as a major component in educational reform programmes around the world (Geoghegan, 1994; Lim, 2002; Luckin et al., 2012; WEF, 2012; Zhu, 2015; Zhang et al., 2016). In addition, UNESCO identified the importance of using ICT in education, and that in this era the use of ICT should be considered a student's right in ensuring a quality education:

> *"ICT can contribute to universal access to education, equity in education, the delivery of high-quality learning and teaching, teachers' professional development, and more efficient education management, governance and administration "(*ITU, 2012).

ICT innovations in supporting teaching and learning practices aim to integrate ICT into supporting the overall educational eco-system, including classroom set-up, curriculum and content, school management, library management, and other applicable educational activities (Goktas, Yildirim and Yildirim, 2009; Barber, 2010; Sancho, 2010). In addition, Groff (2013) describes the potential benefits of the deployment of ICT innovations in education as well as the need to plan such implementation strategically as a change programme:

> "*Innovative technologies not only have the potential to evolve pedagogical practice, but also completely transform entire learning environments. When technology is leveraged with a strategic vision and change management plan, the results can be revolutionary*" (Groff, 2013).

Additionally, several initiatives have been launched, from small-scale to national level programmes aiming to support the diffusion of ICT in education as an effort to improve education and educational outcomes; this indicates the general global direction towards ICT deployment in education and the importance of this topic (Zhang et al., 2016). At a global level, the UN (United Nations) and many of its agencies and working groups, including UNESCO and the ITU (International Telecommunication Union), the Broadband Commission for Digital Development, the World Summit on the Information Society (WSIS), the WSIS+10, and the Sustainable Development Goals (SDG), have emphasised the role of ICT in development and established programmes to support and promote the use of ICT in improving learning and development. Accordingly, ICT diffusion in education is considered an important element of sustainable development goals, as stated in paragraph 15 from the *Transforming Our World: the 2030 Agenda for Sustainable Development*:

> "*The spread of information and communications technology and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide, and to develop knowledge societies*" (United Nations, 2015).

1.1.2 Background of public schools in the UAE

History of public education in UAE

The access to education in the UAE was extremely limited in the early 1950's where there were only few formal schools in the country. Since then and with the creation of the UAE in 1971, the newly established Ministry of Education began facilitating wider access to education which witnessed enormous developments with substantial investments has been made to accommodate for the educational needs and the high aspirations of the new established country. Nowadays, the UAE education system offers a comprehensive education to every male and female student from kindergarten to university higher education. Education is compulsory in the UAE for the primary and secondary level where education is being provided for free at all levels to all the country citizens (UAECD, 2011).

Public schools are schools that are funded by the government and free for nationals. The curriculum in public schools is developed to cater for the UAE developmental goals and cultural values. Public schools in the UAE use Arabic as first language and English as a second language. On the other hand, there is an extensive private school sector in the UAE. The private school sector follows a range of international standards and curricula and are all fee paying (MOE, 2016).

The UAE Education system structure

The education system strategy in the UAE is generally determined by the Ministry of Education where the ministry established local education zones for each emirate to oversee and support school operations in each emirate. At local individual emirates, education councils are set up to assist in implementation the federal government policy for education. Abu Dhabi Education Council (ADEC) develops education and educational institutions in Abu Dhabi; Knowledge and Human Development Authority (KHDA) is the primary driver of educational reform in Dubai, whereas Sharjah Education Council works with the MoE to enhance the education sector in Sharjah. All the schools in the seven emirates follow the MoE general strategy for education and the schools fall directly under MoE (MBRSLP, 2016). A special set up was developed for Schools in Abu Dhabi emirate where the schools are directly overseen and managed by ADEC with a customized local curriculum and schooling system. For this research ADEC schools are out of scope since ADEC schools are not in the scope of MBRSLP initiative.

Public School set-up

The public schools in the UAE are designed to have separate schools for male and female students in consideration of the UAE cultural requirements. That said, all male and female students are entitled to free public education at all levels (Gaad, 2011). In terms of the education system setup in the UAE, it is organised as follows (figure 1.1):

- **Kindergarten school**
  Kindergarten (KG) is considered the start early childhood education and divided into two levels KG1 and KG2.
- **Cycle 1 schools**

After completing KG2, students move to cycle one. Cycle one is composed of six levels and equivalent to primary level school.

- **Cycle 2 schools**
  After completing grade six, students move to cycle 2 which is equivalent to preparatory level school.
- **Cycle 3 schools**
  Cycle three is composed of 3 years and equivalent to secondary level school. In general, there are 2 kinds of cycle three schools. After completing grade 12 students move to higher education level and can join a wide range of colleges and universities locally or globally.

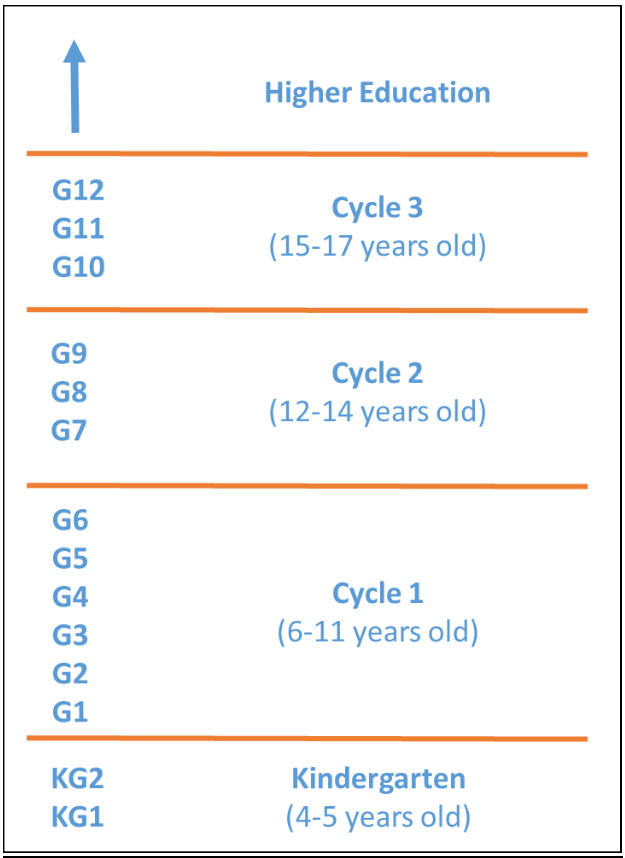


Figure 1.1 UAE education system schooling structure

The UAE Education system performance and future direction

In terms of the UAE education system performance, despite the high-level of investments from the government, the UAE education system is still not performing as expected compared to the wealth of the country and the major developments across different sectors. According to Andreas Schleicher, the director of the OECD education and skills directorate:

> "*The United Arab Emirates is identified by PISA (Programme for International Student Assessment) as one of the most rapidly improving education systems in the world. However its students still perform well below the levels expected in advanced economies. This is important because the knowledge and skills of students are a powerful predictor for a country's wealth and social outcomes in the long run*" (OECD, 2015)

Although the UAE's National Agenda calls for it to rank among top 20 in PISA by 2021, the 2015 PISA results shows that UAE students continue to fall below the OECD average in the three subjects tested – science, reading and maths. The UAE is currently ranked 47 out of 65 counties in the 2015 PISA results focused on mathematics (OECD, 2015).

In general, for the UAE education sector, much had been achieved over the past forty years, however there is deep believe that much more needs to be done. According to the UAE Vision 2021, education remains a top government priority toward developing human capital and the country effort to develop a diversified knowledge-based economy. The UAE Vision 2021 national agenda emphasize on the development of a first-rate education system that will require full transformation of the current education system and teaching methods. **(**Ministry of Cabinet Affairs, 2011).

The following KPIs are defined in the UAE Vision 2021 to allow the development of a first-rate education system:

INDICATOR	DEFINITION	SOURCE	RESULTS	KEY SPONSOR
Average TIMSS Score	An indicator that reflects the nation's ranking and score in the TIMSS test, which evaluates the math and science skills of students in grades 4 and 8	International Association for the Evaluation of Educational Achievement	TIMSS 2015: - Mathematics Grade 4: Rank 39 - Science Grade 4: Rank 40 - Mathematics Grade 8: Rank 23 - Science Grade 8: Rank 23	Ministry of Education
Upper Secondary Graduation Rate	An indicator that measures the percentage of national students graduating from secondary education out of the population in the age group of 18 years (measured as the number of graduates, regardless of age, divided by the population aged 18 years)	Ministry of Education and The Federal Cometitiveness and Statistics Authority	96.7% (2016)	Ministry of Education
Enrollment Rate in Preschools (public and private)	An indicator that measures the percentage of children between the age of 4 and 5 who are enrolled in preschools (This indicator emphasizes the importance of providing children with a good foundation at an early age)	Ministry of Education and The Federal Cometitiveness and Statistics Authority	91.0% (2016)	Ministry of Education
Average PISA Score	An indicator that measures the country's ranking and scores in the PISA exam, which evaluates the reading, mathematics and science skills of 15 year old students.	Organization for Economic Co-operation and Development	PISA 2015: - Mathematics: Rank 47 - Science: Rank 46 - Reading: Rank 48	Ministry of Education
Percentage of Students with High Skills in Arabic, According to National Tests	An indicator that measures the share of ninth grade students with high skills in the Arabic language (reading, writing) according to national tests. The indicator covers students in public and private schools at the national level (NKPI specific to UAE)	Ministry of Education	67.0% (2016)	Ministry of Education
Percentage of Schools with High Quality Teachers	An indicator that measures the percentage of schools that meet certain quality standards of teachers based on a clear system of measurement and evaluation.	Ministry of Education	Work in progress	Ministry of Education
Percentage of Schools with Highly Effective School Leadership	An indicator that measures the percentage of public and private schools that achieve high scores on effective school leadership based on the school monitoring and evalution scheme.	Ministry of Education	Work in progress	Ministry of Education
Enrollment Rate in Foundation Year	An indicator that measures the share of local students who have to undergo foundation year (a program usually focusing on strengthening Arabic, English, Math and IT) out of the total local students enrolled in the universities in the same year.	Ministry of Education	46.8% (2016)	Ministry of Education

Figure 1.2 UAE Vision 2021 KPI's for the development of a first-rate education system

1.1.3 UAE Public Education and ICT Use in Schools

Since its establishment in 1971, the UAE (United Arab Emirates) has witnessed a remarkable development in all sectors, including its economy, infrastructure, social and cultural welfare, health, and education. Education was, and continues to be, a key priority for the country's leadership, starting from the late Sheikh Zayed Bin Sultan Al Nahyan, founder of the UAE, who articulated his vision of education in UAE thus:

> “*The greatest use that can be made of wealth is to invest it in creating generations of educated and trained people. The real asset of any advanced nation is its people, especially the educated ones, and the prosperity and success of the people are measured by the standard of their education”* (UAECD, 2008).

To date, the emphasis on enhancing the quality of education and expanding learning opportunities continues to be a core focus, as stated in the UAE Vision 2021 National Agenda:

> “*The UAE Vision 2021 National Agenda emphasises the development of a first-rate education system, which will require a complete transformation of the current education system and teaching methods. The National Agenda aims for all schools, universities and students to be equipped with Smart systems and devices as a basis for all teaching methods, projects and research*” (Ministry of Cabinet Affairs, 2011).

From the above statement, it can be noted that ICT technologies, or what is referred to as smart technologies, are expected to play a key role in the transformation of UAE education by integrating smart technologies into the teaching and learning experience. As a result, in 2012 the government launched an ambitious initiative to deploy smart technologies into UAE public schools as part of the transformation of UAE education. HH Sheikh Mohammed Bin Rashid Al Maktoum, the UAE Vice-President and Prime Minister, launched the initiative, and it was named after him as a direct indication of the attention given to the programme.

The Mohammed Bin Rashid Smart Learning Programme (MBRSLP) initiative was established with the aim of supporting the realisation of the UAE Vision 2021 in relation to national educational aspirations. The MBRSLP programme’s key role is in supporting and enabling the transformation of all UAE public schools into technologically enhanced teaching and learning environments, equipping all students, teachers, and principals with smart technologies and solutions, and most importantly ensuring the effective adoption of these technologies in enhancing the teaching and learning experience through customised training and professional development programmes for different stakeholders (MBRSLP, 2016). Throughout this research, smart technologies will be referred to as ICT innovations, as the introduction of these new changes into a system is referred to as diffusion of ICT innovation in the research literature.

The MBRSLP implementation was based on a phased yearly deployment, by school grade. The first deployment started in 2012, and it was a pilot deployment in Grade 7 in 15 schools. With the start of the academic year 2013/14, Phase 1 deployment started targeting all Grade 7 students across 123 schools, covering 11,548 students, 10,995 educators, and 440 classrooms. In the next academic year (2014/15), the second deployment reached 145 schools, covering 24,385 students, 4,095 educators, and 1,239 classrooms. The third deployment started with academic year 2015/16, reaching 202 schools, 34,508 students, 6,825 educators, and 1,719 classrooms. The MBRSLP deployment plan will continue progressing until, by 2019, it has covered all public schools, from grades 1 to 12, which are under the remit of the Ministry of Education (MoE) (MBRSLP, 2016).

Such a project represents a very challenging undertaking in different areas; the focus of this study will be to explore the MBRSLP initiative's diffusion of ICT innovations in UAE public schools to gain insight into the process of an ICT innovation diffusion project and the changing dynamics of stakeholder interactions over the activities of the project. The MBRSLP has to deal with the education sector, which is a complex setting, composed of varying stakeholders from different organisational and individual levels, including the Ministry of Education and its different departments, the local education authority, and the school level. The MBRSLP programme management have to ensure the effective management of these stakeholders and actively engage with them throughout the project phases and changing stakeholder dynamics in order to ensure successful programme delivery.

1.2 The need for the research

The ongoing evolution of ICT innovations, and its emerging role in supporting educational reform, has led to a majority of developed and developing countries' governments embedding ICT in education as part of their national strategies (Zhang et al., 2016). Diffusing ICT innovations in education is believed to have a significant positive influence on the overall teaching and learning experience (Sancho, 2010; Zhang et al., 2016). In order to achieve such an impact, diffusion of ICT innovations into education is argued to be a structured deployment and change management programmes that needs to effectively engage with, and manage, different levels of stakeholders (Barber, 2010; Lavin, 2010; Sancho, 2010; Groff, 2013; Zhang et al., 2016). Such engagement is considered challenging as the introduction of ICT innovations might require them to change their existing behaviour and established norms and routines (Edmondson, Bohmer, and Pisano, 2000; Rogers, 2003; Lavin, 2010). Accordingly, it is vital to effectively identify, classify, prioritise and engage with the appropriate stakeholders throughout the ICT innovation diffusion project stages (Donaldson and Preston, 1995; Mitchell et al., 1997; Aaltonen and Kujala, 2010; Nour and Mouakket, 2013; Aaltonen et al., 2015). Management needs to actively and effectively identify key stakeholders, prioritise them, examine their changing dynamics over project stages and in consideration of the project context and the changes that might impact the project or the stakeohlders environment. Accordingly, project management can shape their engagement activities in a more informed approach towards effective diffusion and project success (Bourne and Walker, 2005; Vos and Achterkamp, 2006; Nour and Mouakket, 2013; Aaltonen et al., 2015).

Further, conducting research and sharing knowledge in the field of ICT deployment in education is being promoted by international organisations and the academic community in order to provide practical experiences on ICT deployment in education (Lavin, 2010; Groff, 2013; Zhang et al., 2014). ICT deployment in UAE public schools has witnessed exceptional developments since the launch of the MBRSLP initiative in 2012, which was aiming at diffusing ICT innovation in public schools as part of the UAE National Agenda direction toward the adoption of ICT and smart services in government sectors (MBRSLP, 2016).

The initiative has received wide recognition locally, by being awarded The Mohammed bin Rashid Government Excellence Award twice, in 2014 and in 2016 (SKGEP, 2017). In addition, at a global level, the MBRSLP was awarded the global

WSIS award in 2014 though signing cooperation agreements with the ITU and the Finnish National Board of Education in 2016 (MBRSLP, 2016). As a result, investigating the status and process of ICT innovations diffusion in UAE public schools represents a rich case with a high potential for gaining interesting insights and findings with practical implications for the research literature and practice.

As highlighted in the previous section, the MBRSLP initiative represents a rich case that has gone through four years of deployment and will continue deployment until all UAE public schools are covered by 2019. Over four years of deployment, the project management has had to deal with a complex setting composed of several different stakeholders from different organisations, professional groups, and individual levels, including the federal level, with the Ministry of Education and its different departments, the local level, with education authorities, and at the school level, with teachers, principals, and students. How the project management engage with these different stakeholders throughout the project's life cycle and over changing stakeholder dynamics presents challenge that this research is aiming to overcome by developing a framework to support effective diffusion of ICT innovations in in UAE public schools that address the changing stakeholders dynamics over project lifecycle.

1.3 Research Questions

The research questions revolve around three main areas: the first question aims to identify the most important dimensions for investigating ICT innovations diffusion within the UAE public school sector, which will provide a structure for this explorative research. The second question aims to examine the status of the ICT innovation diffusion project (MBRSLP) in UAE public schools, and it will be guided by the dimensions identified in the first question. The last question aims to investigate the different stakeholders and their interactions, activities, and dynamics over the project's life cycle. Accordingly, the three research questions for this study are:

1. What are the most important ICT innovation diffusion dimensions in the UAE public education sector?

2. What is the status of ICT diffusion in UAE public schools?

3. What is the status of stakeholder dynamics over the life cycle of the ICT diffusion project in UAE public schools?

1.4 Research aim and objectives

This study seeks to obtain further knowledge and understanding on managing ICT innovations diffusion projects in UAE public schools by examining the main dimensions influencing ICT innovation diffusion in UAE public schools. In addition, the research focus on investigating stakeholder interactions and the changing stakeholder dynamics over the project's life cycle. This seeks to build on the existing theoretical body of knowledge in key topics, including diffusion of innovation, project management, and stakeholder management literature, with a specific focus on ICT innovations diffusion in the UAE public school's context.

The aim of this research is to develop a framework to support effective diffusion of ICT innovations in in UAE public schools that address the changing stakeholders dynamics over project lifecycle. This framework will guide examining the status and process of ICT innovations diffusion in UAE public schools and better understand the stakeholders' dynamics over the project life cycle. This aim will be achieved by means of the following research objectives:

1. To review the literature on ICT innovation diffusion, with a specific focus on education.

2. To extract the main dimensions for exploring the ICT diffusion process and status in UAE public schools.

3. To explore the status of ICT innovation diffusion in UAE public schools.

4. To explore the process of ICT innovations diffusion in UAE public schools.

5. Study the interactions between stakeholders over the ICT innovation diffusion project's life cycle activities.

6. Develop a framework to support effective diffusion of ICT innovations in UAE public schools that address the changing stakeholder dynamics over project lifecycle.

1.5 Contribution to the body of knowledge

This thesis provides an original contribution to the knowledge by developing an understanding of the phenomenon of an ICT innovation diffusion project in UAE public school through the MBRSLP initiative. The research provided rich findings extracted through qualitative investigation, providing details on the process and status of ICT in UAE public schools. In addition, the research provided a contribution to knowledge by developing a holistic framework to explore the process and status of ICT innovation diffusion in UAE public schools which supports project managers in effective diffusion of ICT innovation in UAE schools. The framework was based on six constructs, composed of 26 dimensions extracted by integrating innovation theory, the UTAUT technology acceptance model, the TOE framework, the CBAM model, and stakeholder theories and frameworks. Such an approach was recommended in the literature, and this research used it to develop a new holistic framework for investigating ICT innovations diffusion in UAE public schools.

The explorative study was guided by the 26 dimensions identified, and two new unique dimensions that provided valuable insights into the UAE context: 'competition with other public sectors' and 'drivers of ICT diffusion in schools'. The thesis also provides a contribution from a methodological perspective. In this sense, the researcher adopted new methodologies for analysis, including DSM and social network analysis, which helped in visualising the findings and enabling an easier analysis. Furthermore, the research findings provided some implications for practice, with suggestions and recommendations for the UAE project, although some might be applicable beyond the UAE context. The details of this are given in Chapter 8.

The research results provide original knowledge for future researchers who are interested in the subjects of managing ICT innovations diffusion projects in education and stakeholder interactions over project life cycles. References to this topic, for the UAE specifically and even at a regional level, are limited compared to the literature focusing on Western contexts. In addition, project managers of future similar projects, locally or globally, will benefit from this research by understanding the complexities around managing the implementation of a national ICT programme in education, especially when such implementations are expected to grow significantly over the coming few years.

1.6 Research overview and structure of the thesis

The research was divided into eight chapters that are summarised in figure 1.3.

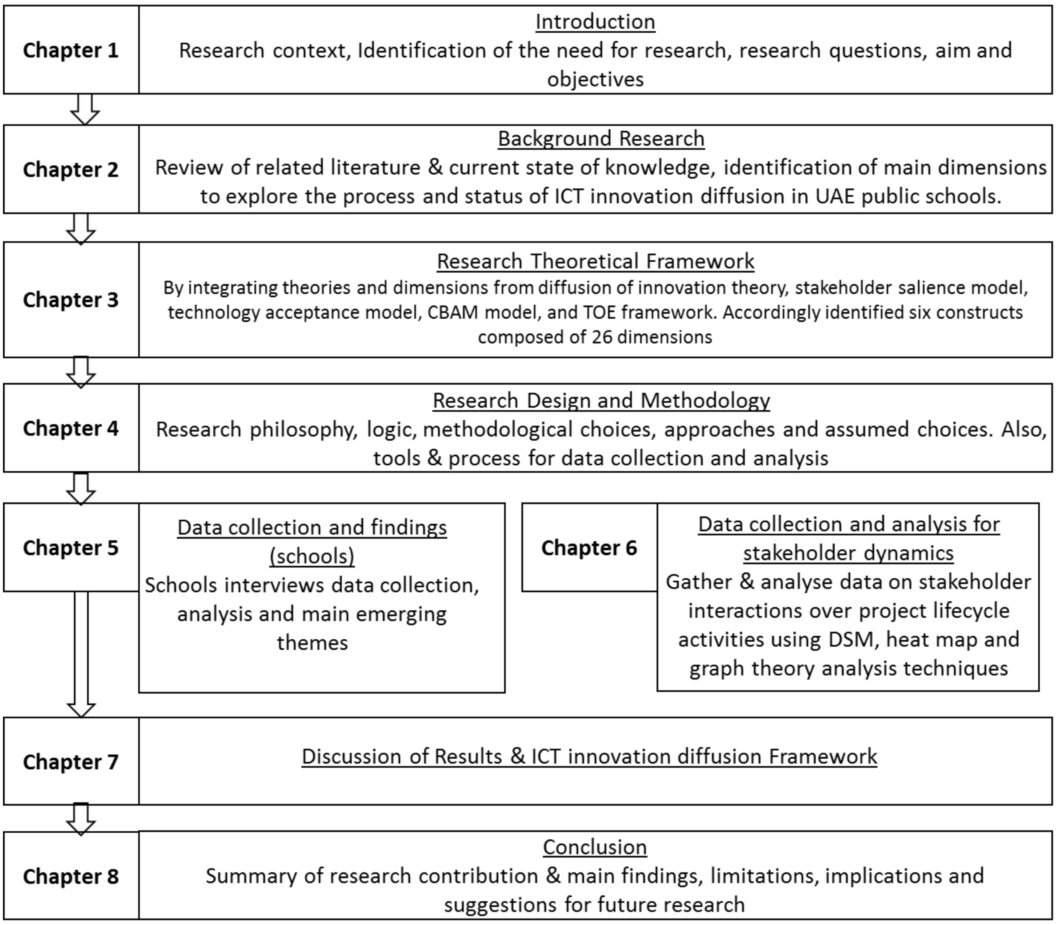


Figure 1.3 Summary of thesis structure

Chapter One provides an introduction to the research. It starts by introducing the evolution of ICT use in education and provides background information on ICT use in the UAE public sector, where this study takes place. This information supports the justification for the research and its significance. Then, the need for the research is presented as well as an explanation of the research questions and aims. In addition, Chapter One provides an overview of the entire thesis structure.

Chapter Two provides the background to the research context through providing a comprehensive understanding of the current ‘state of knowledge’. This is done by carrying out a critical literature review, focusing on the diffusion of ICT innovations and stakeholder theory. The chapter reviews the diffusion of ICT innovations and stakeholder theory from an innovation diffusion perspective in order to build a solid theoretical background as the foundation of the research. In addition, the literature review focused on identifying main dimensions for ICT innovation diffusion in UAE public schools.

Chapter Three builds on the knowledge gained from the literature review where 26 dimensions were identified as the most important ICT innovations diffusion dimensions in the UAE public schools. In addition, the research’s framework was developed by integrating theories and dimensions from diffusion of innovation theory, stakeholder salience model, technology acceptance model, CBAM model, and TOE framework. The main results for Chapter Three will answer the first research question.

Chapter Four reviews the research philosophy, logic, methodological choices, approaches and assumed choices. In addition, the data collection procedure and semi-structured interviews protocol is detailed. Further, Chapter Four demonstrates the procedure for data analysis and organisation as well as the developed validation strategy to achieve reliable and valid research results.

Chapter Five presents the data collected from school interviews through the semi-structured interviews. The analysis was based on the list of 26 ICT diffusion dimensions used to review the status of ICT diffusion in UAE public schools. The findings and main emerging themes are presented. Chapter Five’s findings will feed into answering the second research question.

Chapter Six presents an analysis of stakeholder dynamics and interdependencies over the life cycle of the ICT innovations diffusion project in the UAE. The analysis was based on a dependency structure matrix, heat maps, and social network analysis, which enabled the visual capture of stakeholder dynamics over the project's activities and over the three years of MBRSLP deployment.

Chapter Seven presents discussion on the results and the ICT innovation diffusion framework based on the findings and insights from the school interviews and stakeholders' dynamics analysis. Further, the chapter discusses the implications of the findings on the ICT diffusion project in UAE public schools in specific and for the related literature in general.

Finally, **Chapter Eight** presents a summary of the main findings, research implications and limitations, recommendations for further work, and the original contribution to knowledge made through this research.

CHAPTER 2. BACKGROUND RESEARCH

2.0 Introduction

This chapter discusses the research background and literature review related to this thesis. The aim here is to build a comprehensive understanding of the literature relevant to this research and related theoretical background. The first section reviews the concept of innovation and diffusion of ICT innovation, and the second section discusses the main concepts related to ICT innovation diffusion research leading to some of the research gaps. The following sections critically review the main diffusion innovation theories, ICT acceptance models, stakeholder theories, and, finally, the literature gaps underlining the need for this research and feeding into the theoretical framework.

2.1 Diffusion of ICT Innovation

2.1.1 Innovation Concept and Definition

Innovation is considered one of the major drivers of an organisation's success (Drucker, 1998; Cardozo et al., 1993; Van de Ven et al., 1999). Peter Drucker (1985) defined innovation as "*the act that endows resources with a new capacity to create wealth*". Drucker described innovation as the necessity to cope with change and to achieve prosperity, especially since the modern world is witnessing unprecedented changes in all major areas including politics, economic, technology, and business (Drucker, 2014). However, normally introducing an innovation implies uncertainties with regard to the innovation itself, the potential target, and related stakeholders.

This has resulted in the need to understand the potential target and what factors influence their decision to adopt or reject an innovation (Frambach & Schillewaert, 2002). Accordingly, research on innovation diffusion has gained increasing importance in order to offer such an understanding to parties related to innovation diffusion in different sectors such as organisation, manufacturing, construction, sales and marketing, and project management.

Innovation is a complex concept that has been studied at different levels and from multiple perspectives and disciplines (Damanpour & Schneider, 2009; Cooper, 1998; Rogers, 1995; Van de Ven et al., 1999; Greenhalgh et al., 2004; Shaikh & Karjaluoto, 2015; Peansupap & Walker, 2006). In terms of definition, there are multiple definitions in the literature; some definitions are more generic while others are more specific. According to Cooper (1998), generalising the definition of innovation might not serve well for such a complex phenomenon and emphasises the importance of the need for a specific definition mapped to the related context. King et al. (1994) described innovation as a process encompassing three overlapping stages: invention, innovation, and diffusion. He defined them accordingly:

> "*Invention is a new idea or product which may or may not have economic value",*
>
> *"Innovation is the process whereby inventions move into usable form", and*
>
> *"Diffusion is the spread of the capacity to produce and/or use an innovation and its use in practice*" (King et al., 1994).

One of the commonly referenced definitions in the literature is Rogers' definition, where he defined innovation as "*an idea, practice, or object that is perceived as new by an individual or other unit of adoption*" (Rogers, 2003).

Damanpour and Schneider (2009) supported the perception of newness in terms of the adopting unit and that being first does not matter, where they described the generation of innovation as "*a process that results in an outcome that is new to an organizational population*".

Cooper and Zmud's (1990) description suggests that innovation can be an idea, product, programme, or technology that is new to an adoption unit. In addition, Nohari and Gulati (1996) added that innovation can include policies, processes, structures, service, or methods perceived as novel by the adopters. On the other hand, King et al. (1994) differentiated between invention and innovation, arguing that innovation is the process of making use of an invention. This research will adopt West and Farr's (1990, p.9) definition, which extended Rogers' definition as follows:

> "*The intentional introduction and application within a role, group or organization of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, organization or wider society*"

Accordingly, and in practice, innovation can range from a simple innovative new idea, process, or procedure to a mechanical hardware or technological solution or even computer software. Based on the review of the definitions of innovation, the following key themes emerged:

- Perception of newness by the unit of adoption
- Can be an idea, process, product, policy, procedure, programme, technology, or service
- Intentional introduction to add value
- It is a process which might imply social or organisational change
- The adoption unit can be an individual, group, or organisation
- Better understanding of the innovation process is critical for ensuring successful diffusion and adoption of innovation

The above discussions highlight some definitions of innovation and identified the main themes emerging from the literature on innovation. It is clear that there are varying definitions; however, there is a common agreement in literature around the importance of innovation development and diffusion processes in order to better understand and plan innovation diffusion projects (Rogers, 2003; Jippes et al., 2013). Accordingly, in this study, West and Farr's (1990) innovation definition will be adopted.

2.1.2 Definition of Information and Communication Technologies

In general, the term ICT refers to an extended view for Information technology (IT) to include all technologies for communication and information. According to Oxford Dictionaries, information technology is defined as:

> "*the study or use of systems (especially computers and telecommunications) for storing, retrieving, and sending information*".

Additionally, Merriam-Webster dictionary defined information technology as

"*the technology involving the development, maintenance, and use of computer systems, software, and networks for the processing and distribution of data*".

Furthermore, The United Nations Development Program (UNDP) provided an extended definition and description for ICT:

> "*ICTs are basically information-handling tools – a varied set of goods, applications and services that are used to produce, store, process, distribute and exchange information. They include the "old" ICTs of radio, television and telephone, and the "new" ICTs of computers, satellite and wireless technology and the Internet. These different tools are now able to work together, and combine to form our "networked world" – a massive infrastructure of interconnected telephone services, standardized computing hard ware, and television, which reaches into every corner of the globe*".

Additionally, OECD (2012) described ICT as

> "*a range of different technologies that have access to the Internet, such as computers, tablets or smartphones, and the software that runs on them*".

This section provided an overview of the concept of ICT and discussed its critical role. The UNDP's ICT definition was adopted for this research. The next section will discuss the diffusion of ICT innovations.

2.1.3 Diffusion of ICT Innovations

Diffusion of innovation is concerned with innovation introduction and its spread among target adopters or a social system, where it is described as a social change or a process in which alterations in the structure and function of a social system take place (Rogers, 2003). King et al. (1994) defined diffusion of innovation as "*the spread of the capacity to produce and/or use an innovation and its use in practice*".

In addition, Kwon and Zmud (1987) defined IT innovation diffusion from an organisational point of view as "*an organizational effort to diffuse an appropriate IT within an organizational community*".

On the other hand, the term "innovation diffusion" is often associated with the term "innovation adoption". While innovation diffusion is concerned with the spread of innovation in a social system or organisation, innovation adoption is concerned with the adopter's decision process to accept and adopt an innovation. According to Rogers, the diffusion process is "*the process in which an innovation is communicated through certain channels over time among the members of a social system*", where innovation adoption is "*a decision to make full use of an innovation as the best course of action available*" (Rogers, 2003).

Both concepts are important and interrelated; however, for this research and in light of the research aims, the focus is on the innovation diffusion process, which is wider and covers the adoption aspect. Innovation diffusion plays an important role in describing the ICT implementation stage which is considered the most critical phase to concentrate upon to ensure successful technological innovation (Peansupap & Walker, 2005; Tornatzky & Fleisher 1990). According to Peansupap and Walker (2005), normally, the development of IT innovation is controlled by a relatively predictable environment (such as research labs or IT departments); however, the actual implementation of IT is considered more complex and difficult to control owing to the complex interaction among several factors including human, technological, and environmental factors. The innovation diffusion theory has been used widely to better understand ICT implementation within different contexts (Peansupap & Walker, 2005; Greenhalgh et al., 2004; Oliveira & Matins, 2011; Wisdom et al., 2013; Carter & Belanger, 2005).

2.2 Concepts in ICT Innovation Diffusion

This section reviews some of the main issues related to studying ICT innovation diffusion.

2.2.1 Individual and Organisational Diffusion and Adoption of Innovation

In general, innovation diffusion and adoption normally falls under two main categories: individual level and organisational level, with the majority of the research in the literature focused on individual level (Rogers, 2003; Wisdom et al., 2014; Hameed & Swift, 2012; Oliveira & Matins, 2011). Zaltman et al. (1973) introduced a turning point in the history of innovation research at the organisational level by specifying distinctive aspects of innovation when they take place in an organisational setting where their study focus was on the implementation stage rather than the adoption stage. Zaltman et al. (1973) divided the organisational innovation process into two main stages: initiation and implementation. Rogers describes this transition stating the following:

> "A*uthors specified the distinctive aspects of innovation when it took place in an organization. In such studies, the main dependent variable of study often became implementation (that is, putting an innovation into use) rather than adoption (the decision to use an innovation)*".

Since then, a significant amount of research has been conducted on the process and the factors influencing the adoption of ICT at the organisational level; however, according to Hameed and Swift (2012), still more needs to be done as "*there is a lack of research that offers a complete model to fully explain the IT innovation adoption process and user acceptance of IT in organizations*".

At the organisational level, an important aspect of adoption highlighted by Rogers was that an individual's decision to adopt or reject a specific innovation is often related to other decisions; it might be contingent (dependent) on decisions made by others in the organisation and it can be collective (the urge to cope and agree with group decision) or authoritative (adoption or rejection is mandatory). All these scenarios are valid depending on the organisational context and need to be considered part of the area of study with its possible implications. According to Rogers, authoritative situations might lead to a higher adoption rate initially; however, it might lead to a reduction in successful implementation or effective use of the innovation (Rogers, 2003; Greenhalgh et al., 2004). According to Rogers (2003):

> "*Compared to the innovation-decision process by individuals, the innovation process in orga*nizations is much more complex…*implementation amounts to mutual adaptation in which both the innovation and the organization change in important ways*".

Accordingly, examining the processes ICT innovation diffusion and adoption at the organisational level is fundamental for ensuring successful implementation. Studies on organisational innovation in different disciplines allow one to identify the set of factors that influence the acceptance decision and stress on the implementation stage and putting the innovation into use by integrating it into organisational practices (Rogers, 2003; Bhattacherjee, 1998; Frambach & Schillewaert, 2002). Considering the objectives of this research and the fact that the organisation setting of this research focus on the UAE public schools, the organisational innovation diffusion process will be adopted. The next section will provide further details on the innovation process at the organisational level.

2.2.2 Managing ICT Diffusion Process at the Organisational Level

Emerging ICT developments offer a wide range of opportunities for enhancing effectiveness across different sectors and different types of organisations. The decision to diffuse ICT innovation within an organisation can be influenced by several factors including response to an organisational need, a business requirement, an environmental condition requirement, or simply a decision by senior management. The innovation diffusing in organisations cannot be considered successful with only the acquisition of an innovation, unless the innovation is adopted and integrated into the organisational culture where individuals maintain effective use over a period of time (Gopalakrishnan & Damanpour, 1997; Hameed & Swift, 2012).

While many organisations attempted to gain the benefits of ICT by investing in and diffusing ICT innovations across the organisation, some found that these ICT investments failed to meet their expectations and the main reasons were lack of effective project management and that most ICT implementations are handled as static deployment rather than a systematic change process (Markus & Benjamin, 1997; Yeo, 2002; Griffith et al., 1999; Peasupap & Walker, 2005). According to Peansupap and Walker (2005), ICT implementation, in reality, involves a set of complex technical and social issues that need to be structured and managed to avoid failure of ICT implementations.

A major challenge in IT research is the lack of understanding regarding how to actually manage an ICT implementation project within a specific organisational setting (Peasupap & Walker, 2005); this lack of understanding might lead to a delay in adoption by target users or even failure of an ICT implementation project. In addition, appropriate management of ICT implementation projects, from change perspective, is critical for ensuring effective diffusion and adoption (Peasupap & Walker, 2005; Postema, 2012). Thus, a deeper understanding of the research context is essential to be able to understand such organisational settings and the most influencing dimensions in such a context. This research investigates ICT innovation diffusion within the UAE public school sector, where the education context is considered a totally different organisational setting in terms of the planning and management activities. This explorative study aims to investigate this case and identify the main dimensions for ICT innovation diffusion in this context.

2.2.3 Stakeholder Dynamics during Project Stages

In general, ICT innovation diffusion at the organisational level is considered a complex change process which involves several stakeholders that need to be effectively managed over the project lifecycle (Wisdom et al., 2014; Hameed & Swift, 2012; Oliveira & Matins, 2011). Stakeholders represent a major component in innovation diffusion and the adoption process as they are either the adopters or have direct or indirect influence on innovation development and adoption process. Management of stakeholders' engagement in ICT innovation diffusion projects is a task of growing significance in the literature, as project managers need to effectively identify, classify, and engage with different stakeholders to facilitate effective diffusion and successful adoption throughout the project phases (Walker et al., 2008; Laplume et al., 2008; Vos & Achterkamp, 2006).

Diffusion of ICT innovations into the education process is considered a structured change management process that requires stakeholders to systematically engage with and adopt ICT innovations and effectively use them to enhance teaching and learning practices. Such engagement is considered challenging as, the introduction of ICT innovations requires them to change their existing behaviours and established norms and routines (Walker et al., 2008; Rogers, 2003). In addition, the stakeholder's engagement activities need to consider the context and the on-going changing dynamics within and around the target stakeholder environment throughout a project's lifecycle (Rogers, 2003; Van de Ven et al., 1999). In consideration of the project context, the management needs to actively and effectively identify key stakeholders, prioritise them, examine their changing dynamics over project stages, and accordingly shape their engagement activities towards effective diffusion and project success (Bourne & Walker, 2005; Vos & Achterkamp, 2006).

As this research investigates ICT innovation diffusion in UAE public schools, the review focused on investigating the different stakeholders in this context and their engagement dynamics over the deployment activities and the changes over the years of deployment. This explorative review was undertaken to capture what actually happens in reality, allowing us to draw conclusions and make recommendations for effective diffusion.

2.3 Innovation Theories

2.3.1 Diffusion of Innovation theory

Rogers' Diffusion of Innovation (DOI) model is considered one of the most popular adoption models, with the majority of innovation research studies using the model as a framework (Sahin, 2006). The DOI model was widely used to serve as theoretical base for ICT innovation adoption (Pervan et al., 2005; Hameed & Swift, 2012). Rogers (1995, p.5) defined diffusion as

> "*the process in which an innovation is communicated through certain channels over time among the members of a social system*".

Rogers' DOI theory seeks to explain how, why, and at what rate innovations spread. His theory was published in his book *Diffusion of Innovations*, with the first edition published in 1962 and the latest edition, in 2003. According to Rogers's (2003), the innovation development process consists of all the decisions, activities, and their impacts over the stages of innovation development, represented using a model consisting of six stages: 1) recognition of needs or problems, 2) research, 3) development, 4) commercialisation, 5) diffusion and adoption, and 6) consequences. According to Rogers, the model stages are not always in the same sequence, where the model demonstrates a general process as demonstrated in Figure 2.1.

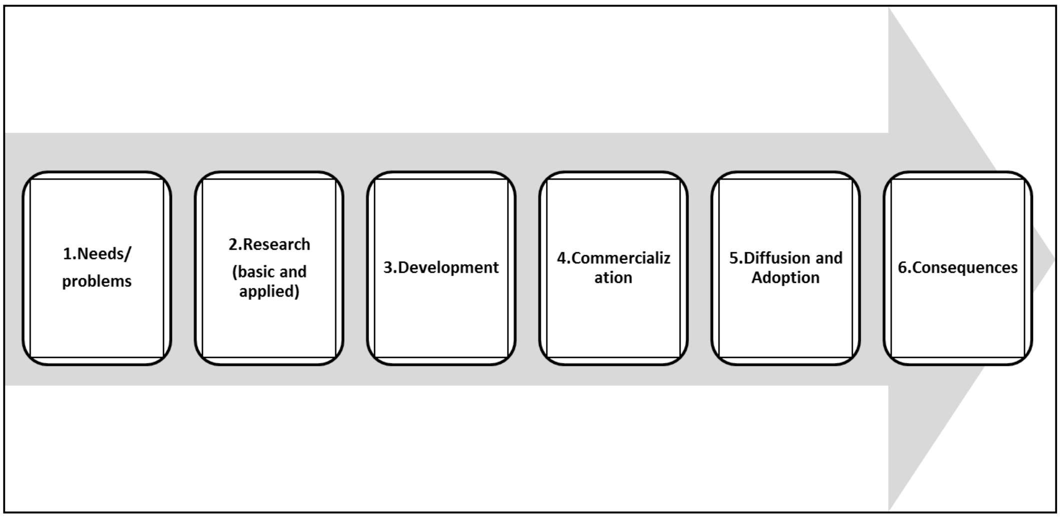


Figure 2.1. Six stages of innovation development process (Rogers, 2003)

The first stage is about recognising the problem and the need for an innovative solution. It might be due to social problems or even highlighted by individual users, a group, or a social system. The next stage is research; according to Rogers, "Not all innovations come from research and development. They may instead arise from practice as certain practitioners seek new solutions to their needs or problems"

(Rogers, 2003). Basic research is described as the initial investigations that do not have specific objectives for applying outcomes to practical problems, where the applied research may take further the outcomes of basic research into scientific investigations aiming to solve a real problem.

The next logical stage after research is development where ideas are transformed into a prototype to meet potential adopters' needs. The fourth stage is commercialisation, which involves the prelaunch steps including actual production, manufacturing, packaging, marketing, and distribution of the product and enhances an innovation. Rogers states that innovation packaging can combine one or more innovations together to facilitate their diffusion. As an example, he refers to a technology cluster or innovation package defined as:

> "*one or more distinguishable elements of technology that are perceived as being interrelated closely. The basic argument in favour of clustering innovations in a package is that more rapid diffusion results*".

The fifth stage is of particular importance for this research (details in Section 2.2.4) and in the innovation development process, where the decision to begin diffusing an innovation to potential adopters is taken and, accordingly, an innovation may be adopted or rejected. Rogers described this stage as "gatekeeping", i.e. controlling the flow of information through communication channels. Innovation gatekeeping can take place in a number of different approaches including experiments or pilots, limited to location or time before expanding to a larger scale, and involving an organisational interface; government organisations or independent research institutes can test or validate an innovation from different aspects such as health, safety, compatibility, and other areas depending in the context or potential target; further, diffusion agencies are responsible for planning and spreading an innovation among potential adopters.

The last stage is "consequence" which is defined as "the changes that occur to an individual or to a social system as a result of the adoption or rejection of an innovation". This stage represents the outcome or impact of introducing this innovation and the changes taking place.

It is important to highlight that although the six stages of innovation development seem to constitute a linear process, Rogers acknowledged that these six stages may not always take place in a linear sequence, and the time order of the stages may be different and certain stages may not occur at all.

2.3.1.1 Innovation Decision Process in Rogers' Model

The innovation decision process is part of the innovation development process and it has received great interest in the literature as part of Rogers' DOI theory. It is can be described as the series of choices taken by an individual, group, or organisation to evaluate the innovation and decide to adopt or reject it. It is defined as:

> "*the process through which an individual (or other decision-making unit) passes from gaining initial knowledge of an innovation, to forming an attitude toward the innovation, to making a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision*" (Rogers, 2003).

Rogers (2003) further explained the innovation decision process by developing a five-stage model as depicted in Figure 2.2. The model identified five perceived attributes or characteristics of an innovation that explain about half of the variance in the rate of innovation adoption: 1) relative advantage, 2) compatibility, 3) complexity, 4) trialability, and 5) observability. According to Rogers, these attributes are important in predicting an innovation's rate of adoption. Rate of adoption is defined as "the relative speed with which an innovation is adopted by members of a social system" (Rogers, 2003). Rate of adoption is often a numerical indicator of the number of individuals adopting an innovation within a certain time period. According to Rogers, rate of adoption can be determined via five types of variables:

- The perceived attributes of an innovation (relative advantage, compatibility, complexity, trialability, observability)
- The type of innovation decision (optional, collective, authority)

- The nature of communication channels (e.g. mass, media, interpersonal, etc.)

- The nature of the social system where the innovation is being diffused (e.g. norms, culture, context, organisation type, etc.)

- The extent of change agents' promotion efforts in diffusing the innovation

These five variables have not received equivalent consideration from diffusion scholars as most of the research was around perceived attributes of an innovation. The five perceived attributes of innovation have been extensively investigated and found to explain around half of the variance in an innovation's rates of adoption (Rogers, 2003).

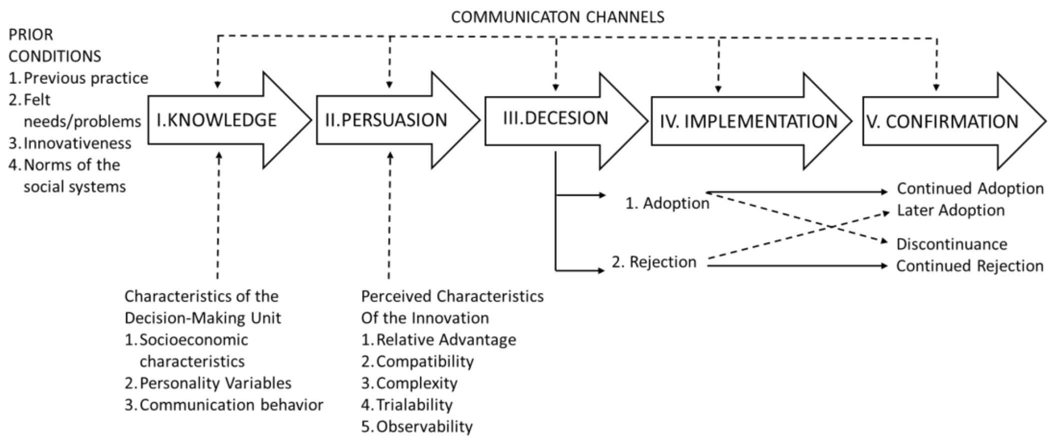


Figure 2.2. Innovation decision process (Rogers, 2003)

Rogers defined diffusion of innovation as "*the process by which an innovation is communicated through certain channels over time among the members of a social system*" (Rogers, 2003, p.5).

This definition identified four key elements in the diffusion of innovation:

- The innovation: Five characteristics influence innovation adoption where identified (relative advantage, compatibility, complexity, trialability, and observability)

- Communication channels: These are the means by which messages get conveyed from one individual to another. Communication can take place through direct communication, vicarious observations of peers and models, or even the influence of mass media. Mass media channels are usually the most rapid and efficient means of informing an audience of potential adopters about the existence of an innovation, i.e. to create awareness/knowledge.

- Time: This is the period in which an individual passes from the first knowledge of an innovation through its adoption or rejection (early adopters versus late adopters).

- Social system: This refers to the context, culture, and environment that an individual is involved in. Rogers defined it as a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. The members or units of a social system may be individuals, informal groups, organisations, and/ or subsystems. The social norms and structure influence and affect how an innovation spreads through a population.

In general, although Rogers' model is more focused on the innovation decision process and the innovation itself, it does emphasise the characteristics of an innovation; however, Rogers asserted that diffusion scholars should keep an open mind when investigating other types of variables and other possible attributes that might be important within a specific context or setting. Therefore, Rogers' five research innovation characteristics will be used as ICT innovation dimensions which will be further discussed in Chapter 3.

2.3.1.2 Rogers' Innovation Process in Organisations

Rogers differentiated between individual and organisational innovation adoption processes; accordingly, he proposed an innovation process in organisations that is different from the individual innovation process discussed earlier. His model was based on the findings of Zaltman et al. (1973) who described innovation adoption in an organisation in light of two sub-processes: initiation and implementation. Rogers (2005) followed a similar approach were he identified initiation and implementation as two broad activities where initiation was described as encompassing information gathering, conceptualising, and planning for the adoption of an innovation, leading up to the decision to adopt the innovation, and the implementation was described as all of the events, actions, and decisions involved in putting the innovation into use. Figure 2.3 shows Rogers' representation of the innovation process in an organisation. Rogers identified five stages in the process of innovation in an organisation, two in the initiation sub-process and three in the implementation sub-process, where the stages are linear and sequential. According to Rogers (2005), "*later stages in the innovation process cannot be undertaken until earlier stages have been completed, either explicitly or implicitly*".

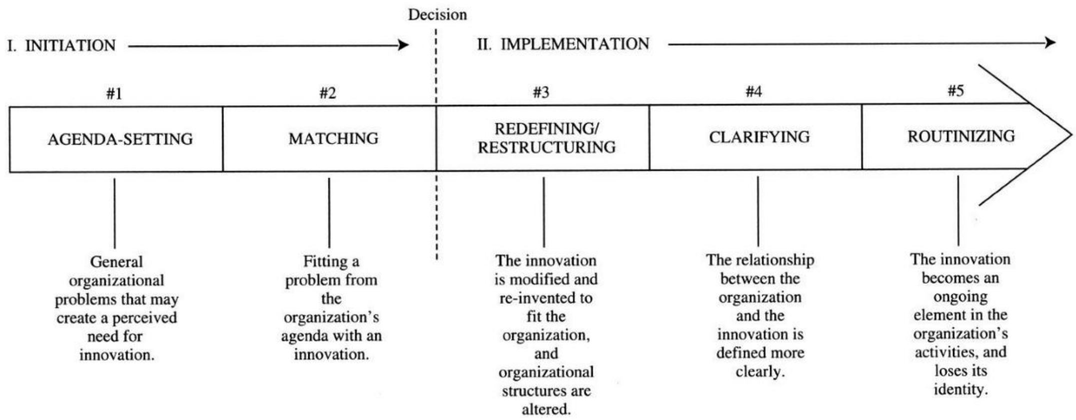


Figure 2.3. Rogers' innovation process in an organisation (Rogers, 2003)

The five stages are briefly described as follows:

Agenda-setting: This refers to the motivation driving the need to start an innovation process and setting the sequence of the innovation process: it can be an organisational problem, requirement, performance gap, or even a leadership decision. The agenda-setting stage consists of 1) identifying and prioritising needs and problem and 2) searching for innovations that might meet the organisational need or problem.

Matching: This is the stage where a potential innovation is tested to ensure its feasibility to meet the need or solve the problem and this match is planned and designed. Based on the results, the decision-makers in an organisation decide whether the innovation is a mismatch, leading to rejection of the innovation and termination of the innovation process prior to its implementation. The matching decision marks the line between the initiation and implementation sub-processes.

Redefining/Restructuring: This stage marks the start of innovation implementation in an organisation. In this stage, both the innovation and the organisational structures get modified (re-invented) to accommodate the organisational need. According to Rogers:

> "*Both the innovation and the organization usually change in the innovation process in an organization…. This mutual adaptation occurs because the innovation almost never fits perfectly in the organization in which it is to become embedded*".

Re-invention is defined as "the degree to which an innovation is modified by adopters as it diffuses" (Rogers, 2003).

The degree to which an innovation is re-invented is positively related to its sustainability. Accordingly, the more an organisation's members are involved in adapting an innovation as they adopt it the greater the degree of ownership among them, where they are likely to sustain adoption over time even when the initial resources are reduced.

Examples of organisational change include the establishment of a new organisational unit, organisational process updates, and changes in organisational structure. The extent of adaptation depends on several factors, especially the organisation itself, context of implementation, and the type of innovation. According to Rogers:

> "*radical innovation represent a type of unstructured decision, and their adoption entails a much more difficult process….Some innovations create a high degree of uncertainty in an organization, an uncomfortable state that may foster resistance to the technology. This uncertainty is one reason for the special difficulties that*

computer technologies often encounter in the implementation subprocess"

Clarifying stage: In this stage, the innovation is put into wider spread within an organisation to the level where the meaning of the innovation becomes clearer and consistent to the organisation members. During this stage, the innovation process needs to manage the different stakeholders and deal with misunderstandings to avoid problems. Rogers described the clarifying stage in the organisational innovation process as a social construction where people in the organisation construct their understanding over time through a social process of human interaction. Innovation change champions play a vital role during this process.

Routinisation: This stage marks the end of the innovation process in an organisation and takes place when the innovation gets embedded into the organisation culture. At this stage, the innovation starts losing its separate identity. Rogers linked routinisation to sustainability which he defined as "the degree to which an innovation continues to be used after the initial effort to secure adoption is completed" (Rogers, 2003).

> *"Rogers considered routinisation a difficult stage and not straightforward as it might seem, where widespread participation (defined as the degree to which members of the organisation are involved in the innovation process) in the innovation process, re-invention, and involvement of innovation champions are important aspects".*

The general view of Rogers' innovation process in an organisation can be split into two stages (initiation and implementation), based on the work of Zaltman et al. (1973), which was widely used by other researchers (Wisdom et al., 2014; Hameed & Swift, 2012; Oliveira & Matins, 2011; Greenhalgh et al., 2004; Frambach & Schillewaert, 2002). This process will be adopted in this research on innovation process at the organisation level.

The next section will review the innovation process by Van de Ven et al. (1999) which is based on the organisational context and places emphasis on the process and characteristics of this process.

2.3.2 Innovation Journey Model by Van de Ven et al. (1999)

Van de Ven et al. (1999) reviewed the concept and process of innovation and diffusion process empirically and characterised this process as a non-linear dynamic process that cannot be managed in traditional ways. They used the term "innovation journey" to describe the innovation development process and its different stages, emphasising the dynamic nature and characterising it as inherently uncertain owing to the influence of different factors such as organisational, social, environmental, technical, or event political factors. Van de Ven et al. (1999) identified three main stages (or periods) in an innovation journey: 1) the initiation period, 2) the development period, and 3) the implementation/termination period. They depicted the innovation journey as shown in Figure 2.4.

Figure 2.4 illustrates the innovation development process that an organisation goes through, starting from point A towards point B, with 12 main characteristics. In the initiation period (1, 2, 3), specific activities form the initial efforts to develop an innovation; in the development period (4, 5, 6, 7, 8, 9, 10), concentrated efforts transform the innovation from idea to reality; and in the implementation or termination period (11, 12), the adoption takes place or the innovation gets terminated either because the implementation is completed or because the required resources run out (Van de Ven et al., 1999).

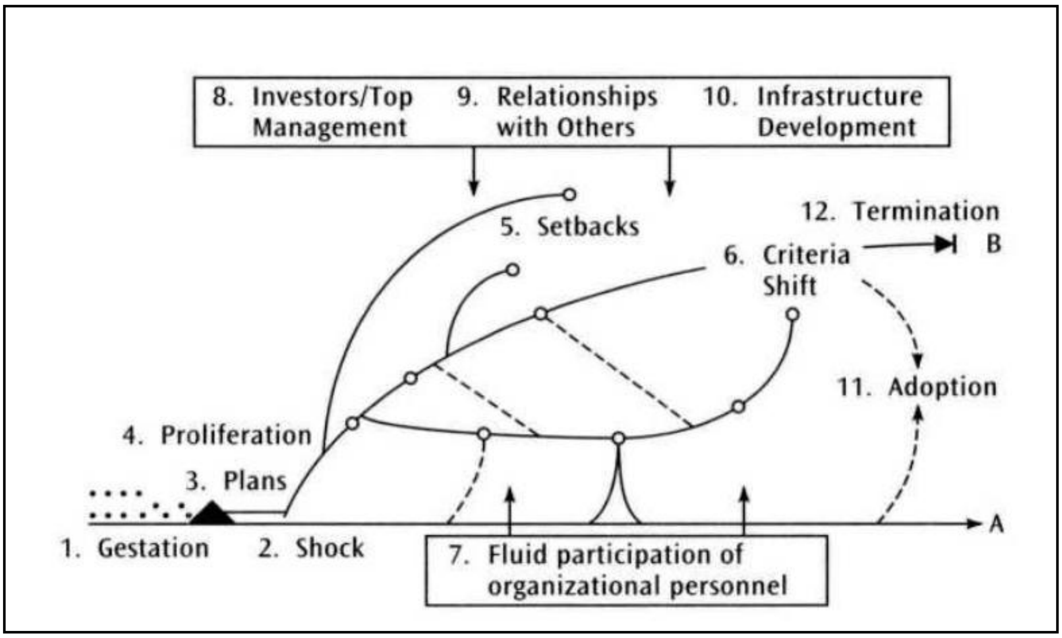


Figure 2.4. Innovation journey (Van de Ven et al., 1999)

An examination of the 12 characteristics identified by Van de Ven et al. (1999) over the innovation journey provides a deeper insight into the innovation development process and the dynamic nature, which was not heavily emphasised in Rogers' innovation process.

Gestation is about what triggers innovation initiation. It can result from a single action taken by an individual over an extended gestation period, which can last for several years. "Technology-push" and "demand-pull" are important concepts in setting the stage for launching an innovation.

Shocks are described as concentrated efforts to allocate support from internal or external sources to initiate an innovation. Shocks help concentrate attention of the diverse organisational stakeholders. Examples of shocks include new leadership, failure, budget, market, or any other elements that trigger the need to initiate an innovation. Sometimes, the incentive or urgency to move from gestation to implementation requires external force, and this is where "shocks" serve to allocate the required support to push things forward.

Plans indicate the end of the initiation period and start of the development period. Plans are considered the sales vehicle submitted to resource controllers with some details on the innovation, it benefits, and required resources to launch innovation development.

Proliferation takes place in the development period and it can be described as expansion from the initial innovative idea into extended details and activities that flourish into a multiple, divergent progression of developmental activities.

Setbacks are the issues, challenges, and mistakes encountered owing to unanticipated events. These events significantly alter initial assumptions and lead to changes in plans, new resource requirements, changes in schedule, and even changes to the innovation itself. Setbacks need to be handled effectively to prevent them from snowballing to serious issues.

Criteria shift is about changes in the criteria of success and failure among the different stakeholders and resource controllers over the innovation journey. It can be due to some setbacks or changes in stakeholder's structure, people's beliefs, or other internal or external factors.

Fluid participation of organisational personnel refers to the reality that personnel participate in highly fluid ways over the innovation stages. This is due to natural human emotions resulting from varying levels of interest, engagement, and commitment from the stakeholders. This represents a challenge to the participants and managers, making it difficult to maintain continuity and momentum over the innovation development activities.

Active engagement of investors and top management in the development stage is vital and plays and key role in the success of various activities.

Relationship with others refers to the fact the innovation development entails relationships with other organisations. Over the innovation journey, relationships, roles, interests, communities, scope, and many other aspects frequently change. This brings us to the concept of innovation journey, which is complex, dynamic, and uncertain.

Innovation participants are often involved with multiple key stakeholders, including government agencies, vendors, competitors, and trade associations, to create community infrastructure to support the development and implementation of innovations.

Adoption occurs throughout the developmental period by integrating the "new" with the "old" or by reinventing the innovation to fit the target context. According to Van de Ven, Angle and Poole, (1989) “In particular, innovation adoption is facilitated when (1) the adopting organisation modifies and adapts the innovation to its local situation, (2) top management is extensively involved and commits resources to innovation adoption, and (3) process facilitators help people understand and apply the new innovation”. Van de Ven et al. (1999) emphasised the importance of the context and social aspect of innovation adoption and overall innovation development process stating that “innovation-adoption success, like development success, more often represents a socially constructed reality than an objective reality”.

The innovation journey stops when the implementation and institutionalisation is completed or when the resources run out. One important element here is the investors and top managers’ attributes, which significantly influence the fate of innovation and the participants.

In general, not all innovation journeys are alike. The 12 process characteristics help realise the innovation journey and intertwined complexities. In reality, these will vary depending on the innovation itself, the target adopter, and the context. Accordingly, these characteristics will be considered in examining the case study in this research and further discussed in the research framework in Chapter 3.

2.3.3 ICT Adoption Models (TRA, TPB, TAM, TAM2, and UTAUT)

In general, several studies in the literature attempted to develop models to explain the potential adopter’s decision to adopt or reject ICT innovations. The Technology Acceptance Model (TAM) is considered one of the most well-established models in such a domain with substantial theoretical and empirical support (Venkatesh & Davis, 2000; Sheng & Tam, 1999; Ward, 2013). Venkatesh & Davis, (2000) compared TAM to other similar alternative models such as Theory of Reasoned Action (TRA) and Theory of Planed Behaviour (TPB) and found that the TAM model explains a substantial proportion of the variance in about 40% of the usage intentions and behaviour. Davis et al. (1989), who developed the TAM model, describe it as an extension of the TRA model.

The theoretical basis of the TAM model is the TRA and its extension is the TPB (Figures 2.5 and 2.6), which aim to understand the relationship between actions and attitudes, theorising that an individual's behaviour is a result of their attitudes, expectations, and social norms related to a particular behaviour (Fichbein & Ajzen, 1975; Ajzen, 1991; Ajzen, 1996). Attitude towards using technology is defined as an individual's overall affective reaction to using a system (Venkatesh et al., 2003). The TAM model theorises that when individuals are presented with a new technology innovation, a number of factors influence their decision to adopt or reject it; however, the two prominent factors are perceived usefulness and perceived ease of use (Davis et al., 1989; Ward, 2013). Also, the effects of external variables on the intention to use (such as system characteristics and training) are mediated by these two major factors. Perceived usefulness is defined as "the extent to which a person believes that using the system will enhance his or her job performance", and perceived ease of use is defined as "the extent to which a person believes that using the system will be free of effort" (Davis et al., 1989).

The TAM model underwent progressive enhancement starting with TAM2, proposed by Venkatesh and Davis (2000), where they added additional theoretical constructs across social influence processes (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use). TAM2 was tested in mandatory and voluntary settings and the results strongly supported TAM2 (Venkatesh & Davis, 2000).

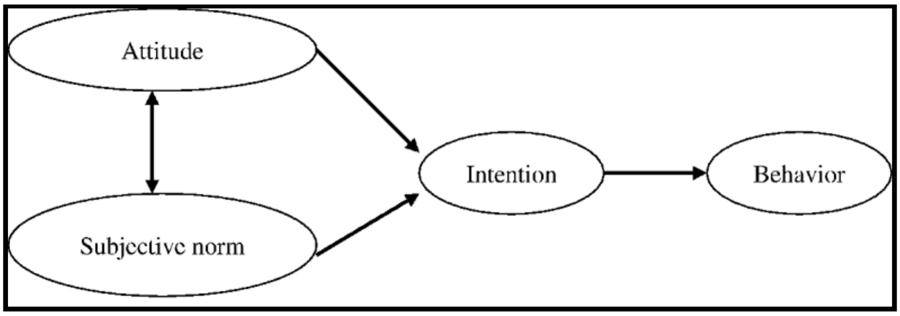


Figure 2.5. Theory of Reasoned Action (Fichbein & Ajzen, 1975)

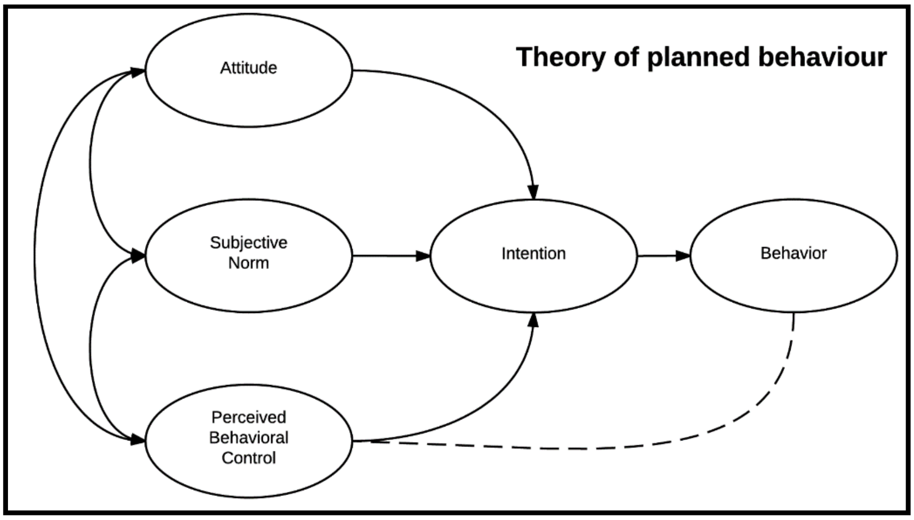


Figure 2.6. Theory of Planned Behaviour (Ajzen, 1991)

Moreover, the TAM2 model was extended again by Venkatesh et al. (2003) to the Unified Theory of Acceptance and Use of Technology (UTAUT). The UTAUT model intends to explain a user's intention to use a technology and subsequently monitor the usage behaviour. It was based on a review of eight prominent models in the area of technology acceptance; the eight models reviewed were the TRA, TAM, the motivational model, TPB, a model combining the TAM and TPB, the model of PC utilisation, the diffusion of innovation theory, and the social cognitive theory. These eight models and their extensions were empirically reviewed in order to formulate a unified model that integrated elements across these models which were then empirically validated in the UTAUT model. As demonstrated in Figure 2.7, the UTAUT model theorises that four constructs – performance expectancy, effort expectancy, social influence, and facilitating condition – are direct determinants of intention and usage behaviour; also, four key factors – gender, age, voluntariness, and experience – act as mediators between the main constructs, i.e. impact, intention, and use behaviours (Venkatesh et al., 2003).

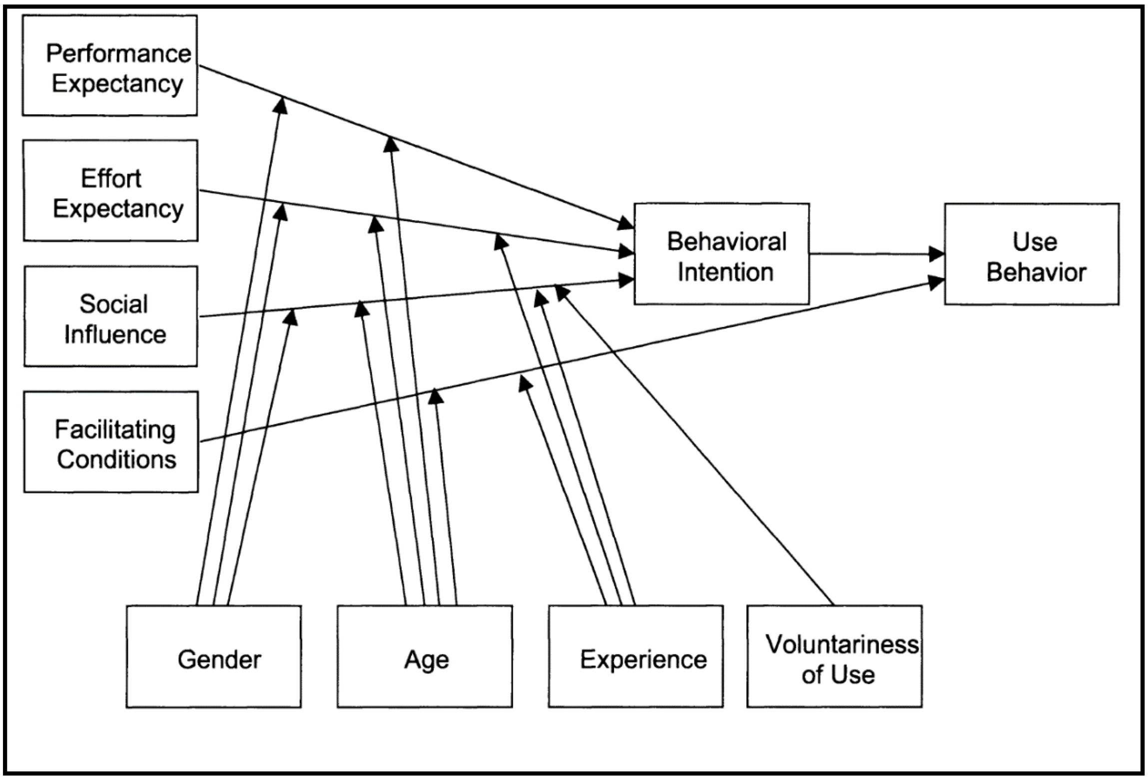


Figure 2.7. UTAUT Model (Venkatesh et al., 2003)

Performance expectancy is defined as “the degree to which an individual believes that using the system will help him or her to attain gains in job performance”; effort expectancy is defined as “the degree of ease associated with the use of the system”; social influence is defined as “the degree to which an individual perceives that important others believe he or she should use the new system”; and the term facilitating conditions is defined as “the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system”.

Concerning performance expectancy, five root constructs were identified: perceived usefulness, extrinsic motivation, job fit, relative advantage, and outcome expectations. Concerning effort expectancy, two root constructs were identified: perceived ease of use and complexity (Venkatesh et al., 2003). Regarding social influence, three root constructs were identified: subjective norms, social factors, and image. Concerning facilitating conditions, three root constructs were identified: perceived behaviour control, facilitating conditions, and compatibility. The details are provided in Tables 2.1, 2.2, 2.3, and 2.4, adopted from Venkatesh et al. (2003).

Constructs	**Definition**	**Items**
Perceived Usefulness (Davis, 1989; Davis et al., 1989	The degree to which a person believes that using a particular system would enhance his or her job	1. Using the system in my job would enable me to accomplish tasks more quickly. 2. Using the system would improve my job performance. 3. Using the system in my job would increase my productivity. 4. Using the system would enhance my effectiveness on the job. 5. Using the system would make it easier to do my job. 6. I would find the system useful in my job.
Extrinsic Motivation (Davis et al., 1992)	The perception that users will want to perform an activity because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself, such as improved job performance, pay, or promotions	Extrinsic motivation is operationalised using the same items as perceived usefulness from TAM (items 1 through 6 above).
Job-fit (Thompson et al.,1991)	How the capabilities of a system enhance an individual's job performance	1. Use of the system will have no effect on the performance of my job (reverse scored). 2. Use of the system can decrease the time needed for my important job responsibilities. 3. Use of the system can significantly increase the quality of output on my job.

		4. Use of the system can increase the effectiveness of performing job tasks. 5. Use can increase the quantity of output for the same amount of effort. 6. Considering all tasks, the general extent to which use of the system could assist on the job. (different scale used for this item).
Relative Advantage (Moore & Benbasat, 1991)	The degree to which using an innovation is perceived as being better than using its precursor	1. Using the system enables me to accomplish tasks more quickly. 2. Using the system improves the quality of the work I do. 3. Using the system makes it easier to do my job. 4. Using the system enhances my effectiveness on the job. 5. Using the system increases my productivity.
Outcome Expectations (Compeau & Higgins, 1995b; Compeau et al., 1999)	Outcome expectations relate to the consequences of the behavior. Based on job empirical evidence they were separated into performance expectations (job-related) and personal expectations (individual goals). For pragmatic reasons, four of the highest loading items from the performance expectations and three of the highest loading items from the personal	If I use the system... 1. I will increase my effectiveness on the job. 2. I will spend less time on routine job tasks. 3. I will increase the quality of output of my job. 4. I will increase the quantity of output for the same amount of effort. 5. My co-workers will perceive me as from the competent.

	expectations were chosen from Compeau and Higgins (1995b) and Compeau et al. (1999) for inclusion in the current research. However, our factor analysis showed the two dimensions to load on a single factor.	6. I will increase my chances of obtaining a promotion. 7. I will increase my chances of getting a raise.

Table 2.1. Performance expectancy: Root constructs, definition, and scale (adapted from Venkatesh et al., 2003)

Constructs	**Definition**	**Items**
Perceived Ease of Use (Davis, 1989; Davis et al., 1989)	The degree to which a person believes that using a system would be free of effort	1. Learning to operate the system would be easy for me. 2. I would find it easy to get the system to do what I want it to do. 3. My interaction with the system would be clear and understandable. 4. I would find the system to be flexible to interact with. 5. It would be easy for me to become skilful at using the system. 6. I would find the system easy to use.
Complexity (Thompson et al., 1991)	The degree to which a system is perceived as relatively difficult to understand and use	1. Using the system takes too much time from my normal duties. 2. Working with the system is so complicated it is difficult to understand what is going on.

		3. Using the system involves too much time doing mechanical operations (e.g., data input). 4. It takes too long to learn how to use the system to make it worth the effort.
Ease of Use (Moore & Benbasat, 1991)	The degree to which using an innovation is perceived as being difficult to use	1. My interaction with the system is clear and understandable. 2. I believe that it is easy to get the system to do what I want it to do. 3. Overall, I believe that the system is easy to use. 4. Learning to operate the system is easy for me.

Table 2.2. Effort expectancy: Root constructs, definition, and scale (adapted from Venkatesh et al., 2003)

Constructs	**Definition**	**Items**
Subjective Norm (Ajzen, 1991; Davis et al., 1989; Fishbein & Azjen, 1975; Mathieson, 1991; Taylor & Todd, 1995a; 1995b)	The person's perception the most people who are important to him think he should or should not perform the behaviour in question	1. People who influence my behaviour think that I should use the system. 2. People who are important to me think that I should use the system.
Social Factors (Thompson et al., 1991)	The individuals' internalisation of the reference group's subjective culture and specific interpersonal agreements that the individual had made with	I use the system because of the proportion of coworkers who use the system The senior management of this business had been

	others in specific social situations	helpful in the use of the system. My supervisor is very supportive of the use of the system for my job. In general, the organisation has supported the use of the system.
Image (Moore & Benbasat, 1991)	The degree to which use of an innovation is perceived to enhance one's social image or status in one's social system	People in my organisation who use the system have more prestige that those who do not. People in my organisation who use the system have a high profile. Having the system is a status symbol in my organisation.

Table 2.3. Social influence: Root constructs, definition, and scale (adapted from Venkatesh et al., 2003)

Constructs	**Definition**	**Items**
Perceived Behavioural Control (Ajzen, 1991; Taylor & Todd, 1995a; 1995b)	Reflects perceptions of internal and external constraints on behaviour and encompasses self- efficacy, resource facilitating conditions, and technology facilitating conditions	1. I have control over using the system. 2. I have the resources necessary to use the system. 3. I have the knowledge necessary to use the system. 4. Given the resources, opportunities, and knowledge, it takes to use the system, it would be easy for me to use the system.

		5. The system is not compatible with other systems I use.
Facilitating Condition (Thompson et al., 1991)	Objective factors in the environment that observers agree make an act easy to do, including the provision of computer support	1. Guidance was available to me in the selection of the system. 2. Specialised instruction concerning the system was available to me. 3. A specific person (or group) is available for assistance with system difficulties.
Compatibility (Moore & Benbasat, 1991)	The degree to which an innovation is perceived as being consistent with existing values, needs, and experiences of potential adopters	1. Using the system is compatible with all aspects of my work. 2. I think that using the system fits well with the way I like to work. 3. Using the system fits into my work style.

Table 2.4. Facilitating conditions: Root constructs, definition, and scale (adapted from Venkatesh et al., 2003)

Based on the outcomes of the study of Venkatesh et al. (2003), the strongest independent variables were performance expectancy and effort expectancy. ‘Social influence’ constructs proved to be significant only in mandatory contexts while in the voluntary setting, none of the ‘social influence’ constructs were significant; this finding was attributed to the compliance requirement in mandatory contexts leading to a direct effect on intentions (Hartwick & Barki, 1994; Venkatesh & Davis, 2000). This finding will be reflected to this research context as it is considered an organisational setting and users are mandated adopt. In addition, based on the findings from Jayari et al., (2006) review for technology acceptance literature, the UTAUT model construct facilitating conditions are largely comparable to his findings improving its validity. In their review, Jayari et al. (2006) identified almost all predictors from major models in the literature and tested them for reliability and significance, where the identified set of predictors largely supported the UTAUT model.

Accordingly, for this explorative research involving the UTAUT model, four dimensions will be adopted to examine the ICT acceptance at school level. Further details are provided in the research framework in Chapter 3.

2.3.3.1 TAM Model – Critique

Since the TAM model and its extensions highly influence technology adoption, it is important to identify its main limitations. In general, the progressions from TAM to TAM2 and then UTAUT reflect the enhancements in response to some of the criticism. One major limitation of TAM is its focus on individual technology acceptance and not on individual differences. Further, perceived usefulness and perceived ease of use are not the only determinants as every individual is different in terms of background, experience, and age. Moreover, the argument that when studying in group or organisational level adoption; different measures need to be considered (Agarwal & Prasad, 1999; Straub, 2009; Goodhue, 2007; Benbasat & Barki, 2007; Li, 2010).

In addition, in the organisational context, measuring technology acceptance goes beyond measuring the intention to use and initial technology usage behaviour because the target adopters do not have the final choice to accept or reject it since it is an organisational decision. This indicates the need to examine acceptance in a deeper sense and for further research for organisational diffusion of innovation; this position was supported by Straub (2009) and Rogers (2003).

In summary, despite these criticisms, the models received wide acceptance and usage among scholars where it underwent several enhancements to map it to specific contexts or needs. The TAM model and UTAUT model have been used frequently when studying technology innovation adoption in different contexts including the education setting (Kocaleva, 2014; Gogus et al., 2012; Al Awadhi et al., 2008; Baker-Eveleth et al., 2007; Cheng-Chang, Gunter, Sivo & Cornell, 2004;

2005; Ndubisi, 2006; Wolski & Jackson, 1999). Accordingly, the model represents a sound theoretical base and was adopted in this research.

2.3.4 The Technology Organisation Environmental Framework

The Technology Organisation Environment (TOE) framework was developed by Tornatzky and Fleischer in 1990. It identifies three broad aspects of an organisational context that influence the process of technological innovation implementation: technological, organisational and environmental context. The TOE framework can be described as follows:

- Technological context (the ICT innovation): It describes both the internal and external technologies relevant to the firm. This includes current practices and equipment internal to the firm as well as the set of available technologies external to the firm.
- Organisational/school context: It refers to descriptive measures relevant to the organisation such as scope, size, structure, etc. (in our case, the school context)
- Environmental context: It is the arena in which a firm conducts its business – its industry, competitors, and dealings with the government.

The TOE framework has been widely used in the literature on technological innovation diffusion and adoption with a focus on organisational setting (Lin & Lin, 2008; Cao et al., 2012; Kuan & Chau, 2001; Chau & Tam, 1997; Oliveira & Matins, 2011)

According to Yang et al. (2015), compared to most innovation theories, the TOE framework is a generic framework that suggests different sources of influence without specifying the variable in each. Yang et al. (2015) state:

> "*researchers may choose different technological, organizational and environmental factors for different IT innovations, making TOE framework highly adaptable and broadly applicable*"

The same position was support by Baker (2012), Zhu and Kraemer (2005), and Oliveira and Matins, (2011). Accordingly, several researchers adopted the TOE framework in technological innovation diffusion research were many use TOE framework in combination with other frameworks or models (Oliveira and Matins, 2011). According to Oliveira and Matins (2011), using several studies used TOE framework in combination with other theories such as DOI and institutional theory. He emphasises that the TOE model has a solid theoretical base and empower the DOI theory by adding environmental context that is missing in DOI theory. The proposition to integrate different models such as DOI, TAM, and TOE was aimed at reducing the limitations of these models alone (Fichman, 1992; Gallivan, 2001; Peansupap & Walker, 2005; Hoti, 2015).

Accordingly, the TOE framework will be used to integrate dimensions from different models and theories to cover the technological, organisation and environmental contexts in this research.

2.3.5 Concerns-based Adoption Model (CBAM)

Although Rogers' model is considered one of the most influential ones in the literature on innovation adoption and diffusion, it is still a generic framework and primarily descriptive rather than prescriptive (Straub, 2009). This means that it does help in understanding why adoption occurs but not how to facilitate adoption and not within specific contexts – in our case, ICT in the education setting. The Concerns-based Adoption Model (CBAM) was developed by Hall in 1979, building on Fuller's work in 1969 on teacher change and classification of teachers' concerns from a developmental perspective (Christou et al., 2004; Fuller, 1969; Hall, 1979, 2010; Hall et al., 2006). According to Straub (2009), CBAM provides a different perspective on facilitating adoption by approaching it from the adopter's perspective which is developmental over the levels of adoption. Greenhalgh et al. (2004) also support CBAM, especially at the organisational level, indicating that CBAM can better explain the findings of empirical studies of complex service innovations.

CBAM tries to facilitate the change process by addressing affective and cognitive concerns of teachers. CBAM is based on six explicit assumptions about change: it is a process, not an event; it is accomplished by individuals; it is a highly personal experience; it involves developmental growth; and change is best understood in operational terms (Hord & Hall, 2006). CBAM is based on three components that can provide a snapshot of individuals in an organisation before, during, and after implementation: stages of concern (deals with the feelings of individuals involved in a change), levels of use (describe how individuals interacts with a new programme), and innovation configuration (refers to the adaptations made in the programme itself). As depicted in Figure 2.8, these three components serve as diagnostic tools to help inform change facilitators to best facilitate the adoption of an innovation. Change facilitators (can be an individual or group) play a central role in the CBAM model as they use different probing techniques (including stages of change, levels of use, innovation configuration) in order to understand the users' (denoted as "i" in Figure 2.8) needs and accordingly make decisions and design interventions using available resources to facilitate change (Hall et al., 2006).

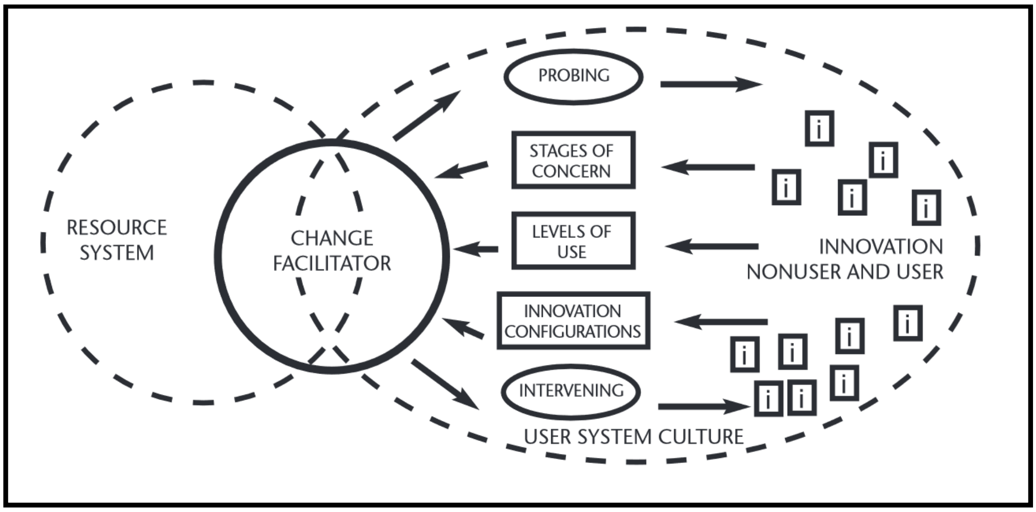


Figure 2.8. Concerns-based Adoption Model (Hall et al., 2006)

Stage of Concern	Term	Expression of Concern

Unconcerned	0	Awareness	I am not concerned about it.
Self	1	Informational	I would like to know more about it.
	2	Personal	How will using it affect me?
Tasks	3	Management	I seem to be spending all my time in getting materials ready.
Impact	4	Consequence	How is my use affecting kids
	5	Collaboration	I would like to coordinate my effort with others, to maximize the innovation effect.
	6	Refocusing	I have some ideas about something that would work even better.

Table 2.5. CBAM stages of concern and expression regarding an innovation (adapted from George et al., 2008)

Level	**Term**	**Description**
0	Non-use	The user has little or no knowledge of the innovation, has no involvement with the innovation, and is doing nothing towards becoming involved.
1	Orientation	The user has acquired or is acquiring information about the innovation and/or has explored or is exploring its value orientation and its demands upon the user and the user system.
2	Preparation	The user is preparing for first use of the innovation.
3	Mechanical	The user focuses most of his/her efforts on the short-term, day-to-day use of the innovation with little time for reflection. Changes in use are made more to meet user needs than client needs. The user is primarily engaged in a stepwise attempt to master the tasks required to use the innovation, often resulting in disjointed and superficial use.

4A	Routine	Use of the innovation is stabilised. Few, if any, changes are made in on-going use. Little preparation or thought is being given to improving innovation use or its consequences.
4B	Refinement	The user varies the use of the innovation to increase the impact on clients within the immediate sphere of influence. Variations are based on knowledge of both short- and long-term consequences for clients.
5	Integration	The user combines his/her own efforts in using the innovation with the related activities of the colleagues to achieve a collective effect on clients within their common sphere of influence.
6	Renewal	The user re-evaluates the quality of use of the innovation, seeks major modifications or alternatives to the present innovation to exert an increased impact on clients, examines new developments in the field, and explores new goals for the self and system.

Table 2.6. CBAM levels of use of the innovation (adapted from Hall et al., 2006)

Tables 2.5 and 2.6 summarise the stages and level of use as defined in the CBAM model. The same can be relatively used in other similar contexts such as the healthcare context (Straub, 2009; Greenhalgh et al., 2004). According to Hall et al. (2006), the stage of concerns and level of use should be identified and assessed through focused interviews and informal conversation. The model suggests a sequence of pre-defined questions and procedures to guide this process.

Although the CBAM has been used for many years as a productive tool for facilitating change and innovation adoption in educational settings, it is not without criticism. Straub (2009) summarised some of the main criticisms of the CBAM with regard to the reliability and validity of its stages of concern. The CBAM pays relatively low attention to students, disregards the teachers’ positive perceptions of innovation, and is heavily focused on the change facilitator to move change along although it is claimed to be a client-centred model.

Hence, the CBAM can be considered very beneficial in assisting an organisation in facilitating dissemination of an innovation by addressing the affective and cognitive concerns of teachers. Moreover, according to Greenhalgh et al. (2004), who reviewed the diffusion of innovation in service organisations with a focus on the health sector, the CBAM was found to better explain the findings of empirical studies of complex service innovations where they summarised the stages of concerns into three levels: concerns in pre-adoption stage, concerns during early use, and concerns of established users. This approach represents a simplified assimilation for understanding and analysing innovation adoption, especially proving its viability in the education context related to this research context. Therefore, the CBAM model will be adopted in this research to serve the education setting by integrating the two dimensions (LoU and SoC) into the research framework.

2.4 Stakeholder Theory

This section will review the stakeholder theory in light of ICT innovation diffusion and the research aim. In general, the stakeholder theory answers the question of "Who are the stakeholders and whose management shall pay attention to (i.e. who matters)?" This research aims to build on the above view by investigating ICT innovation diffusion from the stakeholder's perspective. The management in charge of diffusion programmes (or what Rogers calls diffusion agency) needs to anticipate these changes and accordingly update their stakeholder engagement strategies.

Stakeholders represent a major component of the innovation diffusion process as they are either the adopters or have direct or indirect influence on the innovation diffusion and adoption process. Management of stakeholders' engagement in ICT innovation projects is receiving growing significance in the literature (Walker et al., 2008; Laplume et al., 2008; Vos & Achterkamp, 2006). Accordingly, effective identification, evaluation, and management of stakeholders are vital to effective diffusion and successful adoption throughout the innovation development stages. Stakeholder engagement strategies in the innovation development process consider different types and levels of stakeholders and the changing dynamics within the stakeholders' context to facilitate effective diffusion of ICT innovations.

Freeman summarised stakeholder management as follows:

> "*the stakeholder approach is about groups and individuals who can affect the organization, and is about managerial behavior taken in response to those groups and individuals*" (Freeman, 1984, p.48).

The question arising here is "what is meant by the term stakeholder?" Freeman's (1984) book titled *Strategic Management: A Stakeholder Approach* is regarded as one of the major contributors to the stakeholder theory and embedded the concept of stakeholders in organisational management and business ethics. Freeman's (1984) definition of stakeholder revolved around "who and what really counts" where he defined stakeholder as "any group or individual who can affect or is affected by the achievement of the organization's objectives" (Freeman, 1984, p.46).

Although this definition has been broadly cited in literature, not all scholars accept it as it is very generic (Mitchell et al., 1997). Clarkson (1995) extended Freemen's definition by stating that a stakeholder is "a person or groups that have, or claim, ownership, rights, or interests in a corporation and its activities, past, present, or future".

On the other hand, Lewis and Seibold (1993) defined stakeholders from the innovation perspective as "individuals (alone or together as work units) who have direct and indirect contact with the innovation in the course of their formal and informal activities within the organization".

Postema (2012) further adapted this definition by replacing "contact" with "influence on, or are affected by", so his definition of stakeholders in innovation projects was as follows:

> "*individuals (alone or together as work units) who have direct and indirect influence on, or are affected by, the innovation in the course of their formal and informal activities within the organization*".

These definitions and changes reflect the context each researcher is working within making them more context specific. The last definition is the one most closely linked to this research context and will be used accordingly.

Stakeholder identification is a major starting point for any project (in our case, the ICT innovations process), so we need to identify the different individuals and/or groups that potentially influence the innovation process. The influence is not a fixed variable as it might fluctuate over project stages depending on different internal or external factors. The stakeholder theory allows systematic identification of those stakeholders, their roles, potential influence, and the dynamics taking place throughout the innovation journey. Providing diffusion managers with such insights and systematic approaches will allow them to be on top of their diffusion project.

2.4.1 Stakeholders in Innovation Theories

Throughout the innovation literature, the notion of stakeholders is embedded and considered a key element throughout the process of innovation diffusion. However, in most cases, there was no explicit reference to the term stakeholders. This section will examine the notion of stakeholders throughout the literature on diffusion of innovation. Rogers' model is based on interpersonal and communication network which is described as interconnected individuals who are linked by a patterned flow of information. The following are major stakeholder's roles adopted by Rogers:

Opinion leaders: "Individuals who lead in influencing others' opinions". Opinion leadership is a related term and is described as "the degree to which an individual is able to influence informally other individuals' attitudes or overt behaviour in a desired way with relative frequency". The role of an opinion leader is normally earned not necessarily assumed.

Change agent: "An individual who influences clients' innovation-decisions in a direction deemed desirable by a change agency". Change agents normally seek to obtain the adoption of new ideas but may also attempt to slow down diffusion and prevent the adoption of undesirable innovations. Normally, change agents occupy a professional position with a given role.

Change agency refers to the organisation diffusing an innovation and change agents report to it. Many change agencies employ change agent aides.

An aide is "a less than fully professional change agent who intensively contacts clients to influence their innovation-decisions".

Champion: "A charismatic individual who throws his or her weight behind an innovation, thus overcoming indifference or resistance that the new idea may provoke in an organization".

Decision-making unit is a unit of individuals or groups at the innovation receiving end. Rogers assumes that every individual involved in the innovation adoption processes is a decision-making unit in itself.

Adopter categories: The S-Shaped Curve of Adoption and Normality (early adopters, early majority, late majority, and laggards).

The above examples demonstrate the terms used by Rogers in the diffusion of innovation theory and how the stakeholder's concept was embedded across the theory. In general, stakeholder's identification and classification of their roles and interrelations can offer practical implications to diffusion providers and combing this with innovation diffusion theory can provide an in-depth analysis of the process of ICT diffusion (Papazefeiropoulou, 2002; Postema, 2013; Vos & Achterkamp, 2007).

2.4.2 Stakeholder Identification and Classification

The literature on stakeholder classification identified several models, starting with that proposed by Freeman (1984) – general distinction between "can affect and affected", Vos et al., (2006) – their classification was based on the notions of "actively involved and passively involved", and Savage et al. (1991) – they used the concepts of "primary and secondary". The model proposed by Mitchell et al. (1997) on stakeholder identification and salience is one of the most influential models in the literature. The model is based on the concept of stakeholder salience, which is described as the degree to which managers give priority to competing stakeholder claims. This framework provides an insight into organisational management and how stakeholders can gain or lose salience and who are able to influence an organisation's activities or the project in hand.

This notion of stakeholder salience goes beyond identification to focus on the dynamics intrinsic within each relationship which involves different considerations (Mitchell et al., 1997). The salience model identifies an eight-way dynamic typology where stakeholders may shift from one class to another throughout the project period in response to different organisational issues (Mitchell et al., 1997; Postema, 2012).

As a result, stakeholder classification enables one to focus on the right stakeholders (salience) within the specific context, which in our research is ICT innovation diffusion in education. In the stakeholder salience model, Mitchell et al. identified three main attributes (Table 2.7) with regard to who are the salient stakeholder's that the management should pay attention to: 1) stakeholders' power to influence, 2) legitimacy of the stakeholder, and 3) the urgency of stakeholders' claims. Accordingly, the stakeholder who is believed to possess the three attributes is called as "definitive stakeholder". Similarly, a classification of seven stakeholder groups was developed, depending on the presence of one, two, or three attributes in different combinations.

Stakeholder Salience Attributes	**Definition**
Power	The extent to which stakeholders are able to persuade or coerce others into making decisions and following certain courses of action, having influence over the situation
Legitimacy	The extent to which a stakeholder has the legitimate right to be involved in the solution to the problem, with us taking an inclusive stance in the debate on whether such legitimate rights are based on authority, legal rights or by having 'something at risk' in the decision
Urgency	Urgency is an indicator of the stakeholder's perceived attitude towards the importance or intensity of the problem and need to deal with it (i.e. feeling strongly enough about an issue to act on it)

Table 2.7. Salience model of main attributes (Mitchell et al., 1997)

Bourne (2005) extended Mitchell's (1997) salience model by adding two main areas: first, the 'urgency' construct is argued to be dependent on "vested stake" and "stakeholder's importance to the project"; second, instead of legitimacy, he preferred using "proximity", arguing that it enables the classification of stakeholder salience or priority (Bourne used the term priority for salience). A comparison is provided in Table 2.8.

Mitchell's Salience Model Attributes	Bourne's Priority Model Attributes	Description
Power	Power	The extent to which stakeholders are able to persuade or coerce others into making decisions and following certain courses of action, having influence over the situation Dependent on: - Formal position (hierarchical position) - Informal position (social network position, centrality)
Legitimacy	Proximity	The extent to which a stakeholder has a legitimate right to be involved in the solution to the problem, with us taking an inclusive stance in the debate on whether such legitimate rights are based on authority, legal rights or by having "something at risk" in the decision
Urgency	Urgency: Vested stake Importance to project	Urgency is an indicator of the stakeholder's perceived attitude towards the importance or intensity of the problem and need to deal with it (i.e. feeling strongly enough about an issue to act on it) There are two conditions to be met: - when a relationship or claim is of a time-sensitive nature - when a relationship or claim is important or critical to the stakeholder
Salience	Priority	Resulting from other attributes

Table 2.8. Extension of Mitchell's Model (1997) by Bourne (2005) (adapted from Postema, 2012)

On mapping the salience model to innovation diffusion literature, we find that the notion of salient stakeholder links to our research focus on management's ability to identify priority stakeholders and anticipating changing dynamics in stakeholder setting (Vos & Achterkamp, 2006; 2007; Postema, 2012).

In their review, Vos and Achterkamp, (2006) concluded that "stakeholder identification is considered a problem of classification", indicating that stakeholder identification and classification are interlinked processes. They stated that despite the availability of a classification model, there is still a need for an identification procedure that would fit the context in which the stakeholder is being identified and that using predefined classifications of stakeholders as a method of categorisation is not good enough and needs to go beyond mere classification to gain insights into the dynamics and changes taking place over the project phase. The problem in these classification models is that of dealing with the identification as a matter of drawing boundaries where boundaries can be drawn in many different ways (Pouloudi, 1999; Vos & Achterkamp, 2006).

Hence, there is a need for identifying, classifying, and prioritising stakeholder's interactions over the innovation process and investigating their changing dynamics over the lifecycle of ICT innovation diffusion projects.

2.4.3 Stakeholder Analysis

Pouloudi (1999) reviewed stakeholder identification and analysis within the ICT sector and suggested that the "stakeholder analysis process should not be independent of stakeholder identification since stakeholders have views on who are other stakeholders". This view was also supported by other researchers such as Kivits (2011), Bryson (2004), Missonier & Loufrani-Fedida (2014), and Postema (2012). Pouloudi (1999) also argued that stakeholder behaviour can be captured in a set of universal principles which should help in better identification and classification of stakeholders.

Pouloudi argues that stakeholder identification should be dynamic, context-dependent, and iterative. Accordingly, he developed seven principles of stakeholder behaviour (Table 2.9) to guide the identification and analysis of inter-organisational stakeholders in a given context. These principles will be considered in the theoretical framework development in this research as it is linked to the dynamics in stakeholder management.

Principles of Stakeholder Behaviour	**Implications for Stakeholder Identification and Analysis**
1. The set and number of stakeholders are context and time dependent	Stakeholder map should reflect the context Stakeholder map should be reviewed over time
2. Stakeholders cannot be viewed in isolation	Consider how stakeholders are "linked"
3. A stakeholder's role may change over time	Adopt a long-term perspective; study how perceptions change
4. Stakeholders may have multiple roles	
5. Different stakeholders may have different perspectives and wishes	There are different versions of the stakeholder map to be drawn
6. The viewpoints and wishes of stakeholders may change over time	These different versions of the stakeholder map should be reviewed over time
7. Stakeholders may be unable to serve their interests or realise their wishes	Need to consider political issues (as well as technical, economic, or other issues)

Table 2.9. Principles of stakeholder identification and analysis (adapted from Pouloudi, 1999)

2.4.4 Stakeholder Engagement

After identifying, classifying, and prioritising stakeholders, the next step is identifying appropriate stakeholder engagement strategies and activities that facilitate effective diffusion and adoption. Stakeholder identification, classification, and prioritisation are considered prerequisites for enhanced stakeholder engagement (Freeman, 1999; Vos & Achterkamp, 2006; Mitchell, 1997; Olander & Ladin, 2005; Aaltonen et al., 2015). As stated by Freeman, "the stakeholder approach is about groups and individuals who can affect the organization, and is about managerial behaviour taken in response to those groups and individuals" (Freeman, 1984).

As discussed in the literature, the innovation diffusion process is a dynamic journey, which goes through unexpected changes in the stakeholders themselves and their environment. The same applies to stakeholder engagement, which takes place throughout the innovation diffusion process and is an integral element of stakeholder management and project management (Olander & Landin, 2005; Savage et al., 1991; Postema, 2012; Aaltonen et al., 2015). According to Frooman, (1999), “one central purpose of stakeholder theory has been to enable managers to understand stakeholders and strategically manage them”.

These points highlight that appropriate management and stakeholders’ engagement with the objectives of project, in consideration of the context and different factors, are key to the success of any project. In general, stakeholder management focuses on overseeing relationships that are critical to organisational success where many assume this to be a straightforward intuitive task; however, in practice, this is different (Savage et al., 1991). The aim of stakeholder engagement is understanding stakeholders and influencing their state or position in relation to the project, as they can be proponents or opponents (Olander, 2007). Accordingly, different approaches have emerged to address stakeholder engagement and determine which stakeholders to engage with and how. On the other hand, not all stakeholder needs and concerns can be satisfied; project managers need to prioritise and balance the diverse stakeholders’ claims and accordingly make decisions and implement engagement activities so that the purpose of the project is not compromised (Olander, 2007; Aaltonen et al., 2015).

Savage et al. (1999) identified four essential elements in the stakeholder management process: (1) identify key organisational stakeholders, (2) analyse them along two critical dimensions of “potential for threat” and “potential for cooperation”, (3) formulate appropriate strategies both to enhance or change current relationships with the key stakeholders and to improve the organisation's overall situation, and (4) effectively implement these strategies.

Accordingly, stakeholders can be classified on the basis of two stakeholder constructs: potential for threat and potential for cooperation where they identified four types of stakeholders and recommended the following engagement approaches: supportive (involve), marginal (monitor), non-supportive (defend/transform), or mixed blessing (collaborate). Accordingly, the approach is based on actively engaging stakeholders in order to influence them and change their positions from a less favourable position to a more favourable one as demonstrated in Figure 2.9. Their model provides further elaboration on the stakeholder types and recommended management engagement strategies as demonstrated in Table 2.10.

Stakeholder Type	**Description**	**Strategy**	**Description**
Type 1: The Supportive Stakeholder	the ideal stakeholder type supports the organization's goals and actions low on potential threat but high on potential for cooperation often are ignored as stakeholders to be managed Usually its board of trustees, managers, staff employees, and parent company will be supportive. Other supportive stakeholders may include suppliers, service providers, and non-profit community organizations.	Strategy 1: Involve the Supportive Stakeholder	encourage cooperative potentials executives can involve stakeholders such as employees and lower-level managers by implementing participative management techniques, decentralizing authority to middle managers, or increasing the decision-making participation of these stakeholders. Getting external stakeholders involved in different parts of the organization can also yield positive results
Type 2: The Marginal Stakeholder	Marginal stakeholders are neither highly threatening nor especially cooperative they potentially have a stake in the organization and its decisions generally not concerned about most issues. For medium- to large-sized organizations, stakeholders of this kind may include consumer interest groups,	Strategy 2: Monitor the Marginal Stakeholder	Monitoring helps manage marginal stakeholders whose potential for both threat and cooperation is low. When making strategic decisions, top managers should monitor the interests of typically marginal stakeholders.

	stockholders, and professional associations for employees certain issues such as product safety, pollution, or greenmail could activate one or more of these stakeholders, causing their potential for either threat or cooperation to increase		Only if the issues involved in the decisions are likely to be salient to those stakeholders should the organization act to increase their support or to deflect their opposition otherwise, effort may be wasted
Type 3: The Non-supportive Stakeholder	High on potential threat but low on potential cooperation Most distressing for an organisation and its managers For many large manufacturing organisations, typical non-supportive stakeholders include competing organisations, employee unions, the federal government (and, possibly, local and state governments) and sometimes the news media	Strategy 3: Defend against the Non-supportive Stakeholder	Initially best managed using a defensive strategy Defence strategy tries to reduce the dependence that forms the basis for the stakeholders' interest in the organisation Although this strategy may be necessary initially, executives should always try to find ways to change the status of key stakeholders
Type 4: The Mixed Blessing Stakeholder	Executive faces a stakeholder whose potentials to threaten or to cooperate are equally high Mixed-blessing stakeholder plays a major role In a well-managed organisation, stakeholders of the mixed-blessing type would include employees who are in short supply, clients, or customers, and organisations with complementary products or services Mixed-blessing stakeholder could become either more or less supportive	Strategy 4: Collaborate with the Mixed Blessing Stakeholder	May be best managed through collaboration If business executives maximise the stakeholders' cooperation, potentially threatening stakeholders will find it more difficult to oppose the organisation Variety of joint ventures or other collaborative efforts, up to and including mergers, are possible Mixed-blessing stakeholders and effective collaboration may well determine the long-term stakeholder-organisation relationship If this type of stakeholder is not properly managed through using a collaborative strategy, it can easily become a nonsupportive stakeholder

Table 2.10. Stakeholder types and recommended engagement strategies (adapted from Savage et al., 1999)

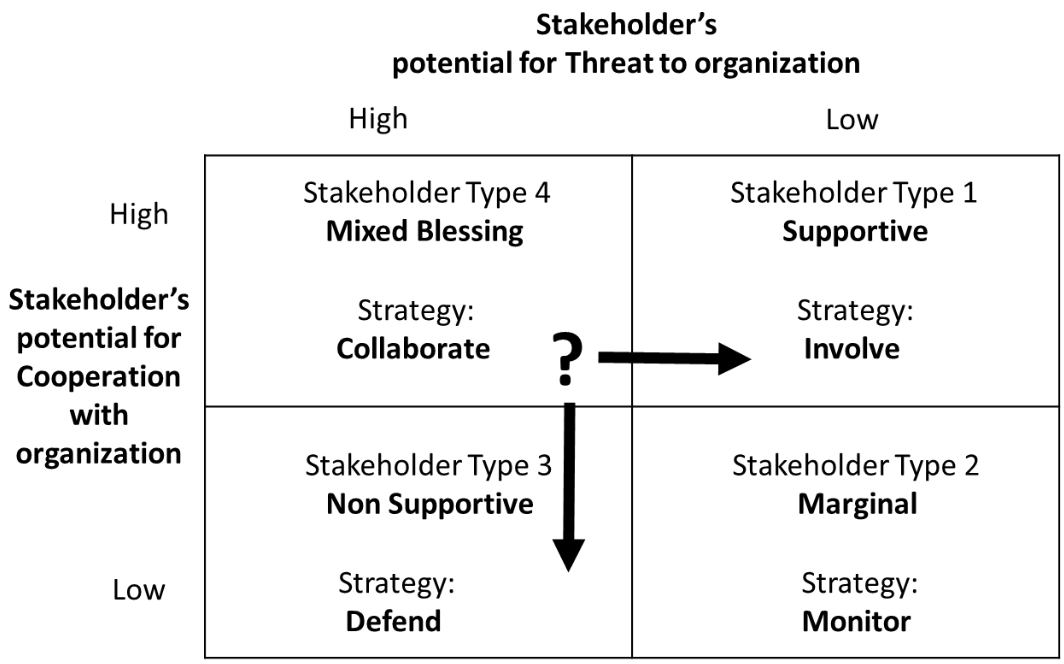


Figure 2.9. Stakeholder classification and engagement approach (Savage et al. 1999)

Olander and Landin (2005) used a similar matrix approach as a method to identify stakeholder influence on project success. The matrix used a combination of stakeholder power and level of interest to help managers decide on one of the four stakeholder engagement strategies: keep satisfied, key player, minimal effort, and keep informed (Figure 2.9). What is interesting in their model is that they mapped it to project life cycle within construction projects. Their case study showed how the model demonstrated the evaluation of stakeholder demands and influence and how it should be considered over construction project stages, as demonstrated in Figure 2.11. In their conclusion, they identified major lessons learned, with two of them being significant inputs to this research.

First conclusion:

> "*The stakeholders base of influence is not static. The stakeholder analysis must be conducted and updated during the entire life cycle of the project,*

with the purpose of gaining knowledge about the potential influence various stakeholders have at different stages of the project";

Second conclusion:

"*Prior to any major decision to proceed into a new phase of the project an analysis of how the decision affects the different stakeholders should be made in order to be proactive in the stakeholder management process*".

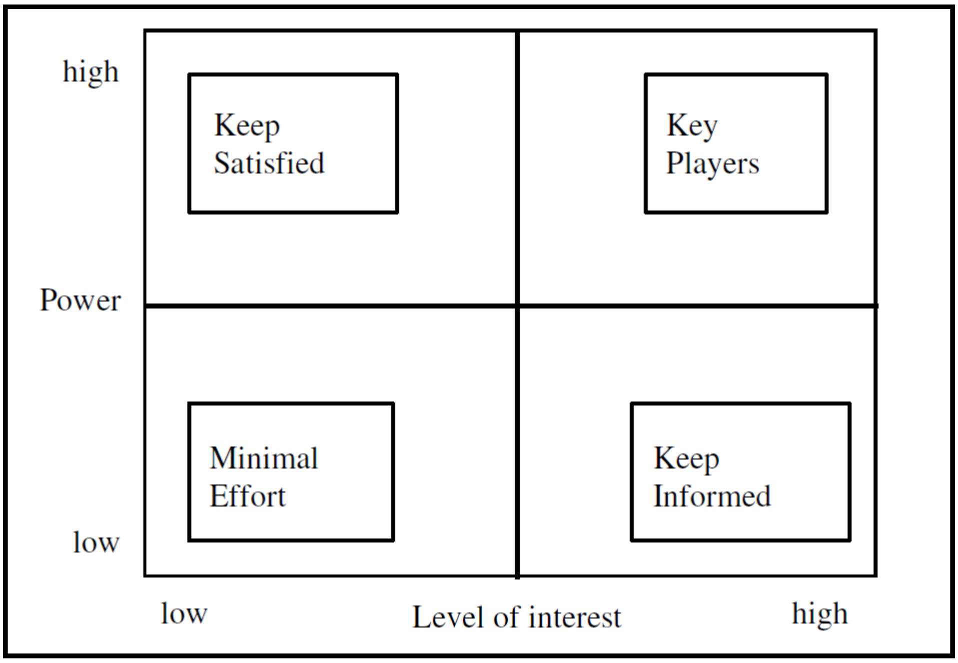


Figure 2.10 Olander and Landin's (2005) stakeholder identification and influence matrix

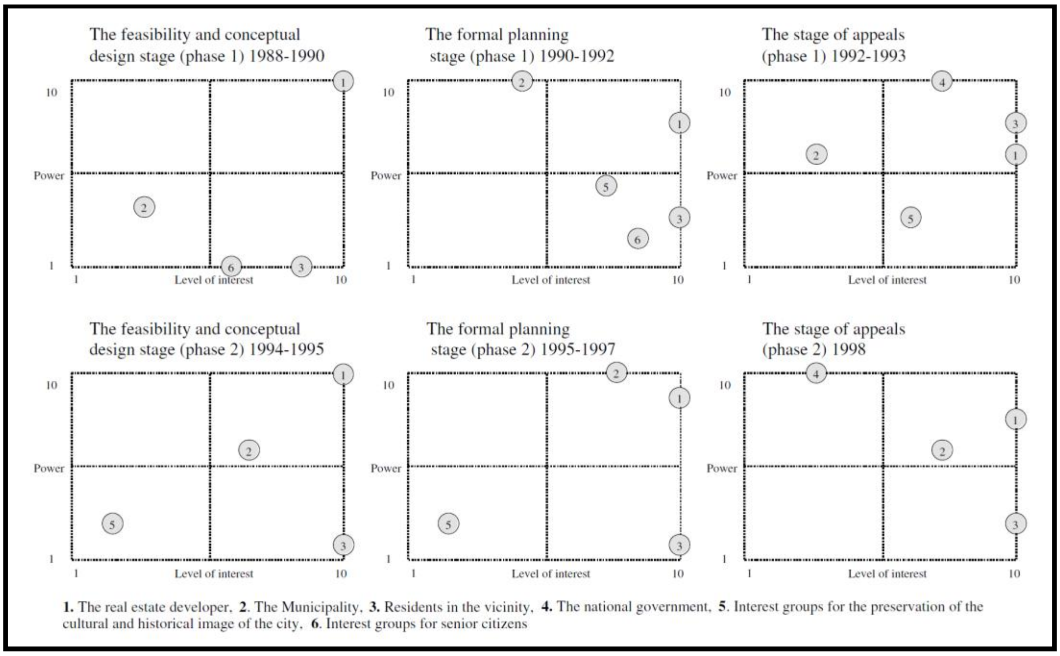


Figure 2.11. Power/Interest matrix for project (Olander & Landin, 2005)

In addition, Aaltonen et al. (2015) used the matrix by Savage et al. (1999) and Olander and Landin (2005) and adapted it to develop the salience/position matrix as an analytical framework for the purpose of examining project stakeholder dynamics in real cases. Their matrix or analytical framework was used to map the changes in stakeholders' salience and position to better understand the reasons behind these identified changes (Figure 2.12). Their argument is that stakeholder salience attributes (power, legitimacy, and urgency from Mitchell's (1997) salience model) and position are project properties and by using stakeholder influence and management strategies, we can change them. In addition, by using this approach, they were able to explore the role of stakeholder influence strategies, stakeholder management strategies, and the project's contextual conditions in explaining stakeholder dynamics (Aaltonen et al., 2015).

Their model was mainly designed to measure stakeholder dynamics during project front-end with a case study of nuclear waste repository projects. They used the model to capture salience/position over several years of the project and demonstrated how stakeholders' salience and positions shifted over the project phase and life span, allowing them to carry out enhanced stakeholder analysis and extract lessons learned to be mapped to management decisions with regard to stakeholder management in such a context.

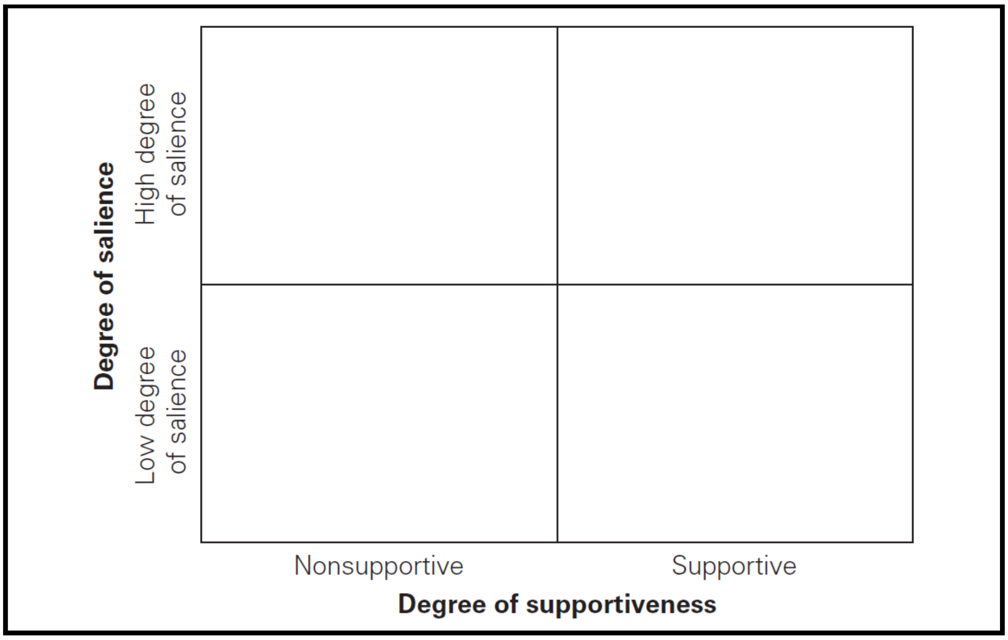


Figure 2.12. Salience/Position matrix (Aaltonen et al., 2015)

The demonstrated matrices provide a simplified tool for project managers and, in our case, diffusion programme managers (change agency) to analyse, prioritise, and identify appropriate engagement strategies. In addition, they can be used to anticipate and plan stakeholder engagement strategy over the project stages and accordingly map the changes from the initial plan, which can facilitate the analysis and understanding of stakeholders' anticipated positions, as compared to the actual positions and what caused such deviations.

For this research, the three attributes of the salience model (power, legitimacy, and urgency) were adopted to facilitate the analysis of stakeholder interactions over project activities. The dimensions are further discussed in the research framework in Chapter 3.

2.5 Themes drawn from the Findings of the Reviewed Literature

On reviewing the research background, certain findings and themes emerged, which will be used to build on the justification for this study. The key insights and conclusions are given below:

Innovation development and diffusion are complex processes and not a single event; Van De Ven describes this as an innovation journey (Rogers, 2003; Van de Ven et al., 1999; King et al., 1994; Damanpour & Schneider, 2009; Cooper, 1998).

This process is non-linear and dynamic, meaning it is difficult to predict and manage using conventional methods (Van de Ven et al., 1999; King et al., 1994; Damanpour & Schneider, 2009).

It is important to understand the differences between individual diffusion and adoption and organisational diffusion and adoption (Rogers, 2003; Frambach & Schillewaert, 2002; Hameed, 2012).

Innovation development and adoption processes represent a socially constructed reality, where managing the social interrelationship is critical (Rogers, 2003; Van de Ven et al., 1999; King et al., 1994; Cooper, 1998; Greenhalgh et al., 2004)

Differentiating between diffusion (let it happen) and dissemination (make it happen) and their implications on planning and implementation stages, especially from managerial and organisational perspectives is important (Greenhalgh et al., 2004; Jippes et al., 2013).

Change facilitators/champions play a vital role in driving diffusion and adoption of innovation. Change facilitators can be individuals, groups, or specific agencies mandated to drive diffusion and adoption among target adopters (opinion leaders, change agents, followers, adopters, change agencies) (Rogers, 2003; Van de Ven et al., 1999; Greenhalgh et al., 2004; Jippes, et al., 2013).

The context for diffusion of innovation and choice of the right approach depend on several internal and external factors. Factor priorities vary depending on the context, so a better understanding of context facilitates better decisions and planning (Rogers, 2003; Van de Ven et al., 1999; King et al., 1994; Cooper, 1998; Greenhalgh et al., 2004).

Relatively, the majority of diffusion of innovation literature focused on the individual level and voluntary settings with less empirical research on mandatory and organisational settings (Greenhalgh et al., 2004; Jippes et al., 2013; Hameed et al., 2012; Straub, 2009).

A review of the innovation theories revealed that most of them share three characteristics that influence the adoption and/or diffusion of an innovation: 1) Individual characteristics (individual differences, states, or traits), 2) innovation characteristics (specific to the particular innovation), and 3) contextual characteristics (environment and surroundings of an individual during the adoption process which can be organisational) (Straub, 2009).

For technology adoption models, the focus is on identifying constructs to predict an individual's attitudes towards behaviours predicting or measuring their intentions. Hence, the TAM and extended UTAUT models assisted in explaining the potential adopters' decision to adopt or reject ICT innovations; however, in-depth analysis is needed to understand context dependencies (Straub, 2009; Greenhalgh et al., 2004; Jippes et al.; Postema et al., 2012).

Managing ICT diffusion and implementation in reality involves a set of complex technical and social issues that need to be structured and managed to avoid failure of ICT implementations (Peansupap & Walker, 2005).

Stakeholder management is a critical element of any project success and every project context has different organisational and environmental factors that need to be identified and considered.

The management needs to actively and effectively identify key stakeholders, prioritise them, examine their changing dynamics over project stages, in consideration of the project context, and accordingly shape their engagement activities towards effective diffusion and project success (Bourne & Walker, 2005; Vos & Achterkamp, 2006).

ICT diffusion in education is receiving growing attention from both academia and industry where it is expected to grow exponentially in the coming years, thus warranting further research in this domain.

The use of the combination of the DOI, TOE, UTAUT, CBAM, and salience models is proposed to provide a holistic review of ICT innovation diffusion in education and is expected to provide rich insights into the body of knowledge.

2.6 Chapter Summary

This chapter presented a review of the literature and theories related to ICT innovation diffusion. The review covered the main innovation theories and models, ICT acceptance models, and organisational innovation process. In addition, stakeholder theories and models were reviewed from the innovation perspective, with a focus on stakeholder dynamics and engagement over project lifecycle phases.

The review provided a theoretical background to the topic and facilitated a better understanding of the current state of knowledge. On the other hand, to provide depth and perspective in the literature review, the CBAM model was also reviewed to gain an insight into the social aspects of diffusion of innovation in the education context. In addition, the TAM model and its extensions including the UTAUT model were reviewed as they are related to this research focus on diffusion and adoption of ICT innovations. Finally, the final section identified the main findings and themes that emerged from the literature review, feeding into the need for this research.

CHAPTER 3. RESEARCH THEORATICAL FRAMEWORK

3.0 Introduction

Chapter 2 introduced ICT diffusion of innovation, innovation theories, stakeholder theory, and the relation between diffusion of innovation and stakeholder theory. The aim of this chapter is to further build on chapter 2 by developing a theoretical framework that integrates the findings from the literature review to provide a description of this study and the relationships between different dimensions related to the research aims to examine the process of ICT innovation diffusion and user acceptance and use within the UAE public schools with a focus on the changing stakeholder interactions over the project stages.

3.1 Research Framework

A research framework refers to the theoretical foundations a study is based on and provides the conceptual foundation to proceed with the research. Collis and Hussey (2013) describe a theoretical framework as the collection of theories and models from the literature that underpins the research. Developing a sound theoretical framework is central to investigating a research problem, especially for qualitative research (Sekaran and Bougie, 2011; Collis and Hussey, 2013). According to Sekaran and Bougie (2011),

> "*the theoretical framework offers the conceptual foundation to proceed with the research, and...the theoretical framework involves nothing more than identifying the network of relationships among the variables considered important to the study of any given problem situation*".

Sekaran and Bougie (2011) provide a three-step process for building a theoretical framework: 1) introducing definitions of the concepts or variables in the model, 2) developing a conceptual model that provides a descriptive representation of the theory, and 3) constructing a theory that provides an explanation for relationships between the variables in the model.

Based on the literature review findings and discussions in chapter 2, a theoretical framework, as illustrated in Figure 3.1, is designed to demonstrate the main concepts and dimensions and their interrelationships. This should facilitate the researcher's efforts to effectively investigate the research problem and collect the data considered most important for the study to meet the identified research aim and objectives.

The framework was based on the integration of different models and theories to provide a holistic view to investigate ICT innovation diffusion in UAE public schools and the stakeholders' interaction over the project stages. The research adopted Rogers' (2003) process of innovation in an organisation (section 2.3.1.2), which maps to the UAE public education setting, composed of a centralised organisational structure. Then the main dimensions influencing ICT innovation diffusion were combined by adopting the TOE framework (section 2.3.4).

To capture the status of ICT innovation diffusion in education settings, dimensions were identified from CBAM (section 2.3.5) along with user ICT acceptance dimensions from the UTAUT model (section 2.3.3). Finally, to investigate and analyse different stakeholders' influence over the innovation diffusion process, three dimensions identified from Mitchell's salience model were adopted (section 2.4.2). Figure 3.1 summarises the research framework and demonstrates all the dimensions and how they and the stakeholders' interactions influence the innovation diffusion process. In the following sections, each identified dimension will be further discussed.

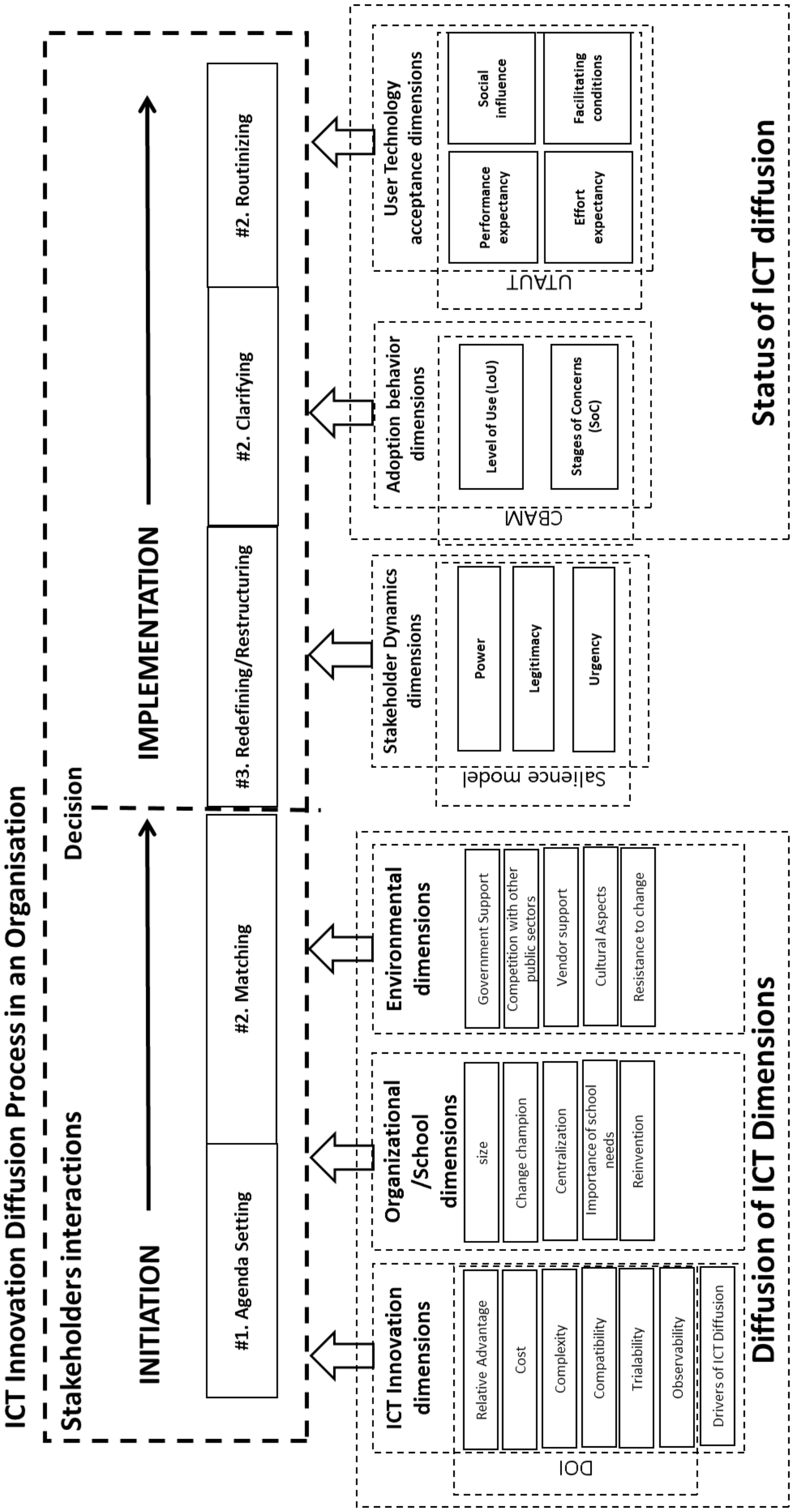


Figure 3.1. Theoretical framework

3.2 Process of ICT innovation diffusion

The literature review discussed the difference between individual and organisational innovation diffusion process (section 2.2.1). In an organisational setting, the organisation decides to adopt an innovation and then focuses on implementation by encouraging and facilitating its use by the target users (Peansupap and Walker, 2005). In contrast, innovation research focuses on two main approaches: the process approach, focusing on the series of processes taking place over the stages of innovation diffusion, and the factors approach, focusing on the main factors influencing acceptance decisions (Frambach and Schillewaert, 2002; Peansupap and Walker, 2005; Hameed et al., 2012).

According to Hameed et al. (2012), examining both the innovation process in an organisation and the factors influencing user ICT acceptance is fundamental for ensuring successful implementation. In addition, Frambach and Schillewaert (2002) recommended studying organisational innovation processes in different disciplines to identify a set of factors specific to each discipline. Accordingly, this research will investigate both the innovation process and factors influencing ICT innovation diffusion in UAE public school settings in an effort to provide insight to guide an ICT diffusion project to successful implementation.

In terms of the innovation diffusion process in an organisation, this research adopted Rogers' (2003) proposed framework discussed in section (2.3.1.2). The process is based on two general stages, initiation and implementation, with the decision to adopt taking place in between. This structure was based on Zaltman et al. (1973) and supported by several studies, including Frambach and Schillewaert (2002), Hameed et al. (2012), Peansupap (2004), and Pichalk (2016).

3.3 Stakeholder interactions

One main objective of this research is to examine the stakeholders' dynamics, which can be simply described as changes in different stakeholder interactions over the innovation diffusion process or project phases. Accordingly, this research aims to capture these interactions and their dynamics over project stages in an effort to better understand the process of innovation diffusion. In addition, Mitchell's stakeholder salience model will be adopted by using its three dimensions (power, legitimacy, and urgency) to guide the analysis and classification of the different stakeholders. Mitchell's framework provides insights into organisational management to help them understand how stakeholders can gain or lose salience and who is able to influence the organisation's activities or the project at hand. The model was discussed in detail in section 2.4.2. The use of Mitchell's salience model is widely supported in the literature of various disciplines including Agle et al. (1999); Frooman (1999); Walker et al. (2008); Vos and Achterkamp (2006); Wagner et al. (2012); de Bussy and Kelly (2010); Spitzeck and Hansen (2010); Salado and Nilcjiani (2013); Bunn et al. (2002); and Jangbloed et al. (2008).

3.4 ICT Innovation dimensions

The diffusion of ICT innovation construct was based on the TOE framework, and this section discusses the technological construct. The the seven dimensions selected (see Figure 3.2) will be previewed in the following subsections.

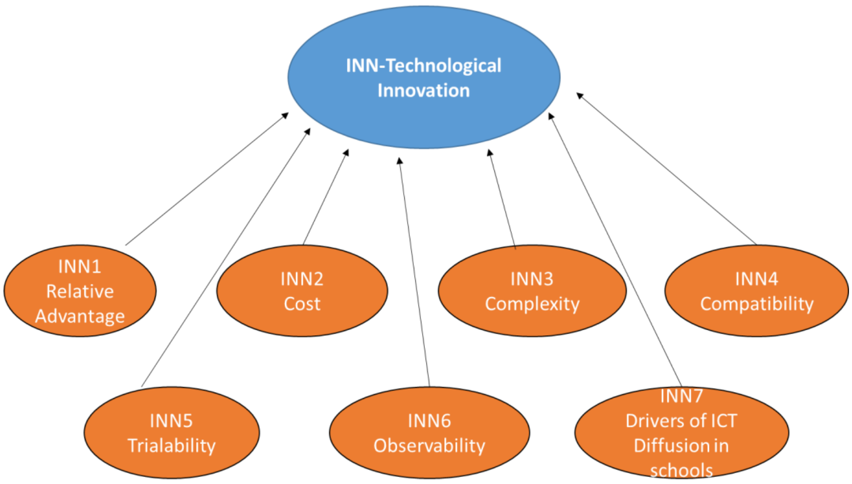


Figure 3.2. Main ICT innovation construct dimensions

3.4.1 Relative Advantage

Relative advantage refers to the degree to which an innovation is perceived as better than the idea it supersedes (Rogers, 2003). According to Rogers (2003), "*The degree of relative advantage is often expressed as economic profitability, as conveying social prestige, or in other ways. The nature of the innovation determines what specific type of relative advantage (economic, social, and the like) is important to adopters*".

Relative advantage was identified as one of the main significant factors influencing the adoption and use of ICT innovation in organisations (Frambach and Schillewaert, 2002; Rogers, 2003; Peanuspap and Walker, 2005). The relative advantage dimension has been used to examine the technological dimension in several studies, including Tornatzky and Klein (1982), Robinson (1990), Mansfield (1993), Oldenburg and Glanz (2008), Lee et al. (2009), Chong et al. (2009), Zhu et al. (2006), and Wange et al. (2010).

3.4.2 Cost

Cost refers to the total expenses incurred in the adoption and implementation of an innovation. This cost includes administrative, implementation, training, and maintenance costs. In general, cost is a critical factor in an adoption decision and relatively easy to measure. The literature suggests that cost is an obstacle to IT innovation adoption and that the less expensive the innovation is, the more likely it it\s to be adopted and used by an organisation (Downs and Mohr, 1976; Tornatzky and Klein, 1982; Rogers, 1995, 2003; Stewart et al., 2002; Huang et al., 2003; Zhu et al., 2006; Hameed, 2012).

3.4.3 Complexity

Complexity refers to the degree to which an innovation is perceived as relatively difficult to understand and use (Rogers, 2003). According to Rogers, complexity is not necessarily as important as the relative advantage or compatibility for many innovations; however, for some new idea, complexity might be a main barrier. The complexity dimension is also widely uses in the literature to investigate the diffusion of innovation, and the complexity of an innovation is negatively related to its rate of adoption (Thong, 1999; Zhu et al., 2006; Lee et al., 2009; Chong et al., 2009; Wang et al., 2010; Frambach and Schillewaert, 2002; Hameed, 2012; Huang et al., 2003; Zhu et al., 2006).

3.4.4 Compatibility

Compatibility refers to the degree to which an innovation is perceived as consistent with the existing values, needs, and experiences of potential adopters (Rogers, 2003). Compatibility is positively related to the rate of adoption (Tornatzky and Klein 1982; Rogers, 2003; Moore and Benbasat, 1991; Ramamurthy, 1994; Peansupap and Walker, 2005; Hameed, 2012; Huang et al., 2003; Zhu et al., 2006). In addition, Rogers (2003) considers naming an innovation and positioning it relative to previous ideas as important means of making an innovation more compatible with the setting.

3.4.5 Trialability

Trialability is the degree to which an innovation may be experimented with on a limited basis. According to Rogers (2003),

> "*The trialability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption*".

Trialability is important in the initiation stage of adoption. However, its implication will affect the use of the innovation later. The ability to try innovations before adoption reduces the uncertainty of potential adopters, and innovations that can be tried are more likely to be adopted (Tornatzky and Klein, 1982; Ramamurthy, 1994; Peansupap and Walker, 2005; Hameed, 2012; Huang et al., 2003; Zhu et al., 2006).

3.4.6 Observability

Observability refers to the degree to which the results of the innovation are visible to others. The observability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption (Rogers, 2003). Observability is sometimes referred to as "visibility". The more visible or observable the usage and the outcome of the innovation are, the more likely it is that the innovation will be adopted and implemented in organisations (Tornatzky and Klein, 1982; Huang et al., 2003; Zhu et al., 2006).

3.4.7 Drivers of ICT Diffusion in schools

The focus is on better understanding the main needs and drivers of ICT diffusion in UAE schools from interviewees' perspective and how they affect adoption and diffusion. Adding new context-related dimensions is supported in the literature by several researchers, including Rogers (2003), Greenhalagh et al. (2004), Hameed (2012), Iacovou et al. (1995), Wang et al. (2010), Lin and Lin (2008), and Zhang et al. (2014).

3.5 Organisational/school dimensions

The organisational construct, schools in our case, refers to the main descriptive measures for the organisation, such as the scope, size, and structure. Five dimensions were identified (see Figure 3.3) for the organisational construct.

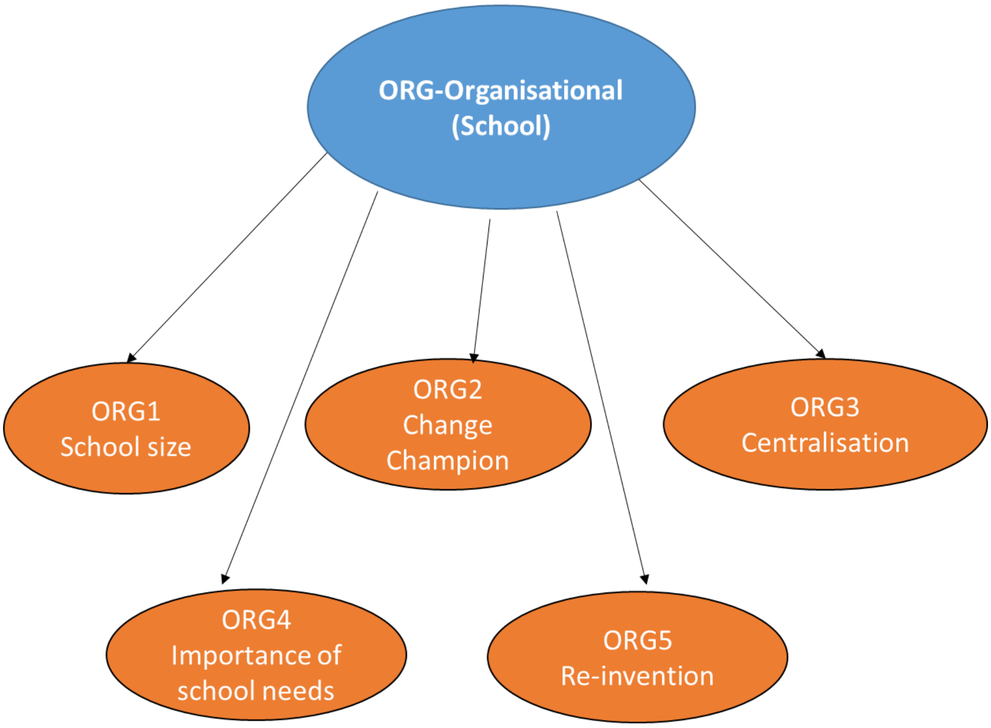


Figure 3.3. Organisation/school main dimensions

3.5.1 Size

Organisation size or, in this case, the school size dimension refers to the relationship between organisation size and ICT diffusion and adoption. Organisation size is one of the most frequently examined factors in organisational innovation adoption studies. According to Rogers (2003), organisational size can be considered the most important factor influencing IT innovation adoption, as the size of an organisation determines other organisational aspects, particularly slack resources, decision-making, and organisational structure. The size dimension has been investigated by several researchers at the organisational level and provided important insights (Damanpour, 1991; Hameed, 2012; Zhu et al., 2006; Peansupap, 2004).

3.5.2 Change Champion

A change champion can be defined as an individual who spreads knowledge of new technological innovation or promotes and supports the diffusion and adoption efforts within the organisation (Rogers, 2003). The existence of a champion influences all stages of innovation diffusion, as they play a key role in facilitating diffusion and adoption among the target adopters. This dimension has been used in several research, including Rogers (2003), Dooley (1999), Tondeur et al. (2008), Hameed (2012), and Premkumar and Ramamurthy (1995).

3.5.3 Centralisation

Centralisation refers to the degree to which power and control in a system are concentrated in the hands of relatively few individuals in an organisation (Rogers, 2003). More concentrated decision-making is associated with a centralised organisational structure. The level of centralisation and decision-making in an organisation are important elements in understanding the level of organisational innovativeness. The centralisation dimension has been used by several researchers, including Nilakanta (1996), Frambach and Schillewaert (2002), and Greenhalgh et al. (2004).

3.5.4 Importance of school needs

The importance of school needs dimension focuses on how much the schools, as the main adopters of diffused ICT, are involved in the diffusion process. This dimension is important for the current investigation, as it will help identify interactions between schools and other stakeholders throughout the innovation process stages. Adding new context-related dimensions is supported in the literature by several researchers, including Rogers (2003), Greenhalagh et al. (2004), Hameed

(2012), Iacovou et al. 1995), Wang et al. (2010), Lin and Lin 2008), Zhang et al. (2014).

3.5.5 Reinvention

Reinvention is a process in which adopters modify an innovation to fit their local implementation setting (Rogers, 2003). In general, both the innovation and the organisation usually change and through the innovation process to accommodate the different evolving needs (Rogers, 2003; Van de Ven, 1999).

3.6 Environmental dimensions

Research has shown that the external and internal environment plays an important role in the diffusion and adoption of ICT innovations (Damanpour and Schneider, 2006). The environmental construct refers to the setting where the ICT innovation is being diffused, and it can include the industry, competitors, and government (Tornatzky and Fleischer, 1990; Damanpour and Schneider, 2006; Hameed 2012; Pichlak, 2016). Five dimensions were identified (see Figure 3.4) for the environmental construct.

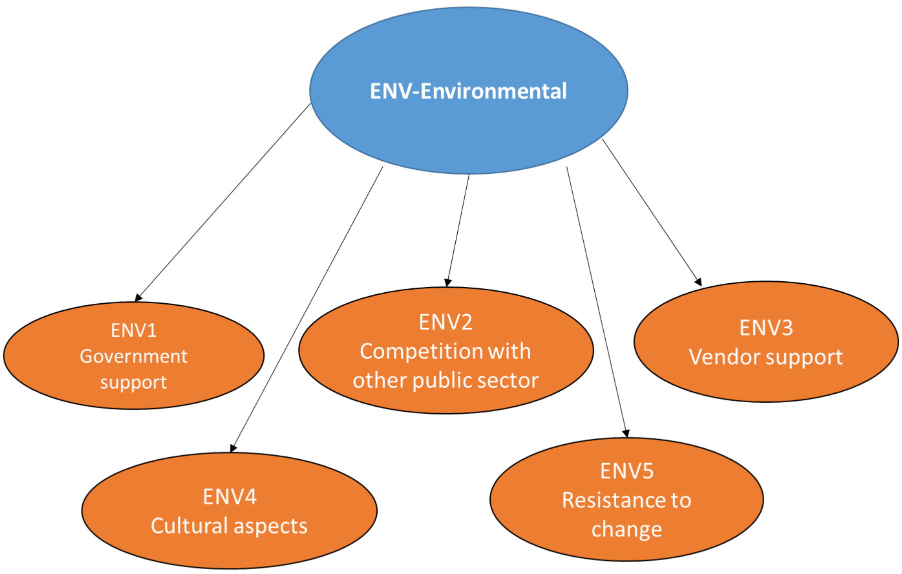


Figure 3.4. Environmental dimensions

3.6.1 Government Support

In general, government support refers to the government initiatives and policies that promote IT adoption and use. Government support is positively related to innovation diffusion and adoption (Rogers, 2003; Damanpour and Schneider, 2006, 2009; Aarons et al., 2011; Hameed 2012; Mitchell et al., 2011; Quaddus and Hofmeyer, 2007).

3.6.2 Competition with other public sectors

Competition with other public sectors in the UAE was perceived as an important dimension related to the diffusion and adoption of ICT innovation. The general direction toward smart government and innovation across different public sector entities in the UAE created competition between these entities (Abdulrahman and Said, 2015; Baddah, 2016). In addition, UAE public-sector entities already have an annual competition for an excellence award and a smart government transformation initiative where every agency's scores and achievements are publicly announced at a high-level award ceremony.

3.6.3 Vendor Support

Vendor support refers to the role of support from and relationships with the vendors, service providers, or suppliers involved in the ICT innovation diffusion. This is an interesting dimension to explore within the current research context. Investigating the influence of supplier activities and readiness in the innovation process in organisations is recommended by Frambach and Schillewaert (2002) and Ismail (2015).

3.6.4 Cultural aspects

Cultural aspects refer to the common patterns of thinking, feeling, and potential action shared among members of the social environment (Hofstede, 2001). The cultural dimension has been investigated in innovation diffusion research and identified as an important dimension (Rogers, 2003; Glasgow, 2003; Hameed, 2012; Aarons et al., 2011).

3.6.5 Resistance to change

Resistance to change refers to the degree of resistance to ICT innovation diffusion in schools. The focus will be on the main challenges that schools have faced that resulted in resistance and negatively affected effective diffusion. Investigation of the ICT diffusion resistance to change dimension is supported by Stewart et al. (2004), Love et al. (2001), Lim and Khine (2006), and Peansupap and Walker (2005).

3.7 ICT acceptance dimensions

For technology user acceptance, dimensions were adopted from the UTAUT model by Venkatesh et al. (2003). The four dimensions (performance expectancy, effort expectancy, social influence, and facilitating conditions) were selected to provide a wider view of the status of ICT innovation adoption by users. Each dimension was discussed in detail in section 2.3.3.

Performance expectancy refers to the degree to which an individual believes that using the system will help him or her to attain gains in job performance as an educator. Effort expectancy refers to the degree of ease associated with the use of the innovation for teaching and learning. Social influence refers to the degree to which an individual feels social pressure to use a provided ICT innovation. Facilitating conditions refers to the degree to which an individual believes that his or her organisation supports the change, and it can also include the objective factors within the specific environment that participants or viewers agree facilitated the change (see Figure 3.5).

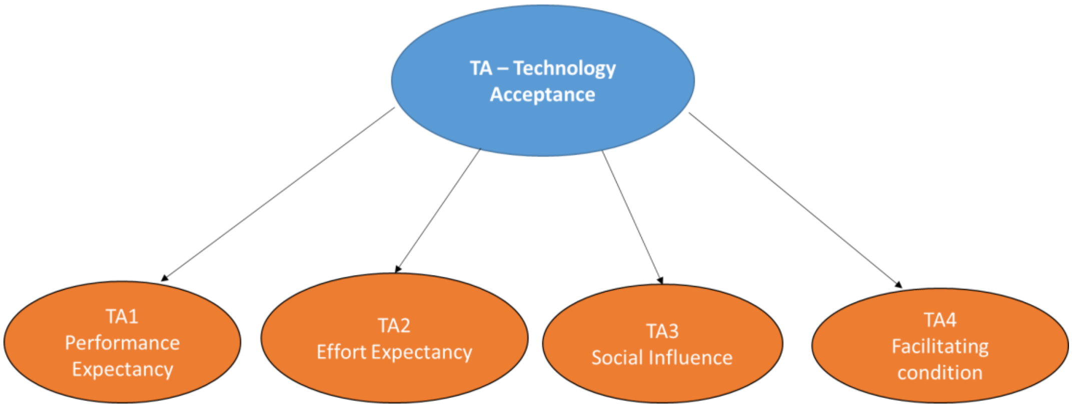


Figure 3.5. Technology acceptance dimensions

3.8 Adoption behaviour dimensions

The adoption behaviour construct reflects the use and adoption level in the education context and is based on the Concerns Based Adoption Model (CBAM) by Hall, Dirksen, and George (2006). Two dimensions were identified for thee adoption behaviour construct: stages of concern and level of use (see Figure 3.6). The CBAM model emerged as an education change model and has been referenced widely in literature on education change and ICT deployment in the education context (Straub, 2009; Greenhalgh et al., 2004; Hall, Dirksen and George, 2006; Surry, 1997).

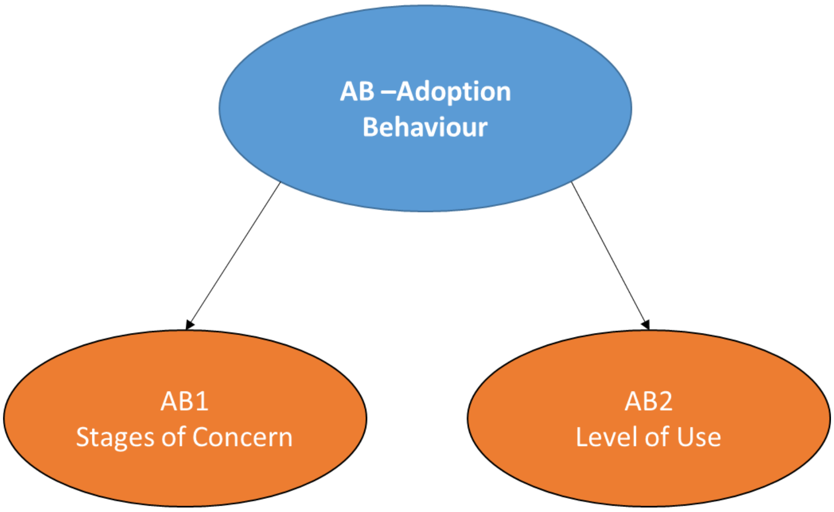


Figure 3.6. Adoption behaviour dimensions

3.8.1 Stages of Concern (SoC)

Stages of concern (SoC) focus on the feelings or concerns of individuals involved in the change process across the different project phases. To simplify the process, four stages of concern were developed based on the original six-stage CBAM model as demonstrated in Table 3.1.

Stages of Concern (SoC)		
Stage 1	Self/personal	From little awareness to seeking knowledge on innovation and demands for innovation
Stage 2	Process & tasks	Attention focused on the process and tasks of using the innovation and integrating into daily jobs

Stage 3	Impact	Attention focused on innovation and its use to impact on students
Stage 4	Improvement	Focus is on how to better implement innovation

Table (3.1) Four stages of concern

3.8.2 Level of Use (LoU)

Level of use describes how individuals interact with an innovation. It is important to highlight that the level of use dimension describes the behaviours of innovation users and does not focus on attitudinal, motivational, or other affective aspects of the user. In addition, it does not attempt to explain causality; instead, the level of use dimension is an attempt to define operationally what the user is doing. To simplify the process, four levels of use were developed, in contrast to the eight levels in the CBAM model as demonstrated in Table 3.2.

Level of Use (LoU)		
Level 1	Pre-use	From non-use to initial awareness and preparation to use
Level 2	Basic	User implementation is poorly coordinated and mainly involves superficial use
Level 3	Established	User has established pattern of use with few thoughts on improving innovation use
Level 4	Refinement & renewal	User makes deliberate efforts to increase impact and seeks more effective alternatives to the established use of the innovation

Table 3.2. Four levels of use

3.9 Chapter Summary

This chapter synthesised the research background findings to develop the research framework and identify the main dimensions to be used to investigate ICT diffusion in UAE schools, which feeds into answering the first research question.

CHAPTER 4. RESEARCH DESGIN AND METHODOLOGY

4.0 Introduction

Research methodology is about the entire process of research (Collis and Hussey, 2009). This chapter discusses the various research philosophies, approaches, design, strategies, and methods for data collection and analysis in this research with justification on the assumed methodological choices in order to achieve the identified research purpose and objectives. In addition, the chapter present the assumed data collection and analysis methods.

To simplify and explain the research process, the researcher has adopted Saunders, et al.'s (2012) research process diagram "the research onion" (see Figure 4.1).

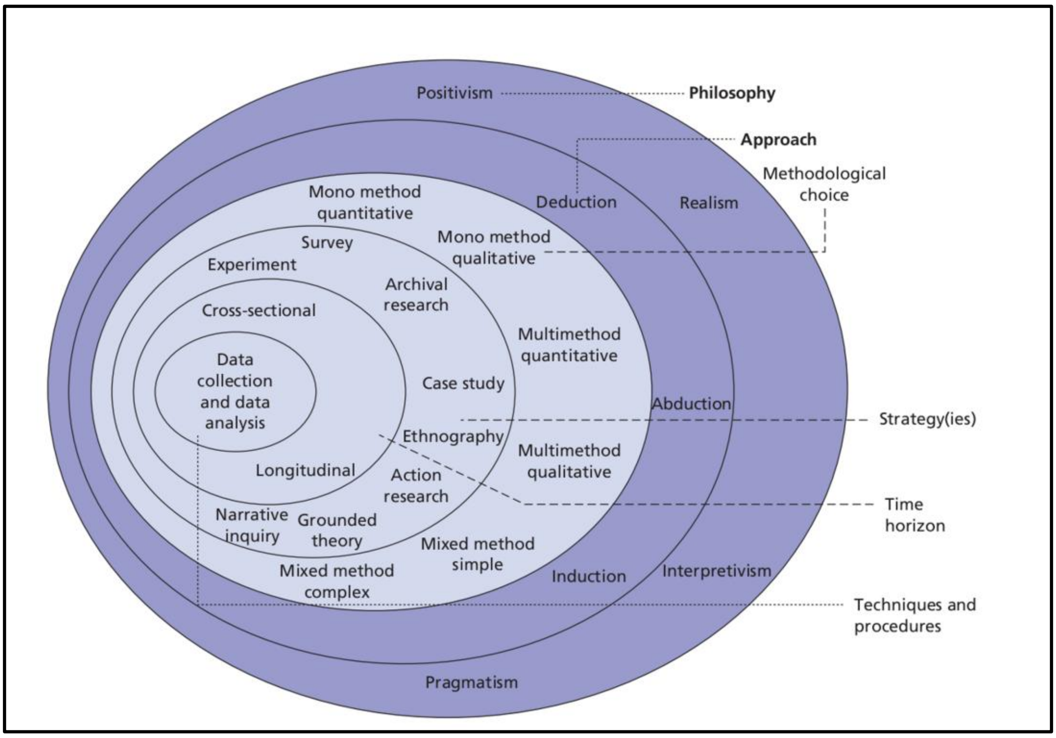


Figure 4.1: The research process model "the research onion" (Saunders, et al., 2012)

4.1 Definition of Research Methodology

In general, research means different things to different people. Merriam-webster.com online dictionary defines research as:

> "*studious inquiry or examination; especially: investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws*".

Saunders, et al. (2012, p.680) suggested a simpler definition:

> "*the systematic collection and interpretation of information with a clear purpose, to find things out*".

Collis and Hussey (2013, p.2) argue that although there is no consensus in the literature on a common definition for research, there is general agreement that research is about three main aspects: it is a process if inquiry and investigation; it is systematic and methodical; and it increases knowledge. Accordingly, they proposed four elements for classifying research:

- Purpose: the reason why research was conducted
- Process: the way in which the data were collected and analysed
- Logic: whether the research logic moves from general to specific or vice-versa
- Outcome: whether the expected research outcome is a solution to a particular problem or a more general contribution to knowledge.

These bases of classification were mapped to types of research in Table 4.1, below.

Basis of classification	**Type of research**
Purpose of research	Exploratory, descriptive, analytical or predictive
Process of research	Quantitative or qualitative

Logic of research	Applied or basic
Outcome of research	Deductive or inductive

Table 4.1: Classification of main types of research (Collis and Hussey, 2013, p.3)

As for research methodology, Saunders, et al. (2012) describe it as how the research is undertaken, including the research theoretical and philosophical assumptions and the implications of the adopted research methods. Collis and Hussey (2013) described research methodology as the entire process of research from the assumed theoretical basis to the data collection and analysis, which encompasses a collection of research methods.

This research supports these views where the research methodology incorporated a systematic methodical process for how the researcher did the work, and the overall research design from the assumed theoretical underpinnings, data collection, and analysis methods to the rigour of the process to ensure validity and rationality, in order to satisfy the stated research purpose and objectives. Figure 4.2 presents the overall research design and the main methodical choices for the research. Over the next sections, more details are provided on the research design and justifications on the assumed methodical choices.

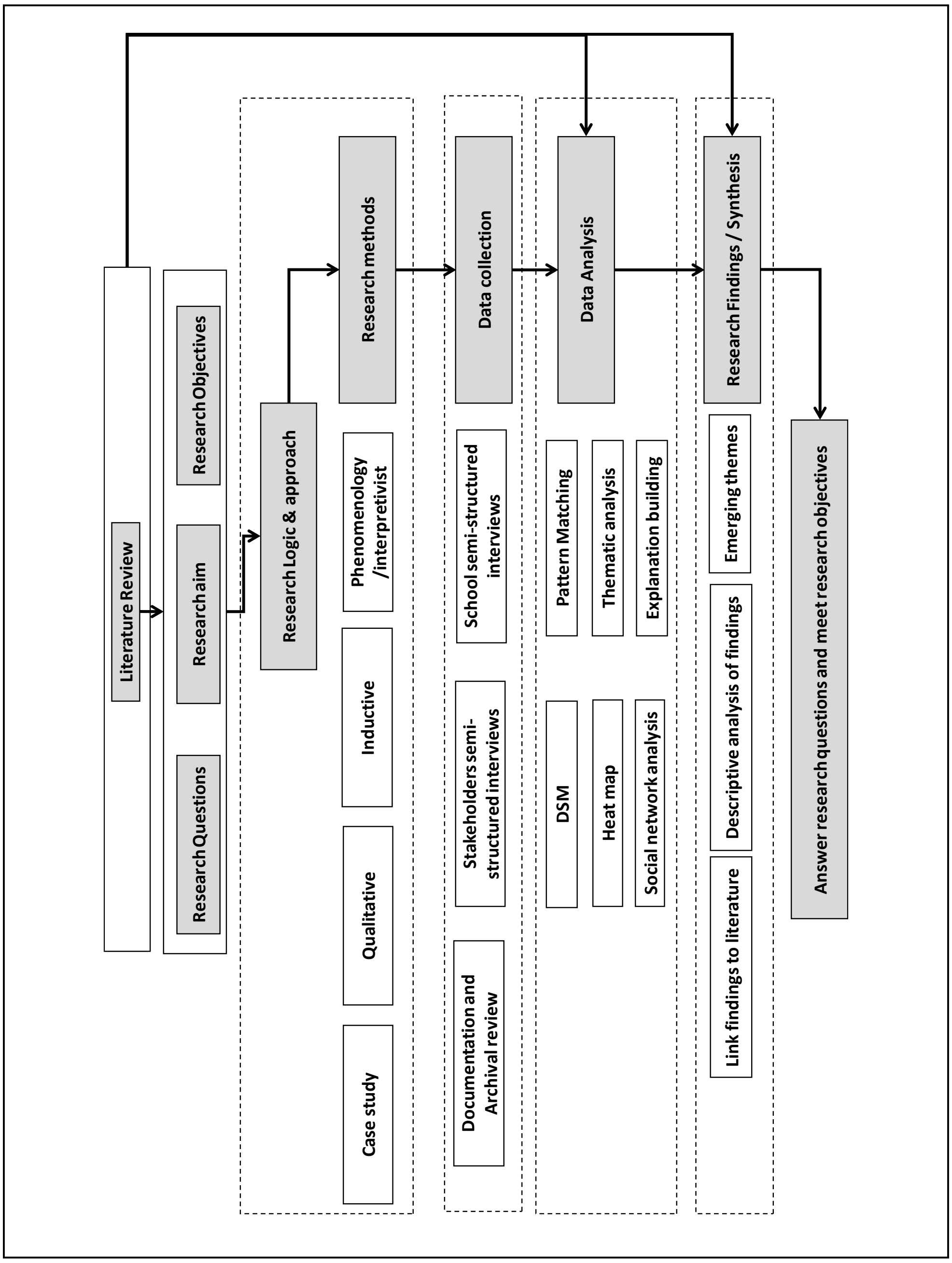


Figure 4.2: The research design

4.2 Purpose of the Research

As discussed in section 4.1, the type of research can be categorised based on research purpose into four types of research: exploratory, descriptive, analytical, or predictive, with a combination of these types being normal. Saunders, et al. (2012) describe exploratory research's purpose as being to discover what is happening and to gain insights about a topic of interest or clarify understanding of a problem or issue when there are very few or no earlier studies to which to refer.

The purpose of descriptive research is to gain an accurate profile describing a phenomena or a situation; it may be an extension of an exploratory research. Analytical or explanatory research, which is a continuation of descriptive research, establishes causal relationships between variables, the emphasis being on studying a situation or a problem in order to explain the relationships between variables. Predictive research aims to generalise from the analysis of a phenomena by making predictions based on the hypothesised general relationships (Saunders, et al., 2012; Collis and Hussey, 2013).

This research purpose implies exploratory and explanatory study. The explorative purpose is to investigate the ICT innovation diffusion project in UAE public schools in order to gain a clear understanding on the ICT innovation diffusion process, status, and the main stakeholders interrelations. The explanatory aspect is to examine the different interrelationships among identified ICT innovation diffusion dimensions and stakeholders over the project activities, in order to gain insight into changing stakeholder dynamics over the project life cycle stages. Finally, use the findings to develop a framework to support effective diffusion of ICT innovations in UAE public schools.

4.3 Research Philosophy

Saunders, et al. (2012) describe philosophy as a term that relates to the development of knowledge and the nature of that knowledge. Cresswell (2013) refers to philosophy as the philosophical assumptions (also sometimes referred to as research paradigm or worldviews) that inform the research approach, in order to show where it fits within the larger picture from a philosophical point of view, which reflects on the overall research design and methods. According to Saunders, et al. (2012), it is wrong to think that one philosophy is better than another; it always depends on the research purpose, questions, and researcher, as research philosophies are suited to achieve different things.

Accordingly, research philosophy is the result of the researchers' undertaken assumptions about how they view the world and decisions toward the research, which underpin the research strategy and chosen methods. This researcher agrees with the conclusion from Johnson and Clark (2006), who argued that the important issue for researchers is to make sure they can clearly reflect upon the assumed philosophical choices and defend them compared to the other alternatives (Saunders, et al., 2012, p.129). In general, philosophical positions are based on two main constructs, ontology and epistemology. Ontology is about the nature of reality and existence; epistemology is about the theory of knowledge and what is considered acceptable knowledge, which helps researchers understand the best ways of enquiring into the nature of the world (Saunders et al., 2012; Easterby-Smith, et al., 2015). According to Easterby-Smith, et al. (2015), researchers generally build their methodologies for conducting research based on the different ontological and epistemological assumptions taken for the research, leading to methodology and research methods and techniques for data collection and analysis.

Referring to Saunders, et al.'s (2012) research process model (Figure 4.1), the first layer is philosophy. Saunders, et al. (2012), Cresswell (2013), Collis and Hussey (2013), and Easterby-Smith, et al. (2015) agree on two main distinct research philosophies: positivism and constructivism. Between those two distinct ends, some authors identify different levels, from strong positivism to strong constructivism, where each level is given different names such as 'scientific methods', 'systems theory', and 'critical realism' for positivism and 'critical theory', 'subjectivism', 'hermeneutics', 'pragmatism', and 'feminism' for social constructivism (Collis and Hussey, 2013; Easterby-Smith, et al., 2015). Positivism mainly follows a traditional scientific approach to develop knowledge and is mainly linked to quantitative methods. According to Easterby-Smith, et al. (2015), positivism's main position is that:

> "*the social world exists externally, and that its properties can be measured through objective methods rather than being inferred subjectively through sensation, reflection or intuition.*"

On the other hand, constructivism is about the idea of 'societal reality' where aspects of societal reality are determined by people rather than by objective and external factors. This fundamentally different view leads to research methodologies where the researcher should not only gather facts and measure quantitative patterns, but also focus on the different constructions and meanings from people and their experience. It is based on qualitative methods to satisfy the need to go beyond initial data gathering to gain insights by investigating what people think and feel, individually and collectively, with attention also paid to the method's communication and interaction (Saunders, et al., 2012; Cresswell, 2013; Easterby-Smith, et al., 2015). According to Gall, et al. (1999), the constructivist or interpretivist approach assumes that

> " *features of the social environment are constructed as interpretations by individuals and that these interpretations tend to be transitory and situational*"

Table 4.2, derived from Easterby-Smith, et al. (2015, p.52), and Table 4.3, from Collis and Hussey (2013), provides a comparison for the main features between positivism and constructivism (some authors call it social constructivism or phenomenology or interpretivism):

	Positivism	Social Constructivism
The observer	Must be independent	Is part of what is being observed
Human interests	Should be irrelevant	Are the main drivers of science
Explanations	Must demonstrate causality	Aim to increase general understanding of the situation
Research progress through	Hypothesis and deductions	Gathering rich data from which ideas are induced

Concepts	Need to be defined so that they can be measured	Should incorporate stakeholder perspectives
Units of analysis	Should be reduced to simplest terms	May include the complexity of 'whole' situations
Generalisation through	Statistical probability	Theoretical abstraction
Sampling requires	Large numbers selected randomly	Small numbers of cases chosen for specific reasons

Table 4.2: Contrasting implications of positivism and social constructivism (Easterby-Smith, et al., 2015, p.52.)

Positivism tends to	Interpretivism (phenomenology) tends to
Use large samples	Use small samples
Have an artificial location	Have a natural location
Be concerned with hypothesis testing	Be concerned with generating theories
Produce precise, objective, quantitative data	Produce 'rich', subjective, qualitative data
Produce results with high reliability but low validity	Produce findings with low reliability but high validity
Allow results to be generalised from the sample to the population	Allow findings to be generalised from one setting to another similar setting

Table 4.3: Main features of positivism and interpretivism (Collis and Hussey, 2013)

Reviewing Tables 4.4 and 4.3, and in consideration of this research's aim and objectives, this research adopted the interpretivist (constructivist) philosophy. This research is considered socially constructed around the project to diffuse ICT innovations in UAE public schools. This is in-line with innovation diffusion literature where one of the main themes drawn from literature review in section 2.5 stated that: innovation development and adoption processes represent a socially constructed reality, where managing the social interrelationship is critical (Rogers, 2003; Van de Ven et al., 1999; King et al., 1994; Cooper, 1998; Greenhalgh et al., 2004). Accordingly, the focus was on gathering rich qualitative data in order to gain deep understanding of the situation.

4.4 Research Approach

After examining the research philosophies in light of this research, the next layer is research approach. Saunders, et al. (2012) identify three research approaches: inductive, deductive, or an abductive research approach. In general, the paradigm of enquiry that underpins scientific research is an inductive movement toward the theory building, or a deductive approach toward testing, confirming, or refusing a theory (Dewey, 1997. p.82). The inductive approach starts by data gathering and analyses to explore a phenomenon and identify whether relationships exist between variables in order to build a theory or framework. In addition, the inductive approach mainly uses qualitative data, focusing on gaining a rich understanding of the phenomenon and context. The inductive approach's strength is the production of an understanding about how the people interpret their social worldview about the phenomenon under investigation (Saunders, et al., 2012); however, it is important to note that the results from inductive logic are not a universal law (Blaikie, 2010).

On the other hand, the deductive approach starts with a theory and uses it to generate a working hypothesis about relationships between variables; then, this hypothesis is tested and, based on the evidence, it is either accepted or rejected. The deductive approach normally uses quantitative data as it driven by scientific principles and is described as a highly structured approach (Saunders, et al., 2012). The abductive approach is described by Saunders, et al. (2012) as a third type of reasoning, which he defines thus:

> "*Research approach involving the collection of data to explore a phenomenon, identify themes and explain patterns, to generate a new – or modify an existing – theory which is subsequently tested*"

A comparison between the three research approaches provided by Saunders is in Table 4.4. According to Collis and Hussey (2013), the researcher can move between the inductive and deductive approaches. Saunders, et al. (2012) support this position and agree that using a combination of induction and deductive approaches within the same research is possible, and state that it might be advantageous to do so.

Accordingly, this research adopted an inductive approach, as the research logic aims to gather data exploring the phenomenon and use it to identify themes and gain insight in order to develop d the ICT innovation diffusion framework for public schools in the UAE.

	Deduction	Induction	Abduction
Logic	In a deductive inference, when the premises are true, the conclusion must also be true	In an inductive inference, known premises are used to generate untested conclusions	In an abductive inference, known premises are used to generate untested conclusions
Generalisability	Generalising from the general to the specific	Generalising from specific to general	Generalising from the interactions between the specific to the general
Use of data	Data collection is used to evaluate propositions or hypotheses related to an existing theory	Data collection is used to explore a phenomenon, identify themes and patterns and create a conceptual framework	Data collection is used to explore a phenomenon, identify themes and patterns, locate these in a conceptual framework and test this through subsequent data collection, and so forth
Theory	Theory falsification or verification	Theory generation and building	Theory generation or modification; incorporating existing theory where appropriate, to build a new theory or modify an existing theory

Table 4.4: Comparing research approaches – deductive, inductive, and abductive (Saunders, et al., 2012, p.144)

4.5 Qualitative Research Methods

In consideration of the research objectives and assumed inductive research approach, qualitative research method was adopted as most appropriate for this research. The qualitative method approach originates from anthropology, sociology, humanities, and evaluation, where each has a different type of inquiry to guide the qualitative research design, including narrative research, phenomenology, grounded theory, ethnography, and case study (Creswell, 2013):

> "*Research methods involve the forms of data collection, analysis, and interpretation that researchers propose for their studies* "(Creswell, 2013. p. 247).

The use of qualitative research methods implies a set of characteristics that should be considered over the whole research phases and choices. Qualitative methods require attention to specific aspects considering the qualitative research design in every step of the research, including the study sample, data gathering, data analysis, interpretation, and validation. Easterby-Smith, et al. (2015) describe qualitative data as pieces of information that are gathered in a non-numeric form, where most of this data accounts for what participants have said or done; for example, interview recording and transcripts, and written notes of observations.

In addition, one major difference for qualitative research methods is that they specifically consider the researcher's role in the research. As qualitative research generally tends to be of an explorative nature and involves open-ended rather than pre-coded questions and responses, this makes the researcher's role critical in recording the entire interactions and, more importantly, to ensure following a consistent technique for qualitative data collection and analysis (Easterby-Smith, et al., 2015). Creswell (2013) supports this position and identifies some common core characteristics for qualitative research methods including:

- *The fact that it takes place in a natural setting where researchers gather empirical data on the ground by directly interacting with people, observing* *their behaviours in a natural setting; also, the researcher is considered a key research instrument where they gather data through examining documents, observing, or interviewing;*

- *The need for multiple sources of data requiring researchers to gather data through interviews, site observations, documents, and audio visual records;*
- *Qualitative methods imply inductive data analysis where qualitative researchers build patterns and categorise them into themes organised from the bottom up in order to develop more abstract units of information;*
- *The researcher has to keep focus on getting the participant's meaning about a problem or situation rather than using his own understanding;*
- *The evolving design nature of the qualitative research can be considered as an imitation plan that cannot be fixed and, as the research progresses, certain processes can change as long as it leads to better understanding of the research problem and help in answering the research question;*
- *Reflexivity is a key feature for qualitative research, wherein the researcher reflects on his or her own experience and background and how it affects the research interpretation*.

4.6 Research Strategy

The previous sections reviewed the research philosophies and research approach to set the basis to underpin the research design, which covers the next four layers: methodical choices, research strategy/strategies, time horizon and data collection, and analysis techniques and procedures. In addition, it includes a discussion on the main ethical issues and constraints that the researcher encounters. According to Saunders, et al. (2012), selecting research strategy should involve consideration of the research questions and objectives, and the coherence of the link with philosophy, research approach, and research purpose. In addition, they add more pragmatic considerations, such as extent of knowledge, amount of time and resources, access to sources of data, and potential participants.

With regard to the type of data inquiry, there are different strategies including experiment, survey, archival analysis, history, and case study; however, selecting the most appropriate strategy is vital, as each method's usage can overlap. Yin (2008) identified three conditions that guide in selecting an appropriate research strategy: (1) the form of research question; (2) the need to have control of behavioural events; and (3) the degree of focus on contemporary as opposed to historical events. Figure 4.3 demonstrates how the three conditions guide in selection. According to Yin (2008):

> "*case study is used in many situations, to contribute to our knowledge of individual, group, organizational, social, political, and related phenomena*"

Saunders, et al. (2012) support this description and assert that the case study strategy best serves in exploring a topic or a phenomenon within its context or real-life setting.

METHOD	(1) Form of Research Question	(2) Requires Control of Behavioral Events?	(3) Focuses on Contemporary Events?
Experiment	how, why?	yes	yes
Survey	who, what, where, how many, how much?	no	yes
Archival Analysis	who, what, where, how many, how much?	no	yes/no
History	how, why?	no	no
Case Study	how, why?	no	yes

Figure 4.3: Selecting research methods (adapted from Yin, 2008)

Therefore, a case study strategy and interviews are best suited to serve the purpose of this research, as these enable the researcher to explore ICT innovations diffusion in the UAE public schools, which is a contemporary event. With regard to control over behaviour, this is mostly related to case experiments and lab environment setting, which is not appropriate for this research.

4.6.1 Research Time Horizon

Time horizon refers to an important element of the research design; it can be a cross-sectional or a longitudinal study. Saunders, et al. (2012) describe time horizon around two questions: 'Do I want my research to be a 'snapshot' taken at a particular time?" or "do I want it to be more takin to a diary or a series of snapshots and be a representation of events over a given period?". The former refers to cross-sectional time horizon and the latter refers to a longitudinal study. In general, most research projects tend to be cross-sectional due to different constraints, especially time and resources (Cresswell, 2013). Longitudinal studies do offer capacity to study change and development over time; this can be done by conducting a study over different points in time or a simpler approach is to use available secondary data, for example, analyse employees' or patients' records over years (Saunders, et al., 2012).

For this research, and considering the defined research objectives, a cross-sectional time horizon was adopted.

4.7 Data Collection Methods

For this research, data collection methods will be based on qualitative methods. Data collection methods are the set of techniques and tools used to gather research data in line with the assumed methodical choices and underpinning research philosophy and approach (Saunders, et al., 2012). According to Yin (2008), case study evidence can come for many sources. He identified six main sources of evidence, which are summarised according to strengths and weaknesses in Table 4.5. On the identified six main sources of evidence, Yin (2008) notes that no single source has a complete advantage over all the others, that these sources are highly complementary, and that a good case study research should use as many sources as possible.

Source of evidence	Strengths	Weaknesses

Documentation	- Stable: Can be reviewed repeatedly - Unobtrusive: not created as a result of the case study - Exact: contains exact names, references and details - Broad coverage: long span of time, many events, and many settings	- Retrievability: can be difficult to find - Biased selectivity: if collection is incomplete - Reporting bias: reflects (unknown) bias of the author - Access: may be deliberately withheld
Archival records	- Same as those for documentation - Precise and usually quantitative	- Same as those for documentation - Accessibility due to privacy reasons
Interviews	- Targeted: focuses directly on case study topics - Insightful: provides perceived causal inferences and explanations	- Bias due to poorly articulated questions - Response bias - Inaccuracies: due to poor recall - Reflexivity: interviewees give what interviewer wants to hear
Direct observation	- Reality: covers events in real time - Contextual: covers context of 'case'	- Time-consuming - Selectivity: broad coverage difficult without team of observers - Reflexivity: events may be processed differently because they are being observed - Cost: hours needed by human observers
Participation / direct observation	- Same as for direct observations - Insightful into interpersonal behaviour and motives	- Same as for direct observations - Bias due to participant observer's manipulation of events
Physical artefacts	- Insightful into cultural features - Insightful into technical operations	- Selectivity - Availability

Table 4.5: Six sources of evidence: Strengths and weaknesses (adaopted from Yin, 2008, p.105)

Accordingly, and in consideration of the assumed philosophical and methodical choices, the researcher adopted semi-structured interviews as the main method for primary data collection. In addition, to ensure validity, data triangulation was done through using data from a combination documentation review and archival records review. Moreover, an important input into this data collection is using the secondary data from MBRSLP documentation and reports. According to Saunders, et al. (2012), secondary data are ‘data that you analyse further which have already been collected for some other purpose, perhaps processed and subsequently stored’. They identified three main types of secondary data: documentary, survey, and multiple source. Further details on the data collection methods and justification of selection are discussed in the following sections.

4.7.1 Interviews

Interviewing is considered the most employed method for information gathering in qualitative research (Bryman and Bell, 2011). Yin (2008) describes the interview as a guided conversation pursuing a consistent line of inquiry through a stream of questions that are mostly fluid compared to questionnaire questions, which are considered rigid. Saunders, et al. (2012, p.372) describe an interview as follows:

> “*essentially it is about asking purposeful questions and carefully listening to the answers to be able to explore these further*.

There are several types of interviews ranging from highly formalised and structured interviews to informal and unstructured conversation. It is important for the selected type to be consistent with the research purpose, questions, and objectives. Table 4.6 summarises three main typologies and corresponding interview types with descriptions.

In general, depending on the research purpose, appropriate research methods can be selected. Since this research purpose is mainly exploratory and explanatory, and in light of the research objectives and its inductive nature, a semi-structured interview method was used for data collection. The features of a semi-structured interview method allow the gaining of rich qualitative data on the selected case by developing the questions and themes mapped to the research objectives and context (Saunders, et al., 2012; Cresswell, 2013).

According to Saunders, et al. (2012), managers are more likely to agree to be interviewed than complete a questionnaire; the response rate for personal interviews is normally higher than for questionnaires. This supports the decision made to use semi-structured interviews as a data collection method in this research. As for the nature of questions in the semi-structured interviews, one should use open-ended questions to obtain as much data as possible, with a clear focus on the research topic and with flexibility to introduce new questions and change the order of questions in response to the interview's progress (Bryman and Bell, 2011, p.472).

Typology	Interview type	Description
Level of formality and structure	Structured interviews	- use questionnaires - predetermined identical set of questions (standardised) - quantitative research interviews - interviewer-administered - must stick to exact written questions - mainly used in descriptive studies
	Semi-structured interviews	- non-standardised - qualitative research interview - prepare list of themes and possible key questions - flexibility in terms of what topics or questions to use in each interview - can use additional questions depending on need - open comments for discussions - mostly used for explanatory studies
	Unstructured interviews	- non-standardised and informal - qualitative research in-depth interviews - no pre-determined list of questions to walk through - non-directive: interviewee talks freely about events and beliefs

		- informant interview: interviewee perceptions guide the conduct of the interview - mostly used in exploratory studies
Nature of interaction between research and participants	Standardised interviews	Interviewer-administered questionnaire
	Non-standardised interviews	- one to one (face to face, telephone, electronic) - one to many (focus group, electronic focus group)
Interviewer degree of direction	Focused interviews	Interviewer exercises greater direction over the interview
	Non-directive interviews	- interviewee talks freely about events and beliefs - informant interview: interviewee perceptions guide the conduct of the interview

Table 4.6: Interview types (adapted from Saunders, et al., 2012, p.375)

4.7.2 Documentation review

According to Yin (2008), documentary information can be applicable to every case study topic. Documentation can include a variety of types including letter, memoranda, emails, diaries, announcements, meeting minutes, reports, administrative documents, proposals, progress reports, internal records, related formal studies, and news articles. Documentation is useful; however, it requires careful review and validation as documents are not always accurate. Yin (2008) advises not to over rely on documents in case study research because the researcher must understand that those documents are written for a specific purpose and audience.

In this study, the researcher was provided with access to public and internal organisational documentation such as the MBRSLP landscape review, annual report, annual research, details of strategy documentation, deployment plans, and routine reports. All this documentation enabled the researcher to develop a better undertaking for the case context.

4.7.3 Designing and conducting qualitative semi-structured interviews

Since semi-structured interviewing was selected as the primary data collection method, this section will detail the process followed and the protocols taken in preparation. In general, semi-structured interviewing generally consists of open-ended questions covering the areas of investigation with flexibility to cover all or some of the topics. In most cases, it takes place in a face-to-face setting; however, interviews can be conducted over the phone or via other means of communication (Creswell, 2013). According to Kvale and Brinkmann (2008), semi-structured interviews are a social interaction between the researcher and the interviewee that need to be carefully planned and managed. This, a key principle for semi-structured interviews is preparing and planning, and, as Saunders, et al. (2012) put it, remember the five P's: 'Prior Planning Prevents Poor Performance'.

Creswell (2012) nine steps process for conducting qualitative interviews was adopted for this research (Figure 4.4).

1. Decide on the research questions to be answered by the interviewee

2-Identify interviewees best able to answer these questions (sampling strategy)

3-Determine type of interview most appropriate to answer the research questions

4-Use adequate recording procedures

5-Design and use an interview protocol or interview guide

6-Refine the interview questions and procedure by pilot testing

7-Determine the place of conducting the interview

8-Obtain required approvals and consent from interviewee

9-Use good interview procedure during the interview

Figure 4.4: Steps adopted in conducting qualitative interview (Creswell, 2012)

The nine steps process are described as following:

- The process starts with identification of the questions or themes of discussion with the interviewee.

- The second step focuses on identifying the interviewees appropriate for the study, normally referred to as sampling strategy; in this case, it will be a purposeful sample.

- The third step is about selecting the most appropriate type of interview (see Table 4.6).

- The fourth step focuses on the importance of recording the interview and the need to use an adequate recording device and recording procedure.

- The fifth step is a critical step that is concerned with designing the interview protocol and guide (this will detailed in section 4.7.3.2).

- Step six discusses the need to test and pilot the interview questions and the procedure to be refined. Piloting the data collection instrument is a critical step and almost all researchers recommend it (Kvale and Brinkmann, 2008; Saunders, et al., 2012; Cresswell, 2012; Bryman and Bell, 2015).

- Step seven is about the location of the interview. Selecting a location that is quiet and free from distraction to ensure quality of recording is recommended. In addition, it is important to consider the possible impact of the interview location on the interviewee's response and ability to speak freely (Saunders, et al., 2012).

- Step eight is concerned with the ethical issue of obtaining required approvals and interview consent to participate. In addition, it is important to provide the interviewee with background information such as the research topic and purpose of interview, confirming privacy and permission to record (Kvale and Brinkmann, 2008; Bryman and Bell, 2015).

- Finally, step nine is related to the interaction between interviewer and interviewee and the importance to consider some of the interview protocol and procedure including timing, focusing on the topic, respecting the interviewee, listening more than talking, and ensuring that the interviewee is comfortable and clearly understands the questions (Kvale and Brinkmann, 2008).

4.7.3.1 Researcher level of knowledge

The research level of knowledge is considered an important measure for the preparation of qualitative interviews (Saunders, et al., 2012). The researcher needs to be knowledgeable about the topic under investigation and the surrounding organisational or cultural context as misinterpretation might occur without appropriate preparations (Saunders, et al., 2012). For this research, the researcher has a very good level of knowledge on the topics under investigation from ICT innovation, ICT use in education, the education context, and UAE culture. This is due to his background as a UAE national, with a Bachelor's degree in IT and Master's degree in IT management, which provides him with the required technical and cultural background. On the other hand, the researcher has participated in different joint committees across the public sector on projects related to a smart government agenda, which allowed him good understanding of the research background. That said, the researcher made sure to do proper planning for each interview individually by reviewing the interviewee's background and the questions to focus on before the actual interview. In addition, the researcher made sure to send the interviewees background information on the research purpose and the discussion's main themes before the interview, so they would have enough time to read and possibly prepare for the interview.

4.7.3.2 Developing semi-structured interview themes and guide

To prepare appropriate interview themes and questions, the researcher used the findings from the literature review, documentation review, and discussions with peer researchers to make sure that the themes reflect the identified research purpose and objective. This supports the validity through triangulating inputs from different sources (Saunders, et al., 2012). Bryman and Bell (2015, p.473) explain that an interview guide can be written words or even other visual prompts that can be

> *"employed to refer to the brief list of memory prompts of areas to be covered that is often employed in unstructured interviewing or to the somewhat more structured list of issues to be addressed or questions to be asked in semi-structured interviewing".*

Saunders, et al., (2012) support Bryman and Bell's (2015) description of semi-structured interviews and assert that the researcher's list of question can be described as themes of discussion, where the interviewer may omit some of them according to the interview's progress. Bryman and Bell (2015) six elements in preparing an interview guide was used in developing the interview guide:

1. *Create a certain amount of order on the topic areas, so that your questions about them flow reasonably well, but be prepared to alter the order of questions during the actual interview.*

2. *Formulate interview questions or topics in a way that will help you to answer your research questions (but try not to make them too specific).*

3. *Try to use language that is comprehensible and relevant to the people you are interviewing.*

4. *Just as in interviewing in quantitative research, do not ask leading questions.*

5. *Remember to ensure that you ask or record 'face sheet' information of a general kind (name, age, gender, etc.) and a specific kind (position in company, number of years employed, number of years involved in a group, etc.), because such information is useful for contextualising people's answers.*

In addition, the kinds of qualitative interview questions are highly variable. Kvale (1996) suggested nine different kinds of qualitative interview questions that were used to guide this research's interviews:

1- *Introducing questions: 'Please tell me about when your interest in X first began'; 'Have you ever . . . ?'; 'Why did you go to . . . ?'*

2- *Follow-up questions: getting the interviewee to elaborate on his or her answer, such as 'Could you say some more about that?'; 'What do you mean by that . . . ?'; 'Can you give me an example . . . ?'; even 'Yes?'*

3- *Probing questions: following up on what has been said through direct questioning.*

4- *Specifying questions: 'What did you do then?'; 'How did X react to what you said?'*

5- *Direct questions: 'Do you find it easy to keep smiling when serving customers?'; 'Are you happy with the amount of on-the-job training you have received?' Such questions are perhaps best left until toward the end of the interview, in order not to influence the direction of the interview too much.*

6- *Indirect questions: 'What do most people round here think of the ways that management treats its staff?' perhaps followed up by 'Is that the way you feel too?', in order to get at the individual's own view.*

7- *Structuring questions: 'I would now like to move on to a different topic.'*

8- *Silence: allow pauses to signal that you want to give the interviewee the opportunity to reflect and amplify an answer.*

9- *Interpreting questions: 'Do you mean that your leadership role has had to change from one of encouraging others to a more directive one?'; 'Is it fair to say that you don't mind being friendly toward customers most of the time, but when they are unpleasant or demanding you find it more difficult?'*

As a result, for this research interview, themes were developed based on the findings from the literature review and the developed research framework by using the dimensions to explore the status of ICT innovation diffusion in UAE public schools (see Appendix A).

4.7.4 Sampling

According to Saunders, et al. (2012), sampling techniques enable the researcher to decrease the amount of data required for collection by focusing on data from a sub-group rather than all possible cases or elements. In general, sampling techniques fall into two main types: probability sampling and non-probability sampling (Saunders, et al., 2012). Probability sampling is mostly associated with survey research as there is a need to make inferences from the sample about the population in order to answer the research questions. According to Bryman and Bell (2015):

> *"Probability sample: a sample that has been selected using random selection so that each unit in the population has a known chance of being selected"*

> *"Non-probability sample: a sample that has not been selected using a random selection method. Essentially, this implies that some units in the population are more likely to be selected than others"*

For this research, the non-probability sampling technique was deemed most appropriate in consideration of the qualitative nature of the research and assumed methodical choice already made. For this research, it will be very challenging to interview all sets of stakeholders related to the UAE public schools and the MBRSL initiative. Thus, a purposeful sampling strategy was adopted in order to gather data from a representative and manageable sample. In terms of sample size, Saunders, et al. (2012) suggest that for semi-structured interviews five to 25 should be minimum sample size, depending on the research question and objectives.

As a result, this research sampling strategy was composed from a sample from different levels of stakeholders, as described in Table 4.7. This was based in the research context rich picture in Figure 6.2.

level	**description**	**Total Interviewees**
Federal MoE level	○ Top management (strategic level: associate undersecretary, minister advisors, department heads) ○ Middle management (section heads, projects lead, cluster leads) ○ Operational teams	6

Local education authority level	○ Edu zone and education councils (total 6 zone heads and 1 education council)	2
Schools – end-users	○ Cycle 2 schools and C3 school's principal/vice principal) ○ teachers	7 principals 16 teachers
MBRSLP level	MBRSLP top management (executive committee)	3
	MBRSLP senior management	4
	MBRSLP team members – operational level	8
	MBRSLP expert advisors	5
	MBRSLP partners/vendors	4
	Grand total	55

Table 4.7: Semi-structured interviewees list

4.7.5 Translating interview data

Using easily understandable language is considered crucial, with both interviewer and interviewee understanding the context of the discussion (Fontana and Frey, 1994). Accordingly, and in consideration of the limited English language among some of the interviewees, especially school level interviewees, the researcher decided to use the Arabic language as it is the mother tongue. Accordingly, the researcher translated the interview questions into Arabic. In order to ensure the accuracy of the translation process, the researcher used help from an Arabic linguist and tested the translations with some colleagues. For the other interviews, and wherever interviewees did not mind using the English language, the interview was carried out in English.

4.7.6 Transcribing interviews

In general, qualitative research interviews are recorded and subsequently transcribed (Kvale and Brinkmann, 2008). Accordingly, wherever audio recording was accepted, the researcher recorded the interviews and then transcribed the interview into written format. Transcription is defined thus:

> "*The written record of what a participant (or respondent) said in response to a question, or what participants (or respondents) said to one another in conversation, in their own words*".

In other cases, the researcher developed an interview summary based on the notes taken during the interviews. The researcher used the Microsoft OneNote application to audio record the interviews, write interview notes, and transcribe summaries. The OneNote application enabled recording and writing notes in the same place and provided the flexibility to link the recording with the notes taken, enabling the researcher to write contextual notes during the interview. Providing contextual notes to interview transcripts was considered an important aspect of qualitative data collection, where data without context might not provide much insight (Kvale and Brinkmann, 2008).

4.7.7 Ethical approval

According to Creswell (2013), ethical considerations should be considered and reflected upon through all of the research stages. Identifying ethical considerations should help in protecting research participants, build trust with them, and support research integrity. Moreover, ethical considerations will cover other aspects including privacy, authenticity, research credibility, and the researcher's role. Accordingly, the researcher identified ethical considerations for this research including the need to ensure obtaining all necessary approvals from the Institutional

Review Board (IRB), the MBRSLP programme, Ministry of Education, educational zone, educational council, schools, individual interviewees, and programme-related vendors and service providers; and the need to ensure any research authorship considerations.

4.7.8 Pilot study

Saunders, et al. (2012) define a pilot test as:

> "*Small-scale study to test a questionnaire, interview checklist or observation schedule, to minimise the likelihood of respondents having problems in answering the questions and of data recording problems as well as to allow some assessment of the questions' validity and the reliability of the data that will be collected*".

A pilot test is considered an important step in conducting research as it helps refining the questions and overall data collection plan (Yin, 2008). As a result, the researcher conducted a pilot test to validate and refine the interview process, questions, and themes. The pilot was done by colleagues at the researcher's office and university, which helped the researcher to ensure the appropriateness of the questions and the designed process. In addition, it enabled the researcher to practice the interview process and estimate the required timing. Based on the feedback and issues identified in the pilot test, the research refined the questions and the process to be more robust. Some of the results of pilot test are as follows:

- The number of questions was reduced, as some questions/themes were felt repetitive.
- The interview period during the pilot test was more than planned and accordingly the researcher reviewed the process to avoid wasting time and reviewed techniques to ensure putting the research discussions back on to interview topic.

4.7.9 Role of researcher

As mentioned earlier, in a qualitative research, the researcher is part of the research characteristics as he or she is involved in the whole process, requiring certain considerations such as ethical and personal considerations, which might affect shaping the interpretations assumed during and from the study (Yin, 2008). For this research, the researcher's professional background is in the field of IT, with more than 10 years' experience in the fields of technology and project management within the public and private sectors in UAE. From a management aspect, the researcher has a Master's degree in IT project management and a degree in executive leadership development programme, where he developed his management skills and knowledge. The researcher also worked in project management roles including managing IT projects and working on strategy and public policy in UAE federal government during his work at the cabinet office and currently in the UAE General Telecommunication Regulatory Authority, which has allowed him to gain knowledge and experience in public sector management.

4.8 Data Validity and Reliability

Validity is concerned with the integrity of the conclusions that are generated from a piece of research (Bryman and Bell, 2015) while reliability is related to demonstrating that the operations of a study, such as the data collection procedures, can be repeated, 'with the same results' (Yin, 2008). On the other hand, in positivist research reliability is usually high; however, in phenomenology research it tends to be low, where researchers need to demonstrate following certain clear procedures to enhance it (Collis and Hussey, 2013).

In reality, data validation takes place throughout the different stages of the research. According to Creswell (2013), qualitative validity refers to the use of specific procedures in ensuring accuracy of findings while qualitative reliability refers to the use of a consistent approach across projects. Based on the specialties of this research, there is a need to use multiple strategies for validation, which should enhance the researcher's ability to assess the findings' accuracy and at the same time convince readers of that accuracy.

To overcome validity issues, Yin (2008) suggests four tests and case study tactics: construct validity, internal validity, external validity, and reliability. Table 4.8 summarises the tests and tactics. Construct validity was described by Collis and Hussey (2013) as an important aspect for business research where the problem is that there are phenomena that are not directly observable, such as motivation or anxiety, and where these are assumed to be factors that explain observable phenomena and need to be explained. Referring to Table 4.8, Yin (2008) suggests three tactics to increase construct validity:

1. Using multiple sources of evidence. For this research, the researcher used evidence from semi-structured interviews, documentation, and archival review.

2. Establish chain of evidence. In this research, this was integrated in the research design and the data collection and handing strategy, described earlier.

3. Have a key informant review the draft case study report. For this research, a draft of the findings was shared with an informant to give feedback on some of the conclusions.

Internal validity is established when the research demonstrates a causal relationship (Saunders, et al., 2012). For a case study, a key to establish internal validity is to ensure establishing the phenomena in a credible way, with only identifying common patterns and themes between interviewees needing to be extended to insights and analysis for these patterns and how they emerged (Riege, 2003). To deal with internal validity, Yin (2008) asserts the importance of data analysis structure and approach and four tactics provided in Table 4.8.

External validity is described by Saunders, et al. (2012) as the extent to which the research results are generalisable to all relevant contexts. Yin (2008) describes external validity as being whether the study findings are generalisable beyond the immediate case study, and this external validity has been and major barrier in doing case studies. For case study research, Riege (2003) argues that it depends on analytical generalisation in order to achieve external validity. Yin (2008) provided two tactics to deal with external validity: use theory in single-case studies and use replication logic in multiple-case studies. For this research, the significance of the findings was discussed at UAE level and possible implications at regional level (see Chapter 8).

Reliability refers to a situation whereby if the same phenomena under investigation were to be investigated again using the same instrument, the same results should be obtained. In general, for quantitative research, reliability is much easier to achieve compared to qualitative research (Yin, 2008). The two tactics suggested to deal with reliability are using a case study protocol and developing a case study database. For this research, to enhance reliability, a case study protocol was created, with details on the research themes development; details of the process followed in data collection were provided.

Tests	**Case study tactics**	**Phase of research in which tactics occur**
Construct validity	• Use multiple sources of evidence	Data collection
	• Establish chain of evidence	Data collection
	• Have key informants review draft case study report	Composition
Internal validity	• Do pattern matching	Data analysis
	• Do explanation building	Data analysis
	• Address rival explanations	Data analysis
	• Use logic models	Data analysis

External validity	• Use theory in single-case studies	Research design
	• Use replication logic in multiple-case studies	Research design
Reliability	• Use case study protocol	Data collection
	• Develop case study database	Data collection

Table 4.8: Four design tests and case study tactics (adapted from Yin, 2008)

4.9 Analysis and Organisation of Data

An important element of research is the organisation of data collection, processing, and analysis. This section previews how the data in this research was organised and stored and the analysis methods and procedures for data used in this research.

4.9.1 Data organisation

This research's data organisation and storage was based on digital methods. All research data including raw materials, notes, audio recording, progress summary, letters, reports, and writing progress was stored in digital form using Microsoft's OneNote application. According to Saunders, et al. (2012), research data needs to be securely stored, and labelled properly to ensure easy access. Using OneNote enabled this, as it is easy to structure, with advanced search features and an ability to access it remotely from anywhere.

In addition, the Dropbox application was used for taking backup on the cloud with an additional backup copy on Microsoft OneDrive cloud. This approach was recommended by different researchers, including Creswell (2013) and Kvale and Brinkmann (2009). On the other hand, the researcher acknowledges the availability of other applications that are dedicated for research; however, he preferred using software that he is familiar with to avoid complexities and the need to learn new software. This is in line with Creswell's (2013) argument on the benefits of using a computer program and the consideration that need to be borne in mind when doing so.

Figure 4.5 summarises the overall process for data collection starting with raw data gathered from the semi-structured interviews. Then, the data processing with the raw data is captured and processed, including audio recording, transcription, and interview notes. The third step is the data analysis where the processed data is coded, sorted, and classified, in order to have processed data ready for detailed qualitative analysis.

Accordingly, to carry out the classification for analysis, the set of identified main dimensions was used to guide the raw data review by mapping them to the dimensions. After that, the researcher started a careful review again to identify the main emerging themes across the dimensions in an effort to interrelate emerging themes. After that, interpretation of the main observations took place to help in the analysis of findings and results discussions. The school interviews findings are discussed in Chapter 5.

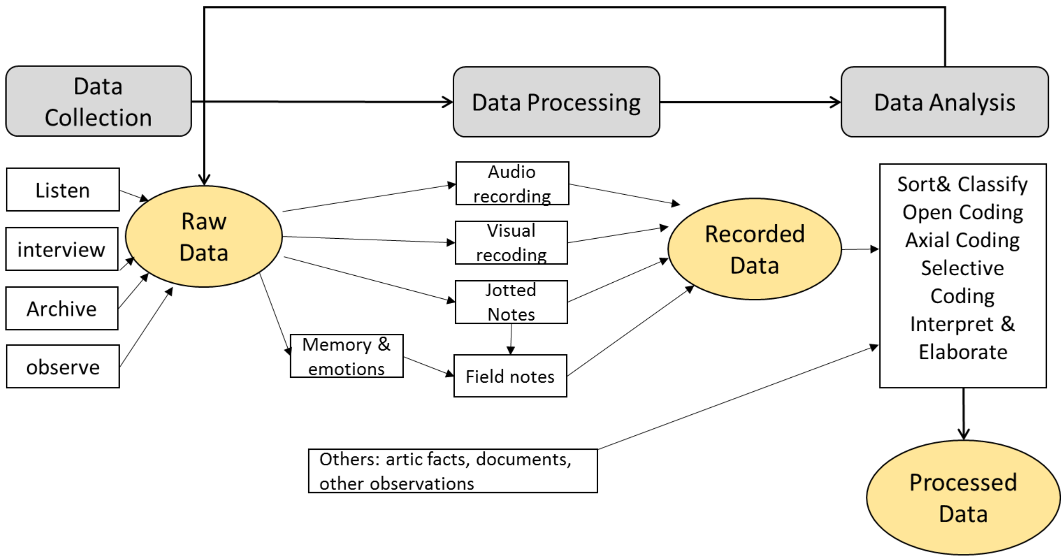


Figure 4.5: Data collection processing and analysis overview (Khairieuum, 2012)

4.9.2 Analysis of qualitative data

In general, qualitative data analysis works by identifying, examining, comparing and interpreting emerging themes and patterns (Cresswell, 2013; Saunders, et al. 2012). Bryman and Bell (2015), suggest that there are no fixed rules for analysing qualitative data. On the other hand, several researchers offer some guidelines and techniques for qualitative data analysis including Creswell (2013), Saunders, et al. (2012), and Yin (2008). According to Creswell (2013), qualitative data analysis normally takes place through multiple levels of analysis from specific to general, as demonstrated in Figure 4.6, based on a hierarchy of seven steps. It is important to note that these steps are interrelated and not always conducted in the presented order (Creswell, 2013).

Accordingly, the assumed approach started by preparing, organising and coding the text, reading through it carefully, summarising it into main themes, interrelating and mapping the themes, and finally interpreting and presenting it in the form of discussion, figures, and tables (Kvale and Brinkmann, 2008; Saunders, et al., 2012; Cresswell, 2013). Subsequently, gathered data findings were categorised and grouped into a number of main themes and sub-themes as required, in order to facilitate analysis. The synthesis of the data collection process, analysis process, findings, their meanings, meaning condensation, and observations are detailed Chapters 5 and 6. The next sections will provide details on the actual process of data collection at school level and different stakeholder level.

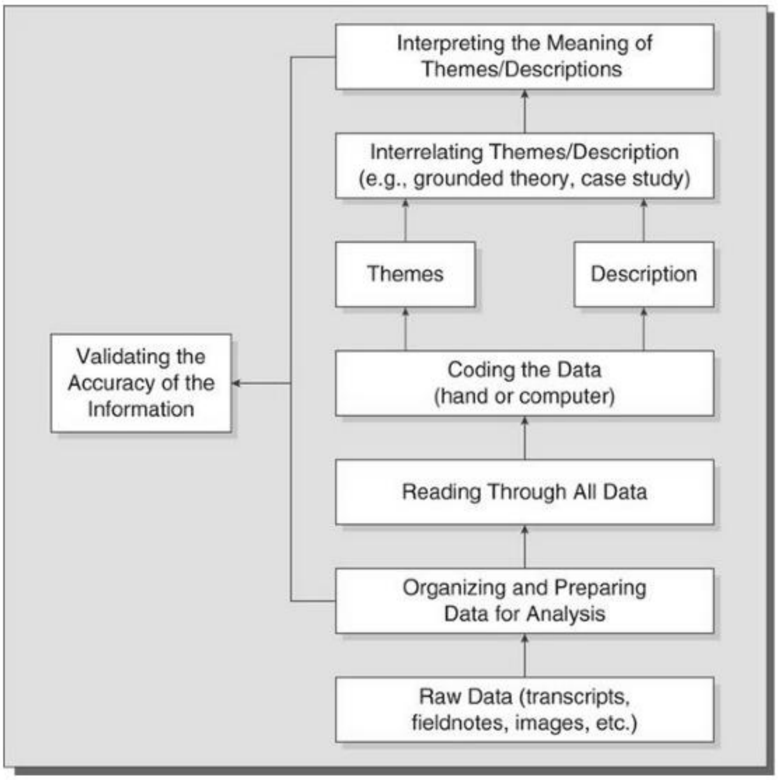


Figure 4.6: Data analysis in qualitative research (Creswell, 2013)

4.10 Actual Data Collection Process

This section demonstrates the process of primary data collection conducted through semi-structured interviews with schools. Semi-structured interviews were undertaken with teachers from each of the interviewed schools with the purpose of gaining rich data about teachers' experiences with the MBRSLP initiative to diffuse ICT in UAE public schools, and to discuss their views and perceptions on the different dimensions identified for this research.

Additionally, one-to-one semi-structured interviews took place with school principals, in some cases vice-principals, to gain rich data about their experience with the initiative and to explore their views and perceptions about the different dimensions identified for this research. The separation between principals and teachers was intentional, in order to be able to compare the consistency and differences among those different levels of adopters. In addition, comparisons were made between cycle 2 and cycle 3 schools, as each cycle has different needs and went through a different experience. This was assumed to help better understand the process of diffusion and adoption among different levels of adopters and to identify the main barriers or drivers.

4.10.1 School interviews

This section provides an overview of the interviewees from schools.

Interviewee profiles

A summary of the schools interviewed appears in Tables 5.1 and 5.2.

Total schools	Male schools	Female schools	Cycle 2 school	Cycle 3 school	Total teachers interviewed	Male teachers	Female teachers	Principal / Vice Principal
7	3	4	4	3	20	8	12	7

Table 4.9: School interview summary

No	School	Gender	Cycle	City

#1	School 1	Female	2	Sharjah
#2	School 2	Male	2	Dubai
#3	School 3	Male	2	RAK
#4	School 4	Female	2	Sharjah
#5	School 5	Male	3	Ajman
#6	School 6	Female	3	UAQ
#7	School 7	Female	3	Dubai

Table 4.10: School interview details

4.10.2 Data themes

The first step was preparing the raw data from interview transcripts, notes, and summary reports noted during the data collection period. Then, after careful reading and review through the data, a set of emerging main themes and sub-themes was identified. The review was guided by the set of main constructs and the dimensions for each construct that was extracted from the literature review and the research framework.

Table 4.11 summarises the main constructs and the underlying main dimensions used to guide data collection and analysis.

Main constructs	Main dimensions
Technological (innovation)	INN1 – Relative advantage INN2 – Cost INN3 – Complexity INN4 – Compatibility INN5 – Trialability INN6 – Observability INN7– Drivers of ICT diffusion in schools
Organisational (school)	ORG1 – School size ORG2– Change champion ORG3 – Centralisation ORG4 – Importance of school needs ORG5 – Re-invention
Environmental	ENV1 – Government support ENV2 – Competition with other public sector ENV3 – Vendor support ENV4 – Cultural aspects ENV5 – Resistance to change
Technology acceptance	TA1 – Performance expectancy TA2 – Effort expectancy

	TA3 – Social influence TA4 – Facilitating conditions
Adoption behaviour	AB1 – Stages of concern AB2 – Level of use

Table 4.11: Data analysis main constructs and dimension

The proposed structure for diffusion of ICT innovations dimensions is based on three broad areas of the TOE framework (Tornatzky and Fleischer, 1990), which is widely used in the literature for technological innovation diffusion and adoption at organisational context:

- Technological context: (the ICT innovation itself) "*describes both the internal and external technologies relevant to the firm. This includes current practices and equipment internal to the firm, as well as the set of available technologies external to the firm*".

- Organisational/school context: refers to descriptive measures about the organisation such as scope, size, structure, etc. (in our case it is school context)

- "*Environmental context is the arena in which a firm conducts its business, its industry, competitors, and dealings with the government*".

Measuring the status of ICT diffusing is based on a combination of:

- ICT acceptance construct: which reflects technology acceptance and is based on the UTAUT (Unified Theory for Technology Acceptance and Use) model from Venkatesh (2003)

- Adoption behaviour construct: which reflects to the use and adoption level in an education context and is based on the CBAM (Concerns Based Adoption Model) model (Hall, Dirksen and George, 2006)

4.10.3 Stakeholders' interactions data collection

In this section, the research will focus on the data collection and analysis process for the stakeholder dynamics over the life cycle of the MBRSLP ICT diffusion project in order to provide an answer to the third research question. The Project Management Institute's (PMI) typical five project phases of initiation, planning, execution, monitoring and control, and closing were used (Rose, 2013). This allowed a better understanding of the stakeholder involvements and perceptions over the different project phases within a year of deployment and over the different years of MBRSLP ICT innovation deployments. To accomplish this task, the researcher adopted the dependency structure matrix (DSM) methodology (also referred to as design structure matrix).

DSM is a powerful simplified tool to visualise the representation of a system or project in the form of a square matrix. DSM is mostly used in project management and system engineering to model the structure of complex system analysis, project planning, and organisational design projects (Browning, 1998; Danilovic and Browning, 2007). DSM has been proved to be a powerful tool in different areas including system planning, sequence planning, and information flow (Browning, 1998; Charlesraj, et al., 2004; Bartolomei, 2007; Bartolomei, et al., 2007; Lee, et al., 2010;).

For this research, DSM was used to map out each stakeholder's interactions over the main project activities and over the different years of MBRSLP ICT deployment in UAE public schools (see Appendices C and D). This allowed the researcher to present a simplified visual representation for changing dynamics in stakeholder interactions over the project stages, which will allow better analysis into reasons behind certain trends and possible justification.

The findings from the DSM matrix were further analysed using a heat map matrix and graph theory, using social network analysis to provide more insights into the stakeholder engagements and dynamics over years of deployments, project life cycle stages, and stakeholder level. Heat maps are considered a practical technique to visually analyse and demonstrate frequencies and variation. In addition, the social network analysis technique enabled the understanding of the dynamic interaction of stakeholders during the deployment stages. Social network analysis has emerged as a key technique in modern sociology. It has gained significant interest and is used across the physical and social sciences (Bryson, 2004; Reed, et al., 2009; Borgatti, 2009; Lienert, et al., 2013).

The overall process used for stakeholder analysis is summarised in a workflow diagram, as depicted in Figure 4.7.

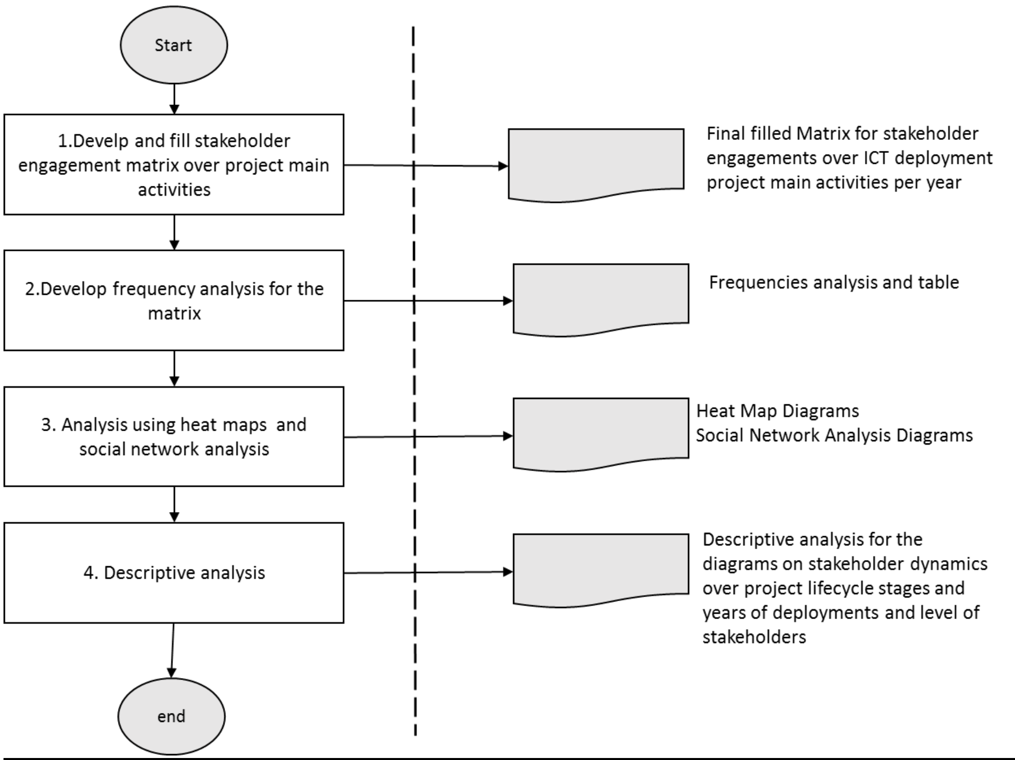


Figure 4.7: The process used for stakeholder analysis

The process to develop the DSM matrix and findings is discussed in detail in Chapter 6.

4.12 Chapter Summary

This chapter explained and justified the selection of assumed research philosophy, approaches, strategies, and methods to achieve the research aim. The overall research design, selected sample, data collection, data interpretation, data analysis, and data validation were discussed. In addition, the research's main ethical considerations were outlined.

Figure 4.8 gives a summary of the research methodology and adopted philosophical and methodological choices.

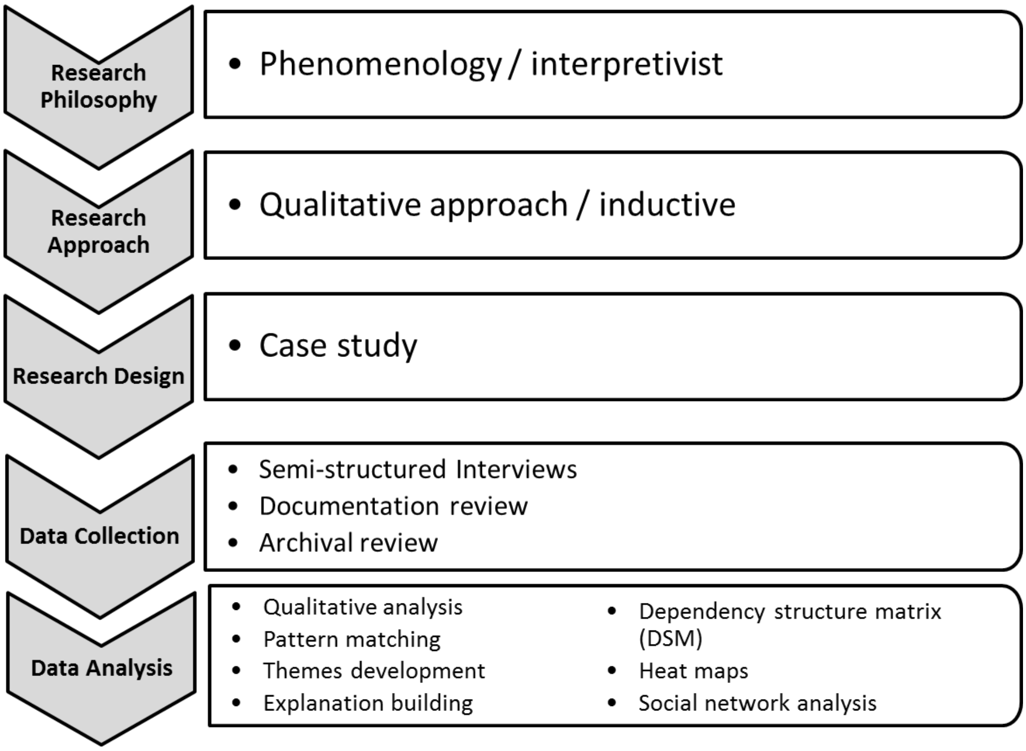


Figure 4.8: Summary of research methodology

CHAPTER 5: DATA COLLECTION AND FINDINGS – SCHOOL INTERVIEWS

5.0 Introduction

This chapter describes the data collection process as well as the findings from the semi-structured interviews with schools. The interviews were conducted according to the process described in Section 4.10.

The next sections present the research findings and the main emerging themes for each of the identified dimensions.

5.1 Technological innovation dimension

After reviewing the schools' interview data related to the 'technological innovation' dimension, a set of themes were identified as depicted in Figure 5.1. The findings for each dimension will be presented and discussed in the following sub-sections.

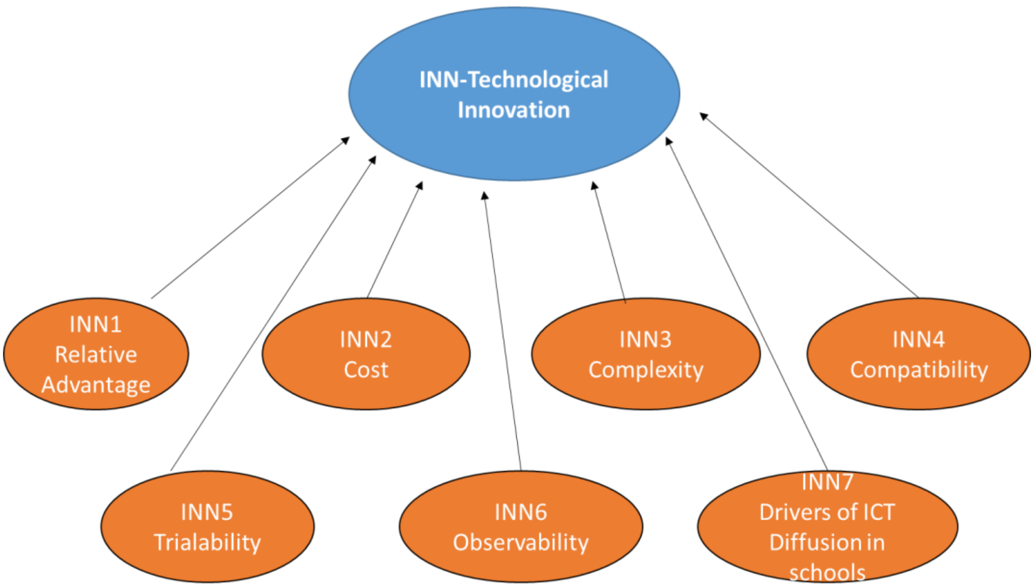


Figure 5.1 ICT Innovation construct main dimensions

5.1.1 INN1- Relative advantage

'Relative advantage' refers to the degree to which an innovation is perceived as being better than the idea it has superseded (Rogers, 2003), and it was identified as one of the most significant factors driving the adoption and use of ICT innovation in organisations. In the interviews, participants were asked to share their experiences of the MBRSLP initiative and their views on the relative advantage of the ICT innovations provided and implemented in their schools. The researcher used different terms to facilitate a better understanding from participants, such as:

- Main advantages and disadvantages of using ICT in schools?
- The importance of ICT use in schools?
- Comparing before and after the MBRSLP initiative?
- What does ICT enable you to do as a teacher/principal/school?
- What has the MBRSLP ICT implementation enabled you to do?
- Is it better educationally than before? If so, how?

In general, there was a consistent view across both cycle 2 and cycle 3 schools on the relative advantage of the provided ICT, and having the ICT was perceived as making the schools better than the previous situation, with limited ICT resources and ad-hoc use. All interviewees agreed that they could not afford to return to a situation where there was less or no ICT in schools. In addition, all schools perceived ICT as adding value to the teaching and learning process as well as making a positive impact on students' learning outcomes. In fact, all interviewees considered it a necessity, even those who had difficulties with ICT in their schools. According to school principal #1:

"*ICT is currently a necessity not luxury for schools*".

Other schools described the benefits and high levels of ICT adoption in their schools as follows:

> *"Using ICT is now part of the daily practice and lifestyle in our school".*

"without ICT, the normal school day will be disrupted".

In addition, there was a general agreement across interviewees that launching the MBRSLP initiative enabled schools to become better as it equipped all schools with an advanced ICT infrastructure and high-speed internet connectivity, and it provided free ICT resources and services to principals, teachers and students. Schools described the status of ICT before the MBRSLP as limited and inconsistent, and according to one of the teachers:

> *"ICT help us develop better content and save time by faster planning for lessons and easier communication with students".*

In addition, principal #3 stated:

> "*before we had limited ICT resources and occasional usage, but now ICT is available across all of cycle 2, and usage is part of the ongoing school day".*

Although all schools agreed on the relative advantages of ICT and the MBRSLP, there was a difference in how principals described the benefits of ICT. One of the school principal's descriptions was more focused on the technical aspects and how more ICT is simply better for schools. In this sense, principal #3 was asked about how he would describe good smart-learning classroom practice, and the subsequent description was more about the quantity of ICT usage (e.g. how many videos there were, and if all students used their tablets). The principal did not provide a deep understanding about the relative educational advantages of ICT usage, and this might have been because the interviewee was actually the vice-principal since the principal was not available that day.

From the discussions, it was discovered that vice-principals are not included in the training programme for the first two years, which might therefore explain this lack of a deeper understanding. In contrast, other school principals' descriptions were more about the educational benefits arising from using ICT, and how ICT can be used to enhance the teaching process as well as students' learning experiences and attainment. The description of principal #7 was in line with the idea of a deeper educational 'relative advantage':

"*the classroom shall have a different rhythm; different activities will be able to consider individual student differences and personalised learning…it will span lecturing to learning and focus on building students*' skills".

On ICT literacy, although implementation in cycle 3 schools started only recently, they were able to demonstrate a good understanding of ICT use in an educational context, and they provided useful examples of good practice in using ICT in education. The principals related the MBRSLP to the professional development programme they went through the previous academic year, which was called the Smart School Transformation Leadership Programme; all principals were very positive about this training and how it had helped them to understand better the educational 'relative advantage and good practice' perspective on ICT. In addition, one of the schools mentioned that they were part of the MAG school initiative, which was launched by the MoE a few years before and has only recently closed. They said that the initiative included, as opposed to regular schools, the enhanced use of ICT, where all teachers were given laptop devices and trained how to use them. This explained the higher level of use in these schools.

Finally, the comparison between principals and teachers' perspectives within the schools revealed some interesting findings. Some schools displayed consistent views and directions among teachers and the school principal, indicating a level of alignment between the principal and teachers. In the aligned schools, teachers and principals' descriptions of smart learning concepts, relative advantages, main challenges, and even their suggestions were consistent or went in the same direction, and this indicated the shared understanding and level of coordination and support between them in serving the educational agenda, which can be viewed as very positive in supporting change. On the other hand, the lack of alignment between principals and teachers might indicate conflicts, misunderstandings, or a lack of coordination, which does not serve the programme for change in implementing ICT in schools.

In summary, the main emerging themes from the ‘relative advantage’ dimension are presented in Figure 5.2.

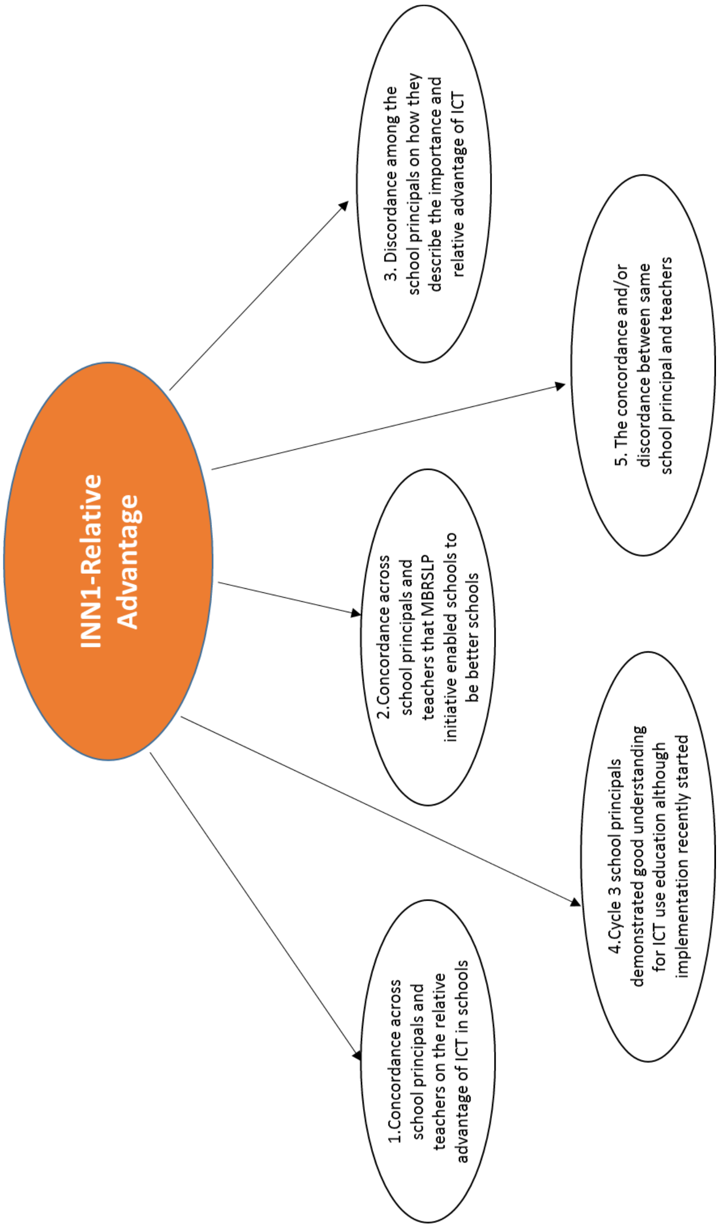


Figure 5.2 Relative advantage: emerging themes

5.1.2 INN2- Cost

‘Cost’ refers to the total expenses incurred in the adoption and implementation of the innovation. This cost includes administrative, implementation, training and maintenance costs. In general, the cost factor is a critical factor in an adoption decision and is a relatively easy characteristic to measure.

In general, cost was the least frequently discussed dimension during the interviews due to the fact that all school received the provided ICT resources and services free from the MBRSLP. Interviewees talked about costs not being a concern for them since the MBRSLP was taking care of everything. In an attempt to gain some insights into such a situation, the interviewer then moved the discussions from the factor of cost in their decision to adopt to their views and observations on the fact that there is no cost concern. In general, both cycle 2 and cycle 3 schools views on the cost dimension were consistent in that costs were not much of a concern since the MBRSLP was taking care of all costs related to providing devices and services as well as administration and training. There were no costs incurred for the schools, which makes acceptance and adoption an easier decision to make. According to principal #2:

> "*before we were eager to see this happen; in the past, we had individual efforts limited in scope, but now we have full support and resources for everything*".

For this initiative, a decision was taken at the highest level, i.e. directly from the Prime Minister, to disseminate ICT across all UAE public schools, and it was added to the main initiatives in the UAE Vision 2021 National Agenda. Accordingly, the decision to accept was much easier for schools, and they moved to the next step of how to use it effectively for teaching and learning purposes.

On the other hand, a majority of interviewed schools identified a concern with providing everything for free as they noticed less care taken with the devices by some students, especially given that all the devices were covered by insurance. Teachers suggested applying some mechanisms to encourage students to take good care of the devices:

> *"make students cover part of device cost".*

> *"keep student devices at school"*

"apply fine fees on students who damage the device".

"conduct awareness sessions to students and their parents".

Additionally, school principal #1 linked taking care of the student devices to the students' grades for behaviour, where their grade would be affected in certain cases related to smart learning, such as students not bringing their devices to school, students damaging their device, or even bringing their device to school with a low battery. In this sense, the principal said:

"*after applying this policy student took more care of the devices and classrooms are less disrupted by a student wanting charge their tablet*"

Moreover, school principal #3 described dealing with this challenge by motivating students in a more positive way:

"*we told them that these devices were gifts from HH Sheikh Mohammed and they needed to take good care of them".*

In summary, the main emerging themes from the 'cost' dimension are presented in Figure 5.3.

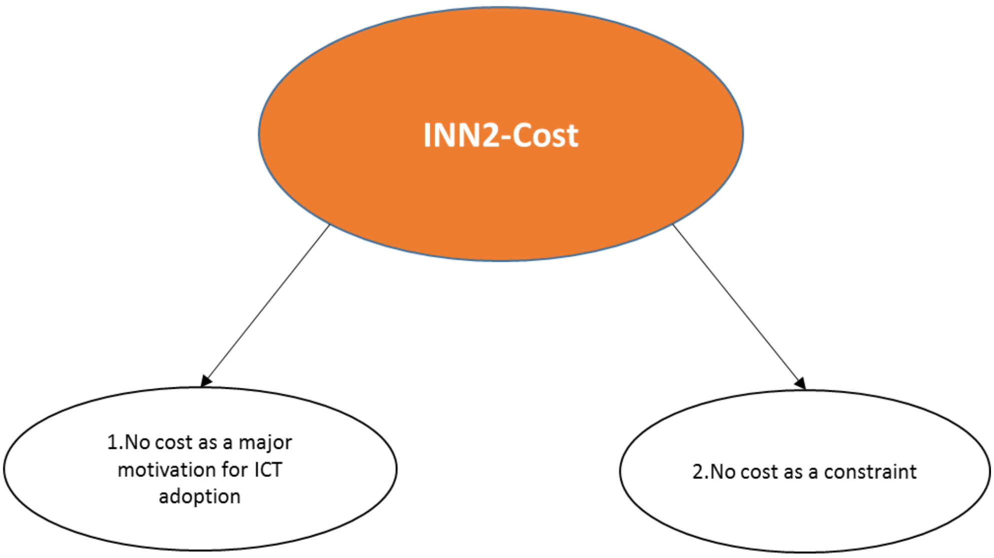


Figure 5.3 Cost: emerging themes

5.1.3 INN3- Complexity

'Complexity' refers to the degree to which a provided innovation is perceived as relatively difficult to understand and use. To discuss the 'complexity' dimension with interviewees, a number of related areas were used for the discussions with cycle 2 and 3 schools, which included:

- The system difficulty or ease of understanding
- The level of intuitiveness or ease of use
- The time to get accustomed to the new system
- The support given to simplify adoption
- The training experience

Cycle 2 findings

In general, cycle 2 schools' views on the level of technological innovation complexity were rated to be at a low to medium level of complexity. Although teachers and schools were challenged to change their teaching styles by learning new ICT technologies and integrating them into their daily teaching experiences, they described the complexity as acceptable and positive. This was related to the high level of support given to cycle 2 schools, where they had a permanent support engineer in each school and a weekly visit from the adoption team to help them use ICT and the provided learning management system (LMS) for educational purposes.

In addition, teacher training was perceived as very positive by both teachers and principals. Further, the implementation of ICT innovation was perceived as effective as it was not only limited to computer devices; in this sense, it extended to a package providing teacher laptops, student tablets, classroom connectivity, smart-boards, digital contents and curriculums, and applications including classroom managers, authoring tools, and smart learning gateways (SLG), which are customised web platforms to facilitate all educational activities and collaboration between school members, students, and parents. All these aspects formed an interrelated solution that supported the educational environment and allowed the schools to put devices into practical use faster. In addition, cycle 2 schools had an appropriate time to adapt to the change as they were in their third year of implementation.

On the other hand, after the third year, schools perceived the level support to reduce as a new support and adoption approach was introduced, where each support engineer was to support four to five schools compared to every school having their own support engineer during the first two years. Finally, after three years of implementation in cycle 2 schools, 'complexity' is currently perceived as being easy to use and that the use of ICT now is a key element of the educational experience. In fact, some schools talked about extending some of the features of the current technology and suggested providing new technologies to enable them to achieve more and cope with constant technological developments.

In general, the difficulty or ease of use was perceived as being between easy to medium difficulty, and in some cases as difficult. In reviewing the teachers' discussions, this was dependent on their existing levels of ICT literacy, which was diverse among teachers. A teacher from school #2 described the complexity and the time needed to get accustomed to the ICT as follows:

> "*it depends, as some teachers were already used to ICT, so it was easier for them to get used to the MBRSLP provided technology however some other teachers were less accustomed to ICT, and they needed more time and support to learn and get used to the provided technologies*"

Most teachers confirmed they had concerns about complexity and how they would cope with these new technologies at the beginning. However, they were less worried after they saw the level of support provided to them, and they started to be more open towards integrating ICT into their teaching practices. Principal #1 described his/her experience as follows:

> "*At first teachers needed some time to get used to* the *new devices and systems, but by the time they provided support, they managed to get used to them*".

On the time needed to get used to the new system, principal #2 stated:

“*it required* a *little time, but after one semester, things seemed more natural*”

On the current status, school #3 teachers stated:

> “*currently all teachers are used to ICT*; we use technology every day, for preparing lessons, during the classroom *and even after school in some cases to support some students”*

In analysing teacher’s suggestions about what they wanted to see or wished to happen in the future with regard to smart learning, the teachers’ discussion demonstrated that they are already thinking ahead and looking forward to implementing more complex ICT innovations in their educational contexts. Teachers in school #1 suggested the following:

> *“we want to see new technologies embedded into educational experience such as 3D printing*
> *-We need MRSLP support to introduce new ways of teaching and learning*
> -*We need to get enhanced interactive content so students get more engaged*
> -*We need to get smart learning specialized support on specific subjects such math, science, etc*”

With regard to provided support, teachers in school #1 described their experience with the provided ICT solutions from the MBRSLP as easy to understand and use, and they related this to the quality of initial training. According to one teacher:

> “*the training was well organised and different than what we were used to in terms of good trainers, good content, and location was outside school in a five-star hotel*”

On the support and adoption teams, teachers considered them as key enablers in simplifying complexity, as directly after training they had ongoing in-school support from the support and adoption teams. A teacher stated:

> "*The technical support and adoption team helped us overcome many challenges especially early stages of deployment*"

In addition, a school #4 teacher stated:

> "*MBRSLP provided our school with a permanent in school support team member to help us with any technical issues. In addition, we had the adoption team visiting us on weekly basis where they conducted workshops on using the learning management system (LMS) and different approaches to use ICT for teaching"*

On support provided to school principals, principal #2 stated:

> *"the adoption team was very beneficial to me as principal….I was aware of what is happening and what my teachers are doing at school level and also comparing to other schools…. they gave us reports on usage, targets given to each teacher, teachers progress with change and adoption of ICT"*

On principals' training, the general view was that it had started too late as cycle 2 schools started some time after the teacher training. On the other hand, cycle 2 principals mentioned the Smart Learning Professional Development Programme for school principals, which started in the third year. There was general agreement that this programme was very good as it provided a deeper understanding of smart learning concepts, what good practice should look like, their roles, and how they can support ongoing improvements for good practice across their schools. All the principals requested extending it to all the school teachers. According to principal #1:

> "*it was really beneficial and adds value to the way school transform to a smart school. …the training enabled better understand what smart learning is really about and my role as principle to make sure effective use of ICT to enhance teaching and learning"*

Cycle 3 findings

In general, cycle 3 schools agreed that using the provided ICT was not complex, especially since most of the cycle 3 teachers already used some ICT elements in their teaching. However, their view was that they had not had sufficient time to make full use of the provided ICT provision due to the late deployment timing. In this sense, they were in their last semester and exams were starting, and also the year had been a very busy one, with several changes affecting core elements of the educational experience, such as changes in the curriculum, assessment, school structure, and teachers' timing schedules. According to principal #5:

> *"there was no actual usage of provided devices due to several reasons including: devices delivery time in third semester, exams timing, there was no digital curriculum for grade 10, and too much pressure on teachers this year.*

In addition, a school #5 teacher stated:

> *"Students received their devices semester 3. At that time, they are busy with almost weekly quizzes, term exams and then final exams. It is a busy time to get distracted."*.

Regarding complexity and ease of use, cycle 3 teachers did not have any difficulties in using the provided ICT solutions, as they were more ICT literate compared to cycle 2 teachers. Instead of challenges relating to use, the list of challenges at the beginning of implementation included the following:

> "*timing of implementation was not appropriate, no digital book on devices to make immediate use, no alignment with new curriculum, support team did not have capacity to support the schools, technical issues with the connectivity, applications activation".*

The provided support was perceived as being below expectations as schools were aware of the higher level of support being provided to cycle 2 schools. This perception was related to late implementation over the second and third semester, compressed training, no dedicated adoption and support team per school, no digital books provided, and huge pressures on the schools due to the major changes across the education sector, and for cycle 3 specifically, such as changes in curriculum, assessment, school structure, teachers' schedule, new subjects, and several new changes to cycle 3. According to a school #6 teacher:

> *"the technical support person is responsible for seven schools, this is too much and she is doing her best to support us…we only have three classrooms…imagine if it is full school…We need at least one full time technical support"*

With regard to teacher training, teachers were generally positive about the quality of training, the quality of trainers, the venue, and the planning of the sessions. In contrast, other observations included that teacher training was delivered during the second and third semesters and extended over a period of five weeks (once a week); this was seen negatively by teachers as they said that by the time they had finished training, they had almost forgotten what they had learned. In addition, teachers hated having to go to school from 8:00-11:00am and then to the training centres from 12:00 to 5:00 pm.

According a school #5 teacher:

> "*it was very late.... Training was conducted over second and third semester and over a long period of 5 weeks (one session a week and each session is compressed) ...by the time of next session, we almost forgot what we learned in previous session!!"*

With regard to principals' training, cycle 3 principals had the advantage of doing a professional development programme based on the Smart School Transformation Framework the previous academic year, which was considered an advantage when compared to the late training for cycle 2 principals. The general feedback of cycle 3 principals on the professional development programme was very positive. However, they supported the teachers with regard to the challenges they faced and they expected to be able to adopt smart learning more effectively once these issues were resolved. According to the principal:

"we really enjoyed the professional development program which allowed us to better understand what smart learning is about and we hope next academic year the issues will be resolved so we start doing effective use of provided ICT resources"

Accordingly, based on an analysis of the interview transcripts for the 'complexity' dimension, two major themes emerged, both of which had two sub-themes as presented in Figure 5.4.

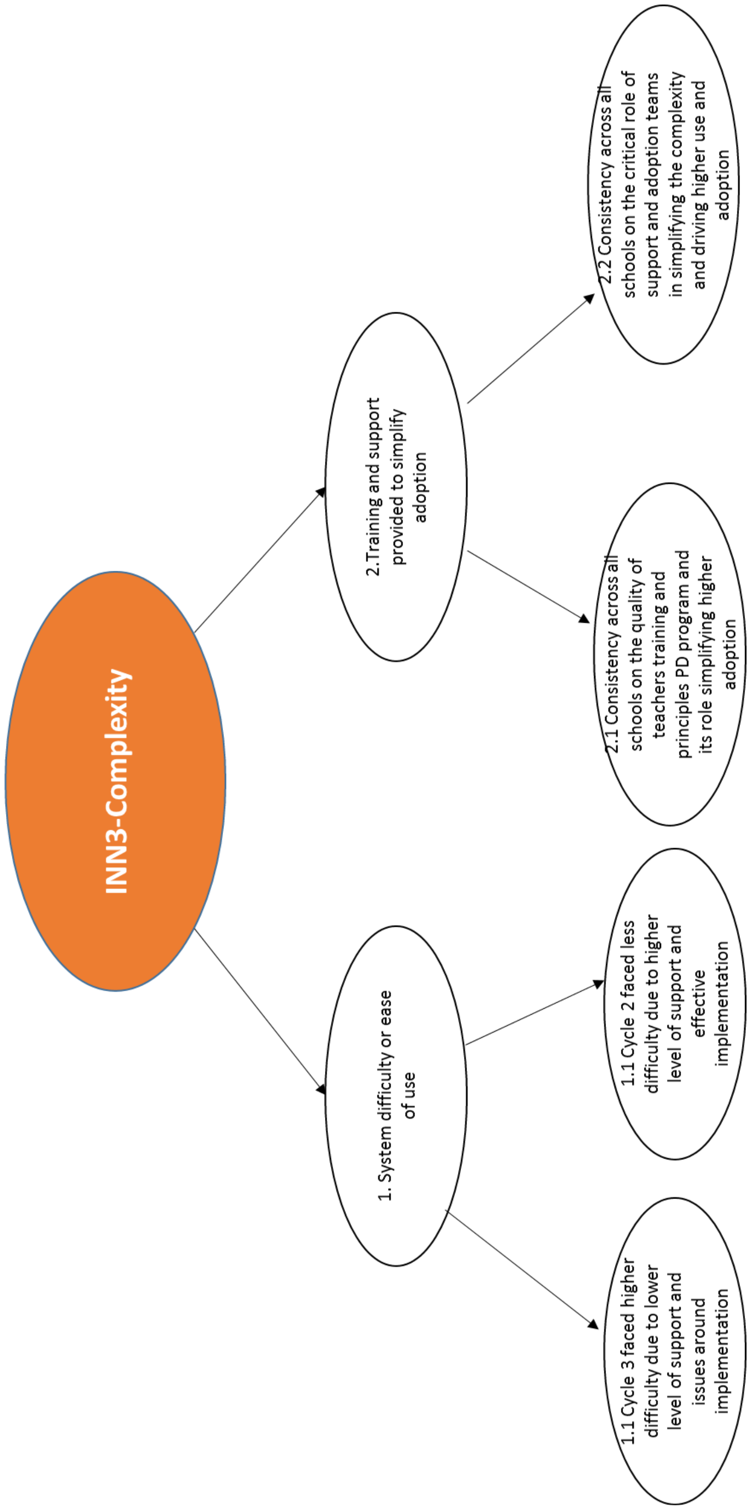


Figure 5.4 Complexity: main emerging themes

5.1.4 INN4- Compatibility

The 'compatibility' dimension refers to the degree to which an innovation is perceived as being consistent with the existing values, needs, and experiences of potential adopters. To discuss the technological innovation 'compatibility' dimension with the interviewees, a number of related themes were used for the interviews:

- Compatible with work aspects
- Consistent with existing values
- Consistent with existing needs
- Consistent with the existing experience of adopters
- Fitting in with the way you like to work/work style
- Naming and positioning of the innovation (e.g. National Agenda, Smart Gov, MBRSLP)

In general, there was a consistency of views from teachers and principals across cycle 2 and cycle 3 schools regarding the high level of compatibility of the provided ICT innovations with their needs, work aspects, and preferred working styles as educators. This was clear from the discussion of the 'relative advantage' dimension in Section 5.1.1 above, and it was clearly related to the general objective of the UAE government to adopt ICT across all sectors. Accordingly, schools felt that adopting ICT was a necessity in order to acquire the advantages and cope with the changes in the national direction (as discussed in the UAE background in Chapter 1).

In relation to consistency with existing needs, there were different views between cycle 2 and 3 schools. Cycle 2 schools considered the provided ICT innovations as consistent with their needs and suitable to them as educators. They explained that their previous limited and inconsistent state of using ICT in the schools was due to limited resources, and that the introduction of the MBRSLP allowed for the provision of ICT resources and smart learning tools across the schools. According to principal #2:

> *"ICT is already spread among people in UAE through mobile phones and so on….On the other hand, ICT help easier access to information and knowledge….before we were eager to see this happening, in past we had individual efforts with limited scope but now we have full support and resources for all"*

On the other hand, cycle 3 schools felt that the implementation was not compatible with their expectations. In the discussion with cycle 3 schools, their feedback indicated the perception that what had been provided to them in terms of the package of ICT resources and support was lower compared to what they had seen for cycle 2 over the past two years. They expected to start implementation at the beginning of the year and not at the end. In addition, they expected digital content for Grade 10 devices and also to have a support team member for each school. According to a cycle 3 teacher:

> *"students were expecting MBRSLP implementation with a lot of excitement ….they were eager to get the new tablets….to be smart school…however since it was late and not much applications and no e-books it came below their expectations"*

On the compatibility with the existing experience of adopters, a difference was noticed between cycle 2 and 3 schools. For cycle 2 schools, limited ICT skills and experience across a large proportion of the school teachers made the ICT provision less compatible with their existing experience at the time of start-up. However, this was the actual change that was planned to take place, and after three years of implementation a very positive outcome was observed, where cycle 2 teachers described the current state of ICT as part of a normal school day (as demonstrated in Section 5.4.1).

On the other hand, cycle 3 teachers and principals appeared to have more ICT skills and experience when compared to cycle 2 schools at the time of start-up, a fact related to the spread of ICT-use culture across the UAE influencing schools to learn how to cope with it. Additionally, at the time of implementation for cycle 3 schools, which was three years after launching the MBRSLP program, the school sector in general, including cycle 3 schools, had started to adopt ICT based on the individual efforts of teachers and principals. In addition, 'MAG schools', which was an initiative by the MoE in previous years, had already introduced ICT to some cycle 3 schools, thus making them more ICT literate.

Finally, naming and positioning was perceived as a major compatibility issue across cycle 2 and cycle 3 schools. Positioning of the ICT innovation was compatible with previous and ongoing directions toward ICT adoption at a national level, such as e-services, the UAE Smart Government, and the UAE National Agenda for Education, which included ICT and smart learning as key elements. On the other hand, naming was perceived as a major driver for compatibility since the initiative was named after HH Sheikh Mohammed bin Rashid Al Maktoum, a visionary leader who was respected locally and globally. In this sense, compatibility reflected an endorsement of HH's vision and initiative, and reflected his highness' support for this change and teacher's adoption. According to one teacher on the perception of the MBRSLP initiative:

> *"it is H.H. Sheikh Mohammed bin Rashid initiative and adopting smart learning is part of UAE vision 2021 and government directions toward smart government which we believe in and are committed to"*

Moreover, Principal #2 indicated that:

> *"naming the initiative under H.H. Sheikh Mohammed bin Rashid was a very clear message of support and had a direct impact in increasing adoption, cooperation from all parties to support the initiative and also it helped reducing negative criticism"*

In summary, the main emerging themes from the 'compatibility' dimension are presented in Figure 5.5.

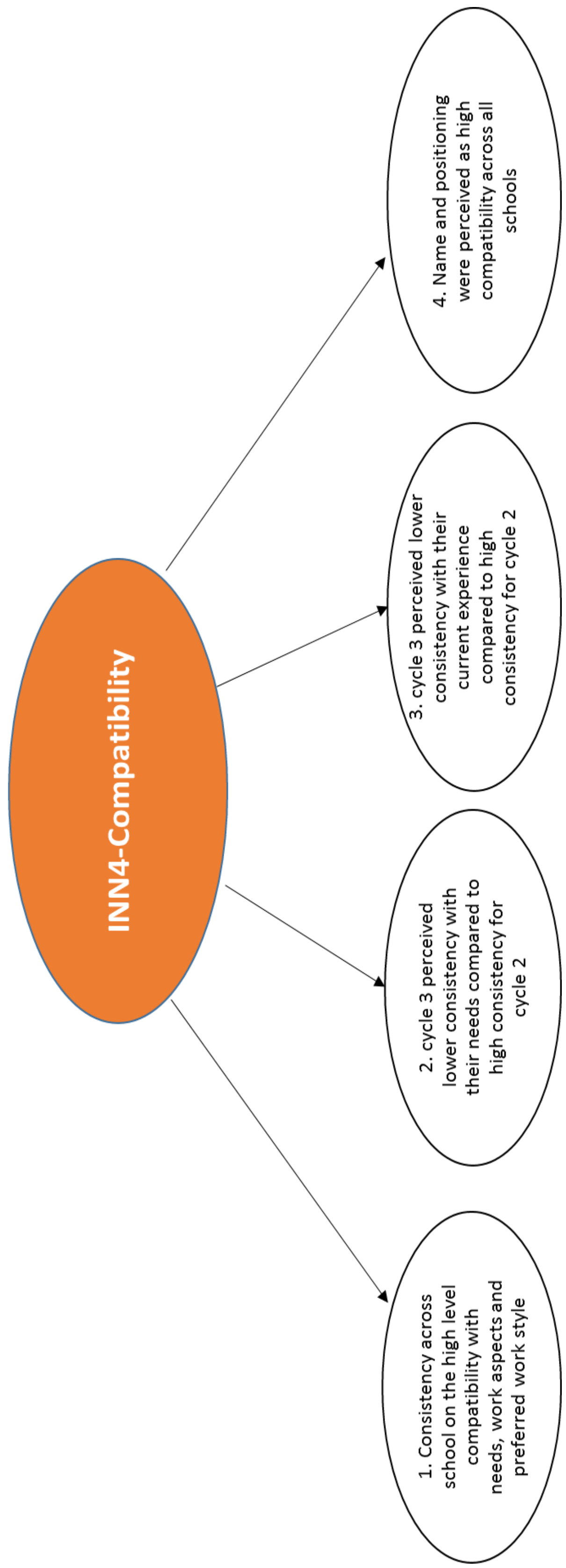


Figure 5.5 Compatibility: main emerging themes

5.1.5 INN5- Trialability

'Trialability' is the degree to which an innovation may be experimented with on a limited basis. To discuss the technological innovation 'trialability' dimension with the interviewees, a number of related topics were used for the interviews:

- Chance of experiments before implementation and testing by users
- Briefings and awareness before implementation
- Pilots
- During initial stages

Cycle 2 findings

In general, during the pilot phase schools were more involved in the ICT solutions provided to them, with ongoing engagement with teachers and principals for their feedback. However, after the first roll-out for grade 7 in 2013, engagement was limited to an annual principals' day briefing about past and future plans and to support and adoption team members. According to principal #2:

> *"at the early stages especially pilot stages there was very strong support, care and engagement from MBRSLP and MoE senior management…they visited the school many times, they sat with us and listened to our suggestions and feedback, however currently and by time this reduced"*

Other cycle 2 schools said they had not had the chance for a trial, first year implementation was very fast, and the first time they tried the technology was during the training period in the first week of the academic year. Principal #4 described the launch and implementation as follows:

> *"at first we heard smart learning from the official launch by H.H. Sheikh Mohamed in news and we were very happy with that and looking forward when it will happen in our schools. Then, without any introductions it was very quick deployment …we were surprised that all cycle 2 school were being transformed to smart schools…it was very quick"*

Principal #3 talked about the briefing and awareness by stating:

> *"after the fast first year implementation, we attended annual smart learning briefing session for principals were they explained what is happening and future directions"*

Some schools had been selected for specific pilots beyond the basic ICT provision that the MBRSLP provides. School #4 was selected to do a pilot for a mobile digital radio station and how to use it in the context of teaching and learning. The school principal said:

> *"we were properly briefed about it, teachers trained and ongoing weekly follow-up and mentoring provided for almost one year".*

Cycle 3 findings

In general, cycle 3 schools were informed and briefed about implementation, specifically for grade 10, at the end of the previous academic year. According to principal #7:

> *"last year in principals meeting day MBRSLP told us Grade 10 will be covered this year…they also told us little about cycle 2 experience and one principle from cycle 2 walked us through her school experience with MBRSLP (success and challenges)….this was good"*

Cycle 3 schools described these briefings as limited to background information as they were not involved in the design or requirements of the ICT technology. In terms of implementation, cycle 3 schools are still at an initial stage as they just received the ICT provision and training was only recently completed.

In general, cycle 3 schools wanted more involvement and engagement with the MoE and the MBRSLP with regard to smart learning. In this sense, principal #6 stated:

> "*we still at early stages of implementation and more engagement could have been better"*

In summary, the main emerging themes from the 'trialability' dimension are presented in Figure 5.6.

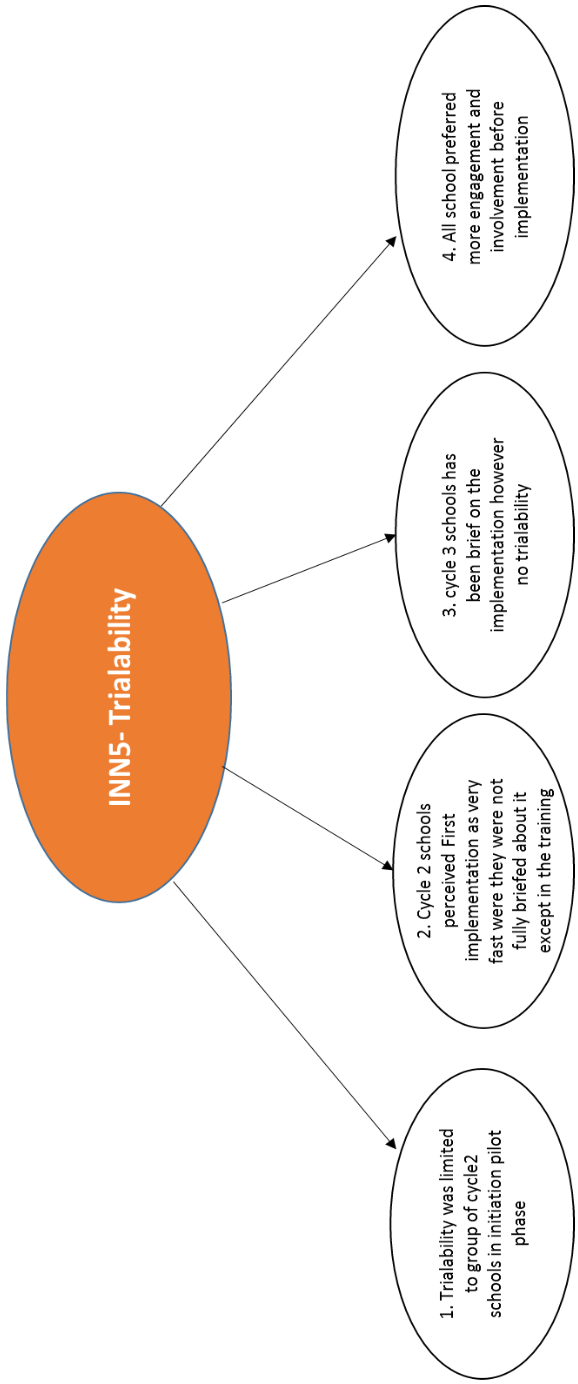


Figure 5.6 Trialability: main emerging themes

5.1.6 INN6- Observability

'Observability' refers to the degree to which the results of the innovation are visible to others. To discuss the technological innovation 'observability' dimension with the interviewees, a number of related topics were used for the discussions:

- Results and visible outcomes or benefits
- Rate of usage visibility
- Good practice visibility

Cycle 2 findings

In terms of the degree to which the results of the implemented ICT innovation are visible or not, after three years of implementation, cycle 2 schools acknowledged very visible results in changing the school culture to be ICT enabled, changing teaching practices through the use of ICT, and changing students' attitudes toward learning by preferring lessons or teachers to use ICT compared to not using ICT.

According to a school #3 teacher:

> *"Currently, all teachers are used to ICT…we use technology every day, for preparing lessons, during the class, and even after school in some cases to support certain students".*

In addition, principal #3 stated:

> "*Before, we had limited ICT resources and occasional usage; now, ICT is available across all cycle 2 schools and usage is part of the on-going school day*".

Teachers and principals explained that ICT is now part of the general classroom experience in cycle 2 schools, and without it normal classroom and teaching experiences would be interrupted. In addition, teachers and principals' ICT skills increased significantly, and their usage increased from ad-hoc and occasional to daily.

Moreover, principals talked about the real benefits gained from the professional development programme for Smart School Leadership Training. All the principals who attended the programme were positive about how it had helped them drive positive adoption in their schools (refer to the quote from principal #1 in Section 5.1.3).

In all of the discussions with cycle 2 schools, nobody proposed removing or stopping using ICT, even when they talked about issues and challenges; instead, they talked about resolving such issues and challenges to ensure the more effective use of ICT and to better impact on learning outcomes.

Cycle 3 findings

In terms of the degree to which the results of the implemented ICT innovation are visible or not, after the initial period of implementation, cycle 3 schools acknowledged the importance of ICT. However, all of them agreed that they still needed more time to see visible results, especially with the challenges they faced in terms of limitations, timing, and technical issues.

Principal #6 stated:

> *"we still at early stages of implementation and more engagement could have been better".*

According to a cycle 3 teacher:

> *"students were expecting MBRSLP implementation with a lot of excitement ….they were eager to get the new tablets….to be smart school…however since it was late and not much applications and no e-books it came below their expectations"*

According to principal #5:

> *"there was no actual usage of provided devices due to several reasons including: devices delivery time in third semester, exams timing, there was no digital curriculum for grade 10, and too much pressure on teachers this year".*

In addition, school teacher #5 stated:

> "*Students received their devices semester 3. At that time, they are busy with almost weekly quizzes, term exams and then final exams. It is a busy time to get distracted.*".

On the other hand, schools described some general observations around the positive attitude of students towards attendance and the learning process after getting their devices. In addition, some teachers talked about the immediate result of having ICT available in all classrooms for all teachers and students since it allowed them to move beyond the limitations they had experienced before due to a limited ICT infrastructure and lack of resources. They stated that having these resources allowed them to plan, prepare, and explain lessons better. However, in consideration of the timing, they thought that more positive results would be forthcoming over subsequent periods. According to principal #6:

> "*Before MBRSLP the school did use ICT however it was individual personal efforts and ad-hoc. However, after launching MBRSLP it is the whole school. MBRSLP changed the school environment to ICT enhanced learning environment for school grade 10 classrooms, teachers, students*"

In all of the discussions with cycle 3 schools, nobody proposed removing or stopping ICT usage, even when they talked about issues and challenges; instead, they talked about resolving such issues and challenges as well as the need for more time, training and support to ensure a more effective use of ICT to better impact on learning outcomes.

In summary, the main emerging themes for the 'observability' dimension are presented in Figure 5.7.

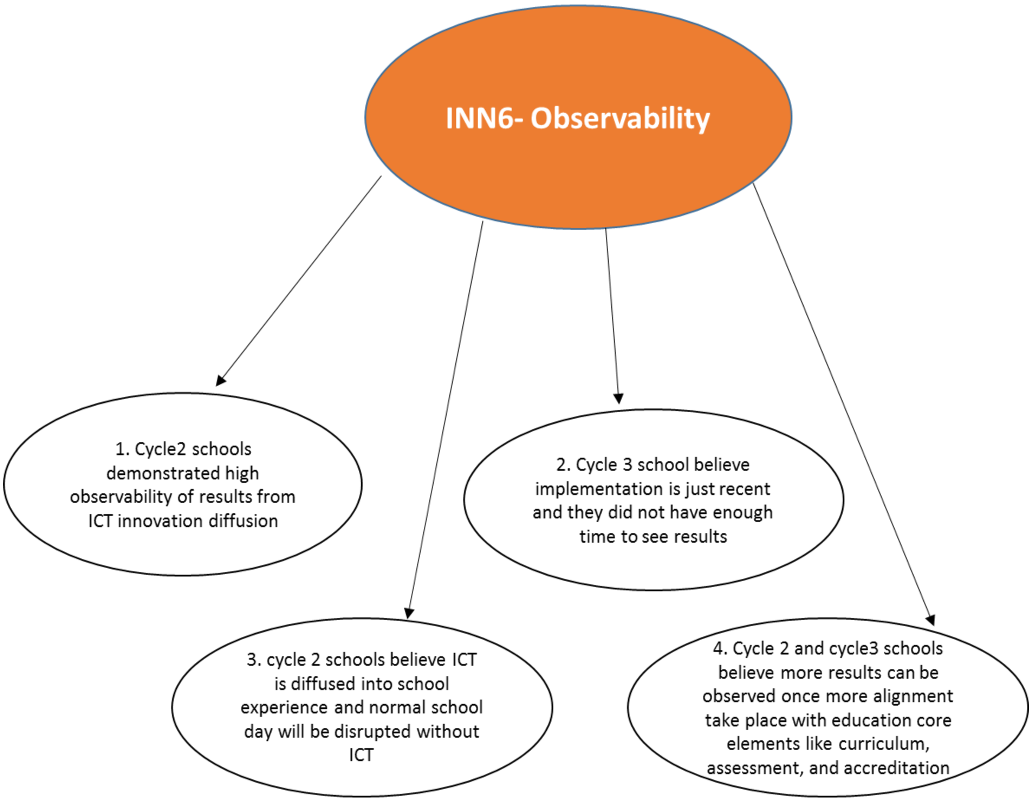


Figure 5.7 Observability: main emerging themes

5.1.7 INN6- Drivers of ICT Diffusion in schools

The focus of this section is on better understanding the main needs and drivers for the diffusion and adoption of ICT innovation in UAE schools from the perspectives of the research interviewees.

To discuss the ‘drivers of ICT diffusion’ with the interviewees, four main drivers were identified:

- Political
- Educational
- Economical
- Social

In general, the educational drivers were the most frequently discussed, and this was demonstrated in the ‘relative advantage’ dimension in Section 5.1.1. In this sense, schools talked about the educational benefits arising from using ICT, and how it could help enhance students' overall educational experience and attainment. Interviewees used statements like that of principal #1:

"*ICT is currently a necessity not luxury for schools*".

In addition, principal #5 talked about being in the knowledge economy:

"*ICT open doors for wider access to knowledge*".

According to principal #6:

> *"ICT is the current age language and students prefer using ICT so we have to cope with that".*

A teacher commented:

> *"ICT help us develop better content and save time by faster planning for lessons and easier communication with students*".

All of the schools talked about another key driver, which can be considered both a political and social driver. In all of the school interviews, the terms 'smart government', 'national agenda', 'direction of HH Sheikh Mohammed bin Rashid', and 'UAE Vision 2021' were used to describe why the schools needed to use ICT.

All of the schools agreed that ICT is a major development and that schools need to cope with, and be an active part of, the developments taking place around them in the UAE. The background of the UAE and the national directions toward adopting ICT innovation were main drivers for schools to welcome such an initiative so as to be able to cope with other public sectors.

In addition, interviewees believed that without the political support of HH Sheikh Mohammed bin Rashid, the acceptance and success could have been much lower. This direct political support was seen and a key enabler and driver since the programme was launched by HH and named after him. Schools considered supporting the MBRSLP programme and adopting ICT innovations as a national mandate since smart learning was one of the key sections in the UAE Vision 2021 National Agenda for Education:

> "*the UAE Vision 2021 National Agenda emphasizes the development of a first-rate education system, which will require a complete transformation of the current education system and teaching methods. The National Agenda aims for all schools, universities and students to be equipped with Smart systems and devices as a basis for all teaching methods, projects and research*" (Vision2021)

In summary, the main emerging themes from the 'drivers of ICT diffusion in schools' dimension are presented in Figure 5.8.

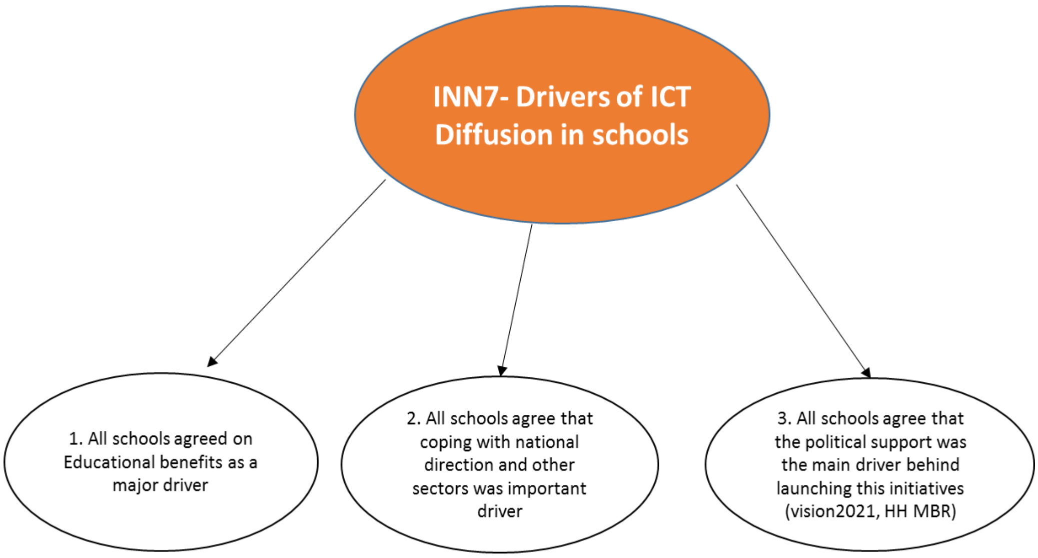


Figure 5.8 Drivers of ICT diffusion in schools: main emerging themes

5.2 Organisational/school dimensions' findings

After reviewing the data related to the 'organisational' dimension in our case school and education sector, a set of themes were identified as depicted in Figure 5.9. For each dimension, the data findings will be presented and discussed in the following sub-sections.

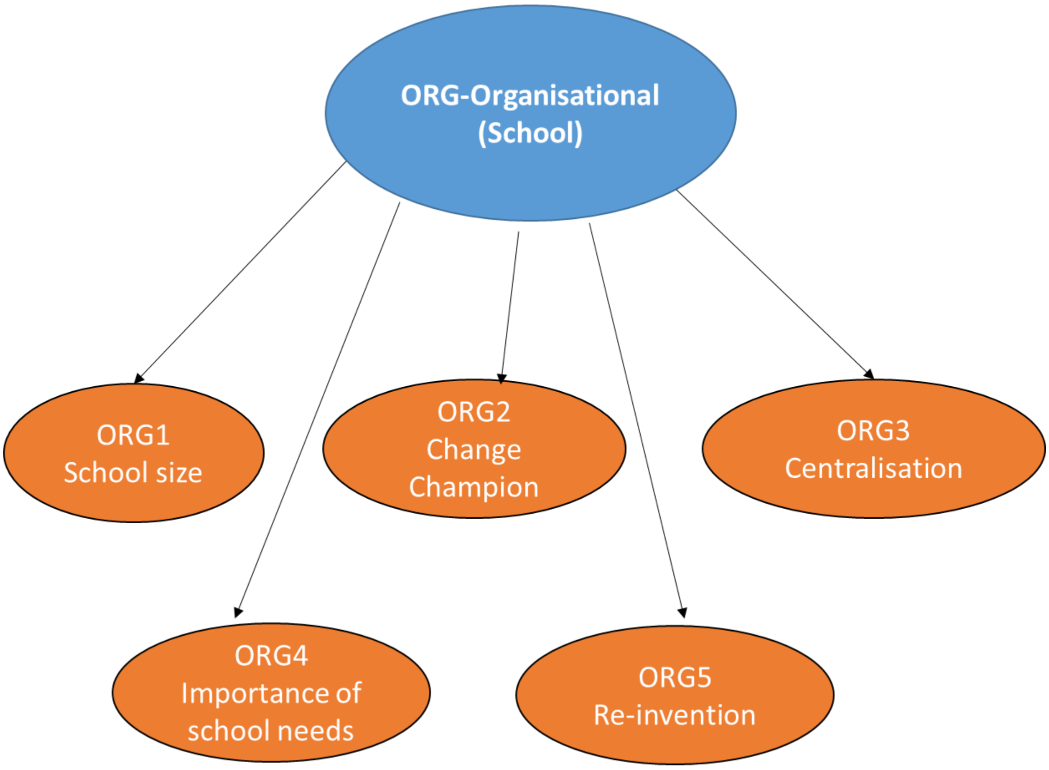


Figure 5.9 Organisational/school: main dimensions

5.2.1 ORG1- School size

The ‘organisation size’, or in this the ‘case school size’, dimension refers to the relationship between organisational size and ICT diffusion and adoption. To discuss the school size dimension with the interviewees, the focus was on the following aspects:

- School size in terms of number of students and teachers
- Roll-out size in terms of the size of each deployment phase by the MBRSLP
- Size of support in terms of the ratio of the number of support team members to beneficiaries for each school

With regard to school size in terms of the number of students and teachers, Table 5.1 summarises school size for the seven interviewed schools:

School	Cycle	Total number of	Total students covere	Total number of	Total teachers covere	Teacher to stude	Total beneficiaries	Suppose to beneficiary ratio

		stude nts	d by the MBRS LP by phase 3	teach ers	d by the MBRS LP by phase 3	nts ratio		
Scho ol #1	Cyc le 2	576	424	44	44	13	468	0.0021
Scho ol #2	Cyc le 2	630	428	49	41	12.9	469	0.0021
Scho ol #3	Cyc le 2	446	337	31	31	14.4	368	0.0027
Scho ol #4	Cyc le 2	1094	826	62	40	16.9	866	0.0011
Scho ol #5	Cyc le 3	254	73	22	17	11.5	90	0.011
Scho ol #6	Cyc le 3	189	78	14	17	13.5	95	0.010
Scho ol #7	Cyc le 3	357	153	25	19	18.7	172	0.0058

Table 5.1 Summary of school size for the seven interviewed schools

In terms of roll-out size, the MBRSLP roll-out was based on a phased deployment approach, where phase 1 roll-out covered grade seven, phase 2 roll-out covered grades eight and nine, and phase three covered grade ten, thus marking the start in cycle 3 schools. Table 5.2 summarises the statistics for each roll-out phase.

Roll-out phase	Phase 1 (academic year 2013-14)	Phase 2 (academic year 2014-15)	Phase 3 (academic year 2015-15)	Grand total
Total number of schools	123	22	57	202
Total number of classrooms covered	440	799	520	1,759
Total number students covered	11,548	13,000	10,185	34,733
Total number of teachers	1,343	2,300	2,750	6,393

Total number of principals	123	22	57	202

Table 5.2 Summary statistics for each roll-out size per phase

As for the size of support team members and their allocation across schools, during phase 1 and phase 2 the support approach was based on one per school. However, in phase 3, a new support approach was introduced, where each support team member covered seven to eight schools based on the schools' geographic distribution. Table 5.3 summarises the support team member per school ratio and Table 5.4 summarises the MBRSLP roll-out phases against geographic distribution.

	Phase 1 (academic year 2013-14)	Phase 2 (academic year 2014-15)	Phase 3 (academic year 2015-15)
Support team members to school ratio	1	1	0.14

Table 5.3 Summary of support team members per school ratio

Emirate	Phase 1 (academic year 2013-14)	Phase 2 (academic year 2014-15)	Phase 3 (academic year 2015-15)	Grand total
Dubai	Schools=24 Beneficiaries=2711	Schools=28 Beneficiaries=2870	Schools=40 Beneficiaries=2408	Schools=40 Beneficiaries=7989
Sharjah	Schools=36 Beneficiaries=3426	Schools=44 Beneficiaries=4650	Schools=59 Beneficiaries=3586	Schools=59 Beneficiaries=11662

Ajman	Schools=12 Beneficiaries=1445	Schools=14 Beneficiaries=1583	Schools=20 Beneficiaries=1411	Schools=20 Beneficiaries=4439
UAQ	Schools=6 Beneficiaries=582	Schools=8 Beneficiaries=666	Schools=11 Beneficiaries=494	Schools=11 Beneficiaries=1742
RAK	Schools=29 Beneficiaries=2859	Schools=32 Beneficiaries=3237	Schools=45 Beneficiaries=2891	Schools=45 Beneficiaries=8987
Fujairah	Schools=16 Beneficiaries=1831	Schools=19 Beneficiaries=2094	Schools=27 Beneficiaries=1941	Schools=27 Beneficiaries=5866

Table 5.4 MBRSLP Roll-out geographic distribution by Emirates

Reviewing the above tables, the main observations are as follows:

- In general, and based on the centralised structure in UAE public schools, all schools should be homogenous for those under the scope of the UAE Ministry of Education, implying that the same curriculum, exams, school structure, hiring of teachers, policies, processes, etc. are all centralised through the Ministry with limited freedom and control within schools.

- Accordingly, the perception from the schools as organisations is consistent and homogenous. On the other hand, the MRSLP provision of ICT innovation to these schools was also found to be homogenous, where all schools received the same ICT resources and services for each roll-out programme.

- Some school have more students than others, depending on the size of the school building and area demographics. For example, few schools outside the main cities have more than one cycle within the same school building.

- The model for adoption team members was one per school for the first two years. This did not consider the total number of beneficiaries (which refers to the students and school staff covered by the MBRSLP roll-out) per school, where some schools had more than 300 students while others had less than 100. This resulted in heterogeneity in the support team member to beneficiary ratio for the first two years.

- For phase 3 roll-out, a new support model was introduced, where each support team member would cover five to seven schools based on the total number of beneficiaries. This new model provided even distribution. However, as discussed earlier, schools preferred having one or more dedicated support team member(s) per school.

- When comparing cycle 2 and cycle 3 schools, the provision of ICT resources and services was heterogeneous. This is because, for cycle 2, the first two deployments, digital content and training, were delivered in appropriate time. However, cycle 3 deployment was perceived as late, and there was lower support and limited provision, with some elements late or missing, such as digital content, a support team member per school, and adoption team provision.

In summary, the main emerging themes from the ‘school size’ dimension are presented in Figure 5.10.

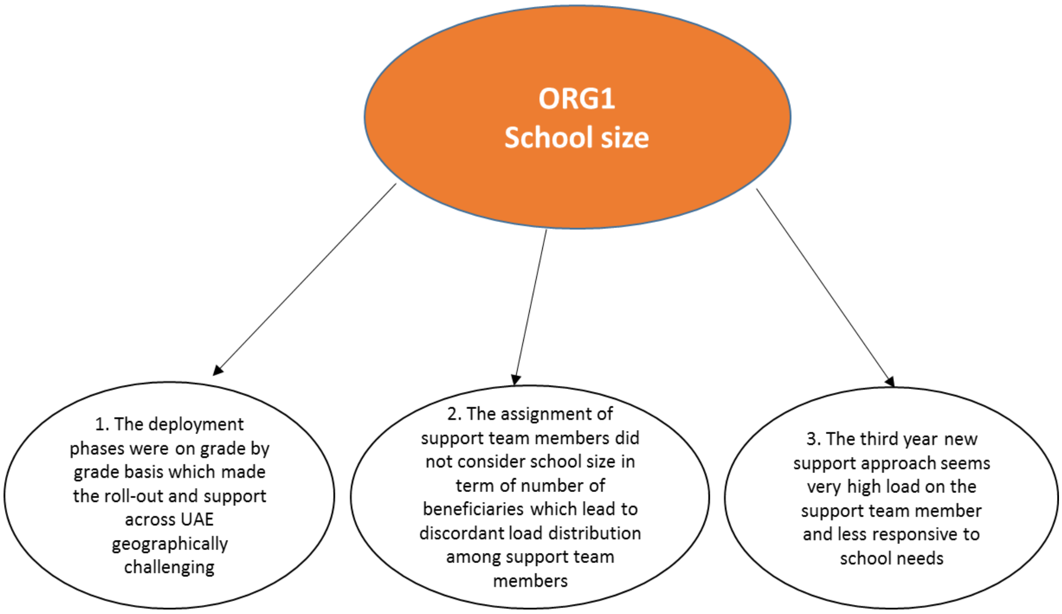


Figure 5.10 School size dimension: emerging themes

5.2.3 ORG3- Change champion

A ‘change champion’ can be defined as an individual who performs the task of spreading knowledge about new a technological innovation or promotes and supports the diffusion and adoption efforts within the organisation. To discuss the ‘change champion’ dimension with the interviewees, the focus was on identifying and better understanding the key individuals who were perceived as the main reasons behind successful diffusion and adoption within a school. Within this study context, the focus was on the following:

- Principal as champion
- Teacher as champion
- Support team member as champion
- Adoption team as champion

For each of above, the interviewer attempted to understand their level of ICT knowledge, their knowledge of the concept of smart learning and good practice for ICT use in educational contexts, how much they support using ICT in schools, the specific efforts they have made in these contexts, and the perceptions of others regarding their efforts. For every school, for example, the interviewer investigated the concept of 'change champion' by asking principals about their role as change champions and also if teachers had such a role and vice versa in order to obtain different perspectives.

Principal as champion

In general, it was clear that all principals generally supported the diffusion of ICT innovation in their schools. This was demonstrated during the discussion of 'relative advantages' in section 5.1.1 and the emergence of the theme of concordance across school principals and teachers on the relative advantage of using ICT in schools. On the other hand, the third emerging theme was discordance among the school principals on how they described the importance and relative advantage of ICT, a discordance which related to the different levels of ICT literacy or understanding among school principals regarding the concept of smart learning and what good practice of ICT use is in an educational context. Some of the principals' descriptions on the value of ICT were limited to the availably of ICT without being able to provide any deeper description on the educational applications of ICT in education.

Principal #1 demonstrated a very good understanding of ICT and the role of ICT in supporting an enhanced educational experience. She gave examples of how ICT can support faster knowledge transfer in a more interactive way. In addition, she described how ICT use in educational contexts can support the development of students' skills and abilities, such as confidence, collaboration, research, and presentation.

In addition, in describing both the smart learning concept and the MBRLSP, she was also aware of all the ICT technologies the MBRSLP implemented in schools as well as the services provided, which indicated her level of involvement in the process in general. With regard to good ICT teacher practice, the principal's descriptions focused on the use of ICT to enhance teaching and learning for students. In this sense, principal #1 stated:

> "*it is about impacting student's outcomes and student centric learning*"

In addition, the principal talked about specific initiatives she had started in order to support the implementation and diffusion of ICT in her school:

> *"to monitor progress and make sure teachers and students adopt technology in the best possible way, I developed customized monitoring and evaluation scheme my school. This scheme ensure teacher adopt ICT and maintain usage as part of their reporting ongoing process".*

Moreover, principal #1 started another initiative to increase adoption among students and ensure that students took good care of their tablets:

> *"for students we linked their behaviour grades to smart learning so they take good care of the devices and bring it to lessons ready and fully charged…after applying this policy student took more care of the devices and classrooms are less disrupted by a student wanting charge their tablet"*

Within the same school, the teachers talked highly about the role of the principal and her efforts in spreading smart learning culture and good practice in the school. One teacher stated:

> "*the principal developed a plan for smart learning in the school based on smart school transformation framework were we have regular session and workshops to discuss school initiatives and activities in regards to smart learning*"

Another teacher mentioned that the principal had assigned her as one of the school's two smart learning coordinators, where they follow and coordinate all activities and issues related to smart learning in the school:

> "*the principal gave us coordinator role and trained us on smart school transformation framework, now we are training other teachers as part of our school plan for smart learning*"

Principal #2 was also a good example of good school leadership in driving the diffusion and adoption of ICT innovations. According to principal #2, the school was involved with the smart learning programme from the first pilot, and since then he had been committed to supporting and driving the effective use of ICT in his school. Principal #3 demonstrated a very good understanding and personal interest in ICT innovation, indicating that the first robotics lab and club in Dubai had been started in his school. On describing the smart learning concept, the principal stated:

> *"it is about integrating ICT technologies into education to make it more motivating more reachable and student centric"*

Principal #2 also talked about some initiatives he had started in the school to support smart learning and the diffusion of ICT innovation. Of the two examples provided, the first was related to the engagement and awareness of parents, especially at the implementation start-up phase, where they organised meetings with parents to explain what smart learning was about, how students would benefit, and how parents could help. The second initiative focused on sharing knowledge and experience of smart learning with other schools. The principal stated:

> *"we did an internal initiative called 'Al Qafela Altanweria' were we our school teachers visited different school in Dubai and started to share our good practices in smart learning and ICT use in education. All schools welcomed the idea and our teachers enjoyed sharing with others"*

Principal #3, who was from a cycle 2 school in the city of Ras Al-Khaimah, also presented a good example of a smart learning school leader. He presented his approach to smart learning through a documented and detailed outline for his school's smart learning strategic plan. This plan included a clear vision and mission mapped to the MBRSLP and MoE visions as well as the UAE National Agenda. The plan had a clear set of objectives and key performance indicators (KPI's). In addition, the plan included a baseline for the initial state-up of smart learning two years ago and its current state, where it included details on students' levels of ICT, teachers' levels of ICT, main challenges, and main suggestions.

The principal also presented an annual survey he had developed for smart learning, which all students and teachers needed to complete, and which he subsequently used to feed into the school's strategic plan. According to principal #3:

> "*last year and part of survey for students is to ask if they have internet access at home which identified 28 students with no internet access at home (for several reasons and mainly some parents over protect kids due to certain perceptions on internet risks)…so we placed those students under special observation…we allocated 5 students under one mentor teacher to support them…examples of support included facilitating internet access for them in school lab whenever they need….arranging meetings with their parents to better explain and rectify any misconceptions….now out of 28 students only 3 students still don't have internet access at home*"

In addition, principal #3 also mentioned assigning teachers as smart learning champions in his school, where they supported students and other less skilled teachers to cope with smart learning practices.

In regard to cycle 3 school principals as change champions, in general all of them were supportive of diffusing ICT innovations and smart learning in their schools, as discussed in the 'technological innovation' dimension in Section 5.1. In general, all cycle 3 principals were at an early stage of implementation and had not had the appropriate time to actually experience and report it accordingly. However, all principals expressed their commitment to the issues faced so far in addition to suggesting improvements and the results they wished to see in the near future.

Teachers as champion

For teachers as change champions, three major examples were identified. First was the 'Al Qafela Altanweria' initiative in school #2, where teachers shared their experience with other school teachers. This initiative represents how teachers can act as change champions within and beyond their own schools. Another example was in school #1, were the principal transferred the knowledge she had gained from the professional development programme to two of the teachers, and they stated sharing this knowledge with other teachers through a series of workshops. Finally, it was noted that many principals assigned a number of school teachers to be change champions, and this helped spread smart learning knowledge and support diffusion within schools.

Considering that cycle 3 schools are still at an early stage of implementation, teachers had not yet had the appropriate time to actually experience and report accordingly. As discussed in the 'technological innovation' section, all teachers expressed their understanding about the relevant advantage of using ICT for teaching and learning.

Support team member as a champion

The support team is a specialised MBRSLP team outsourced from Hewett-Packard (HP) to carry the role of initial adoption and technical support in schools. In general, all schools considered support team members (for the first two years, they were called the 'adoption team') as champions in driving diffusion and higher adoption among teachers and students. A support team member was permanently assigned to each school for the first two years, where they helped in the adoption of the ICT resources by providing technical knowledge, handling all technical issues, and acting as the main point of contact for any smart learning related matters.

According to principal #1:

> "*MBRSLP provided full support to schools to enter into this transformation from technology provision, teachers training, dedicated fulltime on school support (hp adoption), ongoing weekly educational support (ITworx), and ongoing reports on school progress among other schools. All these created motivation and push for schools to effectively adopt change and engage with ICT and MBRSLP*".

School #1 teachers considered the support team members as one of the key success factors:

> "*The technical support / adoption team helped us overcome many challenges especially during the early stages of deployment*"

Principal #2 stated:

> "*support team member supported us planning and conducting all activities and initiatives related to smart learning, they were of great help*"

Principal # 4 stated:

> “*Support team member helped the school in managing all technical issues and also other initiatives such as engagement with parents and doing a competition to promote ICT use*”

A school #3 teacher stated:

> “*the support team members listen to us and tool out suggestions and complains to MBRSLP*”

On the other hand, all of the schools were dissatisfied when the support team members’ role changed to support multiple schools instead of one. They noted that this negatively affected the schools as it was too much of a load to bear and they could not effectively meet the schools’ needs. According to principal #4:

> “*first two years the support team member actively assisted the school in adoption and ICT and overcome technical issues, however for third year under the new approach were he support five schools they don’t have time for us….reporting and resolving technical issues takes much more time… we know they are doing their best but they are very busy*”

Since implementation started in the third year for cycle 3 schools, the support team approach was based on the new approach of one support member for every five schools. The discussions with cycle 3 schools on support team members were generic as they did not engage with them for a long time, and for them the scope of the support team was restricted to IT technical support. Cycle 3 schools stated that they expected to have a permanent support team per school, similar to what they saw in cycle 2 over the previous two years. In addition, the delays from the support team in attending to technical issues they raised were noted as they had been given too many schools to be able to handle all of them effectively. According to a school #6 teacher:

"*One technical support member for seven schools is too much and she is doing her best to support us…we only have three classrooms here…imagine if it is full school!! We need at least one full time technical support*"

Adoption team member as a champion

The adoption team is a specialised MBRSLP team outsourced from the ITworx Company, which is the same company that developed the Learning Management System (LMS) for the MBRSLP. This team visits schools once a week to support the adoption of ICT for educational purposes, and also supports the adoption of the LMS. In general, all schools considered the adoption team as very important in enabling them to use the LMS portal and mapping it to daily school practice. In addition, the adoption team assisted schools in using the provided educational solutions, such as the authoring and classroom management tools as well as the services provided on the LMS portal.

In addition, school principals recognised the adoption team's role in helping them set targets for teachers and get ongoing reports on the teachers and schools' progress compared to other schools in the city. According to principal #2:

"*adoption team (itworx weekly visit) …was very beneficial to me as principal …I was aware of what is happening and what my teachers are doing at school level and also compared to other schools. They gave us report on usage, targets given for each teacher and teachers progress with change and adoption of ICT"*

On the other hand, school #2 teachers expressed a different view on the adoption team member they had. They agreed that he helped them better understand and use the LMS system and the other applications, but they complained that he was over-instructing teachers toward a higher use of the company's solutions even when there were other options. According to one teacher:

"*the challenge was we are being pushed by the adoption team from this company (ITworx) to do more activities on their application to show high usage of their app even if it is not adding value to teaching and learning*"

This observation was noted and discussed in interviews with other schools, but the perceptions were not the same. Other schools thought their adoption teams were very cooperative and helped them to drive adoption by proposing new ideas, such as competitions and introducing new concepts such as flip-classrooms. According to a school #4 teacher:

> "*Adoption team in using the LMS and also to start initiatives to encourage ICT use among students like competitions and flip-classroom concept*"

As for cycle 3 schools, they had been told that adoption team members would start supporting their schools once the implementation for cycle 3 was complete.

In summary, the main emerging themes from the 'change champion' dimension are presented in Figure 5.11.

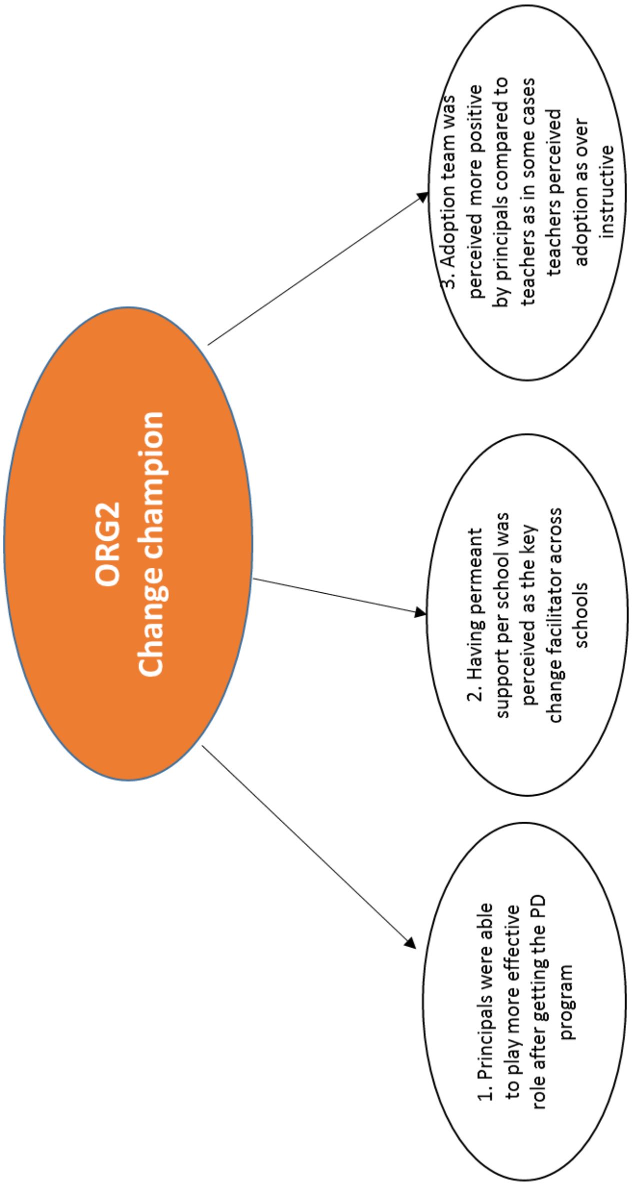


Figure 5.11 Change champion dimension: emerging themes

5.2.3 ORG4- Centralisation

‘Centralisation’ refers to the degree to which power and control in a system are concentrated in the hands of relatively few individuals in an organisation. The organisational level of centralisation and decision making in organisations is an important element in understanding the level of organisational innovativeness. At the school level, the focus was on understanding the schools’ perceptions of the levels of power across schools, education zones, the Ministry of Education, and the MBRSLP in relation to ICT innovation diffusion.

To discuss the centralisation dimension with the interviewees, the focus was on the following aspects:

- Centralised: all decisions and power are with the MoE or the MBRSLP
- Decentralised: all decisions and power are with the schools
- Hybrid: decisions, power, and authority are distributed between the school and the MoE or MBRSLP

In general, there was concordance across schools that public schools in the UAE have very limited power and authority, including with matters related to ICT innovations diffusion. Adoption decisions and the authority for innovation decisions rest with top management at the MoE, and therefore decisions to diffuse ICT across public schools are made at the governmental level and schools are expected to cooperate and comply.

According to principal #4:

> "*all decisions are done by MoE and we only have limited authority on some operational matters*"

Principal #1 described a similar view to principal #4, and added:

> "*I believe if we had more authority* we could have done much better *if we had more authority we could have done much better*"

Principal #2 stated:

> "*all decisions are centralized with MoE and schools has limited authority…we mainly do reporting to education zones and ministry*"

On the other hand, most of the schools could not differentiate clearly between the MBRSLP and the MoE with regard to the smart learning initiative. This was more valid with cycle 3 schools. According to principal #6:

"schools have limited authority, we just execute and report to MoE, though I am not sure what is done by MBRSLP and what is done by MoE in relation to smart learning"

In summary, the main emerging themes from the 'centralisation' dimension are presented in Figure 5.12.

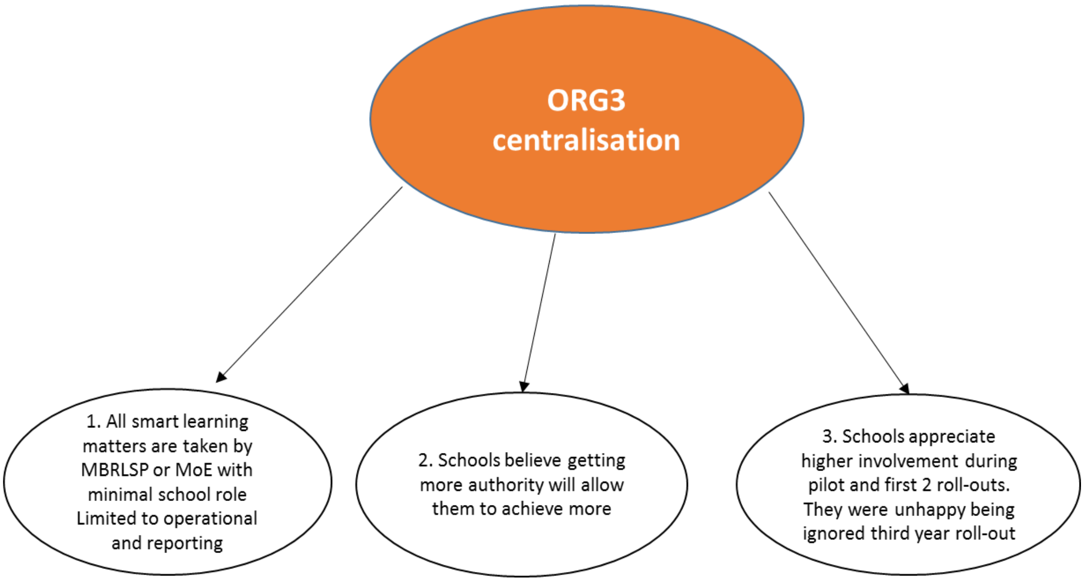


Figure 5.12 Centralisation dimension: emerging themes

5.2.4 ORG5- Importance of school needs

The 'importance of school needs' dimension focuses on how much the schools as main adopters of the diffused ICT innovations are involved in the process of diffusion. To discuss the importance of the 'school needs dimension' with the interviewees, the focus was on following aspects:

- Schools are aware, consulted, involved, or not involved in the ICT diffusion process
- How are the schools' needs and requirements attained?
- How often are the schools' needs and requirements supported and satisfied?
- Schools' needs and requirements go through clear channels of communication and engagement

In general, cycle 2 schools' views on their involvement mainly related to the implementation phase, and they mentioned not being involved in the technology design and selection. On the other hand, they were informed about the implementation plan for their schools, and they were involved in the processes of selecting server room locations, getting parents' approval to hand devices to their kids, and giving final approval for handing out the student devices by stating that the school and teachers were ready and signing a formal letter. According to principal #3:

> "*first year was very fast implementation, we were involved in few things like getting parents to sign acceptable use policy, assigning location to build server room….we were not involved in selecting the devices, applications or any of the provided technologies*"

On the other hand, principal #1, whose school was part of the pilot phase, experienced higher involvement:

> "*at the early stages especially pilot stages there was very strong support, care and engagement from MBRSLP and MoE senior management…they visited the school many times, they set with us and listen to our suggestions and feedback"*

School #2 teachers also described their experience of involvement during the pilot phase:

> "*during pilot phase schools was involved-in the whole process and all our suggestion listened to"*

> "*we were involved in devices testing, we were asked about our comments, suggestions, and ideas to make it better*"

For cycle 3 schools, there was concordance among the schools that they were not involved in the technology design and selection. The same was true for the implementation phase since it was delayed and perceived as below expectations, as discussed in the 'complexity' and 'compatibility' dimensions in Sections 5.1.3 and 5.1.4.

On the level of responsiveness to school needs, all cycle 2 schools perceived a higher level of responsiveness during the first two years, which then dropped during the third year. This was related to the new support approach, where schools no longer had dedicated support team members, as discussed in Section 5.2.2.

With regard to the channels of communication and engagement to communicate school needs, there was concordance across all schools that their formal channels were the support and adoption team members. Schools indicated not having direct formal access channels to the MBRSLP management, and they were not sure who was responsible for the MBRSLP or the smart learning agenda at the MoE and the education zone.

According to principal #1:

> *was no formal channel beyond support team member, I was lucky to have personal relations allowing me direct access to MBRSLP and raise any issues or suggestion*"

Principal #2 commented on a lack of clear formal channels of communication and engagement:

> "*There is no clear formal channel beyond adoption (ITworx) and support team (HP),we don't often engage with MBRSLP team and more engagement is critical for us*"

In addition, all schools indicated that they were not sure about the roles of each of the management teams they reported to in regard to smart learning, including the MoE, the education zone, and cluster managers. Schools described this lack of clarity as making them feel there was no alignment between these areas and the MBRSLP with regard to the smart learning agenda. According to principal #7:

"*regarding smart learning initiatives, we are not sure what is the role of MBRSLP, MoE, education zone, and even the new cluster managers…I feel there is not alignment between them which is not good*"

In summary, the main emerging themes from the 'importance of school needs' dimension are presented in Figure 5.13.

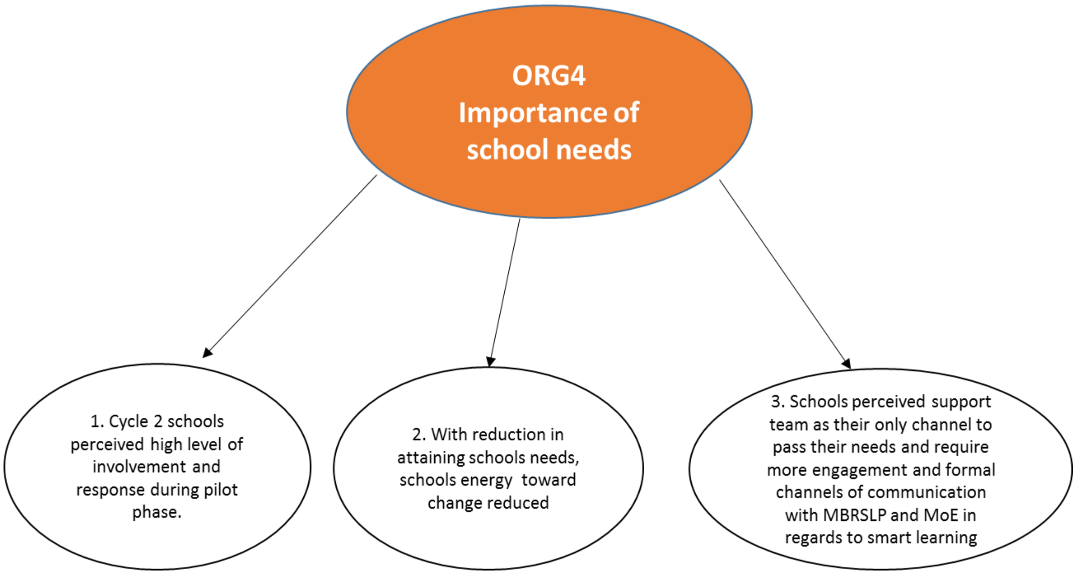


Figure 5.13 Importance of school needs dimension: emerging themes

5.2.5 ORG6- Reinvention

'Reinvention' is a process in which adopters modify an innovation to fit their local implementation settings. To discuss the 'reinvention' dimension with the interviewees, the focus was on the following aspects across schools:

- The degree to which the provided ICT innovations were modified or developed as they were diffused over the implementation period
- Any organisational changes that took place to support innovation diffusion and adoption

The development of the provided ICT innovations from the pilot phase to the first roll-out phase was perceived to be a major development, where the MBRSLP added several elements and ensured higher integration among them. A school #2 teacher stated:

"*there were major improvements compared to pilot phase implementation, we had new application such as classroom management software and the smart learning portal*"

As for the degree of developments from the first year and second year to the third year, cycle 2 schools' perceptions were that not much change had taken place with regard to the MBRSLP provision; the list of changes and additions included changing the brand of computers devices and smart-boards, updating the version of software, and changing the support and adoption model (which was not welcomed). For principals, the main changes were taking part in the professional development programme and getting the Smart School Transformation Framework, which was perceived very positively (as discussed earlier).

As for organisational changes, some principals mentioned making some changes in their schools to accommodate the smart learning requirements, such as assigning one or more teachers to be smart learning champions or coordinators of the school and new policies to support better smart technology adoption and use. For example, in school #1, use and taking care of the devices were linked to grades for student behaviour, in school #2, the Whatsapp application was adopted to create a chat group in order to communicate with parents, and in school #4, competitions amongst students and teachers were created to develop digital content.

In summary, the main emerging themes of the 'reinvention' dimension are presented in Figure 5.14.

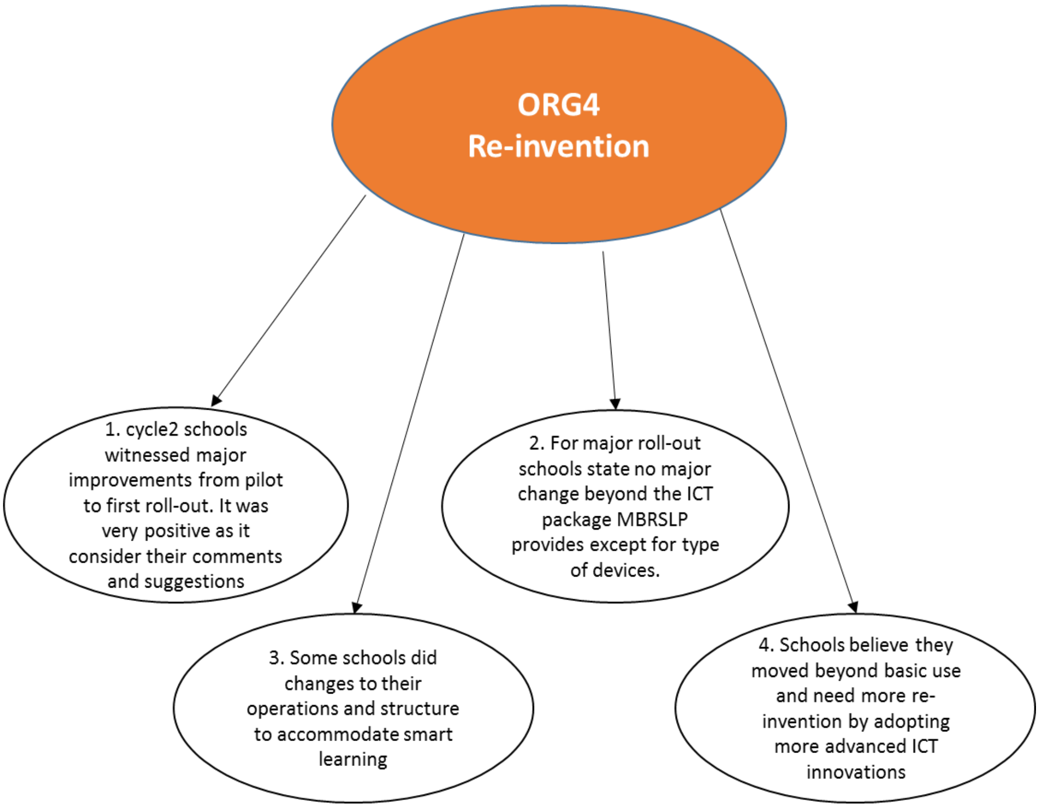


Figure 5.14 Reinvention dimension: emerging themes

5.3 Environmental dimensions' findings

After reviewing the data related to the 'environmental dimension' across the interviewed schools, a set of themes were identified as depicted in Figure 5.15. The data findings for each dimension will be presented and discussed in the following sub-sections.

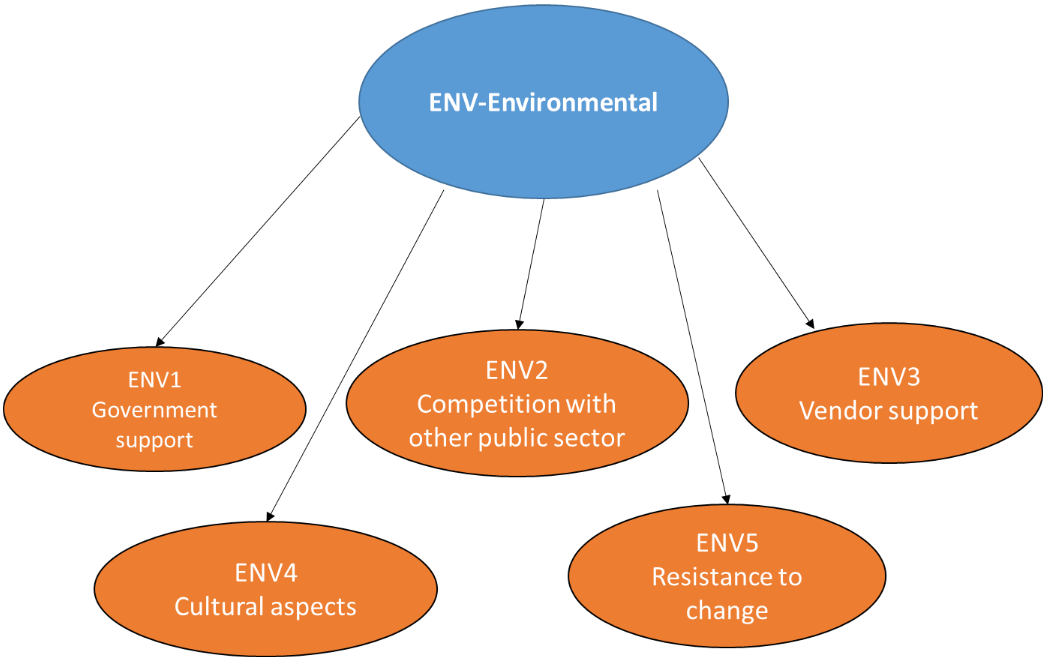


Figure 5.15 Environmental dimensions

5.3.1 ENV1- Government support

In general, ‘government support’ refers to the government initiatives and policies to promote IT adoption and use. To discuss the ‘government support’ dimension with the interviewees, the focus was on the following aspects:

- Extent of government support
- Extent of commitment of resource and support from top management
- Extent of government pressure in driving ICT implementation in schools

In general, all interviewees perceived the government as providing a high level of support and as an actual driver for ICT diffusion in the school sector in particular, and across all other sectors in general, as discussed in the ‘main drivers of ICT diffusion in schools’ dimension in Section 5.1.7 and the ‘compatibility’ dimension in Section 5.1.4. The level of support for resources is undoubtable since all resources and services were provided to schools at no cost, as discussed in the ‘cost’ dimension in Section 5.1.2.

As for the extent of government pressure to drive ICT diffusion in schools, all schools agreed that the government and political support were the main drivers behind launching this initiative (as discussed in section 5.1.7). The interviewees stated that smart learning was part of the UAE Vision 2021 National Agenda for Education, and also the program was named after HH Sheikh Mohammed Bin Rashid, which demonstrated the level of support as well as a level of pressure to make it happen. According to principal #2:

> "*ICT is already spread among people in UAE through mobile phones and so on….On the other hand, ICT help easier access to information and knowledge….before we were eager to see this happening, in past we had individual efforts with limited scope but now we have full support and resources for all*"

In addition, a teacher stated:

> "*it is H.H. Sheikh Mohammed bin Rashid initiative and adopting smart learning is part of UAE vision 2021 and government directions toward smart government which we believe in and are committed to*"

Principal #2 stated:

> "*naming the initiative under H.H. Sheikh Mohammed bin Rashid was a very clear message of support and had a direct impact in increasing adoption, cooperation from all parties to support the initiative and also it helped reducing negative criticism*"

In summary, the main emerging themes for the 'government support' dimension are presented in Figure 5.16.

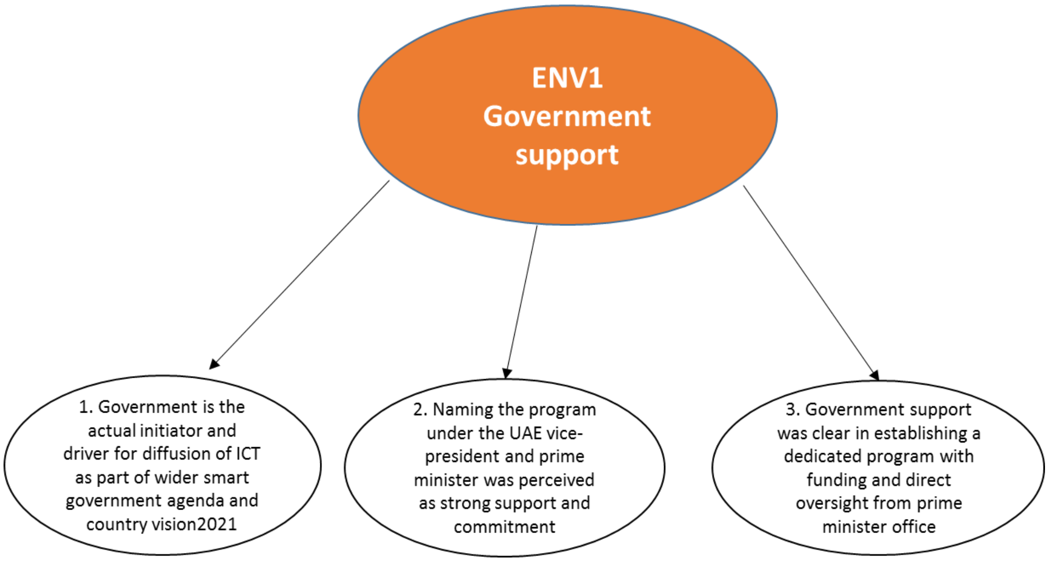


Figure 5.16 Government support dimension: emerging themes

5.3.2 ENV2- Competition with other public sectors

'Competition with other public sectors' in the UAE was perceived as an important dimension related to the diffusion and adoption of ICT innovation. In general, schools' perceptions of this topic were that before the MBRSLP, they were behind, and after the MBRSLP launch, they feel they are now coping with it.

According to principal #3:

"*after MBRSLP launched we feel we are now coping with smart government*"

Principal #7 stated:

> "*MBRSLP changed the school environment to ICT enhanced learning environment for our school grade 10 classrooms, teachers, students …. MBRSLP help prepare students for university and for the future job*"

In addition, school #4 principal stated:

> "*schools need to cope with these developments in the smart government… Technology should be embedded in educational experience…it should be linked to smart government… no office, no paper and can work from anywhere any time on smart phones*"

A teacher from school #5 stated:

> "*it is H.H. Mohammed bin Rashid initiative and adopting smart learning is part of UAE vision 2021 and government directions toward smart government which we believe in and are committed to*"

In summary, the main emerging themes for competition with other public sector dimension are presented in Figure (5.17)

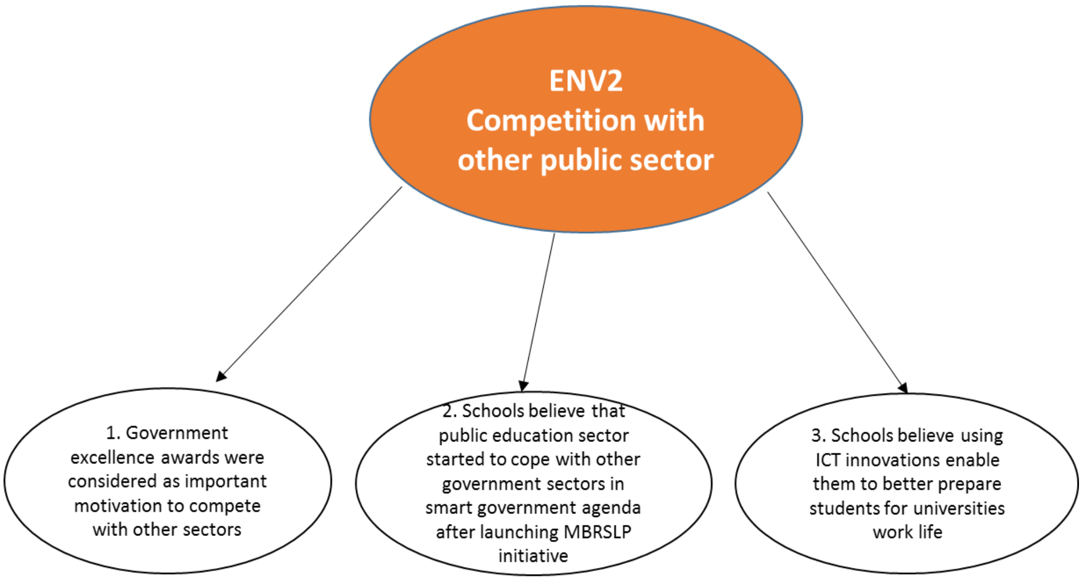


Figure 5.17 Competition with other public sectors dimension: emerging themes

5.3.3 ENV3- Vendor support

'Vendor support' refers to the role of support by, and the relationship with, vendors and service providers involved in the ICT innovation diffusion. To discuss the 'vendor support' dimension with the interviewees, the focus was on the following aspects:

- Level of involvement
- Phases of involvement
- Extent of relationship
- Level of readiness

- Level of satisfaction

In general, schools were not aware of the details in terms of the relationship with vendors of the ICT innovation diffusion as all operations related to vendors were taking care of by the MBRSLP or the MoE. On the other hand, schools knew that the support team members were outsourced from the company Hewlett-Packard, and that the LMS adoption team members were outsourced from the company ITworx. Perceptions on the support and adoption teams were discussed in Section 5.4.2. A teacher from school #2 talked about the vendors:

> "*the challenge in dealing with the MBRSLP partners(vendors) is that companies have personal organisational interests ... and this is why we need clear channels to engage directly with MBRSLP whenever needed*"

In summary, the main emerging themes for the 'vendor support' dimension are presented in Figure 5.18.

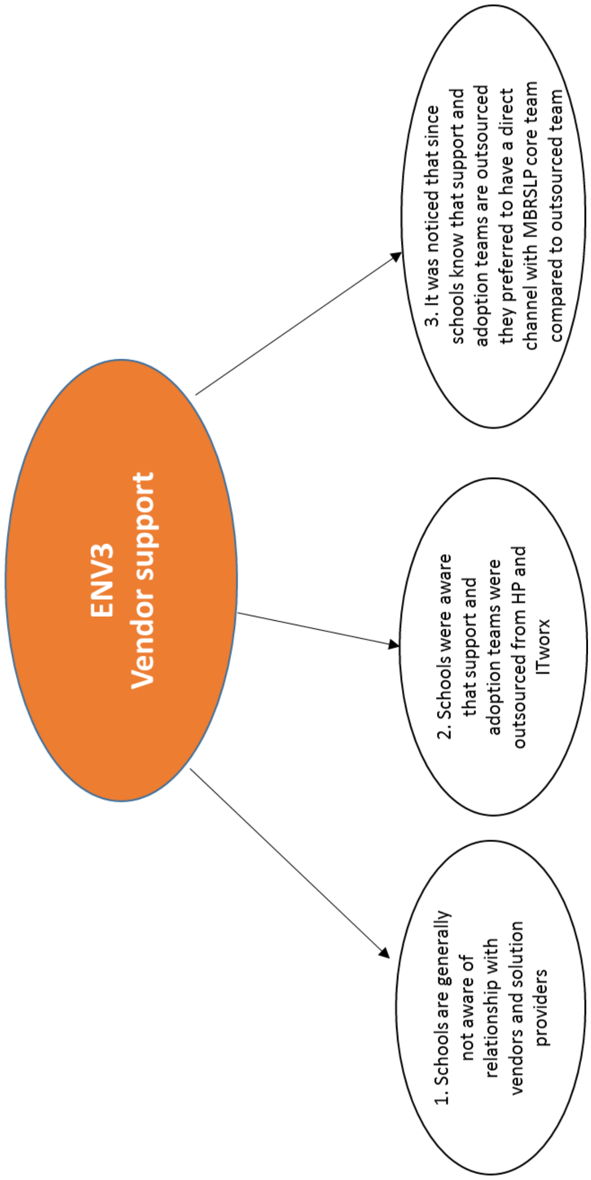


Figure 5.18 Vendor support dimension: emerging themes

5.3.4 ENV4- Cultural aspects

'Cultural aspects' refer to common patterns of thinking, feeling, and potential action shared among members of a social environment. To discuss the 'cultural aspects' dimension within this research context, the focus was on the following aspects:

- The UAE school context
- Parents and ICT use for learning

- UAE culture towards ICT use

With regard to the UAE school context, principals mostly discussed the previous state of ICT in schools and its current state after the MBRSLP. In addition, principals talked about teachers' low levels of ICT literacy and that students were ahead of teachers in this respect. According to principal #2, there were teachers who did not understand ICT and did not want to use it, and such teachers faced difficulties in smart learning schools.

Principal #1 stated:

> "*some new teachers joined the school recently and they could not continue and had to go to another school (different cycle) because they could/did want to not use technology and students could not deal with them.*"

Principal #7 stated:

> "*students skills are ahead of teachers skills….my view on dealing with this is by encouraging students to help in preparing lessons …. Also I asked good teachers to train less ICT skilled teachers so they become better… we also arranged to do extra in-school sessions with the help of MBRSLP adoption team member*"

On the other hand, schools talked about the major changes that had taken place over the past two years, including MoE structure, educational zone role, and a complete change for core elements of the educational experience, such as the curriculum, assessment, structure of school, and teachers' timing schedule. Schools described these changes as considerable and as adding a huge pressure on schools and teachers as they needed to cope with this transition period of instability and change. According to school #6 teachers:

> "*we have full new heavy curriculum that we need to absorb then teach, this needs time we just got the new books with the start of academic year*"

In addition, according to principal #6:

> “*this we have a new organisational structure were schools report to and role called ‘cluster manager’ for all school related matters…cluster managers are new and until know they are not sure of their roles and responsibilities…they also have too much pressure to handle*”

On the other hand, schools talked about the pressure specifically from the private school sector in the UAE, which was perceived as an interesting cultural element to highlight in relation to the diffusion and adoption of ICT innovation within schools. As discussed in the UAE background in Chapter 1, private schools in the UAE compose around 50% of total schools, and the general perception in UAE culture is that private schools are better than public schools. The introduction of the MBRSLP programme had a positive impact on improving public perceptions about public schools, and in some cases parents started to transfer their children from private to public schools after finding out that public schools were now smart learning schools.

According to principal #4:

> “*after launching MBRSLP some parents started to move their kids to public school…they see the positive change taking place and resources provided which are not provided in private schools which they pay a lot for*”

Principal #3 stated:

> ” *now we have resources much better than many advanced private schools*”

With regard to engagement with parents on ICT use, schools mentioned that all parents had to sign an acceptable-use policy for each child so they could get their device from the MBRSLP. The form had general information about the MBRSLP, the purpose of providing tablets to the student, and a list of terms for acceptable use and responsibilities. On the other hand, all schools described the need for more support in engagement with parents with regard to ICT use as they faced some challenges with a few parents who had negative perceptions about giving devices to their children or providing internet access for them at home. According to principal #2:

> “*We need more alignment and coordination …for example we faced challenges in dealing parents and making them aware …there was no clear message or decision on book versus tablet …this made big challenge to schools as parents thought there kids are plying not studying on using tablets and were not sure how to monitor this ….this caused confusion …we needed clear plan and direction from MBRSLP or MoE*”

In addition, principal #1 stated:

> “*On interacting with parents, it is a very important part and as for MBRLSP at the beginning parents were refusing and resisting providing internet access for their kids especially girls, this was from their worry on the negative sides of internet. The school with the support of MBRSLP adoption team managed to do awareness for parents which in return changed their minds to be supportive as they understood the controls in place to safeguard the students.”*

Moreover, principal #3 stated:

> “*There was no dedicated point of contact from MBRSLP or MoE to follow with and communicate with parents on their queries and explain to them purpose of devices and different roles and responsibilities in this regard…MBRSLP relied on schools to do this, but we cannot do everything we need support and guidance*”

With regard to UAE culture toward ICT use, and as discussed in the UAE background in Chapter 1, there is a strong general movement towards using the latest ICT innovations across the UAE, and this is true for the general population, the public sector, and for private companies. Schools were aware of this, and that is why it was perceived as one of the main drivers for ICT diffusion in UAE schools, as discussed in Sections 5.1.4 and 5.1.7.

In summary, the main emerging themes for the ‘cultural aspects’ dimension are presented in Figure 5.19.

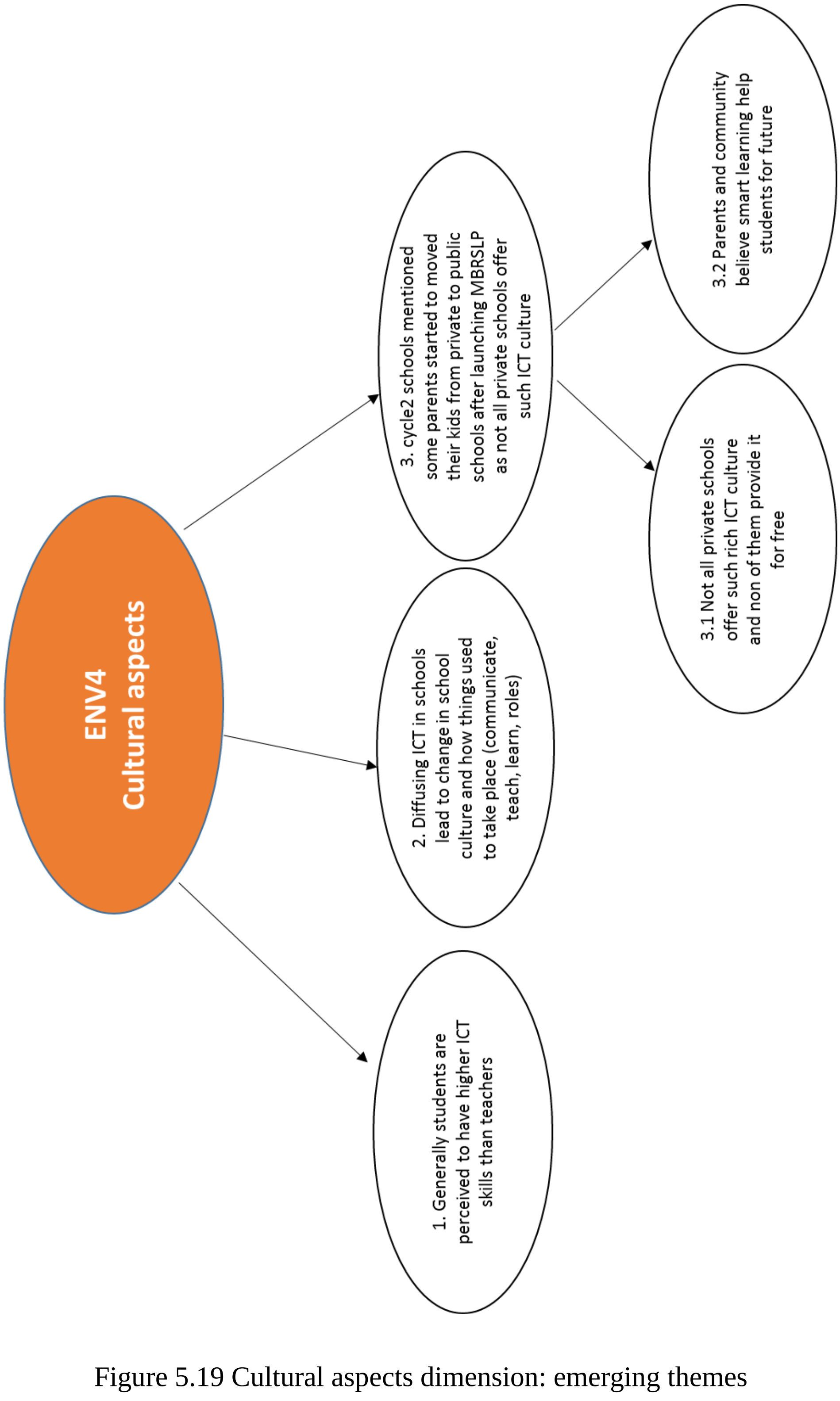


Figure 5.19 Cultural aspects dimension: emerging themes

5.3.5 ENV5- Resistance to change

'Resistance to change' refers to the degree of resistance in regard to ICT innovation diffusion in schools. The focus was on the main challenges schools faced that resulted in resistance and negatively affected effective diffusion. To discuss the 'resistance to change' dimension, the researcher asked interviewees to share their views on the main challenges and to give examples of resistance as well as suggestions to sustain adoption.

In general, all school principals and teachers had a positive attitude toward the adoption and diffusion of ICT innovation provided by the MBRSPL program, as discussed in the 'relative advantage', 'compatibility' and 'drivers for diffusion of ICT in schools' in Sections 5.4.1, 5.4.4, and 5.4.7. However, the challenges stemmed from the schools' interest in an enhanced experience towards the effective diffusion of ICT innovation.

Cycle 2 findings

Cycle 2 schools discussed the resistance and challenges faced over the different phases of deployment. At the initial roll-out phase, there was some resistance, especially from elder teachers or less ICT-literate teachers, which was overcome with time and the necessary support. According to principal #4:

> *"First year there was some resistance by some elder teachers who don't know ICT however by time and support given to them they changed"*

Principal #1 stated:

> "*At first teachers needed some time to get used to new devices and systems, but by time and the provided support they managed to get used to it*"

Another challenge was the speed of deployment, where schools were not certain what was happening and what their role was. However, as the schools clarified, this was fixed over time. According to principal #1 "*at the beginning the vision was not clear to us, even what is our role in smart learning. Also I believe it was not clear at both MoE level and local education zones level. By time it got clear now to at school level.*"

Principal # 4 stated:

"*Without any introductions it was very quick deployment …we were surprised all cycle 2 school were being transformed to smart schools…it was very quick ….by time we got more engagement and support from MBRSLP"*

On the other hand, schools mentioned resistance from parents, especially for female schools. According to principal #1:

"at the beginning parents were refusing and resisting providing internet access for their kids especially girls, this was from their worry on the negative sides of internet. The school with the support of MBRSLP adoption team managed to do awareness for parents which in return changed their minds to be supportive as they understood the controls in place to safeguard the students".

In addition, cycle 2 school principals talked about the principals' training being delayed, and they felt they were a little ignored during the first phase as there was no dedicated training for them, and they received their devices later. According to principal #4:

"*Principals were forgotten… we got devices and training end of the first year…this was too late… we were embarrassed because we are not coping with smart learning and don't know what teachers are doing"*

In addition, principal #1 stated:

"There was no dedicated training to school principals at the initial stage only teachers"

After the first year, cycle 2 schools got more accustomed to the ICT, where their focus moved from initial ICT acceptance and use to more advanced use, and the challenges then related to how to best make use of ICT and sustain the usage. Descriptions of challenges related to the following: how to get better technical support, extra applications, more integration with the curriculum, and the need for more specialised training. According to principal #4:

> "*First year there was more acceptance and more adoption and energy because we had more support from MBRSLP…however it notably reduced once deployment delayed and adoption team members removed to be only once a week*"

Principal #1 stated:

> *"We need Coordination with curriculum to get interactive digital curriculum on time…as for Training for teachers…first year training was full week now compressed to 3 days and no on site adoption to help teachers with ICT knowledge….also we need more alignment between MBRSLP and MOE in SIS, curriculum ,school operations, training"*

School #1 teachers mentioned similar challenges to principal #1:

> "*we need more digital content and also more educational applications*"

Principal #2 talked about the technical issues, focusing on the delay in fixing damaged devices:

> "*we faced technical challenges with devices and connectivity…for devices we expected devices damages especially with kids….the devices of the second roll-out we faced many technical problems and maintenance and fixing was always late and in some cases students stayed without devices for more than 2 month. There is a need for quick process to fix technical problems as it is having large negative impact on student's adoption and sometimes causing frustration*"

School #2 teachers agreed with the principal and talked more specifically about the classroom experience and the specific applications and features they needed. On the main challenges, a teacher stated:

"*the curriculum shall cope with these developments ...also the time is not enough to teach with ICT …we need to consider that every teacher has his own way to deliver and class... teachers need more freedom to use different apps and be creative*"

Another teacher talked about the need for alignment between the MBRSLP and the MoE systems to save time and cope with smart government:

"*there is high pressure on teachers .... we had to do things twice on MBRSLP system and MoE system .... electronic and paper based...waste of time ...seems there is no alignment and we suffer*"

Another teacher talked about letting books go:

"*Ta no need for books anymore ... tablets and smart boards are more than enough*"

Principal #3 talked about the need to embed smart learning into school planning, accreditation, and evaluation so that schools are driven to adopt and maintain adoption:

"*There is no link to school assessment and evaluation so adoption of smart learning will be much faster and sustainable*"

As for the third roll-out, most of cycle 2 school's challenges remained that same, with the addition of some extra challenges due to the major transformations taking place across the public education sector in the UAE. In general, because of these changes, there were adjustments in deployment, extended implementation delays, new roles and responsibilities, and extra pressure on schools to cope with the new curriculum and requirements. According to principal #1:

"*last period witnessed many changes at different levels impacting all educational sectors…. it was like a tsunami…. change is always challenging and I see many positive aspects from these changes in curriculum and school operations which smart learning must cope with or smart learning can really add value to…for example new jobs and functions created such* *as health and safety, school services, nursing, and canteen…. I think ICT can add a lot to these areas and make our schools really smart …"*

A teacher from school #2 stated:

"*the issue is that now some students don't use tablets or do not bring it to school every day.... this happen especially after new curriculum change and MBRSLP or MoE did not provide new digital content*"

School principal #4 talked about the changes and the delay in distributing devices to grade 7 students:

" *Grade 7 did not get devices …. This caused shock for students as they were promised they will get them in G7…over semester one we continued to assure they will get it…but they did not…we did not know to handle the students or parents…. teachers were also less interested as they were not sure what is the plan forward"*

Principal #4 also talked about the technical issues and reduced support which came with the new approach, as discussed earlier.

"*The internet connection quality was a major critical issue as it caused rejection for ICT …. connection dropping disrupting class lessons… teachers not able to reliably connect online to do normal activities caused disconfirm and ICT felt to be a barrier…. The only connection working is in principal office and this is not acceptable …The technical support team reduce … one visit per week where in past we had full time in school*"

Cycle 3 findings

In general, and as discussed earlier in the 'complexity' dimension in Section 5.1.3, cycle 3 schools did not have the appropriate time to use the provided ICT innovations. However, from the discussions, it appears that cycle 3 school's resistance to change and challenges resulted from the complexities surrounding the implementation delays and limitations. It is clear that cycle 3 schools were not resisting the adoption of ICT in their schools, they were eager to do that, but they wanted it to be done properly and they wanted to have the appropriate time and support to do so.

As highlighted earlier, cycle 3 schools had higher ICT skills when compared with cycle 2 schools at the start of implementation three years ago. For this reason, they had higher expectations and the implementation was perceived to be below expectations due to the timing and limitations in content, training, and support, particularly when compared with what had been provided in cycle 2 deployment. On the other hand, the major challenge cycle 3 faced was related to the fundamental changes taking place across the school structure and the new mandatory requirements they had to cope with.

In summary, the main emerging themes for the ‘resistance to change’ dimension are presented in Figure 5.20.

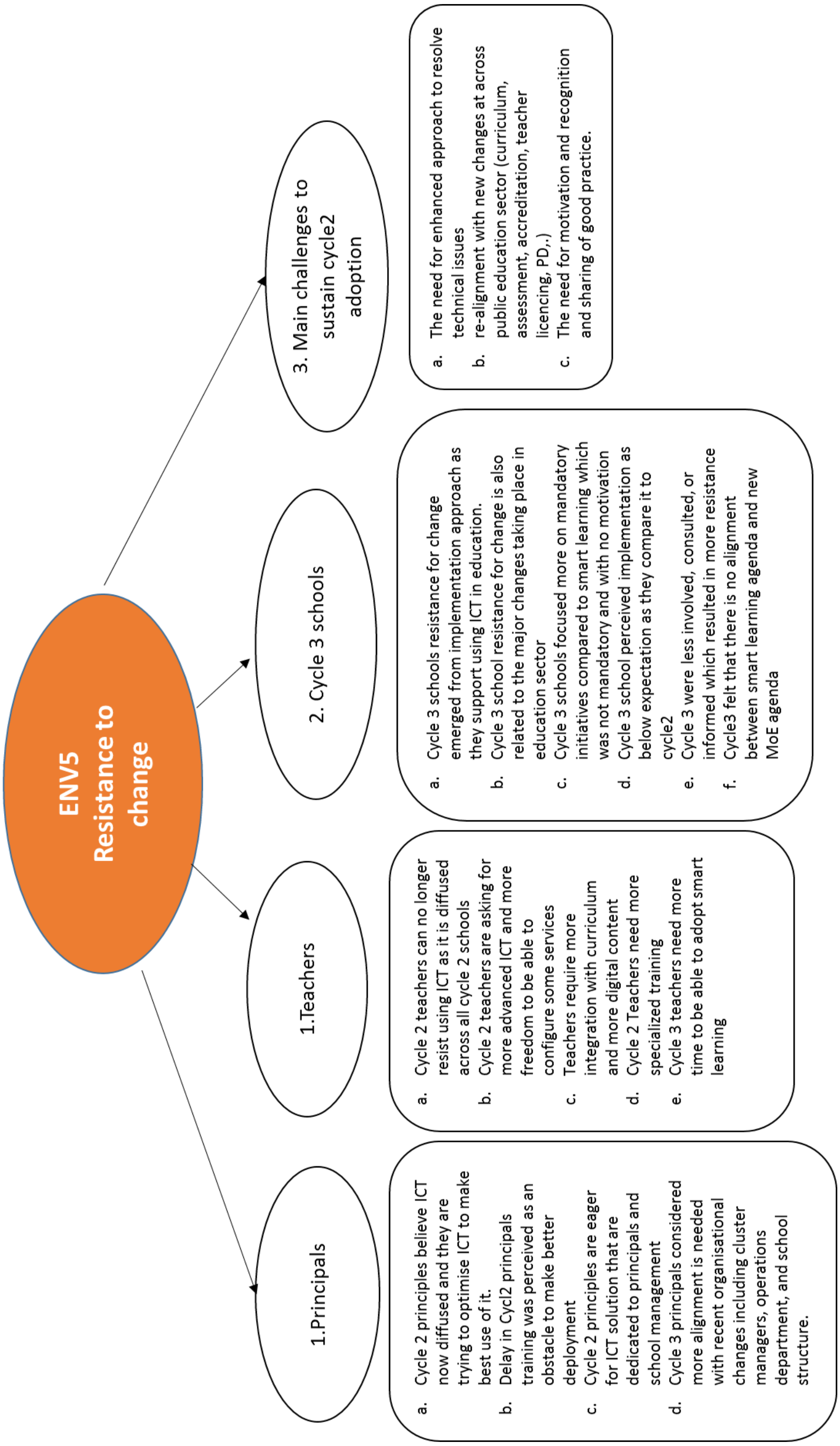


Figure 5.20 Resistance to change dimension: emerging themes

5.4 ICT Acceptance dimensions

After reviewing the data related to the 'technology acceptance' construct, a set of four key themes were identified, as depicted in Figure 5.21. The data findings for each dimension will be presented and discussed in the following sub-sections

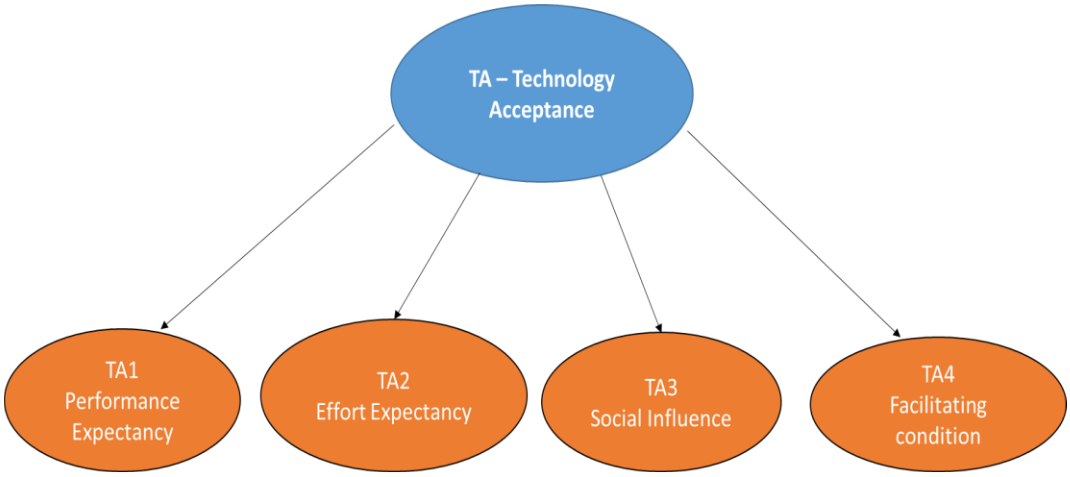


Figure 5.21 Technology acceptance dimensions

5.4.1 TA1- Performance Expectancy

Performance expectancy refers to the degree to which an individual believes that using the system will help him or her to attain gains in job performance as an educator. In the interviews, participants were asked to share their experiences with the MBRSLP initiative and their views on the performance expectancy with regard to the use of ICT innovations provided and implemented in their schools. The researcher used different terms to facilitate a better understanding from participants, including:

- Enables me to accomplish tasks more quickly
- Improves my job performance
- Increases my productivity
- Enhances my effectiveness on the job
- Makes it easier to do my job
- The provided ICT is useful for my job
- Using ICT assists in my job as a teacher

Cycle2 findings

In general, cycle 2 schools had a high degree of belief that using ICT in an educational context would help them achieve higher gains in their jobs as educators. This was clear from the discussions on 'relative advantage' (Section 5.4.1), 'compatibility' (Section 5.4.4), and 'drivers of ICT diffusion in schools' (Section 5.4.7). Both teachers and principals believed that embedding ICT in education is a necessity and that the education sector must cope with technological developments in order to attract students' attention and prepare them for the future. In addition, teachers believed that using ICT enabled an increase in the quality of their lessons, easier planning, faster preparation, and more student engagement.

As for principals, they believed that ICT helped to track school operations better. However, teachers believed that more could be done at school management level using ICT. Some of the main quotes relating to performance expectancy for cycle 2 schools are as follows:

On the main drivers for using ICT in education, principal #1 stated:

> *"in a technology driven age, education need to cope with the century developments. Also this is UAE national direction and we need to cope with it in preparing next generation*"

Principal #1 also talked about the use of ICT as a necessity for education:

> "*ICT is currently a necessity not luxury for schools*".

Moreover, Principal #1 talked about the benefits of using ICT in education:

> "*ICT use in education can support building student's skills such as confidence, research, presentation, and collaboration. In addition, ICT allow students to widen their knowledge resources and learning opportunities*"

A teacher from school #1 stated:

> "*ICT play important role in better delivery of class lessons to students ... it makes lesson delivery faster than usual classroom, better students*

engagement and enable us as teachers to make better impact on students learning and outcomes"

Principal #2 talked about the importance of ICT in education:

> "*education need to adopt ICT …. knowledge is changing at this age and it is everywhere and technology allow students or teachers to reach this knowledge. Technology widen student learning options and make learning in their hand*"

In addition, he gave an example of teachers who could not cope with such changes and had to leave:

> "*some new teachers joined the school recently and they could not continue and had to go to another school (different cycle) because they could/did want to not use technology and students could not deal with them*"

Principal #3 strongly believed that using ICT enables principals and teachers to do their jobs as educators better:

> "*this is the way forward….as it is part of national agenda and new generation language …. I believe teachers need to cope with this otherwise student's will no longer be interested*"

A teacher from school #3 stated:

> "*using ICT allowed me to collaborate easier with my students and also with other teachers…this saves a lot of time and effort*"

Principal #4 stated:

> "*ICT in lessons make it more accepted for students…students already living in digital world*".

Cycle 3 findings

In general, although cycle 3 schools had many challenges in their implementation, their view was that they still believed that using ICT in education would help them achieve higher gains in their job performance as educators. This was clear from the discussions on ‘relative advantage’ (Section 5.4.1), ‘compatibility’ (Section 5.4.4), and ‘drivers of ICT diffusion in schools’ (Section 5.4.7). Both teachers and principals believed that embedding ICT in education is a necessity and that the education sector must cope with technological developments. In addition, they believed that the MBRSLP enabled their schools with the needed ICT resources, particularly when compared with the limited and ad-hoc use in the past. However, all of them agreed that more time and support was vital to making this happen.

In summary, the main emerging themes for the ‘performance expectancy’ dimension are presented in Figure 5.22.

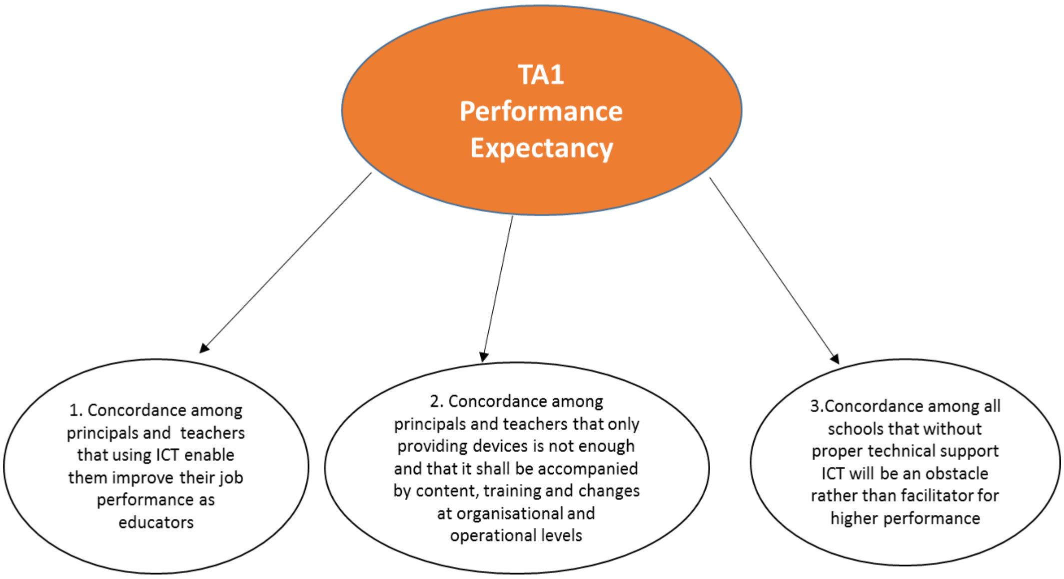


Figure 5.22 Performance expectancy dimension: emerging themes

5.4.2 TA2- Effort Expectancy

‘Effort expectancy’ refers to the degree of ease associated with the use of the innovation for teaching and learning. In the interviews, participants were asked to share their experience with the MBRSLP initiative and their views on the effort expectancy in regard to the use of ICT innovations provided and implemented in their schools. The researcher used different terms to facilitate a better understanding from participants, including:

- The ICT or system ease of use
- The ICT or system is complicated to understand and takes time to learn
- Using ICT for teaching and learning is easy or complicated

In general, the ‘effort expectancy’ was discussed in the ‘complexity’ dimension in Section 5.1.3, where the two main emerging themes were:

- Cycle 2 faced less difficulty due to a higher level of support and effective implementation.
- Cycle 3 faced greater difficulty due to a lower level of support and issues surrounding implementation.

In addition, two other emerging themes were identified:

- Cycle 3 had a lower ‘effort expectancy’, though in reality they had a higher ‘complexity’ as deployment was below their expectations.
- Cycle 2 had a lower ‘effort expectancy’ for the second and third year as they had higher expectations for development of the provision to go beyond basic ICT use. However, the major transformations which took place in the education sector changed this.

In summary, the main emerging themes for the ‘effort expectancy’ dimension are presented in Figure 5.23.

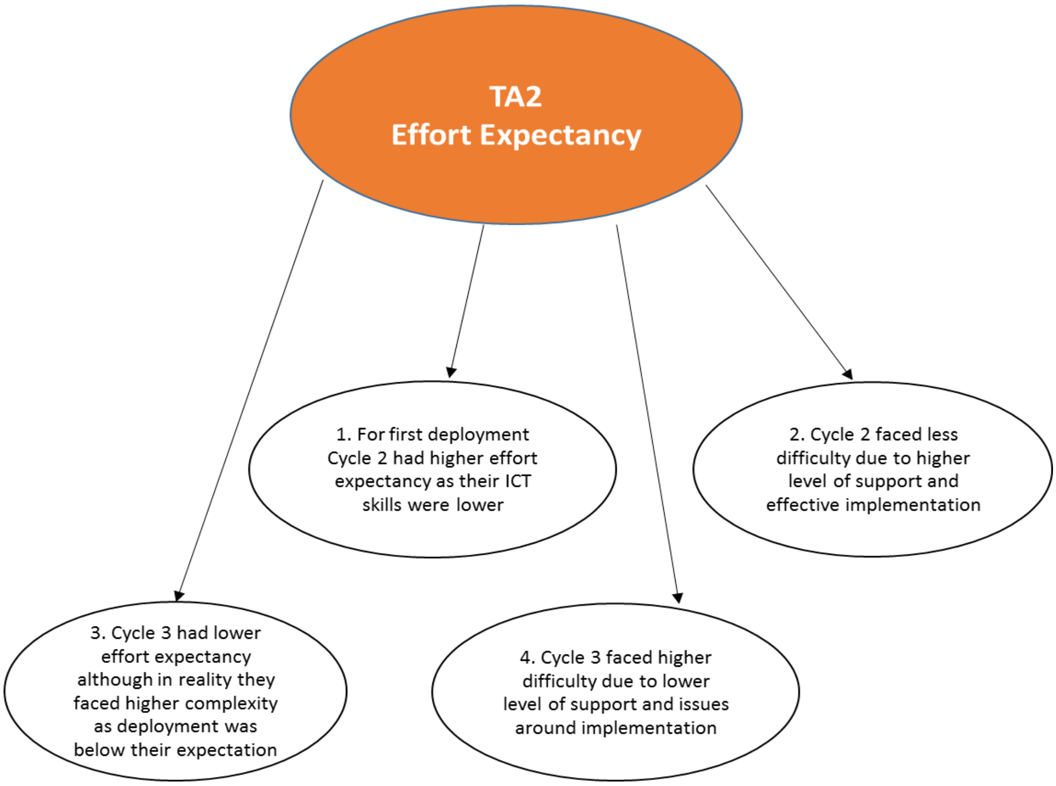


Figure 5.23 Effort expectancy dimension: emerging themes

5.4.3 TA3- Social Influence

'Social influence' refers to the degree to which an individual feels social pressure to use the provided ICT innovations. In the interviews, participants were asked to share their experiences of the MBRSLP initiative and their views on the 'social influence' with regard to the use of ICT innovations. The researcher used different terms to facilitate a better understanding from participants, including:

- People who influence my behaviour think that I should use the system
- Senior management from the education sector and government were supportive and promoted the use of ICT
- People who are important to me think that I should use the system
- The surrounding cultural attitudes and community influence the use of ICT
- The proportion of co-workers who use ICT
- Using ICT perceived to enhance social image or status in the social system

Different elements related to the ‘cultural aspects’ dimension were discussed in the ‘compatibility’ (Section 5.4.4), ‘drivers of ICT diffusion in schools’ (Section 5.4.7), ‘change champion as principal’ (Section 5.5.2), ‘government support’ (Section 5.6.1) and ‘cultural aspects’ (Section 5.6.4) dimensions.

In general, management and government support in promoting the use of ICT was perceived as a major driver and facilitator to diffuse ICT in education. All interviewees stated that the UAE Vision 2021 National Agenda was a key driver since using ICT innovations in education was a key pillar of the Agenda. In addition, government launching specific initiatives, such as smart government, innovation year, and the government excellence award where ICT was a key pillar, had a high influence across the culture in using the latest ICT innovations. In addition, all schools perceived using ICT as a necessity in education, which demonstrated cultural change and how it influences others to use ICT. Schools demonstrated cultural pressure in the following statements:

> “*ICT is the current language with students*”

> “*ICT is everywhere in our life today we need to cope with*”

> “*in UAE the government is smart, all services done using mobile phone, everybody has access to smart technologies, it is a reality*”

In certain schools, some new teachers who did not have appropriate ICT skills and did not want to cope with it had to leave to go to other schools because the school culture perceived them at a lower level of readiness to teach in a smart learning school.

In summary, the main emerging themes for the ‘social influence’ dimension are presented in Figure 5.24.

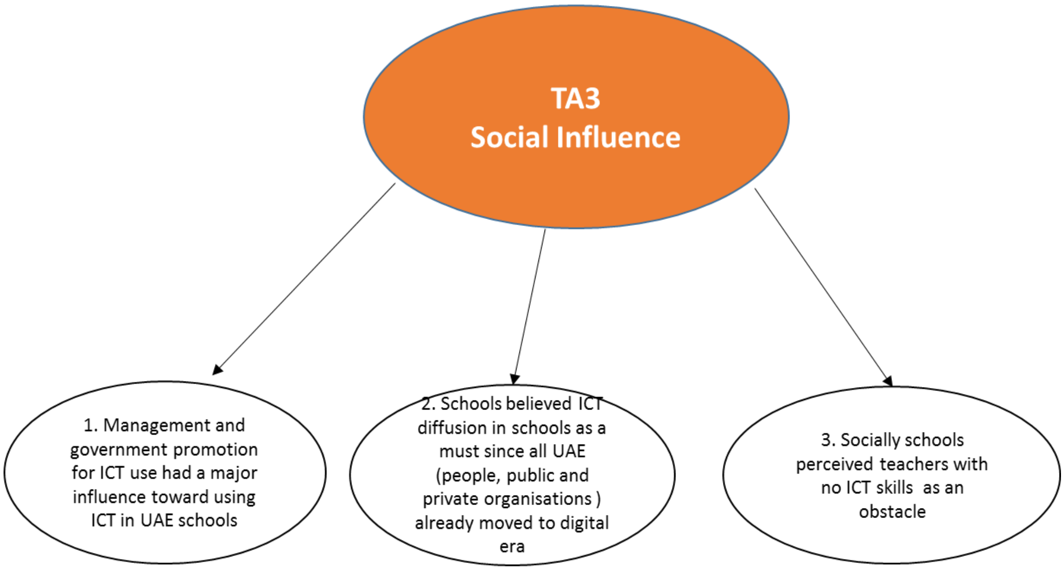


Figure 5.24 Social Influence dimension: emerging themes

5.4.4 TA4- Facilitating Conditions

'Facilitating conditions' refer to the degree to which an individual believes that his or her organisation is supporting the change. It can also include the objective factors within the specific environment that participants or viewers agree has facilitated the change. The researcher used different terms to facilitate a better understanding from participants, including:

- Guidance and training was provided
- What good practice looks like
- Specific people/groups available to assist with any difficulties
- Have control over using the system
- Have the resources necessary to use the system
- Have the knowledge necessary to use the system
- Integration with other systems

In general, both cycle 2 and 3 schools perceived government support as a key enabler to the success of the programme (refer to Section 5.3.1). Moreover, all schools agreed that naming the programme after HH Sheikh Mohammed was a key facilitating factor (as discussed in Sections 5.3.1 and 5.3.4). With regard to training, all interviewees perceived the training as beneficial and helping them adopt ICT in their teaching.

In addition, all principals appreciated the professional development programme and believed it had helped them understand what smart learning is really about and what good practice looks like (as discussed in Section 5.1.3). In regard to providing dedicated people for support, as demonstrated in Section 5.2.2, support and adoption team members played a key role in helping schools with the change and adoption of ICT.

Schools also perceived management support in terms of the MoE as critical in supporting the change and supporting schools going through this change. Cycle 2 schools perceived the MoE support as high at initial stages, but they felt it had been significantly reduced over the past period. According to principal #4:

> "*over the past period we feel MoE support reducing in regards to smart learning…comparing to other MoE new projects …there is continuous follow-up reports we need to submit, instruction come to school…we don't see such things for smart learning*"

In general, all cycle 2 principals highlighted the need for more MoE support and integration of smart learning into school accreditation, teacher evaluation, and training programs. According to principal #3:

> "*The biggest issues in my view …there no twinning …alignment and integration between MoE and MBRSLP …. no full alignment with MoE curriculum, assessment, training, … there are no circulars from MoE toward ICT adoption*"

Finally, cycle 2 schools considered integration between the MoE and MBRSLP systems as vital in enhancing the smart learning experience. According to principal #1:

> "*we need alignment between MoE and MBRSLP systems such as SIS and Question Bank*"

In summary, the main emerging themes for the ‘facilitating conditions’ dimension are presented in Figure 5.25.

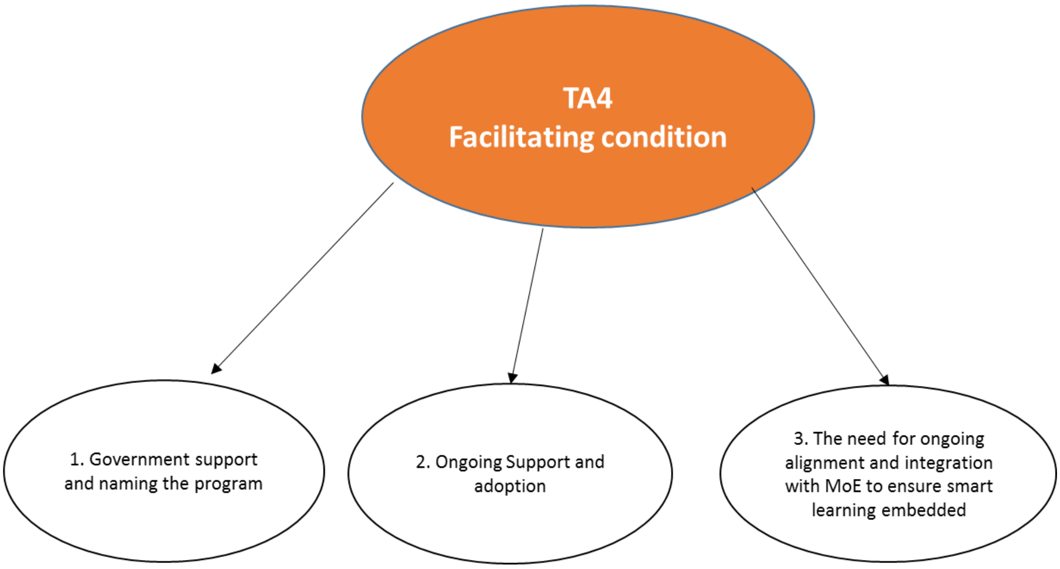


Figure 5.25 Facilitating condition dimension: emerging themes

5.5 Adoption Behaviour dimensions

There were two main key dimensions identified for ‘adoption behaviour’, which was based on the CBAM model. The data findings for each dimension will be presented and discussed in the following sub-sections.

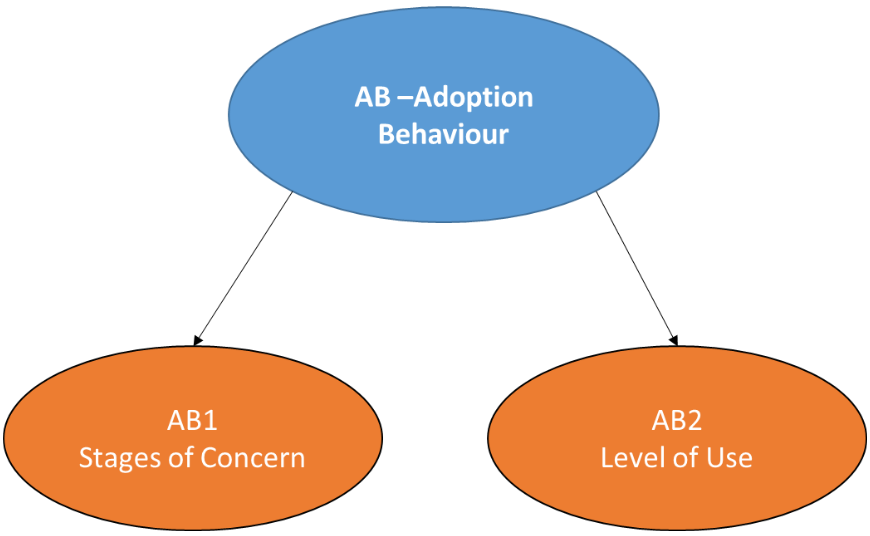


Figure 5.26 Adoption behaviour dimensions

5.5.1 AB1- Stages of Concern

'Stages of concern' (SoC) focuses on the feelings or concerns of individuals involved in the change process and over the different project phases. The four stages of concerns were developed based on the CBAM model, as discussed in Section 3.6.1 and in Table 3.1.

Based on the interview data findings, the researcher attempted to map each school to the appropriate current stage of concern. This was done separately for school principals and school teachers in an attempt to identify any differences in perceptions, as presented in Table 5.5.

School #	Cycle	Principal SoC	Teachers SoC
School #1	Cycle 2	level 3 (impact)	between level 2 (process and tasks) to level 3 (impact)
School #2	Cycle 2	level 3 (impact)	between level 2 (process and tasks) to level 3 (impact)
School #3	Cycle 2	between level 2 (process and tasks) to level 3 (impact)	between level 2 (process and tasks) to level 3 (impact)
School #4	Cycle 2	between level 2 (process and tasks) to level 3 (impact)	between level 2 (process and tasks) to level 3 (impact)
School #5	Cycle 3	stage 1 (self and personal)	stage 1 (self and personal)
School #6	Cycle 3	between stage 1 (self and personal) and stage 2 (process and task)	between stage 1 (self and personal) and stage 2 (process and task)
School #7	Cycle 3	between stage 1 (self and personal) and stage 2 (process and task)	between stage 1 (self and personal) and stage 2 (process and task)

Table 5.5 Summary of data findings on school stage of concerns

Cycle 2 schools' data findings

School #1

The principal's stage of concern was rated at level 3 (impact).

The teachers' stage of concern was rated between level 2 (process and tasks) and level 3 (impact).

It can be noted that the teachers' stage of concern was rated less than that of their principal. In this sense, the principal demonstrated how she had established processes and tasks internally to ensure ICT integration in the school's daily practices. In addition, she presented her plan and actions taken to make a higher impact on students' attainment through the use of ICT innovations. The principal also described how the Smart Learning Leadership Professional Development Programme and the Smart School Transformation Framework had guided her in achieving this:

> ”*it is about impacting student's outcomes and student centric learning*”

Moreover, the principal described several initiatives she had started in her school to establish new processes and policies in order to support the diffusion of ICT innovation and make a bigger impact on student attainment, which was highlighted in the 'change champion' dimension in Section 5.2.2. On the other hand, teachers were trying to implement these changes in processes and tasks coming from the principal with regard to smart learning. Teachers noted that the principal had started transferring knowledge to them from the Smart School Transformation Framework. Principal #1 talked about this programme as follows:

> "*it was really beneficial and adds value to the way school transform to a smart school. …the training enabled better understand what smart learning is really about and my role as principle to make sure effective use of ICT to enhance teaching and learning*"

The teachers' discussions were more concerned about getting comfortable with the new process changes as well as trying to resolve the technical problems and the extra load that had come from the recent changes across the education sector. A teacher stated:

> "*we need more digital content and also more educational applications*".

School #2

The principal's stage of concern was rated at level 3 (impact).

The teachers' stage of concern was rated between level 2 (process and tasks) and level 3 (impact).

The principal described the process of use as being established with a few challenges in integration with the MoE and some technical issues. However, he said they had decided to move on and focus on increasing the impact on students. The principal supported establishing a robotics lab and team in the school, which succeeded in reaching international competitions. In addition, the principal described other initiatives he had started in order to impact on students use of ICT, such as using WhatsApp to communicate with parents as well as the knowledge sharing initiative 'Al Qafela Altanweria', which was highlighted in the 'change champion' dimension in Section 5.2.2.

On the other hand, it was observed that school teachers were at stage 3 (impact) by the end of the second roll-out. However, due to the changes in the the education sector impacting on the curriculum and the schools' structures and processes, teachers attention went back to stage 2 in order to reconsider the smart learning processes under the new changes. Teachers expressed concerns about the realignment of smart learning within the new curriculum, new teaching schedule, new teachers licencing standards, and so on. Teachers expressed that they were still committed to impacting on students, but, to focus fully on this aim, they believed that the new process-related concerns needed to be addressed.

School #3 and School #4

The principal's stage of concern in school #3 was rated between 2 (process and tasks) and 3 (impact).

The teachers' stage of concern in school #3 was rated the same as their principal.

The principal's stage of concern in school #4 was rated between 2 (process and tasks) and 3 (impact).

The teachers' stage of concern in school #4 was rated the same as their principal.

For both schools, it was observed from the interviews with the principals that the schools had moved their focus to impact. This is clear from the examples both principals provided and the suggestions list, but it seems that the schools were still concerned with establishing processes and tasks related to ICT use and integration in teaching and learning, especially after the major changes in the public education sector. As for the school teachers, they expressed a similar understanding and position as their principals. They were trying to focus on impact, but the major changes that were taking place around them were forcing them to go back and review current processes in line with the changes taking place.

Cycle 3 schools' data findings

In general, and as discussed earlier, cycle 3 schools are at early phase of deployment, and the timing did not help them to focus and actually use and experience the technology provided to them in practice. In addition, schools were distracted and busy with the major changes taking place across the education sector, especially for cycle 3 schools, where they had to focus on the mandatory tasks from the MoE, with ICT use not being one of them. Meanwhile, as highlighted in the 'complexity' dimension in Section 5.4.3, schools were willing to diffuse ICT and seek more awareness and chances for using ICT.

School #5

The principal's stage of concern was rated at stage 1 (self and personal)

The teachers' stage of concern was rated at stage 1 (self and personal)

In fact, the interview in school #5 was with the vice-principal as the principal was not available. This needs to be considered in the analysis as, in general, he had less knowledge and awareness about the smart learning programme when compared to other cycle 3 principals. That said, the vice-principal concerns were more related to the lack of a complete picture about the smart learning initiative, its role, and what it provides being mostly just ICT resources with some basic training. Unlike cycle 3 principals, vice-principals were not enrolled in the Smart Learning Professional Development Programme to obtain such an understanding. As an exception, this vice-principal attended two sessions of training, covering for his principal's absence, and he said it was different and beneficial, but not everything was clear to him:

> "*in general the training was really beneficial but I did not continue and some practical hands on activities like classroom observation and cross school visits could have been very beneficial for me*"

The teachers' stage of concern was rated at stage 1 (self and personal). The teachers' descriptions confirmed a similar view to that described in the cycle 3 schools' findings above.

School #6

The principal's stage of concern was rated between stage 1 (self and personal) and stage 2 (process and task).

The teachers' stage of concern was also rated between stage 1 (self and personal) and stage 2 (process and task).

The principal and school teachers' interviews indicated a good level of ICT literacy when compared to other cycle 3 schools, where all teachers were used to having laptops from the MoE. This was because the school had been part of the MAG school initiative, which was launched by the MoE a few years before and has only recently closed. They said that the initiative included, in contrast to normal schools, the enhanced use of ICT, where all teachers were given laptop devices and trained to use them. This justified the higher level of use in these schools. Accordingly, the principal and most teachers did not have concerns with regard to ICT use in education. As for the teachers, the introduction of the MBRSLP was perceived as positively building on what they already had, so they were not starting from zero. Teachers' discussions were related to the processes and tasks, how the MoE/MBRSLP wanted them to integrate new ICT into their teaching and learning, and what they wanted to do at the school level. Accordingly, after MBRSLP deployment, the school immediately started to think about integrating ICT by reviewing the process and tasks, but they were still concerned about the cycle 3 deployment challenges as discussed earlier.

School #7

The principal's stage of concern was rated between stage 1 (self and personal) and stage 2 (process and task).

The teachers' stage of concern was also rated between stage 1 (self and personal) and stage 2 (process and task).

The principal and school teachers' interviews indicated a good level of ICT literacy when compared to other cycle 3 schools, where a big proportion of teachers had their own personal laptops and used them on a regular basis. The principal mentioned that their school took self-initiatives in using ICT and spreading that culture. She explained that their school is in the centre of Dubai and that all students and teachers were witnessing the smart transformation around them and decided to make their best effort to cope with that. She also mentioned they had received some support from the Dubai local education zone in this regard.

With the introduction of the MBRSLP, they believed it would allow them to achieve more and integrate ICT across a wider spectrum, in particular as the MBRSLP would provide resources to all school teachers and students with support to enable them to move to another level. The principal also talked about the Smart Learning Leadership Professional Development Programme she had attended at the end of the previous academic year and how it had helped her to understand better the good use of ICT for teaching and learning and how to start deploying some of the concepts in her school. On the other hand, the school still faced the challenges described earlier, which means they still require more personal awareness and knowledge about the new directions in the education sector and how smart learning will fit into that.

In summary, the main emerging themes for the 'stages of concern' dimension are presented in Figure 5.27.

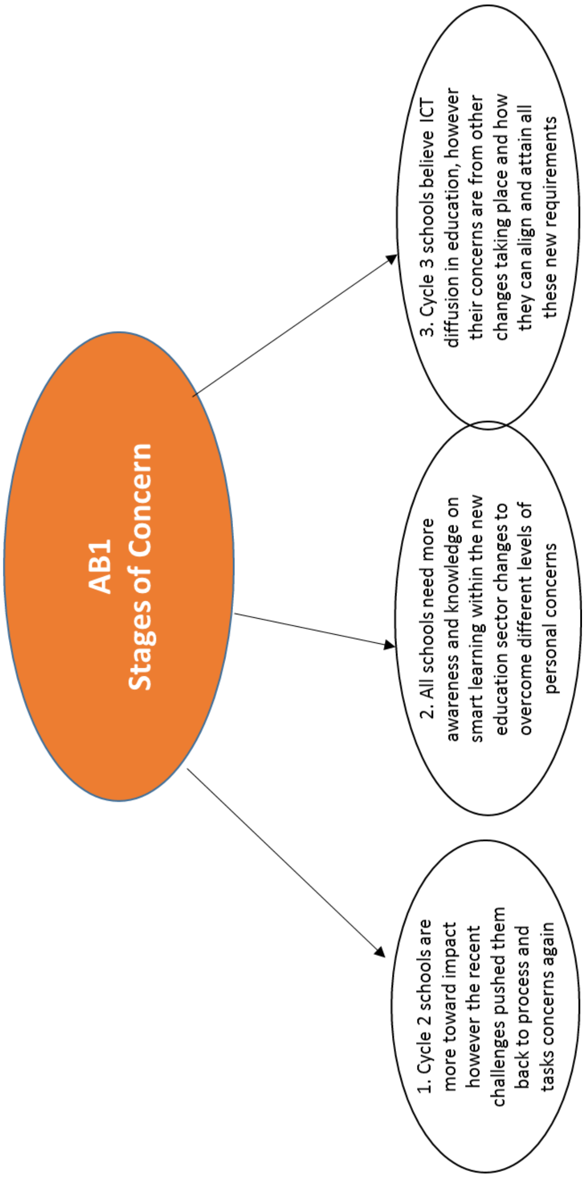


Figure 5.27 Stages of concern dimension: emerging themes

5.5.2 AB2- Level of Use

'Level of use' describes how individuals interact with a new innovation. The four levels of use that were developed were based on the CBAM model, as discussed in Section 3.6.3 and in Table 3.2.

Based on the interview data findings, the researcher attempted to map each school to its appropriate level of use. This was done separately for the school principals and school teachers in an attempt to identify any differences in perceptions, as presented in Table 5.6.

School #	Cycle	Principal LoU	Teachers LoU
School #1	Cycle 2	between level 3 (established) and level 4 (refinement and renewal)	between level 3 (established) and level 4 (refinement and renewal)
School #2	Cycle 2	between level 3 (established) and level 4 (refinement and renewal)	between level 3 (established) and level 4 (refinement and renewal)
School #3	Cycle 2	between level 3 (established) and level 4 (refinement and renewal)	between level 3 (established) and level 4 (refinement and renewal)
School #4	Cycle 2	level 3 (established)	level 3 (established)
School #5	Cycle 3	level 2 (basic)	level 2 (basic)
School #6	Cycle 3	level 2 (basic)	level 2 (basic)
School #7	Cycle 3	level 2 (basic)	level 2 (basic)

Table 5.6 Summary of data findings on school level of use

Cycle 2 findings

School #1

The principal's perception on the level of use was rated between level 3 (established) and level 4 (refinement and renewal).

The teachers' level of use was also rated between level 3 (established) and level 4 (refinement and renewal).

The principal and school teachers' discussions indicated that currently ICT is integrated in daily school routines for teaching and learning practices. The principal also demonstrated school-based initiatives and new processes to encourage the effective use of ICT in teaching and learning. According to principal #1:

> "*it is about impacting student's outcomes and student centric learning*"

In addition, the principal talked about specific initiatives she had started to support the implementation and diffusion of ICT in her school:

> *"to monitor progress and make sure teachers and students adopt technology in the best possible way, I developed customized monitoring and evaluation scheme my school. This scheme ensure teacher adopt ICT and maintain usage as part of their reporting ongoing process*".

Moreover, principal #1 started another initiative to increase adoption among students and ensure students take good care of their tablets:

> *"for students we linked their behaviour grades to smart learning so they take good care of the devices and bring it to lessons ready and fully charged…after applying this policy student took more care of the devices and classrooms are less disrupted by a student wanting charge their tablet"*

All these factors indicate established use and a movement towards making deliberate efforts to increase impact. As for teachers, they demonstrated an established pattern of use, and they provided suggestions to enhance current provision in the future, which demonstrated their changing focus toward refinement and renewal. For example:

> *"We want to see new technologies, such as 3D printing, embedded into the educational experience.*
>
> *We need MRSLP support to introduce new ways of teaching and learning.*
>
> *We need to get enhanced interactive content so students can become more engaged.*
>
> *We need to receive smart learning specialised support on specific subjects such as maths, science, etc*."

The teachers mentioned that the principal trained them on the Smart School Transformation Framework, which allowed them to gain a better understanding of the concept of smart learning and think about more innovative ideas to impact on their students' learning.

School #2

The principal's perception on the level of use was rated between level 3 (established) and level 4 (refinement and renewal).

The school teachers' level of use was also rated between level 3 (established) and level 4 (refinement and renewal).

The principal stated that all teachers and students are used to ICT and it is naturally embedded in their daily activities. In addition, the principal described the efforts of the school to increase impact and refine ICT use, such as the robotic lab and the 'Al Qafela Altanweria' programme discussed in Section 5.2.2.

On the other hand, teachers' descriptions demonstrated an established level of use and that their normal day would be disrupted without ICT. Teachers also talked about the demand for current improvements, such as the need for specific new applications, enhancements to the current system, and the necessity for more freedom to install the applications they need. Teachers were eager to get more advanced technologies, and they explained how this would help them improve their impact on learning.

School #3

The principal's perception on the level of use was rated between level 3 (established) and level 4 (refinement and renewal).

The teachers' level of use was also rated between level 3 (established) and level 4 (refinement and renewal).

The principal and school teachers' discussions indicated that ICT is currently integrated in daily school routines for teaching and learning practices, and there is an established pattern of use for ICT. The principal demonstrated evidence for an established pattern of use through his reporting and monitoring approach for smart learning. The principal expressed that there were still issues to be resolved relating to establishing use in consideration of the emerging challenges, technical issues, and major changes this year. However, the school use of ICT was established, and the focus now is on in how to enhance the use of ICT in order to increase impact. Teachers shared a similar view with the principal in that they had established patterns of use and ICT is now integrated into their school life. They also made suggestions to increase the features of current ICT provision and to introduce new technologies. Teachers related this development to the principal's efforts and commitment to the smart learning agenda, where he accelerated the culture of smart learning in the school.

School #4

The principal's perception on the level of use was rated between level 3 (established) and level 4 (refinement and renewal).

School teachers' level of use was also rated between level 3 (established) and level 4 (refinement and renewal).

The principal's interview discussion indicated an established pattern of use as teachers and students were used to ICT after two years of implementation. On the other hand, the principal described the challenges they are currently going through and how this restricts their ability to build on this experience (as discussed in Section 5.3.5). As for the teachers, they shared a similar view to the principal and believed that once the new structure becomes more stable, they will be able to focus again on making the best use of smart learning.

Cycle 3 schools' data findings

In general, all cycle 3 schools' interviews demonstrated a basic level of use (level2).

School #5

Both the principal and teachers had consistent views. The discussions were centred on the implementation delays along with the changes taking place across the education sector. They described the current usage as poorly coordinated and that usage is limited to personal ad-hoc cases. In addition, they did not have the sufficient time to put the provided ICT into actual use (as discussed in Sections 5.1.3 and 5.3.5).

School #6

Both the principal and teachers had consistent views. Although the school already had some elements of technology and better ICT literacy among teacher, they are still at a basic level with regard to a holistic view of smart learning. The implementation delay, along with the changes taking place, indicated poorly coordinated usage that was limited to personal ad-hoc cases. They also shared the other cycle 3 challenge in that they did not have the sufficient time to put the provided ICT into actual use (as discussed in Sections 5.1.3 and 5.3.5).

School #7

Both the principal and teachers had consistent views. Although the school already had teacher devices and some smart-boards based on individual efforts, they are still at basic level with regard to a holistic view of smart learning. It is clear that there was a wide increase in usage, but it does not yet represent a coordinated or structured pattern of use. They also shared the other cycle 3 challenge in that they did not have sufficient time to put the provided ICT into actual use (as discussed in Sections 5.1.3 and 5.3.5).

In summary, the main emerging themes for the 'level of use' dimension are presented in Figure 5.28.

Figure 5.28 Level of use dimension: emerging themes

5.6 Chapter Summary

This chapter presented the discussed and analysed the data gathered from school semi-structured interviews. The findings were presented based on the dimensions identified for ICT innovation diffusion. For each dimension a brief overview of the nature of questions used during the interviews, a sample of statements from interviewees indicating their different views and finally the main emerging themes for this dimension across the interviewees were presented. Table 5.7 summarise the main emerging themes for each dimension. These emerging themes will be further analysed and synthesised in-light of the literature in chapter 7.

Dimension Code	Dimensions	Main emerging themes
INN1	Relative advantage	1.Concordance across school principals and teachers on the relative advantage of ICT in schools 2.Concordance across school principals and teachers that the MBRSLP initiative enabled schools to be better schools 3. Discordance among the school principals on how they describe the importance and relative advantage of ICT 4.Cycle 3 school principals demonstrated good understanding for ICT use in education although implementation had recently started 5. The concordance and/or discordance between same school principal and teachers
INN2	Cost	1.No cost as a major motivation for ICT adoption 2.No cost as a constraint
INN3	Complexity	1. System difficulty or ease of use 1.1 Cycle 3 faced greater difficulty due to a lower level of support and issues around implementation 1.1 Cycle 2 faced less difficulty due to a higher level of support and effective implementation 2.Training and support provided to simplify adoption 2.1 Consistency across all schools on the quality of teacher training and principals PD programme and its role in simplifying higher adoption 2.2 Consistency across all schools on the critical role of support and adoption teams in simplifying the complexity and driving higher use and adoption
INN4	Compatibility	1. Consistency across schools on the high level compatibility with needs, work aspects, and preferred work style 2. Cycle 3 perceived a lower consistency with their needs compared to a high consistency for cycle 2 3. Cycle 3 perceived a lower consistency with their current experience compared to a high consistency for cycle 2 4. Name and positioning were perceived as high compatibility across all schools
INN5	Trialability	1. Trialability was limited to group of cycle 2 schools in the initiation pilot phase

		2. Cycle 2 schools perceived first implementation as very fast, where they were not fully briefed about it except in the training 3. Cycle 3 schools had been brief on the implementation; however, no trialability 4. All schools preferred more engagement and involvement before implementation
INN6	Observability	1. Cycle 2 schools demonstrated high observability of results from ICT innovation diffusion 2. Cycle 3 school believed implementation is just recent and they did not have enough time to see results 3. Cycle 2 schools believed ICT is diffused into school experience and normal school day will be disrupted without ICT 4. Cycle 2 and cycle 3 schools believed more results can be observed once more alignment takes place with core elements like curriculum, assessment, and accreditation
INN7	Driver of ICT diffusion	1. All schools agreed on Educational benefits as a major driver 2. All schools agree that coping with the national direction and other sectors was an important driver 3. All schools agree that the government and political support were the main drivers behind launching this initiative (Vision 2021, HH MBR)
ORG1	School size	1. The deployment phases were on a grade by grade basis, which made the roll-out and support across UAE geographically challenging 2. The assignment of support team members did not consider school size in term of number of beneficiaries, which lead to a discordant load distribution among support team members 3. The third year new support approach seems a very high load on the support team members and less responsive to school needs
ORG2	Change champion	1. Principals were able to play a more effective role after getting the PD programme 2. Having permeant support per school was perceived as the key change facilitator across schools 3. Adoption team was perceived more positively by principals compared to teachers as in some cases teachers perceived adoption as overly instructive
ORG3	Centralization	1. All smart learning matters are taken by the MBRLSP or MoE with minimal school role limited to operational and reporting issues 2. Schools believe getting more authority will allow them to achieve more 3. Schools appreciate a higher involvement during the pilot and first roll-outs. They were unhappy being ignored in the third year roll-out
ORG4	Importance of school needs	1. Cycle 2 schools perceived a high level of involvement and response during pilot phase. 2. With reduction in attaining school needs, schools energy towards change reduced 3. Schools perceived the support team as their only channel to pass on their needs and they required more engagement and formal channels of communication with the MBRSLP and MoE in regard to smart learning

ORG5	Reinvention	1. Cycle 2 schools witnessed major improvements from the pilot to the first roll-out. It was very positive as it considered their comments and suggestions 2. For the major roll-out, schools stated no major change beyond the ICT package the MBRSLP provides, except for type of devices 3. Some schools made changes to their operations and structure to accommodate smart learning 4. Schools believe they moved beyond basic use and need more re-invention by adopting more advanced ICT innovations
ENV1	Government support	1. Government is the actual initiator and driver for diffusion of ICT as part of wider smart government agenda and country vision 2021 2. Naming the programme after the UAE vice-president and prime minister was perceived as strong support and commitment 3. Government support was clear in establishing a dedicated programme with funding and direct oversight from the prime minister's office
ENV2	Competition with other public sectors	1. Government excellence awards were considered as important motivation to compete with other sectors 2. Schools believe that the public education sector started to cope with other government sectors in smart government agenda after launching the MBRSLP initiative 3. Schools believe using ICT innovations enabled them to better prepare students for university and work life
ENV3	Vendors support	1. Schools are generally not aware of the relationship with vendors and solution providers 2. Schools were aware that support and adoption teams were outsourced from HP and ITworx 3. It was noticed that since schools know that support and adoption teams are outsourced, they preferred to have a direct channel with the MBRSLP core team compared to the outsourced team
ENV4	Cultural aspects	1. Generally, students are perceived to have higher ICT skills than teachers 2. Diffusing ICT in schools led to a change in school culture and how things used to take place (communicate, teach, learn, roles) 3. Cycle2 schools mentioned some parents started to move their children from private to public schools after launching the MBRSLP as not all private schools offered such ICT culture 3.1 Not all private schools offer such rich ICT culture and none of them provide it for free 3.2 Parents and community believe smart learning helps students for the future
ENV5	Resistance to change	1.Principals a. Cycle 2 principals believe ICT now diffused and they are trying to optimise ICT to make best use of it. b. Delay in Cycle 2 principals training was perceived as an obstacle to make better deployment c. Cycle 2 principals are eager for ICT solution that are dedicated to principals and school management d. Cycle 3 principals considered more alignment is needed with recent organisational changes, including

		cluster managers, operations department, and school structure. 2.Teachers a. Cycle 2 teachers can no longer resist using ICT as it is diffused across all cycle 2 schools b. Cycle 2 teachers are asking for more advanced ICT and more freedom to be able to configure some services c. Teachers require more integration with the curriculum and more digital content d. Cycle 2 teachers need more specialised training e. Cycle 3 teachers need more time to be able to adopt smart learning 3. Cycle 3 schools a. Cycle 3 schools resistance for change emerged from the implementation approach as they support using ICT in education. b. Cycle 3 school resistance for change is also related to the major changes taking place in the education sector c. Cycle 3 schools focused more on mandatory initiatives compared to smart learning which was not mandatory and with no motivation d. Cycle 3 school perceived implementation as below expectation as they compare it to cycle2 e. Cycle 3 were less involved, consulted, or informed, which resulted in more resistance f. Cycle 3 felt that there is no alignment between the smart learning agenda and the new MoE agenda 4. Main challenges to sustain cycle 2 adoption a. The need for an enhanced approach to resolve technical issues b. Re-alignment with new changes at across the public education sector (curriculum, assessment, accreditation, teacher licensing, PD) c. The need for motivation, recognition and sharing of good practice
TA1	Performance expectancy	1. Concordance among principals and teachers that using ICT enables them improve their job performance as educators 2. Concordance among principals and teachers that only providing devices is not enough and that it should be accompanied by content, training, and changes at organisational and operational levels 3.Concordance among all schools that without proper technical support ICT will be an obstacle rather than a facilitator for higher performance
TA2	Effort expectancy	1. For the first deployment, Cycle 2 had a higher effort expectancy as their ICT skills were lower 2. Cycle 2 faced less difficulty due to a higher level of support and effective implementation 3. Cycle 3 had a lower effort expectancy although in reality they faced higher complexity as deployment was below their expectation 4. Cycle 3 faced higher difficulty due to lower level of support and issues around implementation
TA3	Social influence	1. Management and government promotion for ICT use had a major influence towards using ICT in UAE schools

		2. Schools believed ICT diffusion in schools as a must since all UAE (people, public and private organisations) already moved to digital era 3. Socially, schools perceived teachers with no ICT skills as an obstacle
TA4	Facilitating condition	1. Government support and naming the programme 2. Ongoing support and adoption 3. The need for ongoing alignment and integration with the MoE to ensure smart learning is embedded
AB1	SoC (stage of concerns)	1. Cycle 2 schools are more toward impact; however, the recent challenges pushed them back to process and tasks concerns again 2. All schools need more awareness and knowledge on smart learning within the new education sector changes to overcome different levels of personal concerns 3. Cycle 3 schools believe in ICT diffusion in education; however, their concerns are from other changes taking place and how they can align and attain all these new requirements
AB2	LoU (level of use)	1. Cycle 2 schools have an established level of use and started to focus on refinement and renewal 2. Some cycle2 schools perceived the challenges as major obstacles towards a higher level of use and possibly reducing the level of use 3. All cycle 3 schools lack of established pattern of use with regard to implementation issues

Table 5.7 Summary of main emerging themes per dimension

CHAPTER 6. STAKEHOLDER FINDINGS AND ANALYSIS

6.0 Introduction

In this chapter, the research will focus on the data collection and analysis for the stakeholder dynamics over the life cycle of the ICT diffusion project, in order to provide an answer to the third research question. The overall process used for stakeholder analysis is summarised in a workflow diagram as depicted in figure 4.7. The chapter will start by presenting the process used to develop and fill the DSM matrix, the extraction of the list of stakeholders, and project activities. Then, the data analysis will be presented using the heat maps along with the social network analysis for the four years of deployments.

6.1 The process used to develop and fill the DSM matrix

The process started by developing the DSM matrix to capture stakeholder engagement over the annual ICT deployment project activities. Figure 6.1 summarises the process used to develop and fill the matrix.

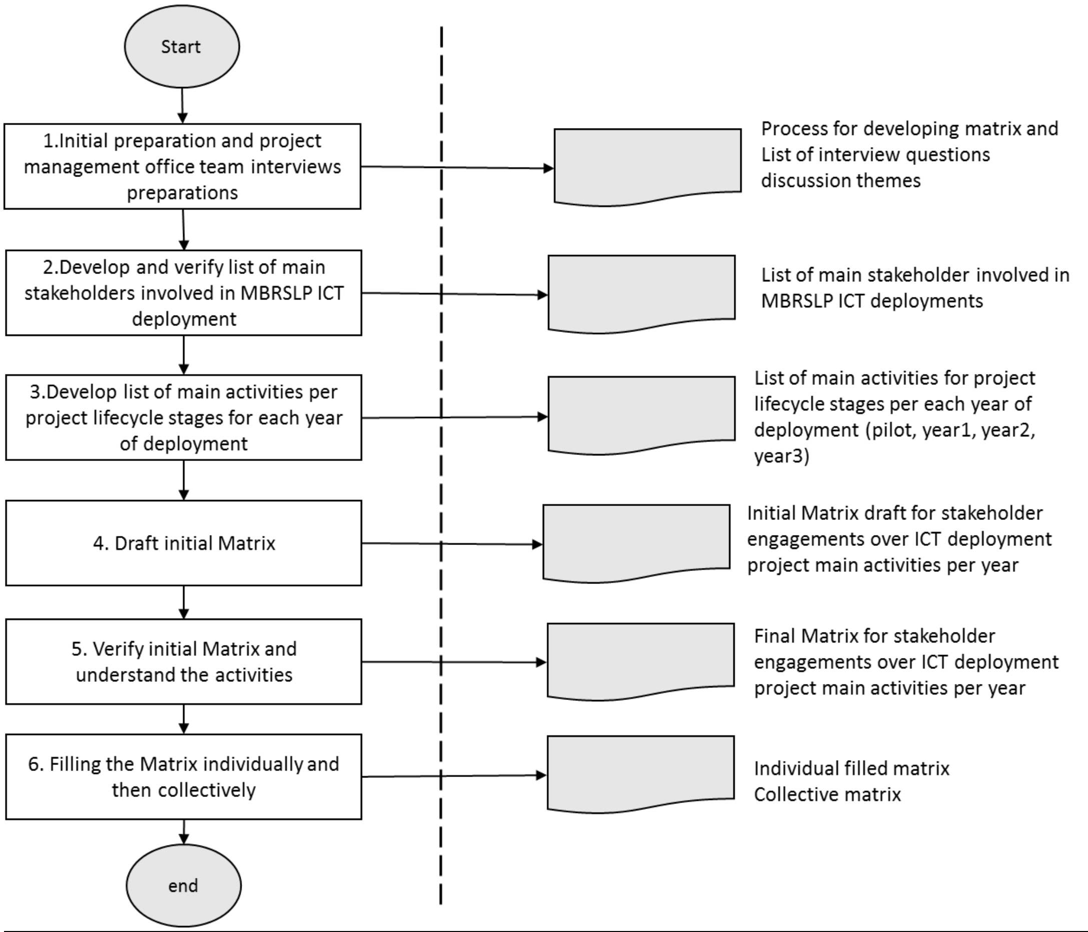


Figure 6.1: The process used to develop and fill the matrix

6.1.1 The MBRSLP project management office team interview

The choice was to interview the MBRSLP project management office team in order to capture and better understand the list of main activities over the MBRSLP deployment phases; this will feed into developing the matrix and analysis. In addition, in this interview, the list of stakeholders was verified and reviewed within a project management context. The interview followed a semi-structured approach to allow more flexibility and to gain more insights on related topics whenever needed. Accordingly, interview themes were developed and a list of open-ended list of questions.

The interview followed interview protocols mentioned in the research methodology chapter, including a formal request to get approval to conduct the meeting, notifying interviewees on the topics to be discussed, so they could prepare, and selecting appropriate times and locations according to interviewee preferences.

6.1.2 Steps to develop and fill the matrix

The project management office team interview and process used to develop the DSM matrix is summarised in the following points:

a. The first interview was with the head of project management office at MBRSLP. The goal of the interview was to develop and verify the list of main stakeholders and list of main activities for each year of deployment and by the project life cycle phases. The MBRSLP had four deployments: pilot, year 1, year 2, and year 3 deployment. In addition, an initial list of main stakeholders was developed.

b. After the interview, the researcher developed an initial matrix that lists all stakeholders and lists activities over annual deployments by project life cycle stages. This list was sent to the project management team to review before the second meeting (see Tables 6.2, 6.3, 6.4, 6.5).

c. A second meeting was carried out with the project management office team in order to go over the list of stakeholders and list of main activities in order to verify them and provide more details for each of the activities and justify some of the changes over the years.

d. The researcher developed a first draft of the DSM matrix for stakeholders' engagements over the project's main activities for the yearly deployments (see Appendix-B).

e. A third meeting was held with the head of the project management office in order to explain the matrix and how to fill it in. In addition, there was agreement to use consistent naming for activities across the years. A final review was conducted to ensure that the project management office understood the matrix and how to fill it in.

f. The DSM matrix was sent to the project management office team to be filled in. It was filled in individually by the three MBRSLP project management office team members and was then sent to the researcher.

g. In the last step, the researcher asked the project management office team to review what they had collectively filled in and agree a final single version for the matrix that reflected their collective view. This was done and the final collective version was sent to the researcher. For the filled matrix, see Appendix-C.

6.2 Data processing and analysis

Based on the process described in section 6.1, the data findings are reported based on the following headlines:

a. List of main stakeholders

b. Pilot deployment project main activities

c. Year 1 deployment project main activities

d. Year 2 deployment project main activities

e. Year 3 deployment project main activities

f. Master matrix filled by MBRSLP project management team representing what the stakeholder's involvement is in the deployment activities over the four deployment stages.

Information from tasks (a) to (e) was used to construct matrices. The information in the matrices was analysed as follows:

- Analysis of the matrix to identify frequencies of stakeholder involvement by yearly deployments and by project life cycle phase

- The researcher developed heat maps to present the frequencies visually

- The researcher carried out further analysis using a social network analysis technique in order to provide visual representation of social networks, to understand the network data and convey the result of the analysis.

Over the following sections, stakeholder engagement data findings and analysis will be presented and discussed.

6.2.1 Stakeholder analysis

The first purpose of the interview process was to extract the list of stakeholders and confirm it with the project management office from MBRSLP. The list is presented in Table 6.1.

Code	Stakeholders	Description	Grouping by level
s1	Students	Public schools students	Schools level
s2	Teachers	School teachers	
s3	Principals	School principals	
s4	MOE top management	MoE strategic level staff including associate undersecretary, minister advisors, department heads	MoE level – federal
s5	MOE middle management	MoE middle management including section heads, project leads, and cluster leads	
s6	MOE operational teams	Operational teams/staff who are directly linked to the project and delivery including cluster managers, mentors, coordinators, education subject experts	
s7	MOE IT department	MoE IT department and information system department staff involved in the process	
s8	MoE cluster managers	Cluster manager responsible for group of schools (new function added during third-year deployment)	
s9	Education zone authority	Operate at local emirate level and report to Ministry of Education. They oversee all school operations in each emirate.	Local level
s10	Education council authority	A local authority entity aimed to support the educational agenda, reporting directly to the local authority of an emirate. Currently, only Sharjah emirate has an	

		education council named Sharjah Education Council (SEC).	
s11	Parents	Students' parents	Key stakeholders outside public schools
s12	Prime Minister Office	Prime Minister Office as key sponsor for MBRSLP initiative	
s13	Telecom Regulatory Authority (TRA)	TRA as a key sponsor and the funding body for MBRSLP	
s14	Other government entities	Other government entities that might be involved in MBRSLP deployments. This includes Ministry of Infrastructure Development, Ministry of Interior, and local government entities as well.	MBRSLP inter-organizational key stakeholders
s15	Connectivity services provider (Etisalat)	The connectivity and Internet service provider that was Emirates Telecommunications Corporation, branded trade name 'Etisalat'	
s16	MBRSLP higher committee members	MBRSLP higher committee composed of minister of education, chairman ICT fund from TRA, representative from PMO and the director general of MBRSLP	
s17	MBRSLP executive committee members	Executive committee oversees the strategic delivery of MBRSLP, headed by MoE undersecretary and including members from MoE top management with representatives from TRA and PMO	
s18	MBRSLP senior management team	MBRSLP heads of departments along with MBRSLP director general	
s19	MBRSLP operational team members	Team members responsible for operation delivery and tasks.	
s20	MBRSLP expert advisors	Subject matter experts and advisors within MBRSLP	
s21	MBRSLP partners/vendors	Industry partners and vendors working with MBRSLP in the deployments and projects delivery	
s22	Support team	Team members assigned to schools to support change process and technical support matters	
s23	Adoption team	Mobile team visiting schools weekly to share knowledge and drive change in using ICT educationally with focus on the LMS solution adoption and use	

Table 6.1: List of main stakeholders

Table 6.1 summarises the list of main stakeholders. The initial list was developed based on the one-to-one interviews with different stakeholders from MoE, MBRSLP, and schools. Accordingly, the researcher developed a diagram to provide a rich picture of the stakeholders, as can be seen in Figure 6.2. This helped the discussion in the project management office to develop and to enrich the picture and develop the list in Table 6.2.

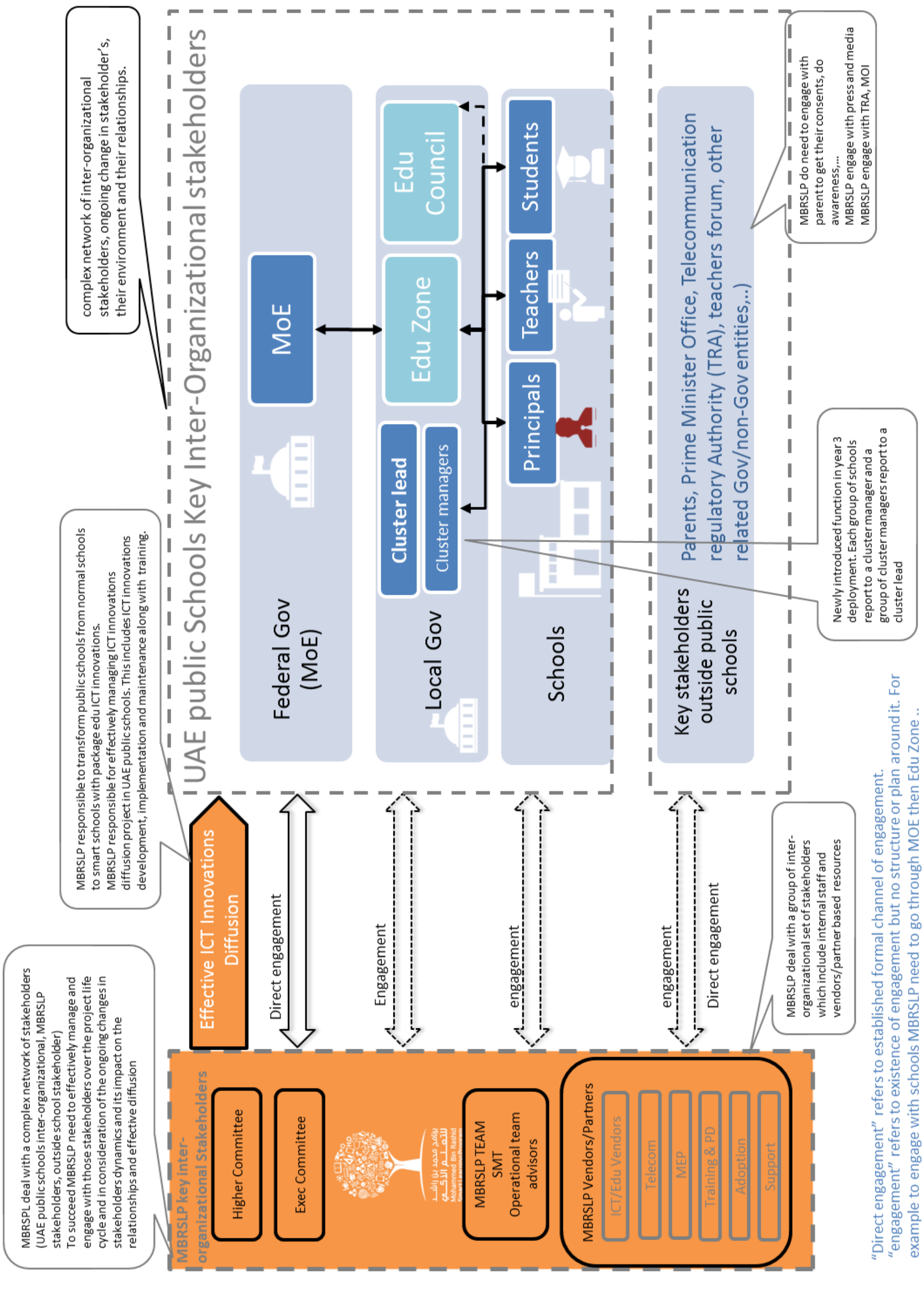


Figure 6.2: MBRSLP ICT innovations diffusion project stakeholders

Stakeholders were categorised into five different levels:

1. School level: This refers to the actual users of the ICT diffusion, mainly students, teachers, and school principals.

2. MoE federal level: refers to the Ministry of Education, which operates at federal level within the UAE. At federal level, different groups of stakeholders were identified including MoE top management, MoE middle management, and MoE operational staff. In addition to these, the MoE IT department was added, given that it has a central role in the project, and MoE cluster managers – a new role introduced during the third year of deployment.

3. Local level: This refers to the local authority as part of the UAE education system structure. In this level there are education zones for each emirate; only one emirate had an extra local education authority, which is the Sharjah Education Council. These entities act as a hub between schools and MoE in the case of education zones, and with local governments in the case of education councils.

4. Key stakeholders outside public schools: This refers to the main MBRSLP stakeholders outside the UAE public schools inter-organisational structure. For this level, the focus was on three stakeholders: student's parents, the Telecommunication Regulatory Authority (TRA), and the Prime Minister Office (PMO).

5. Final level: This comprises MBRSLP inter-organisational stakeholders, which refers to the main stakeholders involved in the MBRSLP ICT diffusion project. The MBRSLP operational model was based on partnership with a group of vendors and solution providers in order to deliver its mandate. Additionally, the MBRSLP itself was governed under a specific governance structure. Accordingly, the list of main stakeholders with MBRSLP inter-organisational stakeholders included the MBRSLP higher committee, MBRSLP executive committee, MBRSLP senior

management team, MBRSLP operational team, MBRSLP expert advisors, and MBRSLP vendors and partners. In addition, specific partners added included the connectivity service provider, other government entities, and finally the support team and adoption team, in consideration of their key roles over the different project stages.

6.2.2 Project activities per project life cycle phase

The list of project activities was developed based on discussion with the project management office team from MBRSLP. The project management office team is responsible for all project management, planning, and activities, including documentation. Based on the process described in section 6.1, the following four tables demonstrate the list of main project activities for each deployment (pilot, year 1, year 2, and year 3).

Pilot Deployment		
Project phase	Activity	Code
Initiation	• Establish joint committees	i1
	• Develop smart learning concept	i2
	• Identify stakeholders and key partners	i3
	• Develop pilot project charter	i4
Planning	• Pilot schools selection	p1
	• Vendor and partner engagement	p2
	• Develop time plan	p3
	• Develop procurement and budget plans	p4
Execution	• Conduct procurement and awarding	e1
	• Oversee performed work	e2
	• Manage stakeholder engagement (schools, MoE, others directly involved or impacted by roll-out)	e3
Monitoring and Control	• Oversee roll-out performance	m1
	• Validate performed scope	m2
	• Continuous engagement and feedback from stakeholders	m3
Closing	• Pilot closure and recommendations reports	m1

Table 6.2: Pilot deployment project main activities

Year 1 Deployment		
Project phase	Activity	Code
Initiation	• Develop statement of work	1i1
	• Develop business case	1i2
	• Identify stakeholders and key partners	1i3
	• Develop pilot project charter	1i4
Planning	• Develop detailed requirements	1p1
	• Define roll-out scope	1p2
	• Develop time plan	1p3
	• Develop procurement and budget plans	1p4
Execution	• Conduct procurement and awarding	1e1
	• Oversee roll-out of performed work	1e2
	• Manage stakeholder engagement (schools, MoE, others directly involved or impacted by roll-out)	1e3
Monitoring and Control	• Oversee roll-out performance	1m1
	• Validate performed scope	1m2
	• Monitor roll-out risks and outcomes	1m3
Closing	• Operation and support handover	1m1
	• Roll-out closure reports	1m2

Table 6.3: Year 1 deployment project main activities

Year 2 Deployment		
Project phase	Activity	Code
Initiation	• Update and confirm business case for roll-out 2	2i1
	• Re-confirm stakeholders and key partners	2i2
	• Develop roll-out initiation document (PID)	2i3
Planning	• Scoping and roll-out approach	2p1
	• Roll-out planning and scheduling	2p2
	• Stakeholders Engagement Planning and communication planning	2p3
	• Procurement Planning	2p4
Execution	• Conduct procurement and awarding	2e1
	• Overseeing work streams (under HP, direct MBRSLP, MoE)	2e2
	• Manage vendors at different work streams	2e3
	• Manage stakeholders and perform communication activities	2e4
Monitoring and Control	• Monitor and control work streams	2m1
	• Validate and control scope (in regard to vendors' delivery scope and change requests)	2m2

	• Control master schedule (overall roll-out details include HP, MBRSLP, MoE and other vendors) – single point of truth for roll-out status	2m3
	• Control stakeholders (manage expectation in regard to delivery, engagements with principals and teachers, notes on delivery)	2m4
Closing	• Roll-out handover to operation	2m1
	• Roll-out closure reports	2m2
	• Lessons learned and closure report	2m3

Table 6.4: Year 2 deployment project main activities

Year 3 Deployment		
Project phase	Activity	Code
Initiation	• Update and confirm business case for roll-out 3	3i1
	• Re-confirm stakeholders and key partners	3i2
	• Develop roll-out initiation document (PID)	3i3
Planning	• Scoping and roll-out approach	3p1
	• Roll-out planning and scheduling (master planning)	3p2
	• Resource planning and assignments	3p3
	• Identify risks and mitigations plans	3p4
	• Procurement planning and budget allocation	3p5
	• Stakeholders engagement planning and communication planning	3p6
Execution	• Conduct procurement and awarding	3e1
	• Manage teams and vendors at different work streams (all vendors managed by MBRSLP this year)	3e2
	• Manage stakeholders and perform communication activities	3e3
Monitoring and Control	• Monitor and control work streams	3m1
	• Validate and control scope (in regard to vendors' delivery scope and change requests)	3m2
	• Control master schedule (overall roll-out details include HP, MBRSLP, MoE and other vendors) – single point of truth for roll-out status	3m3
	• Control stakeholders (manage expectation in regard to delivery, engagements with principals and teachers, notes on delivery)	3m4
Closing	• Roll-out handover to operation	3m1
	• Contract closure	3m2

	• Lessons learned and closure report	3m3
	• Document roll-out best practices	3m4

Table 6.5: Year 3 deployment project main activities

In reviewing the activity tables, some observations were made. These include:

- The project activities in the pilot deployment were limited and different from other deployments

This was attributed to the fact the pilot phase was mainly focused on testing and trails and requirements gathering, in order to develop the concept of smart learning, what needs to be done, and how. This is why it started by setting the joint committee and working groups. According to MBRSLP:

> "*pilot deployment was mostly a technology deployment as we were still working to develop what ICT we will provide to schools and how…. the joint committees participated in a wide landscape review to explore what is happening globally by visiting similar ICT implementation initiatives in education including UK, Singapore, Turkey, Australia, and South Korea*".

The pilot deployment covered 14 schools over two semesters. Each group of schools was given a different set of ICT technologies, in order to be able to test different vendors.

- Year 1 deployment was a more structured set of activities

Year 1 deployment activities were described as a large roll-out over a very short period. The deployment approach was done through a prime system integrator partner who managed all the deployment activities and work streams. According to MBRSLP:

> "*year1 deployment was driven political leadership directions to start deployment with next academic year which left us with less than 4 months to do a deployment across more than one hundred school across UAE*".

- Year 2 deployment included a new set of activities in response to change in the scope of the prime system integrator where MBRSLP directly managed some of the vendors this year, also establishing a project management office team

- Year 3 deployment activities were changed to reflect another change in MBRSLP – directly dealing with most of the vendors (see activities 3i3, 3e2, 3e2, 3m3, and 3m2)

- In general, the change and development in project activities over the years indicates a change in the maturity of project management practices at MBRLSP

Based on these tables and the list of stakeholders, a master matrix was developed and filled in by the MBRSLP project management office team, according to the process described in Figure 6.2 (for the master matrix, see Appendix D). In the following sections, interdependency analysis will take place using frequency analysis, heat maps, and social network analysis techniques.

6.3 Interdependency analysis

The interaction between project activities and stakeholders was analysed using the following process:

a. Analysis of the matrix to identify frequencies of stakeholder involvement by life cycle of the ICT diffusion project in UAE public schools

b. Analysis using heat maps to present the frequencies visually

c. Analysis using a social network analysis technique in order to provide visual representation of stakeholder dynamics over project life cycle stages.

Over the following sections stakeholder engagement data findings and analysis will be presented and discussed.

6.3.1 Analysis of stakeholder involvement per year of deployment

The first heat map matrix, in Figure 6.3, represents total involvement activities per deployment for each stakeholder. The numbers indicate frequency of engagements over the deployment years and colouring (ranging from red to orange, yellow, and green) indicates lower or higher frequency of activity involvement.

			The frequency of stakeholder involvement activities per deployment year			
			Pilot deployment	Year 1 deployment	Year 2 deployment	Year 3 deployment
stakeholder leve	stakeholders	code	total per SH	total per SH	total per SH	total per SH
school level	students	s1	4	1	2	2
	teachers	s2	4	1	3	3
	principals	s3	4	5	10	8
MoE level - federal	MOE top management	s4	7	4	7	15
	MOE middle management	s5	9	7	10	19
	MOE operational teams	s6	5	6	9	16
	MOE IT Dept.	s7	10	9	11	20
	cluster managers	s8	0	0	0	1
local level	Education zone management	s9	1	2	1	1
	Education council management	s10	0	1	1	1
Key stakeholders outside public schools	Parents	s11	3	1	3	3
	Prime Minister Office	s12	7	1	4	2
	Telecom Regulatory Authority	s13	9	5	7	6
MBRSLP inter-organizational key stakeholders	other Gov entities (ministry of infra, ministry of interior, ..)	s14	0	0	1	2
	Connectivity Services Provider (Etisalat)	s15	5	6	8	10
	MBRSLP Higher committee members	s16	10	12	14	17
	MBRSLP Executive committee members	s17	12	12	16	17
	MBRSLP Senior Management Team	s18	15	16	18	19
	MBRSLP operational team members	s19	14	16	19	20
	MBRSLP expert advisors	s20	14	16	19	20
	MBRSLP partners/vendors	s21	13	6	16	18
	Support Team	s22	4	5	13	14
	Adoption Team	s23	4	2	6	7

Figure 6.3: Heat map matrix for frequency of stakeholder involvement activities per deployment year

The matrix review, analysis, and emerging themes will be highlighted over the following list of observations:

- As highlighted in section 6.2.2, pilot deployment activities were focused on developing the concept of smart learning and developing the ICT innovation to be deployed across schools over the next academic year. From the heat map, it can be seen that there were four activities where students' teachers and principals were involved: develop smart learning concept (i2); stakeholder engagement (e3); validate performed scope (m2); and continuous engagement and feedback from stakeholders (m3). According to principle#2:

  > *"at the early stages especially pilot stages there was very strong support, care and engagement from MBRSLP and MoE senior management…they visited the school many times, they sat with us and listened to our suggestions and feedback, however currently and by time this reduced"*

- Students' engagement was limited to pilot deployment. According to MBRSLP:

  > "*during pilot phase we developed use case scenarios for students, teachers, principals to help us better understand the requirements and accordingly design appropriate technology*".

- It seems that there was no focus to capture students' feedback. From the interviews with schools and stakeholders there was no channel dedicated for students to share their comments and feedback. Some MBRSLP stakeholders did mention cases where they responded to individual students' suggestions, but there was no dedicated channel for them.

- Principals' engagement increased from medium to a little higher over the years. This indicated more involvement. On the other hand, from principals' interviews, most involvement activities concerned coordination tasks related to the deployment execution phase and the monitoring and control phase. Principals were being asked to facilitate access to their schools so vendors could carry out their deployment tasks. Additionally, principals were asked to sign-off receiving devices, readiness for deployment, and get the acceptable use policy signed by parents.

- From the heat map, it can be seen that the MoE level of involvement increased from year to year. This was explained by higher collaboration with MoE and more involvement of MoE in years 2 and 3, in response to the new organisational changes at MoE level. In addition, in year 3 deployment MBRLSP started the process to hand over ICT infrastructure and operations to MoE, which resulted in more involvement. According to MBRSLP:

  "*year 2 and year 3 we had more engagement with MoE across the deployment activities, especially with MoE IT department. We started integration of systems and services as part of MoE new strategic plan launched by the new minister*".

  - This indicates MoE taking a more active role in the ICT diffusion and deployment process.
  - On the other hand, interviewing MoE middle management revealed that not all departments were fully aware of the MBRSLP agenda. Some felt that they are ignored and believe that engagement should include all MoE departments.
  - Although MoE involvement was at its highest in the year 3 deployment, in the perception of schools it was the most challenging year. This was justified by the MoE major changes in year 3, which included restructuring, with the changing of curriculum, roles, responsibilities of staff, new functions, and new subjects.
  - MBRSLP stated that ICT operations and support were being handed over to the MoE IT department. The process had already started. This was the initial plan with the start of MBRSLP – to hand over operations to MoE.

- The local level education authorities' involvement was minimal. The mentioned involvement activities were limited to general stakeholder engagement. According to one education zone:

  "*we were not much involved the process. For year 1 deployment we facilitated access and communication with school*"

- Schools indicated that local education authority roles were reducing with the new MoE structure and cluster managers taking a more active role in terms of school operations instead of the education zone. According to principle#5:

  "*the role local education zone this year is not clear, most of the responsibilities moved to new cluster manager*"

- Cluster manager level involvement is not for the first three years and only once during year 3. The justification was that cluster manager is a new role introduced during year 3 deployment and the staff in this role were not yet settled into the job, as it was considered a major change and required several changes across the ministry. The expectation was that they would assume their full role by next year.
- The local education council involvement was also limited to deployment information, as there was no communication channel established with MBRSLP. According to the local education council:

  "*for pilot and year1 we were not involved in the process, however from year 2 we established relationship with MBRSLP to support the Sharjah education council in educational technologies areas. This cooperation was very productive were did joint pilot activities for smart radio and 3D printing*"

  This cooperation was not noted in the deployment activities since the pilot was not considered part of these.

- Parents' involvement over deployment was seen to be low (red to orange colour):
  - Referring to schools' interviews, most of the schools demanded more focus on parents' engagement

        - Referring to stakeholders' interviews, an MBRSLP interviewee noted that more is needed in this area
    - Engagement with PMO and TRA as the main sponsors remains medium on average, with more involvement for TRA since they were supporting the procurement process for the first two deployments.
    - For MBRSLP inter-organisational stakeholder, the following are the main observations:
        - Increase in the number of involvements due to an increase in the number of activities over deployment years. This indicates the increasing maturity of project management practices at MBRSLP.
        - MBRSLP started to engage with other government entities such as the Ministry of Infrastructure development, so they carry on in school mechanical and electrical work. According to an MBRSLP interviewee:

          > [For the] first few years, MBRSLP took care of all MEP work to drive change. Now gradually we are moving things to MoE and other related entities.

          In addition, MBRSLP had engagement with the Ministry of Interior to cooperate in the area of e-safety.

        - MBRSLP involvement in the activities continued across all the activities over the years.
        - MBRSLP depends in its work on vendors and partners. MBRSLP's vendor engagement approach changed over deployments:
            - Year 1 deployment was done through a prime system integrator company
            - In Year 2, the prime system integrator had some parts and MBRSLP handled some other vendors
            - In Year 3, MBRSLP did not use a prime system integrator and handled all vendors and suppliers directly.
        - In term of support team member involvement, over the years this was increasing across different activities. Most of the activities were

related to communication and coordination activities. According to a support team member:

> "*we started in year1 one and our focus was to support schools with change and adoption of ICT in addition to technical support activities. Year2 things change as we did other activities including supporting the annual deployment activities, higher focus on technical support tasks*"

- Support team involvement increased over the years over the different project life cycle phases:
  - They were utilised to do a school site survey, quality assurance, monitoring and control of work being performed in schools
  - From the interviews, they noted an extra load, which did not allow them to focus on supporting schools.

6.3.2 Analysis of stakeholder involvement over project life cycle phases and main observations

This section reviews the frequency stakeholder involvement over the project life cycle phases. The second heat map matrix, in Figure 6.5, represents frequency of stakeholder involvement over the project life cycle phases. Figure 6.4 was extracted from the master DSM matrix to reflect involvement over the project phases of initiation, planning, execution, monitoring and control, and closing. Reviewing this heat matrix revealed following main emerging themes:

Frequency of stakeholder involvement over project lifecycle phases																						
			initiation				planning				execution				Monitor and Control				Closing			
stakeholder level	stakeholder list	code	pilot	year1	year2	year3	pilot	year 1	year2	year3	pilot	year 1	year2	year3	pilot	year 1	year2	year3	pilot	year 1	year2	year3
school level	students	s1	1	0	0	0	0	0	1	1	1	1	1	1	2	0	0	0	0	0	0	0
	teachers	s2	1	0	0	0	0	0	1	1	1	1	1	1	2	0	1	1	0	0	0	0
	principals	s3	1	0	2	0	0	0	3	3	1	2	2	1	2	1	2	2	0	2	1	2
MoE level -federal	MOE top management	s4	3	2	2	2	0	0	3	6	1	1	1	3	2	1	1	3	1	0	0	1
	MOE middle management	s5	4	2	2	2	1	2	3	6	1	2	2	3	2	1	3	4	1	0	0	4
	MOE operational teams	s6	2	1	0	0	1	2	3	6	1	2	2	3	1	1	3	3	0	0	1	4
	MOE IT Dept	s7	4	3	1	3	3	3	3	6	1	1	1	3	1	1	3	4	1	1	3	4
	cluster managers	s8	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
local level	Education zone management	s9	0	1	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
	Education council management	s10	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0
Key stakeholders outside public schools	Parents	s11	1	0	0	0	0	0	1	1	1	1	1	1	1	0	1	1	0	0	0	0
	Prime Minister Office	s12	4	1	0	0	0	0	3	1	1	0	1	1	1	0	0	0	1	0	0	0
	Telecom Regulatory Authority	s13	4	2	1	1	1	1	3	2	2	1	2	2	1	0	0	0	1	1	1	1
MBRSLP inter-organizational key stakeholders	other Gov entities (ministry of infra, ministry of interior, ..)	s14	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0
	Connectivity Services Provider (Etisalat)	s15	0	1	0	0	1	0	3	3	3	2	1	1	1	1	2	3	0	2	2	3
	MBRSLP Higher committee members	s16	4	2	3	3	1	3	5	6	3	3	3	3	2	3	2	4	1	1	1	1
	MBRSLP Executive committee members	s17	4	2	3	3	2	3	5	6	3	3	4	3	2	3	3	4	1	1	1	1
	MBRSLP Senior Management Team	s18	4	4	3	3	4	4	5	6	3	3	4	3	3	3	4	4	1	2	2	3
	MBRSLP operational team members	s19	3	4	3	3	4	4	5	6	3	3	4	3	3	3	4	4	1	2	3	4
	MBRSLP expert advisors	s20	3	4	3	3	4	4	5	6	3	3	4	3	3	3	4	4	1	2	3	4
	MBRSLP partners/vendors	s21	3	0	2	2	3	0	3	6	3	2	4	3	3	2	4	3	1	2	3	4
	Support Team	s22	0	0	1	0	0	0	2	5	2	2	3	2	2	2	4	3	0	1	3	4
	Adoption Team	s23	0	0	0	0	0	0	2	2	2	1	1	1	2	0	1	1	0	1	2	3

Figure 6.4: Frequency of stakeholder involvement over project life cycle phases

6.3.2.1 Initiation phase

- School level users (actual end-users) were only involved during the pilot year initiation phase and had marginal involvement over other deployment years' initiation phase:

    - Schools were involved in activity i2 (develop smart learning concept). According to the MBRSLP member interviewed:

      "*during pilot phase conducted scenario planning sessions, brain storming sessions, requirements gathering sessions with schools and students to get their requirements in designing our smart learning concept*"

    - The limited involvement with end-users over the other years of deployment indicates an assumption that requirements are static, which is a false assumption. From the perspective of the innovation diffusion theory, the importance of school needs dimension (ORG4) and re-invention (ORG5) dimension highlighted the positive relationship between diffusion and amount of re-invention and attention being paid to school needs.

    - School principals' interaction was noted to be marginal where they were involved in administrative activities related to facilitating access to schools, dates of deployment, and signing-off on devices delivery.

- MoE top management and middle management had a medium level of involvement during initiation phase:

    - The pilot phase was seen to have higher involvement since it was the start-up of an initiative

- Representatives from MoE top management were members of MBRSLP executive and higher committees.

- Local education authorities were totally out of picture:
  - The limited involvement was year 1 informing them about implementation taking place in their schools
  - In general, it appears that education zones' involvement was at a minimal level
  - Education council involvement was also minimal.
- Parents were involved in one activity, which was i2 (develop smart learning concept). From the interviews, it was focused on capturing parents' requirements during the initial stage.
- PMO and TRA witnessed their highest involvements during the pilot phase and then reduced to a medium low involvement:
  - This was justified as the start needing a much higher focus since it was a new project, then once established they shifted to the strategic monitoring and tracking of progress.
- It is noticed that MBRSLP partners/vendors were involved in the initiation phase:
  - According to MBRLPS, during pilot deployment, MBRSLP worked closely with global technology companies – including Microsoft, Intel, HP, Google, Apple, and Samsung – to develop the smart learning concept.
- The support and adoption team were not involved. This was because this role was not established until year 1 deployment, and then their role was mostly operational over the execution but not planning phase.

6.3.2.2 Planning phase

- At school level they were not involved in the first two deployments' planning phase; most involvement was with the principal to facilitate coordination, not actual ICT deployment project planning. A principal noted a high level of engagement during the pilot phase, as they were involved in some areas such as granting access for contractors to the school, specifying the location of the ICT equipment room, signing-off work completion, receiving devices, school readiness to distribute students' devices, and getting parents' signatures on the acceptable use policy.

- MoE top management were not involved in the actual planning of the pilot and year 1 deployment; however, from year 2 onward, MoE top management were more involved in the planning phase.

- TRA was involved in the planning over the activity procurement and budget plans since TRA is the funding body for MBRSLP. In addition, the MBRLSP procurements process involved TRA as part of the process. Year 3 deployment witnessed more involvement due to a change in processes and budgets in alignment with MoE changes.

- For other government entities, the engagement only started in year 3 with the process of migrating the mechanical and electrical tasks to the Ministry of Infrastructure Development.

- The support and adoption teams were not involved in the first two deployments as they were established during year 1 deployment. During years 2 and 3 deployments, they were involved in scoping and stakeholder engagement activities (2p2, 2p3, 3p3, and 3p4). More stakeholder planning activities involved the support team from year 2 onward.

6.3.2.3 Execution phase

- School level execution phase involvement was limited to a single activity, related to communication, where schools were being informed of what was happening on their premises and some coordination tasks related to the implementation work therein. From the interviews, a school principal noted that in years 1 and 2 they were more informed about what was happening in their schools and their requests were being attended to by MBRSLP; however, from year 3 things were not clear, deployment was delayed, and they were not sure when implementation would finish.

- MoE top and middle management involvement during the pilot, year 1, and year 2 deployments mostly related to communication and stakeholder engagement activities. This was because MBRSLP noted that they could not engage directly with schools, and that the MoE had to send circulars and process approvals related to execution activities in schools. Then, year 3 witnessed increased MoE top and middle management involvement, being involved in all execution phase activities.

- MoE IT department involvement also increased in year 3, being involved in all execution phase activities.

- As for the local education authority, engagement during the execution phase was also marginal, limited to one activity concerned with communication and general information.

- Parents' interaction took place during the execution phase as part of the stakeholder engagement activity. The core task was to get parent sign-off on the acceptable use policy so that students could receive the devices. According to an MBRSLP interviewee:

> *"parents were engaged to get their approval to hand their kids a computing device by signing the acceptable use policy….in addition, we gave parents a booklet which indicate general information about MBRSLP, benefits of the device to their kids, and some general advice on e-safety and contact numbers of support"*

- Support teams were highly involved in the execution phase. According to a support team member:

> ”*for every year deployment we were involved in the deployments activities of managing engagement and communication between schools and MBRSLP, coordination with different vendors in schools, reporting progress to MBRSLP*”

- The adoption team was mostly involved in the general communication and stakeholder engagement activities as part of deployment tasks.

6.3.2.4 Monitoring and control phase

- In the monitor and control phase, school level involvement was limited to some coordination and reporting through school principals. The principals were involved in validating confirmed scope and overseeing performed work activities.

- At MoE level, the involvement during the monitor and control project phase was a single activity of overseeing and validating performed work scope. According to an MBRSLP interviewee:

> “*during pilot and year 1 MoE joint teams supported in validating performed work especially from curriculum department on the new digital content and building department on validating performed mechanical and electrical work in schools*”.

- Over other deployments, MoE level involvement evolved to be involved in almost all monitor and control activities.

- The local education level was not involved in any monitor and control activities.

- TRA and PMO were not involved in monitoring project level activities, as their focus was more on a strategic level.

- As for the connectivity provider, their involvement was for first two deployments focused on scope and dealing with change requests; however, for year 2 and year 3 deployments they had a more active involvement, since they were contracted directly with the wider scope.

- MBRSLP was highly involved in the monitoring and control activities.

- The support team was also highly involved in the monitoring and control activities as they were reporting status in schools and monitoring progress on behalf of MBRSLP.

- The adoption team did not have a high role in the monitoring and control project phase as their involvement was limited to school level engagements and requests.

6.3.2.5 Closing phase

- The closing phase was mostly focused on closing pending project tasks and handing over to operations teams.

- At school level, most engagement was done to get school feedback and get principals to sign off and close pending deployment activities.

- At MoE level, MoE top and middle management were not involved in the process of project closing; however, from year 3 this changed. The same applied to MoE operation and IT teams.

- As for local education authority, parents, PMO, and TRA, they were not involved in the closing activities.

- Since MBRSLP was managing the overall project, they managed the project's closing phase and other stakeholders who were involved to feed into the project's closing activities and report.

- Local education authorities were not involved in any closing phase activity.

- The support and adoption teams did most of the reporting and verification tasks on behalf of the MBRSLP.

6.3.3 Interdependency analysis using social network analysis

This section will conduct data analysis using the social network analysis technique to provide visual representation of stakeholder dynamics and interdependencies on project activities and over project life cycle phases. In general, the graph theory in social network analysis is mainly used to identify "important" actors within a network. In social network analysis, a number of measures can be used to conduct analysis; for this research, the focus will be on a 'degree centrality measure'. Degree centrality measure analysis assists in identifying the most important stakeholders in the ICT deployment process. These stakeholders should be strategically positioned within the network of interaction. The centrality value is measured by the degree of each stakeholder through the ICT project deployment, depending on the frequency of contact of a stakeholder in relation to that of other stakeholders. This interaction will vary according to the stage of the project. The nodes that have a degree occupy a structural position (network location) that serves as a source or conduit for significant influence over activity nodes.

Node Measures	Description
Graph	A common way to visually represent social networks, consisting of two dimensions: actors and relations (also called nodes and edges).
Node	Nodes are the entities in a graph (also called vectors).
Edge	These are the relationships between nodes.
Degree centrality measure	This identifies the most important stakeholders in the ICT deployment process. These stakeholders should be strategically positioned within the network of interaction. The centrality value is measured by the degree of each stakeholder through the ICT project deployment depending on the frequency of contact of a stakeholder in relation to that of other stakeholders. This interaction will vary according to the stage of the project. The nodes that have a degree occupy a structural position (network location) that serves as a source or conduit for significant influence over activity nodes.
Class modularity (community detection)	This measures how well a network decomposes into modular communities.

	A high modularity score indicates sophisticated internal structure. This structure, often called a community structure, describes how the network is compartmentalised into sub-networks. These sub-networks (or communities) have been shown to have significant real-world meaning.

Table 6.6: Defining social network analysis terms and measures

6.3.3.1 Analysis of stakeholder involvement per year of deployment using social network analysis

The network analysis used the Gephi (0.9.1) tool by extracting the data from the DSM table to generate a social network for stakeholder interactions over the pilot deployment project activities.

6.3.3.2 Pilot deployment

For the pilot deployment, interactions between stakeholders and project activities were captured using the Gephi tool and a network diagram consisted of 38 nodes and 155 edges, presented in Figure 6.5. The nodes were composed of 23 stakeholders and 15 project activities over the project life cycle phases of initiation (i), planning (p), execution (e), monitoring and control (m), and closing (c). The edges represent the stakeholder involvement in the project activities. The higher the number of edges connected to a node indicates higher involvement and a higher role for this node in this deployment.

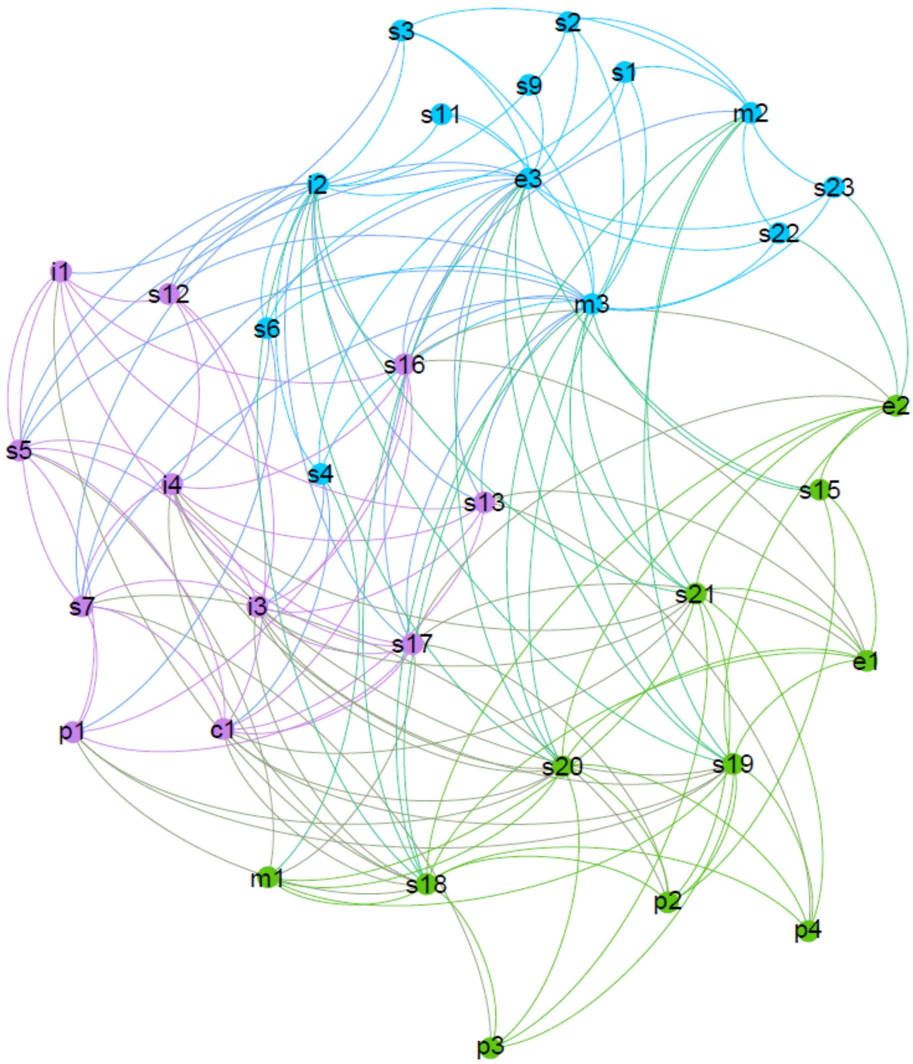


Figure 6.5: Pilot deployment social network diagram

A. Pilot deployment network degree centrality analysis

Among the most common social network analysis measures is degree centrality, which refers to the multiple ways to determine a node's importance, or centrality. Table 6.7 depicts the degree centrality score for pilot deployment nodes. The pilot deployment degree centrality and social network analysis main deployment degree centrality and social network analysis main observations are:

Node	degree
s1	4
s2	4
s3	5
s4	6
s5	9
s6	5
s7	10
s8	0
s9	1
s10	0
s11	3
s12	7
s13	9
s14	0
s15	5
s16	11
s17	12
s18	15
s19	14
s20	14
s21	13
s22	4
s23	4

Node	degree
i1	8
i2	16
i3	11
i4	11
p1	8
p2	7
p3	5
p4	5
e1	8
e2	9
e3	20
m1	7
m2	10
m3	19
c1	11

Table 6.7: Degree centrality for pilot deployment nodes

- **At MBRSLP inter-organisational stakeholders level, the main observations were:**

Stakeholders with the top five degree-centrality scores for pilot deployment were from MBRSLP inter-organisational stakeholders: MBRSLP senior management team (s18), with a degree of 15; MBRSLP operational team (s19), with a degree of 14; MBRSLP expert advisors (s20), with a degree of 14; MBRSLP partners/vendors (s21), with a degree of 13; and MBRSLP executive committee (s17), with a degree of 12.

This indicates that MBRSLP inter-organisational stakeholders had most interdependencies and played very important roles during pilot deployment, as they were involved in most of the 15 project main activities. Node s18's interaction with project activities is demonstrated using an ego network diagram, Figure 6.6, where s18 was involved in all project activities. An exception here was for other government entities (s15), support team (s22), and adoption team (s23), where they had lower interaction compared to other MBRSLP level stakeholders.

From the interviews, it was noted that the reason behind this was that these were added to the project later, with the start of the implementation occurring during the execution project phase. This was attributed to time constraints; however, this resulted in a lower readiness level in fulfilling their roles, as they were not prepared appropriately to deal with the school sector and students. According to an MBRSLP interviewee:

> "*we noted that IT support people were used to corporate environment compared to working with schools and students… we had to brief them and train them again so they better understand the education context*"

From the stakeholder interviews, it was clear that pilot deployment was mainly managed and delivered by the MBRSLP team. On the other hand, from a stakeholder theory perspective, higher involvement does not necessarily indicate a salient stakeholder, as the focus area and level of involvement per stakeholder were different, depending on their role. For example, MBRSLP expert advisors' (s20) degree was more than that of the MBRSLP executive committee (s17); however, their role was largely providing specific information and advice focused on developing the concept of smart learning. On the other hand, the executive committee's official role was to develop the smart learning approach and monitor and approve operational plans, as this is part of their official work mandate based on the MBRSLP establishment decree from the UAE Cabinet.

The MBRSLP executive committee (s17) was highly involved in the pilot deployment activities, as it was composed of representative from MoE, TRA, and PMO. The committee was ultimately responsible for developing MBRSLP's strategic approach and reporting it to the MBRSLP higher committee (s16) for direction and approval. During the pilot stage, the focus was in developing the approach and strategic direction for such a new unique initiative where there was no clear strategy yet in place. According to an executive committee member:

> "*At pilot time the level of thinking about smart learning was not sophisticated enough to go beyond ICT to education change…mainly it was devices. What was decided as technology package at that time was enough for that stage*"

The MBRSLP senior management team (s18) and MBRSLP operation teams (s19) were responsible for the overall delivery of the pilot deployment, and coordination with different vendors, schools, and MoE. According to an MBRSLP interviewee:

> "*pilot deployment was mostly technology deployment…. We were trying different technologies per school and with different solution providers in an effort to develop our MBRSLP smart learning concept, what technologies we will install in schools and our approach toward this new change*"

As for MBRSLP vendors, their role was mainly to pilot their technology, show that it works, and prove that their proposed solution and services meet the MBRSLP requirements. According to MBRSLP, the vendors were highly committed in an effort to get an extended national-level business deal. According to an MBRSLP vendor:

> "*our company worked with MBRSLP from inception phase from initial pilots where MRSLP asked different technology companies to show them what and how ICT can help schools and education…at that stage requirements where not clear and accordingly MBRSLP worked with different technology companies to help in defining what MBRSLP smart learning schools will look like….these companies included HP, Microsoft, ITworx, Samsong, LG, etc…*"

Accordingly, the power and legitimacy attributes of stakeholder salience were officially in the hands of the MBRSLP higher committee, then the MBRSLP executive, and then the MBRLSP senior management team. High power was dependent on the formal position assigned to it by the UAE Cabinet Resolution No.25 for 2012 and indirectly, from the name given to the programme, which was named after the vice-president, prime minster of the UAE HH Sheikh Mohammed

Bin Rashid Al Maktoum. The urgency was also high since diffusing the ICT initiative was a national priority of the UAE cabinet. In terms of legitimacy, it was also high from the official authority based on the Cabinet Resolution assigning this mandate to MBRSLP. As for the MBRSLP vendors/partners, the vendors and solution providers were contracted by MBRSLP to deliver the specific tasks. Accordingly, they did not have formal decision-making power. They had high urgency due to their interest to prove themselves in this deployment, which might increase their chances in getting the extended national-scale business. In terms of legitimacy, vendors, especially during pilot deployment, had no formal legal position.

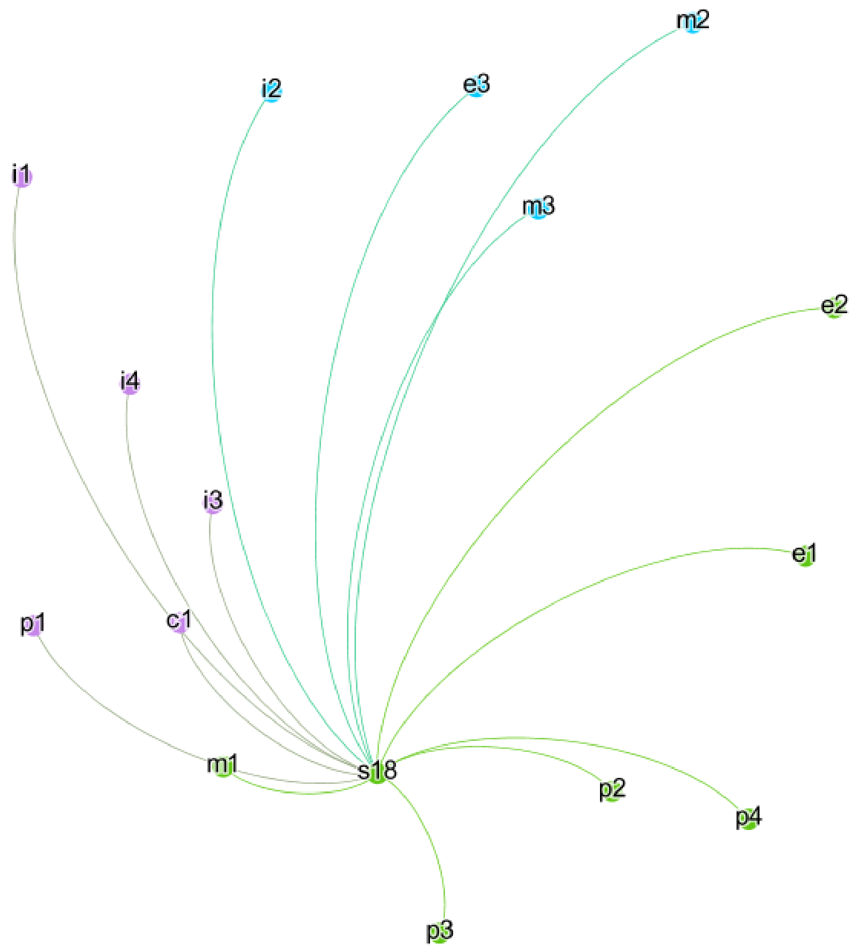


Figure 6.6: Pilot deployment – highest connected stakeholder node s18 ego network

- **At school level, the main observations were:**

During pilot deployment, it was noticed that school level involvement seems lower than expected, especially as they are considered the main beneficiaries and actual adopters of the ICT innovation that MBRSLP is trying to diffuse. That said, reviewing the pilot deployment activities, schools were involved in all activities related to gathering requirements, developing the smart learning concept, testing the technology, and giving comments and feedback. Other activities they were not involved in were mainly administrative activities related to cross entities coordination, procurement, and project management activities not related to schools. On the other hand, from school interviews, it was noticed that school level involvement was at its highest during pilot deployment.

Principals, teachers, and students were engaged in several activities during pilot deployment, where the focus was to get their requirements, and so MBRSLP can develop the smart learning concept. This is in high alignment with innovation diffusion theory and co-creation concept where schools, being the clients, felt that they were part of the process and as such were fully engaged and committed during pilot deployment. According to principle #2, whose school was part of the pilot deployment:

> "*early stages especially pilot stages there was very strong support, care and engagement from MBRSLP and MoE senior management…they visited school many times, they set with us and listen to our suggestions and feedback*"

The school teachers noted:

> "*On pilot phase … we were involved in devices testing, we were asked about our comments, suggestions, and ideas to make it better"*

In summary, schools were highly involved during the pilot deployment, which resulted in schools' sense of ownership, leading them to welcome the experience and adopt the provided ICT innovations. Schools were seen to have high legitimacy in being involved in the ICT diffusion process, since they are the ultimate users or clients. In addition, schools were seen to have high urgency toward using ICT, as they perceive ICT use as a necessity these days, especially given the UAE national direction toward ICT adoption. On the other hand, schools had limited power authority in terms of organisational rights or power to make decisions. This is because the UAE education system is based on a centralised decision-making structure, where almost all decisions are made at MoE level and schools have very limited authority and power. On the other hand, from an innovation diffusion perspective and informal position, schools have a high power in that the success or failure of the ICT innovation diffusion process goes back to school-level stakeholders being the actual users. All activities related to the adoption and use of the deployed ICT are carried out by the users.

- **At MoE federal level, the main observations were:**

As for MoE level involvement, the MoE IT department (s7) was the most involved stakeholder during the pilot deployment. This was because the pilot deployment was technology driven, and the MBRSLP worked closely with the MoE IT department in this regard. The MoE middle management (s5) were the second most involved stakeholders from the MoE level, which includes heads of departments and sections at MoE. According to the stakeholder interviews, not all MoE middle management was involved as it was limited to specific department heads such as those of IT, curriculum, strategy, buildings, and the administration department.

On the other hand, some of the interviewed MoE middle managers noted that they were not involved in the MBRSLP unless recently, which they perceived negatively because they assumed that involving them would allow them to align with the smart learning agenda. This explains some of the school suggestions and comments during the pilot deployment, which indicated misalignment with other MoE departments.

MoE top management (s4) were involved during pilot deployment; some of them were members of the MBRSLP executive committee and the higher committee. Their role was mainly around providing support, approving plans, and reviewing progress reports. As for MoE operational teams, it was limited to specific section and subject matter experts like mentors, and experts on curriculum, IT, and school buildings. The focus was to get technical and education requirements and facilitate access to schools. According to the MBRSLP member:

> "*during pilot phase we worked closely with MoE departments especially IT to get current technology status, and curriculum be able to plan how ICT can support curriculum*"

In summary, MoE level interactions were mostly done through the committee members and specific subject matter experts involved during the pilot deployment, where not all departments were involved or informed about what was happening, which resulted in some misalignment or challenges at school level that were resolved later. In terms of stakeholder salience, MoE top management has high power, legitimacy, and urgency, especially MoE top management who are also members in the MBRSLP higher and executive committees. MoE middle management was seen to have low salience since most of the organisation powers are in the hands of heads of departments.

- **At the local education level, the main observations were:**

At local education authority level, local education zones were partiality involved for coordination at local level as, before doing any work, the education zone needed to be informed. That said, local education zones were not part of any committee related to MBRSLP or actually involved in the deployment activities. Schools viewed this as a limitation as they need to report to their local education zone authority on all activities taking place in schools; also, the school mentors, who are based in the local education zone, monitor them. Schools considered that informing and involving the local education zone would facilitate their adoption and make them avoid any misunderstanding. As for the Sharjah Education Council, it was not involved during pilot deployment.

In summary, local education zones are seen to be entities with power and legitimacy at local level as they have formal authority locally over schools. If they were involved properly this could have provided further support to schools, as they have a direct reporting line to the local education council. In terms of urgency, the local education zones had similar urgency to that of the schools. In particular, some local zones made some efforts to diffuse ICT in schools on a limited basis and the MBRSLP initiative represents a great support to achieving a common goal.

- **At key stakeholders outside MBRLSP level, the main observations were:**

From the data findings, parents (s11) were involved in the pilot deployment to get their inputs and feedback over the deployment. According to an MBRSLP interviewee:

> "*as part of our requirements gathering and scenarios development we met with parents to get their inputs and feedback, parents are important element and we need to get their input and manage their expectations*"

From innovation diffusion, parents are seen to have a critical role in driving effective diffusion; however, it was seen that they had low salience since they were involved for information and awareness purposes. More involvement for parents is seen as critical to drive effective diffusion.

Being the initiator and main sponsor of the MBRSLP, the Prime Minister Office (s12) had a direct involvement in the pilot deployment's major activities, with a focus on providing support and monitoring progress. In particular, a very senior member from the Prime Minister Office is a member of the MBRSPL higher committee and another is a member in the MBRSLP executive committee. The Prime Minister Office was seen to be an entity of high power, legitimacy, and urgency. According to the MBRSLP senior management team interviewee:

> "*the prime minister office (PMO) keep close eye on the deployment progress and MBRSLP directly report to education team from PMO on regular basis*"

The UAE Telecommunication Regulatory Authority (TRA) (s13) also had a role during the pilot deployment, as it is the funding body for the MBRSLP. In addition, TRA had membership of the higher committee and executive committee of the

MBRSLP. Moreover, TRA provided resources and expert staff to support MBRLSP. At organisational level, TRA focus was on governance of MBRSLP, being a programme funded by TRA and one the most strategically important and highest-funded initiatives. The TRA had high power and legitimacy in consideration of what was mentioned earlier. In addition, TRA had higher urgency being the entity responsible to drive ICT diffusion across different sectors in the UAE, and education is a critical strategic sector.

- **Main observation on pilot deployment project activities**

Degree centrality for the top five project activities were: the activity 'manage stakeholder engagement' (e3), with a degree of 20; continuous engagement and feedback from stakeholders (m3), with a degree of 19; develop smart learning concept (i2), with a degree of 16; identify stakeholders and key partners (i3), with a degree of 11; and develop pilot project charter (i4), with a degree 11. The highest degree for activity node was node e3=20, where 20 out of the 23 stakeholders were involved in this activity. Figure 6.7 presents the ego network for node e3. The figure is a star network diagram representing node e3 interdependencies with stakeholders during the pilot deployment. Activity e3 was generally focused on engagement with all related stakeholders, which justifies why it was the highest degree. The next highest activity degree was for develop smart learning concept (i2), which was the focus of the pilot deployment and involved almost all stakeholder levels. An observation was that there was no engagement with local education level entities for activity (i2), which supports the earlier observation of misalignment between schools and local education zones.

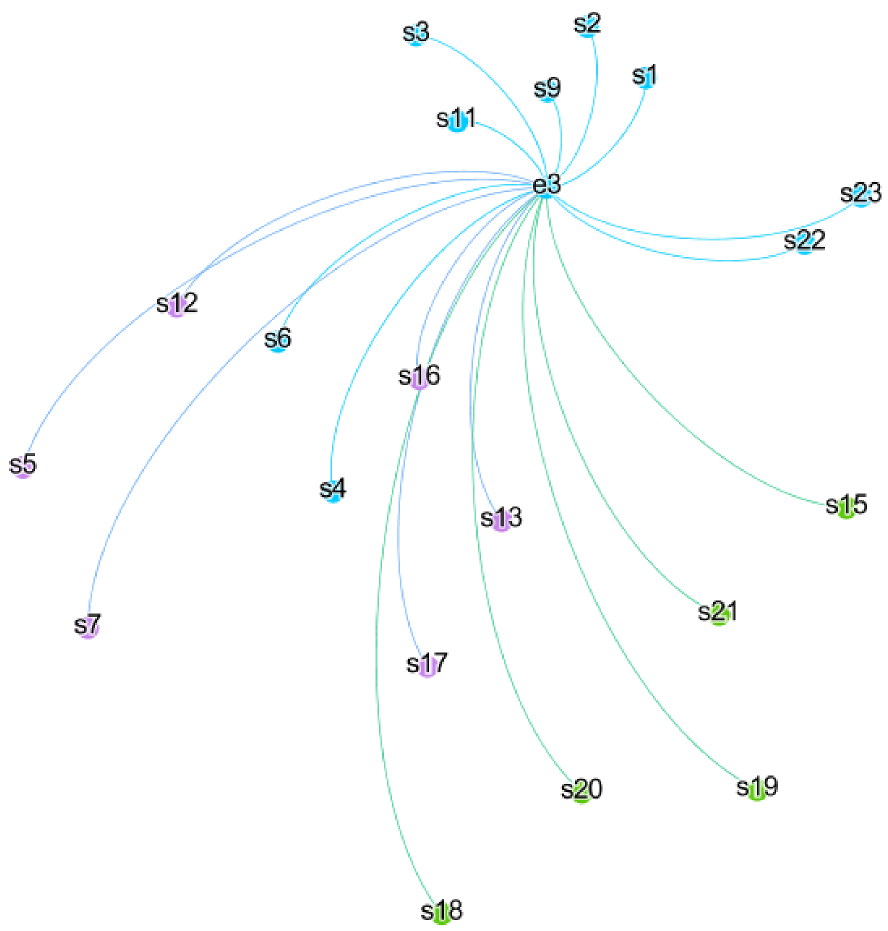


Figure 6.7: Pilot deployment – highest connected activity node e3 ego network

B. Modularity network analysis for pilot deployment

Modularity measures how well a network decomposes into modular communities – also called clusters, or groups. Networks with high modularity have dense connections between the nodes within modules but sparse connections between nodes in different modules. Running the class modularity measure in the Gephi tool will simply look for the nodes that are more densely connected together than to the rest of the network, and then colour the identified cluster into different colours. In our case, it should show which stakeholders and activities nodes are more densely connected between each other than the rest of the network. This assists in a better understating for the network structure of the changing dynamics over the project life cycle phase or years of deployment.

From the pilot deployment diagram, three clusters were identified for pilot deployment network, presented in three different colours for the nodes and edges, as depicted in Figure 6.8. This was generated using the class modularity function with parameters configured as follows: randomise = on; use edge weights = on; and resolution = 1. Results provided modularity = 0.202 and number of communities = 3. The pilot deployment network clustering main observations were:

- Three communities were identified where the number of nodes per community was 11, 11, and 13.
- Filtering of the network diagram based on communities can be seen in Figure 6.9. From the diagram, the main observations are:
    - Modularity community (A) has the highest number of stakeholder nodes (s1, s2, s3, s4, s6, s9, s11, s22, s23). The stakeholders cover all school levels, one from MoE operational teams, the education zones, and adoption and support teams. On the other hand, this community is grouped by the top three activity nodes in degree centrality (e3, i2, m3). This community represents most of the operational level stakeholders and users, in addition to stakeholder engagement activities.
    - Modularity community (B) included the top four stakeholders in degree centrality (s18, s19, s20, s21). Those stakeholders represent the MBRSLP core team carrying out the actual delivery of the pilot deployment.
    - Modularity community (C) included the stakeholders with the highest salience or power, including the funding body TRA (s12), the Prime Minister Office (s13), MBRSLP higher committee (s16), and MBRSLP executive committee (s17).

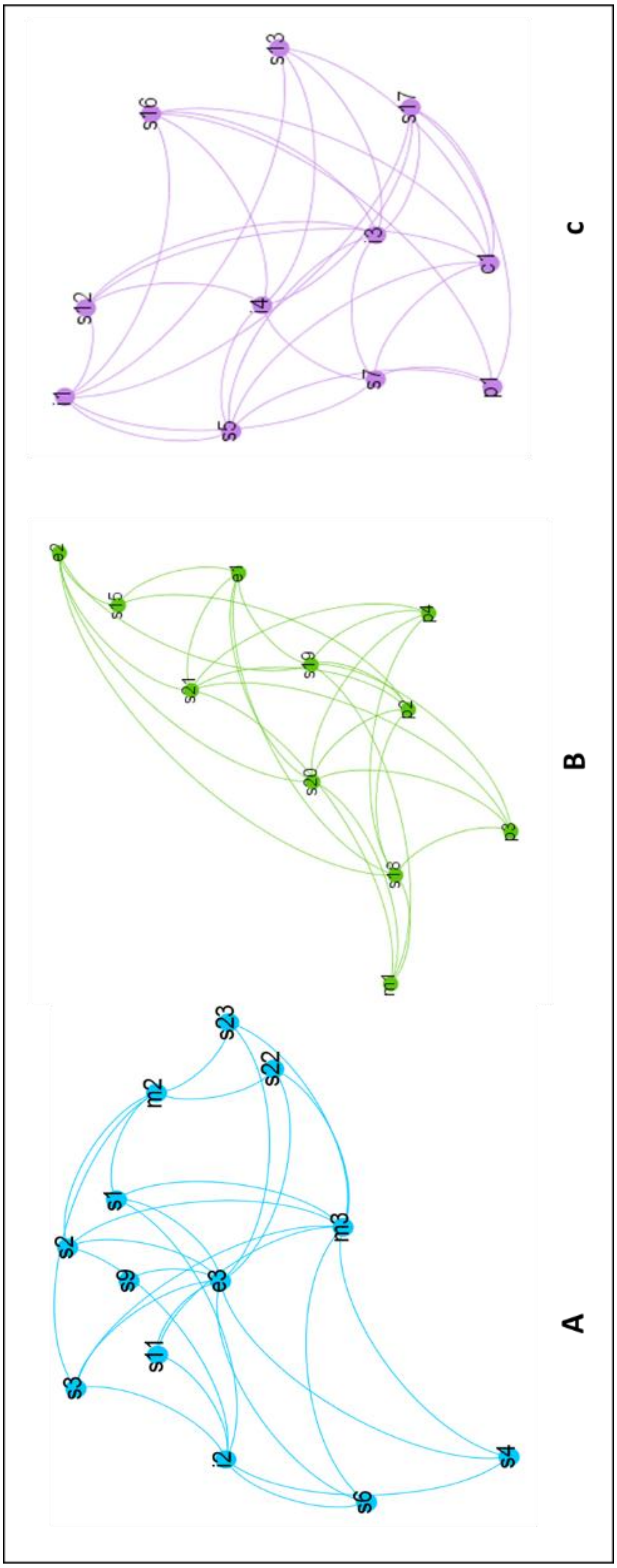


Figure 6.8: Pilot deployment modulity communities

C. Pilot deployment network by project life cycle phases

This section will review the pilot deployment network using the project life cycle phase by phase. Figure 6.9 demonstrates how the pilot deployment network grows, starting from the initiation phase through the planning, execution, monitoring and control, and closing phases. The approach allows us to clearly model for the dynamics of interactions and interdependencies across project life cycle phases. Each project phase will be discussed over the following sub-sections.

Initiation phase

The initiation phase was composed of four main activities: establish joint committee (i1); develop smart learning concept (i2); identify stakeholders and key partners (i3); and develop pilot project charter (i4). Being in the pilot deployment, considered the initiation of the MBRSLP initiative, the activities were focused on defining who should be involved by establishing the committees and defining what constitutes the concept of a smart learning initiative in UAE.

The main stakeholders involved in the initiation phase were s4, s5, s7, s12, s12, s16, s17, s18, s19, s20, and s21. At MoE level, top and middle management (s4, s5) were highly involved since they were key members of the joint committees. In addition, the MoE IT department (s7) was fully involved since it was an IT-based initiative. The strategic stakeholders of TRA (s12) and the Prime Minister Office (s13) were also fully involved, being the funding body and main sponsor of the initiative and especially as MBRSLP is named after the prime minister. This demonstrates the level of political support given to MBRSLP. At MBRSLP level, the higher and executive committees (s16, s17) were also fully involved, taking their roles as per the Cabinet resolution for establishing the MBRSLP initiative.

From the stakeholder interviews, the pilot deployment was very fast and scope was limited to 14 schools; the complexity of deploying ICT in 14 schools was not considered a big challenge. The actual challenge was to develop the concept of smart learning and, at that time, it was limited to a technology deployment. According to an executive committee member:

"*At pilot time the level of thinking about smart learning was not sophisticated enough to go beyond ICT to education change…mainly it was devices. What was decided as technology package at that time was enough for that stage*"

In addition, an MBRSLP interviewee supported this view, stating:

"*pilot deployment was mostly technology deployment…. We were trying different technologies per school and with different solution providers in an effort to develop our MBRSLP smart learning concept, what technologies we will install in schools and our approach toward this new change*"

On the other hand, some stakeholders were not involved during the initiation phase. Cluster managers (s8) were not involved because, at that time, there was no cluster manager's role at ministry level; it was only introduced during year 3 deployment. In addition, local education authorities (s9, s10) were not involved although they had high authority and a critical role in dealing with schools directly. The implications of this were discussed in a previous section, with it resulting in misalignment between the local authority and schools. Other government entities (s14) and the connectivity service provider (s15) were not involved. Finally, the support and adoption teams (s22, s23) were not involved, as these roles had not yet been established.

In summary, during the initiation phase, most activities were managed and involved decision-makers and strategic stakeholders aiming to establish the initiative and working teams.

Planning phase

The planning phase was composed of four main activities: pilot school selection (p1); vendors and partner engagement (p2); develop time plan (p3); and develop procurement budget plans (p4). As highlighted earlier, pilot deployment was considered a technology-driven deployment with much lower complexity compared to the other years of deployment. Selected vendors and solution providers were given a school in order for each one to demonstrate how they enrich the teaching and learning environment with ICT. Planning activities were mostly managed by MBRSLP senior management and operational teams (s18, s19). In addition, MBRSLP utilised the expertise from specific partners such as Intel and Microsoft to assist in the planning phase and facilitate access to technology solution providers and similar initiatives around the world.

Execution phase

The execution phase was composed of three main activities: conduct procurement and awarding (e1); oversee performed work (e2); and manage stakeholder engagement (e3). The main activity for this phase was e3, where the network grows significantly because of the stakeholder management activities. From the interviews and upon reviewing the activities, it was noticed that school level involvement was mostly around testing the new technology and giving feedback on their experience. According to an MBRSLP consultant:

> "*the main objective from pilot phase was mainly usage …to break any barriers between use of technology in teaching and learning and communication… MBRSLP introduced ICT to teachers and students…this was something new to deal with…so we tried to make them familiar with it and use it freely with confidence…we started with teachers first and then engaged students*"

Monitor and control phase

The monitor and control phase was composed of three main activities: oversee roll-out performance (m1); validate performed scope (m2); and continuous engagement and feedback from stakeholders (m3). During this phase, school and MoE level stakeholders were involved again. Schools were involved to get their feedback on the experience of using the provided ICT their schools. MoE level stakeholders were involved to get feedback and get support in overseeing performed scope, especially the IT department and school buildings department. It is worth mentioning that education zones were not involved in this phase, although they could have assisted in monitoring and control, considering their direct involvement in school operations.

Closing phase

The closing phase was composed from the single activity of pilot closure and recommendations report (c1), where MBRSLP worked closely with the different teams and committee to report on the pilot deployment and recommendations on the way forward. On this activity, the MBRSLP senior management team interviewee noted:

> "*from the review of international experience and the pilot deployment, it was clear that a technology driven deployment will not be sufficient and the direction was toward a holistic change program were ICT support education*"

Accordingly, MBRSLP submitted the pilot report with the list of recommendations to develop a holistic approach toward ICT deployment in UAE public schools.

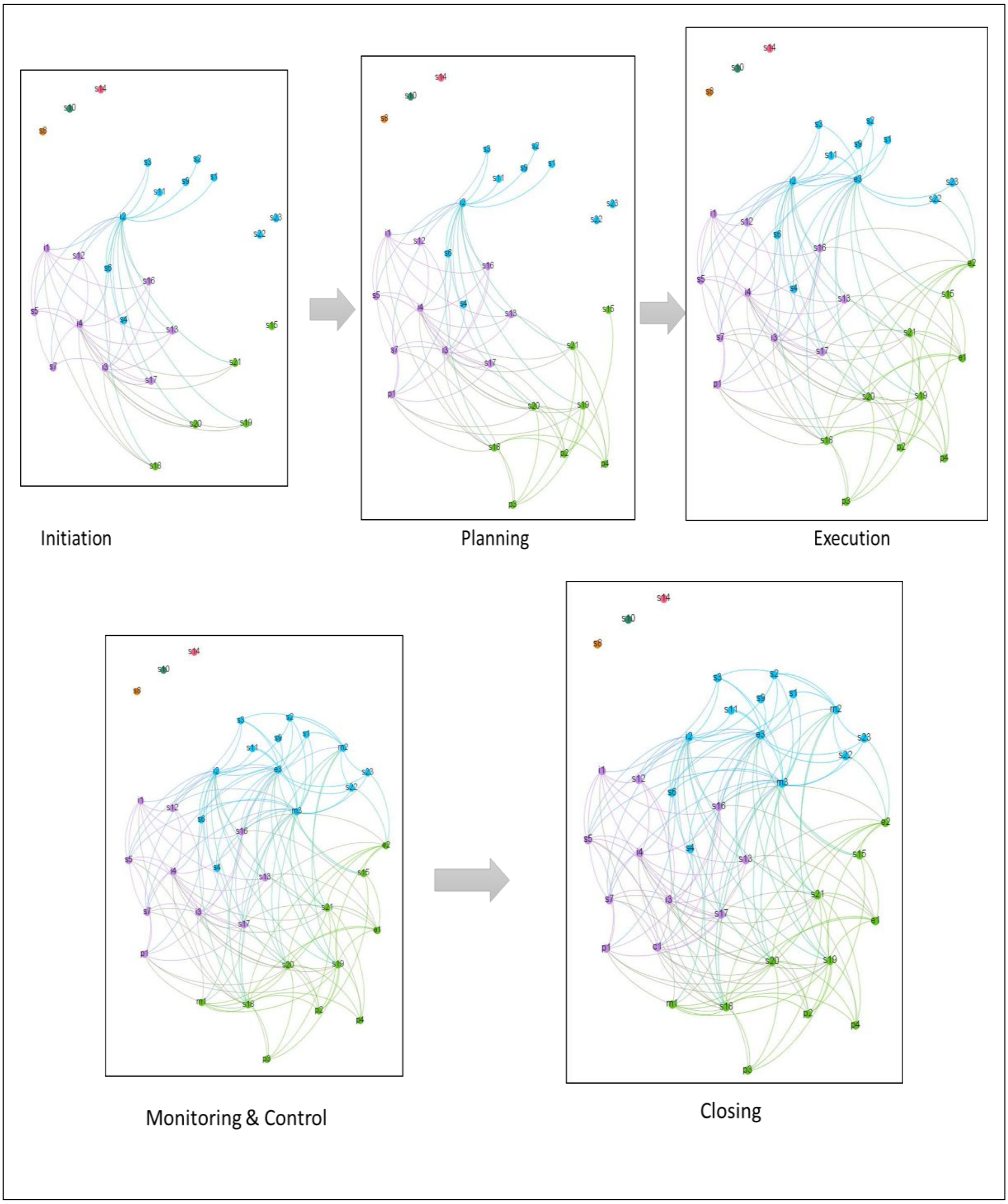


Figure 6.9: Pilot deployment network growing over project life cycle phases

6.3.3.3 Year 1 Deployment

Following on from the pilot deployment observation, year 1 deployment was of larger scale and complexity. Year 1 deployment scope was to cover all grade 7 students across UAE public schools, comprising 123 schools, 440 classrooms, 1,343 educators, and 11,548 students. The year 1 deployment project was under extreme time pressure, driven by political leadership urgency to diffuse ICT in UAE schools. MBRSLP had less than four months to plan and execute a large scope and extended provision of ICT based on the lessons learned from the pilot deployment. Year 1 ICT deployment was more holistic, with the package of ICT devices and services clearly defined and the concept of smart learning and deployment approach more mature. For the year 1 deployment, the network diagram consisted of 39 nodes and 134 edges, presented in Figure 6.10. The nodes were composed of 23 stakeholders and 16 project activities over project life cycle phases. Over the next sub-sections, the following network analysis will be discussed:

A. The degree centrality analysis

B. Network modularity analysis

C. Network analysis by project life cycle phases.

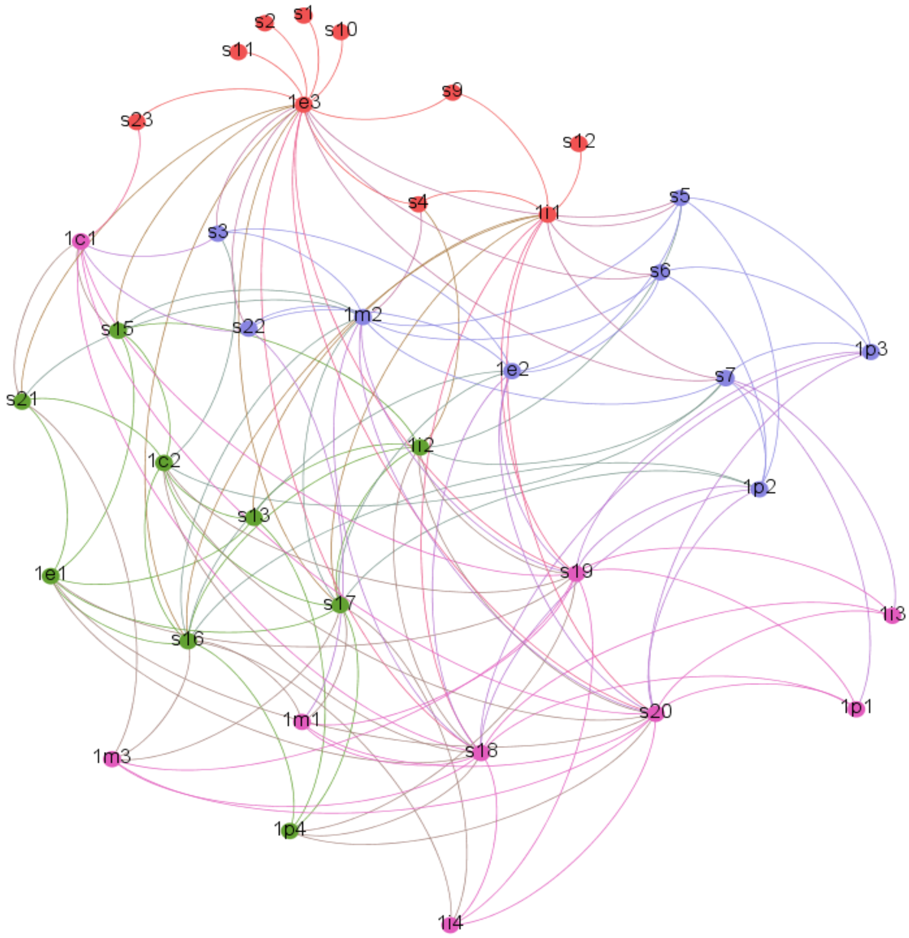


Figure 6.10: Year 1 deployment social network diagram

A. Year 1 deployment network degree centrality analysis

Year 1's degree centrality is summarised in Table 6.8. The year 1 deployment social network diagram main observations are:

Node	degree
s1	1
s2	1
s3	5
s4	4
s5	7
s6	6
s7	9
s8	0
s9	2
s10	1
s11	1
s12	1
s13	5
s14	0
s15	6
s16	12
s17	12
s18	16
s19	16
s20	16
s21	6
s22	5
s23	2

Node	degree
1i1	12
1i2	10
1i3	4
1i4	5
1p1	4
1p2	8
1p3	6
1p4	6
1e1	8
1e2	9
1e3	19
1m1	6
1m2	13
1m3	6
1c1	8
1c2	10

Table 6.8: Degree centrality for year 1 deployment nodes

- **At MBRSLP inter-organisational stakeholders level, the main observations were:**

Stakeholders with the top five degree scores for year 1 deployment were all MBRSLP inter-organisational stakeholders: MBRSLP senior management team (s18), with a degree of 16; MBRSLP operational team (s19), with a degree of 16; MBRSLP expert advisors (s20), with a degree of 16; MBRSLP higher committee members (s16), with a degree of 12; and MBRSLP executive committee members (s17), with a degree of 12. This indicates that MBRSLP inter-organisational stakeholders maintained a high interaction and played a central role during year 1 deployment, as they were involved in all 16 project activities for s18, s19, and s20. Node s18's interaction with project activities can be seen in the ego network diagram in Figure 6.11, where s18 was central in all project activities. On the other hand, MBRSLP partners/vendors' (s21) involvement is reduced in comparison to their pilot deployment. Vendors were not involved in the initiation and planning activities due to procurement and tendering processes until vendors' awarding took place.

On the other hand, once the prime system integrator vendor was awarded, all implementation activities were going to this vendor, which played the central role in year 1 deployment implementation. According to MBRSLP, the year 1 deployment approach was through a prime system integrator, who was in charge of the overall delivery tasks including dealing with any sub-contractor. The HP company was appointed the prime system integrator for all year 1 deployments. The system integrator role was described thus by an interviewee from the vendors:

> '*HP company proposed to do end-to-end solution to cover all the experience that a student or teacher will go through from device to network to internet to applications and operations and support functions. This was sought to reduce the burden of managing multiple solution providers each at different area and they positioned HP to be the single point of contact and system integrator for MBRSLP. We took care of all sub-contractors and other vendors in the background of such complex setup including hardware vendors (screens, students and teacher devices, and equipment's), the MEP work, the connectivity (wifi, internet lines, MPLS network), back operations in data centre, IT operations, help desk functions, and MBRSLP support team*'

One observation was noted on the in-school support and adoption teams where MBRSLP tasked the prime system integrator vendor to allocate one permanent member per school. This was an important yet complicated task, where the vendor had to provide 123 support team members (males for boys' school and female for girls' schools) within a less than two-month period. During the pilot phase, an observation was noted on the difference between working in a school with students compared to a corporate context, highlighting the need to ensure an appropriate level of readiness for the school context. The same observation remained a challenge during year 1 deployment as some schools complained about the members allocated to their school. According to a prime system integrator interviewee:

> "*we did huge effort to allocate appropriate candidates for in-school support and adoption team members….we monitored their performance and based on the review we had to change a number of them as appeared to be less qualified members*"

In general, at MBRSLP level, stakeholder power, legitimacy, and urgency remained the same as the pilot deployment with maybe more urgency to deliver. Officially, the power and legitimacy attributes of stakeholder salience were in the hands of the MBRSLP higher committee, then the MBRSLP executive, and then the MBRLSP senior management team. As for the MBRSLP vendors/partners, they did not have formal decision-making power, as they were only implementers. On the other hand, after awarding a vendor as the prime system integrator, all MBRSLP deployments were going through this vendor, which give it power from an informal position where their role was central to the success of the ICT diffusion.

The vendors were seen to have high urgency due to their interest to prove themselves in this national deployment level, which might open doors for more business at regional level and for coming deployments. In terms of legitimacy, vendors had no formal legal position to be closely involved; however, from an informal position they had the right to be closely involved. From the diffusion perspective, they played a central role in the ICT deployment, controlling all implementation activities and sub-contractors and having direct interaction with schools on behalf of MBRSLP through the support and adoption teams. This way, the prime system integrator vendor, from a risks perspective, was seen to have high salience and a central role in year 1 deployment.

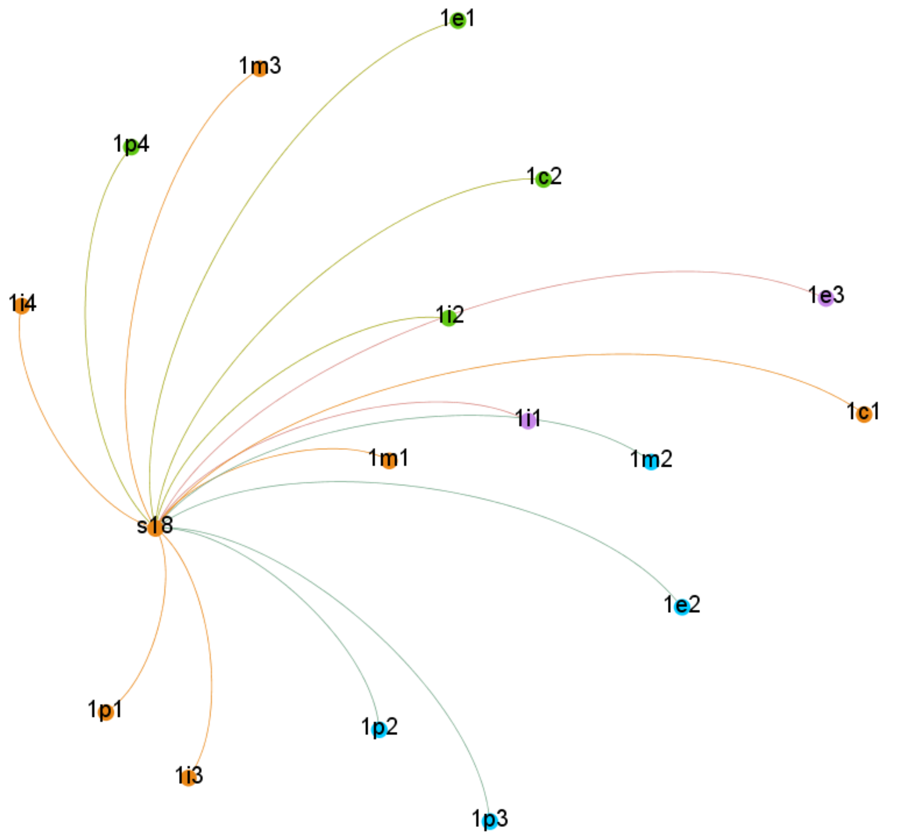


Figure 6.11: Year 1 deployment – highest connected stakeholder node ego network

- **At school level, the main observations were:**

School level interaction reduced significantly during year 1 deployment. Students (s1) and teachers (s2) were involved in only one activity. School principals were involved in different activities related to facilitating access, execution tasks, and monitoring progress within the schools. On the other hand, schools were not involved in initiation and planning activities, despite being the ultimate users. From the interview discussion with an MBRSLP senior management team member, this was justified due to the very short timeline as the decision to give year 1 extended scope was taken around the end of the academic year, when all schools go on extended summer leave. Accordingly, schools were closed during the initiation, planning, and early execution phases of year 1 deployment. According to a school principal on year 1 deployment:

> “*we heard about smart learning initiative from the official launch by HH Mohammed bin Rashid in news and we were very happy with that and looking forward when it will happen in our schools… it was very quick deployment …we were surprised all cycle 2 school were being transformed to smart schools”*

The principal explained how, with the start of the 2013-14 academic year, ICT was already deployed across all grade 7 classrooms and that, during the first, week teachers had to go for a full week of training to get their personal laptops and get to know how to use the new technologies and applications in their school.

In terms of school level stakeholder salience, it is even higher in the year 1 deployment compared to the pilot deployment. This is related to the fact that year 1 ICT diffusion is a larger-scale roll-out, with higher complexity and high expectation from the project sponsors. Being the direct adopters gives them an informal position of power, legitimacy, and urgency. In summary, schools were not highly involved during the year 1 deployment initiation and planning phases and had a small role over the other phases. Although schools were not involved and it was big sudden change that they need to cope with, the high level of support given to schools nevertheless provided comfort to accept and adopt this change. Schools appreciate the high level of attention given to the teachers’ training, the quality of devices, the quality of IT help desk, and providing permanent support and adoption team members per school. All these were key drivers for schools welcome the experience and adopt MBRSLP.

At MoE federal level, the main observations were:

The MoE IT department (s7) was also the most involved stakeholder from MoE level during the pilot deployment. This indicates that at MoE IT department was the most important stakeholder during pilot deployment. According to stakeholder interviews, during the pilot deployment the highest interaction at MoE level was with the IT department and curriculum department. According to the MBRSLP member:

"*MoE IT department was like our main contact and coordinator within MoE…they arrange access for MBRSLP to specific department and provide us with required statistics since they control the SIS (student information system)*"

On the other hand, the curriculum department was highly involved as their curriculum experts were supporting the development of the interactive curriculum for grade 7. According to the MBRSLP senior management team member:

"*a big part of year 1 deployment was to develop digital interactive curriculum for grade 7…this was done with direct coordination with MoE curriculum department where MoE curriculum experts were responsible to develop the educational scenarios that will be digitized by the specialized vendor MBRSLP awarded the contract*"

As for MoE top and middle management (s4, s5), they were involved in general support and monitoring the progress, especially MoE staff who were members of the MBRSLP executive committee (s17). On the other hand, it was noted that not all MoE department were properly informed about what is taking place in schools under the MBRSLP initiative, which resulted in misalignment between MoE departments and more importantly with schools. According to a school principal:

"In year1 deployment ... some MoE departments or staff were not aware of what is happening in schools under smart learning project…we had a problem with school mentors were they insisted to have the class planning book which is now digitized in the LMS …after raising this to MBESLP it was resolved later on…there must be more coordination between MBRSLP and MoE and between MoE departments"

When this matter was discussed with MBRSLP members, they confirmed that more coordination was needed and that time was a huge challenge, especially for year 1 deployment. In addition, upon discussing the coordination topic with MoE middle management, it was noted that coordination between MoE departments is one of the biggest challenges and that sometimes it feels as if there are silos between departments. According to an MoE middle management interviewee who is a head of a key department:

> *"MBRSLP did start very fast…the expectation over time was to fix some of the challenges including involving other key departments, improving the provision and higher engagement with schools to ensure sustaining adoption…"*

The interviewee also talked about the organisational challenges at MoE level stating:

> *"we have a challenge in MOE configuration ... departments work in silos…and I think MBRSLP was wrong when they assumed MOE departments will work with each other for MBRSLP agenda and that they will align with MBRSLP*"

The interviewee also talked about the importance of alignment between all stakeholder levels, stating:

> "*it is important to have a full plan involving three levels of stakeholders: level#1 top managements from MoE, level2 departments heads and education zones, level3 schools principals, teachers, students, parents ,..*"

In summary, MoE level interactions were mostly done through the committee members and specific subject matter experts involved during the pilot deployment, where not all departments were involved or informed about what was happening, which resulted in some misalignment or challenges at school level that were resolved later. In terms of stakeholder salience, MoE top management has high power, legitimacy, and urgency, especially MoE top management who are also members of the MBRSLP higher and executive committees. MoE middle management was seen to have low salience since most of the organisation powers are in hands of heads of departments. As for the MoE IT department, it was seen to have high power from the formal position relating to IT and the fact that the MBRSLP LMS system is interdependent with the MOE SIS (student information system) to be able to retrieve users' and classrooms' data. In addition, the MoE IT department played a central role in facilitating access and interaction with other MoE departments.

- **At the local education level, the main observations were:**

At local education authority level (s9, s10), the status remained similar to the pilot deployment, with marginal involvement. The interaction with the education zone was limited to informing them about what was taking place in schools, with no direct role assigned to them. According to MBRSLP, to engage with the education authority MBRSLP needed to go through MoE, which limited their ability to engage and assumed that MoE would inform and brief the education zones. The local education authorities were concerned about not getting appropriate involvement and awareness on the smart learning agenda, noting that they were waiting for MoE or MBRSLP to approach them with details.

In summary, the local education authorities are seen to be entities with power and legitimacy at local level, as they have formal authority locally on schools. If they were involved properly this could have provided further support to schools as they have a direct reporting line to the local education council. In terms of urgency, the local education zones had similar urgency to schools, especially, some local zones made some efforts to diffuse ICT in schools on a limited basis and the MBRSLP initiative represents a great support to achieve a common goal.

- **At key stakeholders outside MBRLSP level, the main observations were:**

For year 1 deployment, parents (s11) were involved later, at the execution phase, where they had to sign an acceptable use policy and approve handing a computer tablet to their kids. On the other hand, some schools noted that they took the initiative and conducted workshops and parent meetings to explain to them what was happening and how the students will benefit from the smart learning project. School principals expressed the need for more parent engagement, especially at female schools.

The engagement with the Prime Minister Office (s12) was lower in the year 1 deployment; this was justified in that the MBRSLP year 1 plan was approved by the Prime Minister Office, specifically the extended scope, and their role turned into monitoring. As for TRA (s13), the involvement was reduced compared to the pilot deployment. TRA were involved in several key activities during year 1 deployment, with a focus on budget and procurements activities since TRA is funding the MBRSLP project; in addition, year 1 tendering and procurements were directly support by TRA. According to an MBRSLP interviewee:

> '*in year 1 deployment MBRSLP core team was not yet built and TRA supported MBRSLP through its departments including legal, procurement and finance departments…also TRA provided MBRSLP with expert staff members who worked with different deployment teams and vendors to meet the short timeline*'

In summary, parents are seen to have an important role to drive effective diffusion and principals believed more engagement was needed for year 1 deployment. As for PMO, the shift was to a strategic role and away from operational activities since the MBRSLP was established, and the MBRSLP strategic plan was approved by PMO. PMO maintained high power, legitimacy, and urgency since they were still members of the MBRSLP higher and executive committees. As for TRA, the power, legitimacy, and urgency remained as high as in the pilot deployment. In addition, TRA continued to provide operation level support to MBRSLP in procurement, legal matters, and providing expert staff.

- **Main observation on year 1 deployment project activities**

Degree centrality for the top five project activities were: manage stakeholder engagement (1e3), with a degree of 19; validate performed scope (1m2), with a degree of 13; develop statement of work (1i1), with a degree of 12; develop business case (1i2), with a degree of 10; and roll out closure reports (ic2), with a degree of 10. The highest degree for an activity node was node (1e3), with 19 out of the 23 stakeholders involved in this activity. Figure 6.12 presents the ego network for node (1e3). The figure is a star network diagram representing node (1e3) interdependencies with stakeholder during year 1 deployment.

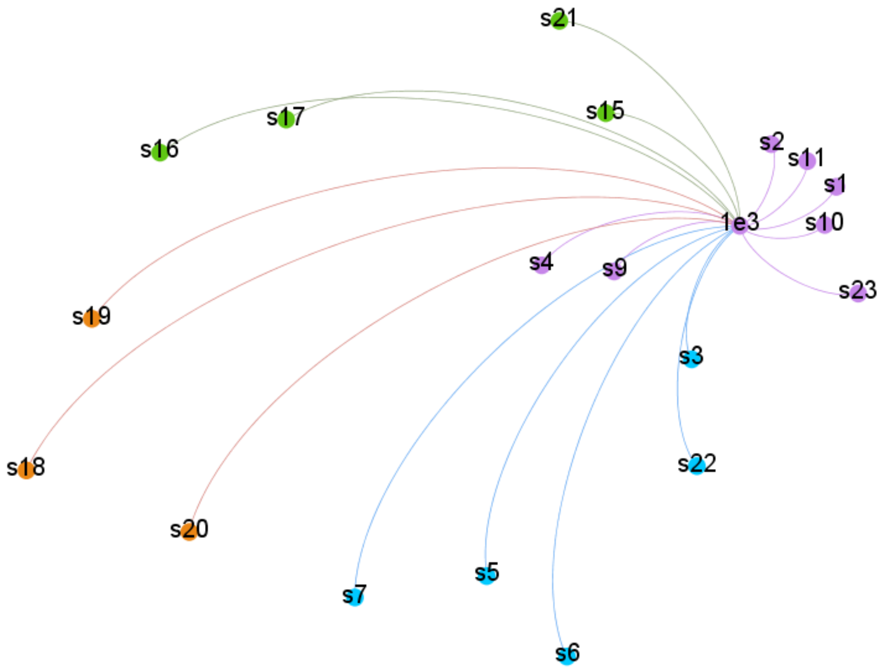


Figure 6.12: Year 1 deployment – highest connected activity node ego network

B. Modularity network analysis for year 1 deployment

From the year 1 deployment network, four clusters were identified in four different colours for the nodes and edges. This was generated using class modularity function with parameters configured as follows: randomize = on, use edge weights= on, and resolution = 1. Results provided modularity = 0.187 and number of communities = 4. The year 1 deployment class modularity main observations are:

- Four communities were identified, with the number of nodes per community being 9, 9, 9, and 10.
- Filtering the network diagram based on communities can be seen in Figure 6.13. From the diagram, the main observations are:
    - Modularity community (A) has the highest number of stakeholder nodes = 8 (s1, s2, s4, s9, s10, s11, s12, s23). The stakeholders cover school level, MoE top management, the local education authority, the Prime Minister Office, and adoption teams. Reviewing the

degree centrality of these stakeholders it can be noticed that all scored 4 or below. On the other hand, this community grouped MoE top management and the Prime Minister Office, which are the stakeholders with the highest formal salience; in addition, this cluster groups two of the top three activity nodes in degree (1e3, 1i1).

- Modularity community (B) included three stakeholders where the degree was 16 among all of them (s18, s19, s20). Those stakeholders represent the MBRSLP core team carrying out the actual delivery of year 1 deployment and all activities go through them.

- Modularity community (C) included three stakeholders with the highest salience or power including the funding body TRA (s12), the MBRSLP higher committee (s16), and the MBRSLP executive committee (s17).

- Modularity community (D) grouped most of the MoE level stakeholders including MoE middle management (s5), MoE operational teams (s6), and the MoE IT department (s7).

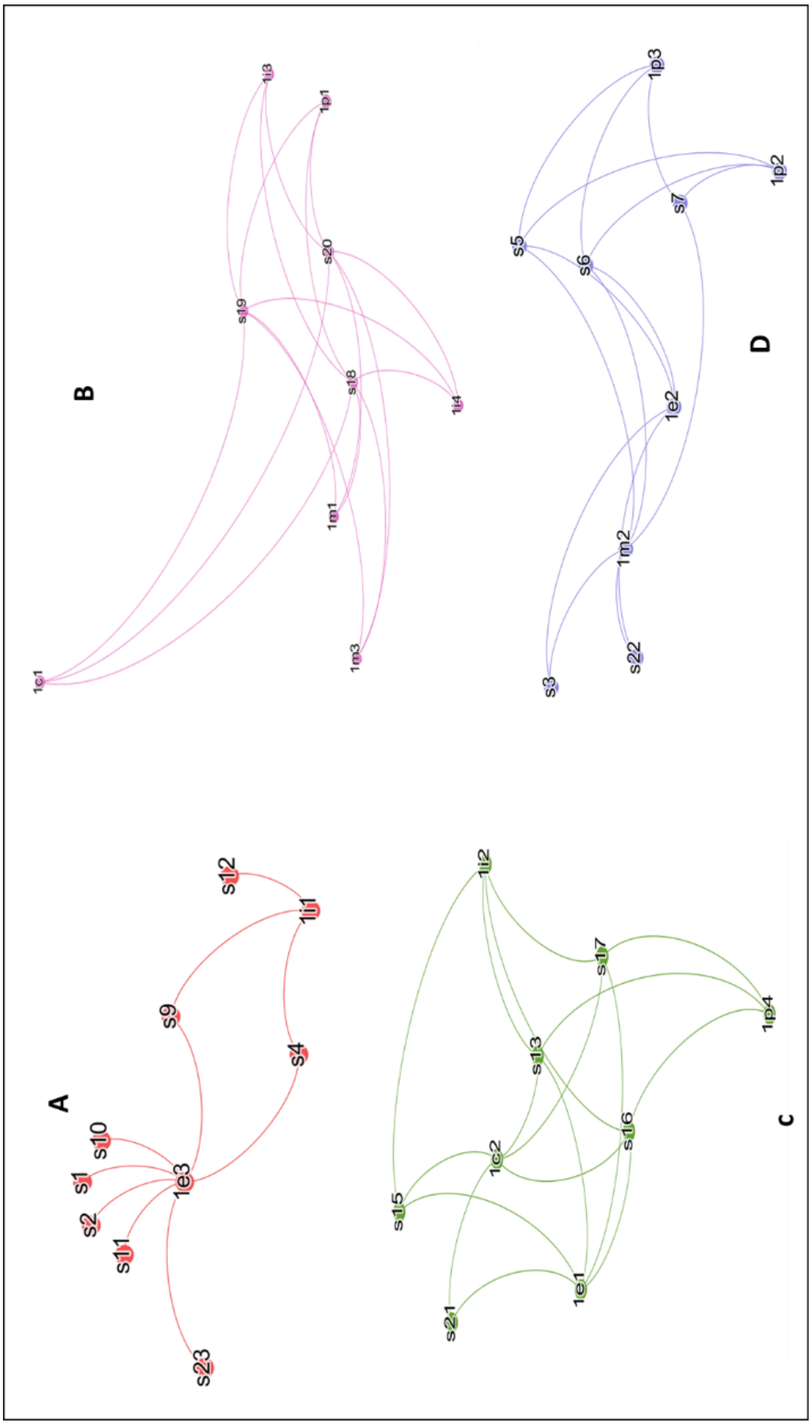


Figure 6.13: Year 1 deployment modulity communities

C. Year 1 deployment network by project life cycle phases

This section will review the year 1 deployment network using the project life cycle phase by phase. Figure 6.14 demonstrates how the year 1 deployment network grows, starting from the initiation phase through the planning, execution, monitoring and control, and closing phases. The approach allows us to clearly model for the dynamics of interactions and interdependencies across project life cycle phases. The main observations for each of the project phases will be discussed over the following sub-sections.

Initiation phase

The initiation phase was composed of four main activities: develop statement of work (1i1); develop business case (1i2); identify stakeholders and key partners (1i3); and develop project charter (1i4). The year 1 initiation phase activities represent typical project initiation activities in comparison with the different type of activities discussed in the pilot initiation phase.

The main stakeholders involved were s17, S18, s19, and s20 from the MBRSLP level and the MoE IT department (s7) from the MoE level. As discussed earlier, year 1 deployment was challenged with an extended scope to cover 127 schools in less than five months, which required a fast-track process over all phases. Comparing the network diagram, the initiation phase network density in year 1 was less than that in the pilot deployment. The focus was on developing the project charter and moving to procurement process, where actual ICT deployment was after awarding vendors to deliver it as part of the execution phase.

In addition, the focus was on finalising the requirements, an approach to year 1 deployment based on lessons learned from the pilot deployment. According to the MBRSLP member:

> "*a key requirement for year 1 deployment was to finalize the requirements that will go into the tenders to the market… decision has been made to target all grade 7 across UAE, the nature of student and teacher's devices, class room set up, the nature of ICT infrastructure, digital content, learning*

management system, and training needs… all these went into the tenders circulated to market"

Planning phase

The planning phase for year deployment was focused on developing detailed requirements that will go into the tenders where the actual deployment of ICT will take place after awarding vendors. According to the MBRSLP member:

> "*we had to develop detailed requirements to build a solid tender, circulate it to market and awarding in less than 2 months*"

This process was support by MBRSLP expert advisors and staff from TRA and the MoE IT department. According to the MBRSLP member:

> *"during the detailed requirements gathering some key decisions has been made including centralizing the infrastructure through a new data centre, decision to select interactive screens instead of project technology, the LMS solution, configuration of digital content, the support and adoption, and technology requirements for students and teacher devices*"

In addition, according to the MBRSLP senior management member:

> "*we decided to develop our request for proposals (RFP) based on educational requirements not technical configuration…so we stated a computing device is need to provide specific functionalities…. these we drown form the case scenarios we developed during pilot deployment and enhanced for year 1 deployment*"

Referring to innovation theory and the innovation development process, this stage is that in which the ICT innovation for school was being finalised, based on the pilot deployment and the education requirements. By end of this phase MBRSLP defined the package of ICT innovation going to be deployed to grade 7. The package included computing devices for students and teachers, ICT infrastructure, connectivity, LMS solution, interactive digital content, support and adoption service, and help desk services. All these were based on the lessons learned from the pilot deployment and reviewing lessons learned from international experiences for similar projects. That said, the MBRSLP strategy was still in development, according to an MBRSLP advisor:

> "*in consideration of realities and new priorities…we have been working on two tracks, first to support delivering the mandate for year1 scope and second track was to continue our landscape review and MBRSLP strategy development to be approved by prime minster office and other key stakeholders*"

This indicates a special case where year 1 deployment was not based on a short-term plan until the full strategic plan is finalised. According to the MBRSLP senior management interviewee:

> "*in developing the strategic plan we had to take into consideration how year 1 deployment which can be noticed in the strategic approach and deployment plan*"

Execution phase

The execution phase started with conducting procurements and awarding (1e1) and then the actual delivery of the planned package of ICT innovation designed for grade 7. Within the execution phase, the awarded system integrator vendor established a complicated fast-track delivery project. According to an MBRSLP partner:

> "*right after being awarded we established nine main project tracks: computing devices, smart screens, data centre, connectivity, Mechanical Electrical & plumping (MEP), LMS, digital content, support services, and training and change management. We worked closely with MBRSLP and all the subcontractors to plan the activities and delivery through a set of joint working groups and committee"*

Form the network diagram, it can be seen that with the execution phase the network got higher density. The main involved stakeholder nodes were s18, s19, and s20.

Additionally, it can be seen that with the execution phase vendor/partner engagement started right after the awarding activity (1e1). MBRLSP vendors/partners, specifically the system integrator vendor, became central to all activities during the executions phase, where all implementation took place.

Monitor and control phase

The monitoring and control phase for year 1 deployment involved vendors and partners (s20), since there is a prime system integrator vendor responsible for the majority of the delivery on behalf of MBRSLP. In addition, MBRLSP focus was on monitoring the progress of the prime system integrator vendor and ensuring that proper coordination was happening with schools, MoE, and even between sub-contractors to meet the short deadline. According to an MBRSLP vendor:

> "*we established robust monitoring and control process which was being reported to key partner's alignment meeting every Sunday…MBRLSP senior management team was one of the main participants of this weekly meeting were progress will be reported, risks will be highlight and issues will be resolved*"

Accordingly, most of the operational data and its flow were managed and controlled by the prime system integrator vendor. In addition, the MBRSLP management team had a critical role to govern all these activities and progress using the routine meetings and progress reports.

Closing phase

The year 1 deployment's closing phase was focused on handing over the deployed ICT to the operations team. The operations team is a team that will take care of maintaining the ICT devices and services to ensure sustainable use of the deployed ICT and assist in any technical issues. According to an MBRSLP vendor:

> "*part of the hand over process is to get confirmation of delivery from schools, delivery inspection team and then certification of completion will be issued and operations team officially takeover*"

In addition, the MBRSLP team mentioned that part of closing phase is to prepare a different report to the MBRSLP executive and higher committee, in addition to TRA and PMO. These reports included details such as what was done, lessons learned, challenges, and suggestions going forward.

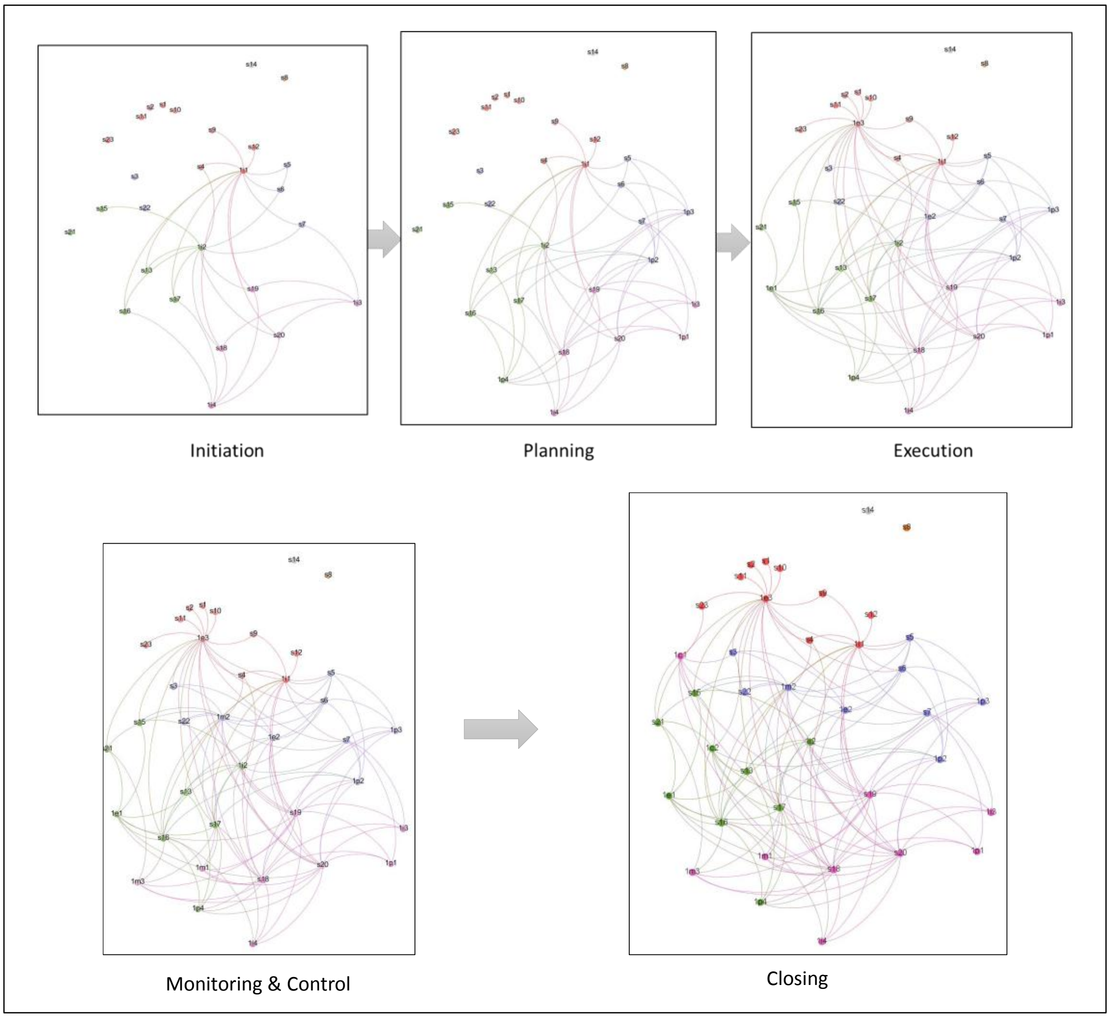


Figure 6.14: Year 1 deployment network growing over project life cycle phases

6.3.3.4 Year 2 deployment

Following on from year 1 deployment, year 2 deployment was based on the roll-out plan from the MBRSLP approved strategy. This scope accumulated to a total of 24,539 students, 3,973 teachers, 147 schools, and 1,300 classrooms (MBRSLP Annual Report, 2014). A major observation for year 2 deployment was that the package of ICT deployment was similar to the year 1 offering, with no major changes.

For the year 2 deployment, the social network diagram consisted of 42 nodes and 198 edges, as seen in Figure 6.15. The nodes were composed of 23 stakeholders and 19 project activities over the project life cycle phases. Over the next sub-sections, the following network analysis will be discussed:

A. The degree centrality analysis

B. Network modularity analysis

C. Network analysis by project life cycle phases

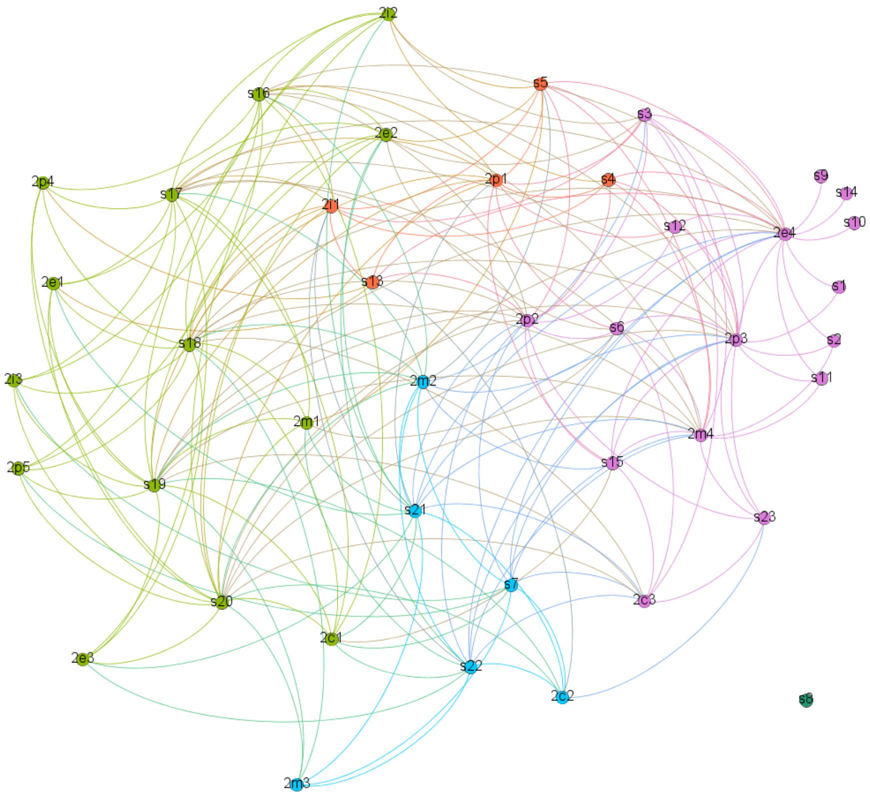


Figure 6.15: Year 2 deployment social network diagram

A. Year 2 deployment network degree centrality analysis

Year 2 degree centrality is summarised in Table 6.9. Year 2 deployment social network diagram main observations:

label	degree
s1	2
s2	3
s3	10
s4	7
s5	10
s6	9
s7	11
s8	0
s9	1
s10	1
s11	3
s12	4
s13	7
s14	1
s15	8
s16	14
s17	16
s18	18
s19	19
s20	19
s21	16
s22	13
s23	6

label	degree
2i1	11
2i2	9
2i3	6
2p1	13
2p2	16
2p3	18
2p4	6
2p5	6
2e1	7
2e2	10
2e3	6
2e4	22
2m1	8
2m2	12
2m3	6
2m4	16
2c1	9
2c2	7
2c3	10

Table 6.9: Degree centrality for year 2 deployment nodes

- **At MBRSLP inter-organisational stakeholders level, the main observations were:**

The stakeholders with the top five-degree centrality scores for year 2 deployment were all MBRSLP inter-organisational stakeholders: the MBRSLP operational team (s19), with a degree of 19; MBRSLP expert advisors (s20), with a degree of 19; the MBRSLP senior management team (s18), with a degree of 18; the MBRSLP executive committee members (s17), with a degree of 17; and MBRSLP higher committee members (s16), with a degree of 14. This indicates that MBRSLP inter-organisational stakeholders maintained they high interaction and played central roles during year 2 deployment. According to the MBRLSP interviewee:

> "*after approving MBRSLP strategy, a series of workshops took place with almost all MoE departments in an effort to make them fully aware of MBRSLP and the strategic plan and to ensure alignment across MoE departments*"

On the other hand, MBRSLP partners/vendors' involvement notably increased compared to year 1 deployment, where the degree was 16 for year 2 deployment compared to 6 in year 1. Vendors were involved in all year 2 deployment project phases. This was because year 1 deployment awarded a prime system integrator vendor a three-year contract for data centre, help desk, IT operations, and support team services. Accordingly, the prime system integrator vendor played a central role over all the year 2 project phases.

Accordingly, at MBRSLP level, stakeholder power, legitimacy, and urgency remained the same as with year 1 deployment. Officially, the power and legitimacy attributes of stakeholder salience were in the hands of the MBRSLP higher committee, then the MBRSLP executive, and then the MBRLSP senior management team. As for the MBRSLP vendors/partners, they still did not have formal decision-making power but were seen to have power from an informal position, in that their role was central to the success of the ICT diffusion. The vendor's urgency was seen to be reduced where their responsiveness to attending issues was seen to be less than in year 1 deployment. This can be due either to the complexities for larger scope or to a different mode of operation since the contract had been secured.

In terms of legitimacy, the prime system integrator vendor is seen to have a higher position to be closely involved, since the scope of work and period of relations are legally three years. On the other hand, from stakeholder interviews, it was identified that alignment gaps started during year 2 deployment, where system integrator vendors felt that they were not aligned at strategic and tactical levels and that their level of engagement was reduced. According to the prime system integrator interviewee:

> "*during year 1 deployment there was strong alignment at strategic, tactical and operational levels…down the road it went to only operational which created a gap for us*"

From stakeholder and innovation diffusion perspectives, this gap between central stakeholders is considered a high risk. Feedback from an MBRSLP senior management interviewee indicated that the programme was undergoing strategic changes, which cannot be discussed outside the organisation, especially with entities reflecting conflict of interest.

At school level, the main observations were:

At school level, degree centrality indicated an increased level of involvement compared to year 2 deployment. Students (s1) = 2, teachers (s2) = 3, principal (s3) = 10. This is very true for principals; however, students' and teachers' involvement was still low. From school interviews, it was noted that the principal's involvement was not in actual planning activities or the specification of the ICT innovations, where the purpose of their involvement was to facilitate access to schools, verify work done in schools, and some administration tasks. In addition, schools noted that there were no major changes or enhancements to the provided ICT from year 1. In addition, there were no major changes at MoE level to cope with or facilitate the smart learning initiative. According to a school principal:

> "*we don't have clear point of contact at MoE in regards to smart learning*"

From innovation theory, re-invention is considered a major dimension for adoption and a driver for sustaining adoption, as discussed in section 3.5.5. In terms of school level stakeholder salience, it is seen to be even higher in the year 2 deployment compared to year 1 deployment. This is related to the fact that the scope is increasing and expectations to see tangible results are increasing from MBRLSP sponsors after two years of deployment. This makes school level views critical to measure the success or failure.

- **At MoE federal level, the main observations were:**

For year 2 deployment, the highest involvement was also from the MoE IT department (s7), followed by MoE middle management (s5), and the MoE operations team (s6). These stakeholders carried out the same roles in year 1 deployment. With regard to alignment with other MoE departments, more engagements took place, especially after the MBRSLP's series of strategy awareness workshops. From interviews with MoE middle management interviewees, it was noted that during year 2 deployment more interaction was happening between the MBRSLP with other MoE departments, including assessment, accreditation, school support, strategy, health and safety, and school activities departments at MoE.

In summary, MoE level interactions went beyond the committee members to involve different MoE departments. In terms of stakeholder salience, MoE top management still has high power, legitimacy, and urgency, especially those individuals who are also members of the MBRSLP higher and executive committees. MoE middle management is still seen to have low salience, since most of the organisation powers are in hands of heads of departments. As for the MoE IT department, it is still seen to have high power from the formal position relating to IT and the fact that the MBRSLP LMS system is interdependent on the MOE SIS (student information system).

- **At the local education level, the main observations were:**

At local education authority level (s9, s10), the status remained similar to the pilot deployment, with marginal involvement. The interaction with the education zones continues to be limited to an informational level. On the other hand, the MBRSP team noted that year 2 deployment witnessed increasing engagement directly with the Education Council of Sharjah, which resulted in shared initiatives and pilot activities sponsored by the Education Council and supported by MBRLSP. According to the Education Council interviewee:

> *"we worked closely with MBRSLP to get expert advice on smart learning matters…* together *we launched pilot activities targeting schools in Sharjah including smart radio and 3D printing pilot"*

In summary, local education authorities are seen to be entities with power and legitimacy at local level, as they have formal authority locally over schools. The engagement with Sharjah Education Council demonstrated a good example in this regard, which might have huge potential. In terms of urgency, the Education Council demonstrated urgency by sponsoring the pilot project to diffuse innovative

ICT in schools in cooperation with MBRSLP, which represents a great support toward achieving a common goal.

- **At key stakeholders outside MBRLSP level, the main observations were:**

The interaction with parents (s11) remained similar to year 1 deployments, with extra emphasis on e-safety awareness. According to MBRLSP, during year 2 deployment, higher emphasis was given to e-safety awareness, with awareness materials being shared with parents and sessions held at schools on the subject.

The engagement with the Prime Minister Office (s12) remained at strategic level. As for TRA (s13), the involvement also reduced to strategic level, where by year 2 MBRLSP built its team and internal capacity for procurement and legal matters. That said, PMO and TRA still have the same high power, legitimacy, and urgency.

- **Main observation on year 2 deployment project activities**

The degree centrality for the top five project activities were: manage stakeholders and perform communication activities (2e4), with a degree of 22; stakeholders engagement planning and communication planning (2p3), with a degree of 18; roll-out planning and scheduling (2p2), with a degree of 16; control stakeholders (2m4), with a degree of 16; and scoping and roll-out approach (2p1), with a degree of 13. The highest degree for activity node was node 2e4=22. Ego network analysis was done using Gephi. The findings are demonstrated in Figure 6.16. The figure is a star network diagram representing node (2e4) interdependencies with stakeholders during year 2 deployment.

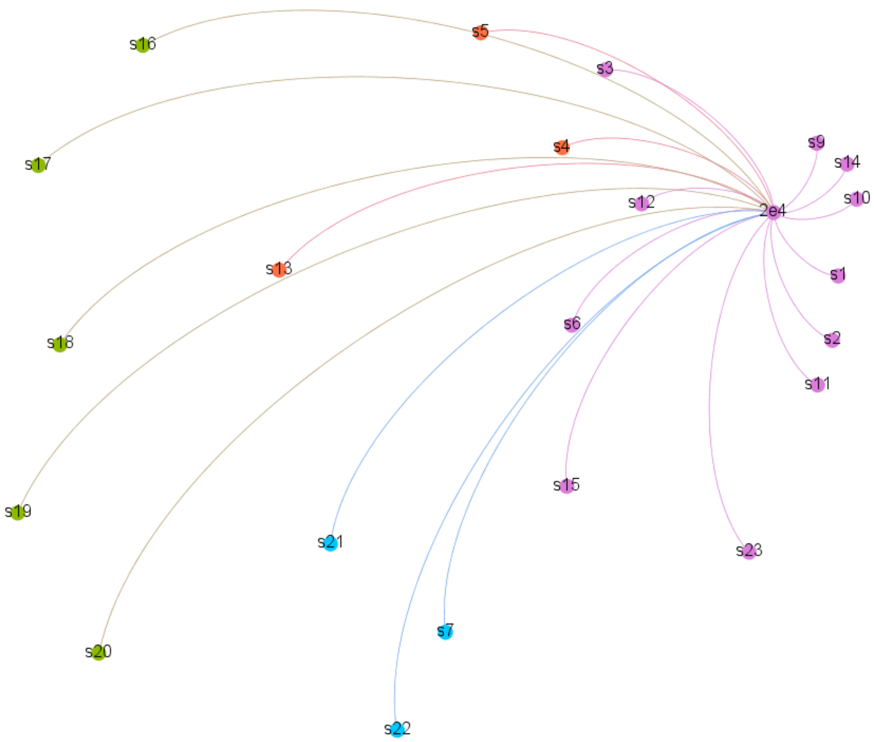


Figure 6.16: Year 2 deployment – highest connected activity node ego network

B. Modularity network analysis for year 2 deployment

From the year 2 deployment diagram, different colours represent clusters or communities, which visually display how the network is compartmentalised into sub-networks (or communities). Four clusters were identified for the year 2 deployment network, presented in three different colours for the nodes and edges. This was generated using a class modularity function with parameters randomize = on, use edge weights = on, and resolution = 1. Results provided modularity = 0.166 and number of communities = 4. The main observations of the findings are:

- Four clusters were identified, with the number of nodes per community being 5, 6, 14, and 15.
- Filtering the network diagram based on communities can be seen in Figure 6.17. From the diagram, the main observations are:

- Modularity community (A) represents a small community composed of six nodes: three stakeholder nodes and three activity nodes. The stakeholders are MoE IT department (s7), MBRSLP vendors (s21), and support team (s22). In reality, it seems the community cluster grouped the IT and support functions from MoE and MBRSLP sides.

- Modularity community (B) is also a small community composed of five nodes: three stakeholder nodes and two activity nodes. The stakeholders are MOE top management (s4), MOE middle management (s5), and Telecom Regulatory Authority (s13). In reality, it seems this community grouped the most powerful authority at MoE level and the funding body (TRA).

- Modularity community (C) contains the highest number of stakeholder nodes: 11. On the other hand, the community grouped the activity nodes with the top four degrees (2e4, 2p2, 2p3, and 2m 4). This community seems to represent most of the operational level stakeholders and users, in addition to the main stakeholder engagement activities.

- Modularity community (D) grouped the top five stakeholder nodes in degree (s16, s17, s18, s19, 20). In reality, this community seems to group the MBRSLP core stakeholders and the stakeholders with highest salience at MBRLSP level (S16, s17).

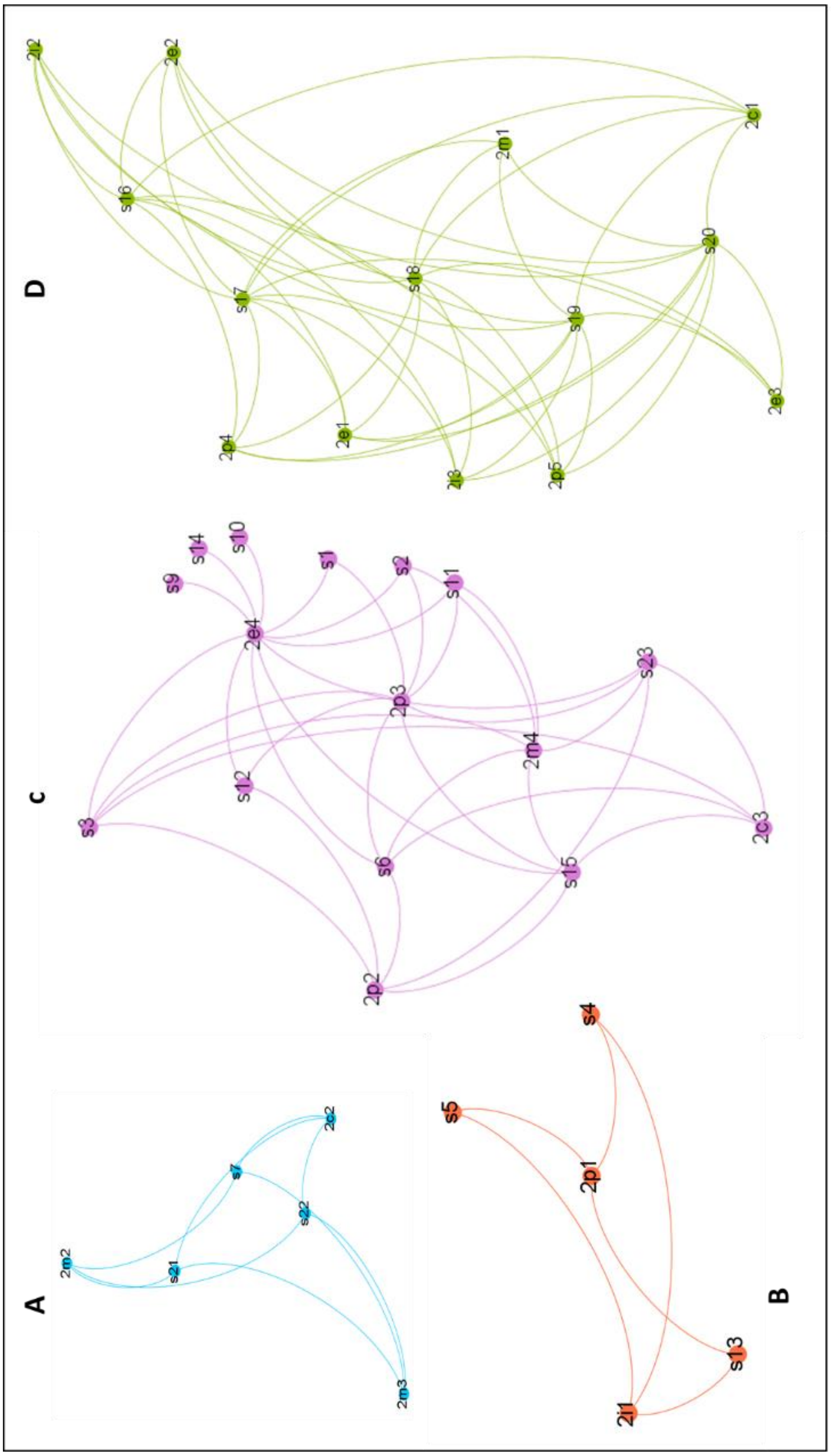


Figure 6.17: Year 2 deployment modulity communities

C. Year 2 deployment network by project life cycle phases

This section will review the year 2 deployment network using the project life cycle phase by phase. Figure 6.18 demonstrates how the year 2 deployment network grows, starting from the initiation phase through the planning, execution, monitoring and control, and closing phases. The approach allows us to clearly model for the dynamics of interactions and interdependencies across project life cycle phases. The main observations for each project phase will be discussed in the following sub-sections.

Initiation phase

The year 2 initiation phase started with a clear scope based on the approved MBRLSP strategic plan. The focus of activities 2i1, 2i2, and 2i3 was on re-confirming the scope details and stakeholders to clear the project initiation document. A major observation for year 2 deployment is that the MBRSLP project management office was established and tasked to project manage all the deployment activities, compared to full dependence on the single prime system integrator vendor during year 1.

Comparing with year 1 and year 2 deployments, some stakeholder dynamics took place, including principals getting involved in the initiation phase and MBRSLP partner/vendors getting involved in the initiation phase. This was seen as a natural development since the MBRSLP strategic deployment plan is in place and because MBRSLP internal teams and processes were established, leading to less or no dependency on external support. The MBRLSP partners/vendors' involvement was mainly through the prime system integrator partner who had an extended three-year contract, as explained earlier.

Planning phase

The year 2 planning phase activities (2p1, 2p2, 2p3, 2p4) were focused on the roll-out approach, planning and scheduling, stakeholder engagement, procurements planning, and managing risks. With the establishment of the MBRSLP project management office, planning activities were expanded and all activities were monitoring through this office. In addition, a new activity was added – identify risks and mitigation plans (2p5) – which indicates the enhanced maturity of the project management practices. According to an MBRSLP member:

> "*we established our project management to centrally manage, monitor and control all deployment activities…we ensured to develop our processes based on international best practice and that's why we utilised the professional services from Price waterhouse Coopers –PwC to build our project management office*"

The project management team planned the year 2 deployment in 11 delivery tracks: civil mechanical and electrical provision, in-school infrastructure, connectivity, classroom interactive display solution, student devices, staff devices, imaging, learning management system, training, e-content, and operation and support. Comparing the year 1 planning phase to that of year 2, it can be observed that more stakeholder engagement activities took place, and for each delivery track there was a working group and reporting structure. This can be noticed from the network diagram and from the manner in which it had grown from initiation to planning phase.

Execution phase

The year 2 execution phase was different from that of year 1, as the MBRSLP project management office team was overseeing the overall execution, including the prime system integrator vendor. Activity 2e3 (manage vendors at different work streams) was added as a response to this new evolved deployment approach, which was divided into the 11 delivery tracks. In addition, the activity 2e4 (manage stakeholders and perform communication activities) was described as an evolvement to the general stakeholder engagement activity 1e3 in year 1 deployment, where there was more focus on alignment and a clear line of escalation if required.

On the other hand, the prime system integrator vendor involvement continued to play a central role in the year 2 deployment. This was because they are responsible for two of the most important tasks: first, the IT operations and help desk function; and second, the MBRSLP support team. These two functions represent core services in the MBRSLP ICT provision and any issues will directly impact the end-users. In addition, the MBRSLP support team were the single direct point of contact between school level and MBRSLP level, since there is a permeant support team member per school. It was noticed that the support team was highly involved in year 2 deployment activities, where they provided support in school engagement, facilitating contractors' access, monitoring and reporting progress, and verifying closure activities. All these activities were added in addition to their primary role of supporting ICT adoption in schools. According to a support team member interviewee on year 2 deployment:

> "*our role started to change, we were given more responsibilities in the annual deployment were we had to do site survey, coordinate with sub-contractors, hand-over students devices, verify completion reports along with a lot of reporting ….All this created huge load especially we are supposed to continue our support & adoption role with extra students this year.*"

Accordingly, the support team played a more central role in year 2 deployment, making them a key influencer, which was discussed in the diffusion dimension of change champions where many school interviewees considered the support team as champions and key drivers for the diffusion and adoption of ICT in their schools.

Monitor and control phase

The year 2 monitoring and control phase was also extended in response to the new deployment approach. The activity of monitor and control work streams (2m1) was focused on reporting and monitoring the 11 delivery tracks. Validate and control scope activity (2m2) was focused on the vendor's delivery scope and managing change requests. A new activity of control master schedule (2m3) was added to manage the overall deployment details, including any involved third-party vendors or partners. The project management team referred to the master schedule as the single point of truth for roll-out status. Finally, control stakeholder activity (2m4) was focused on managing expectation about delivery, through engagements with principals and teachers to get their notes on deployment.

On the other hand, the MBRSLP continued collaboration with MoE operations and IT departments in verifying the delivery and monitoring progress, especially with the school building department.

Closing phase

The year 2 deployment's closing phase was focused on verifying tasks' closure in order to start handing over to operations teams. In addition, more emphasis was given to lessons learned, with a detailed report developed as part of the requirements of the project management office team in knowledge management.

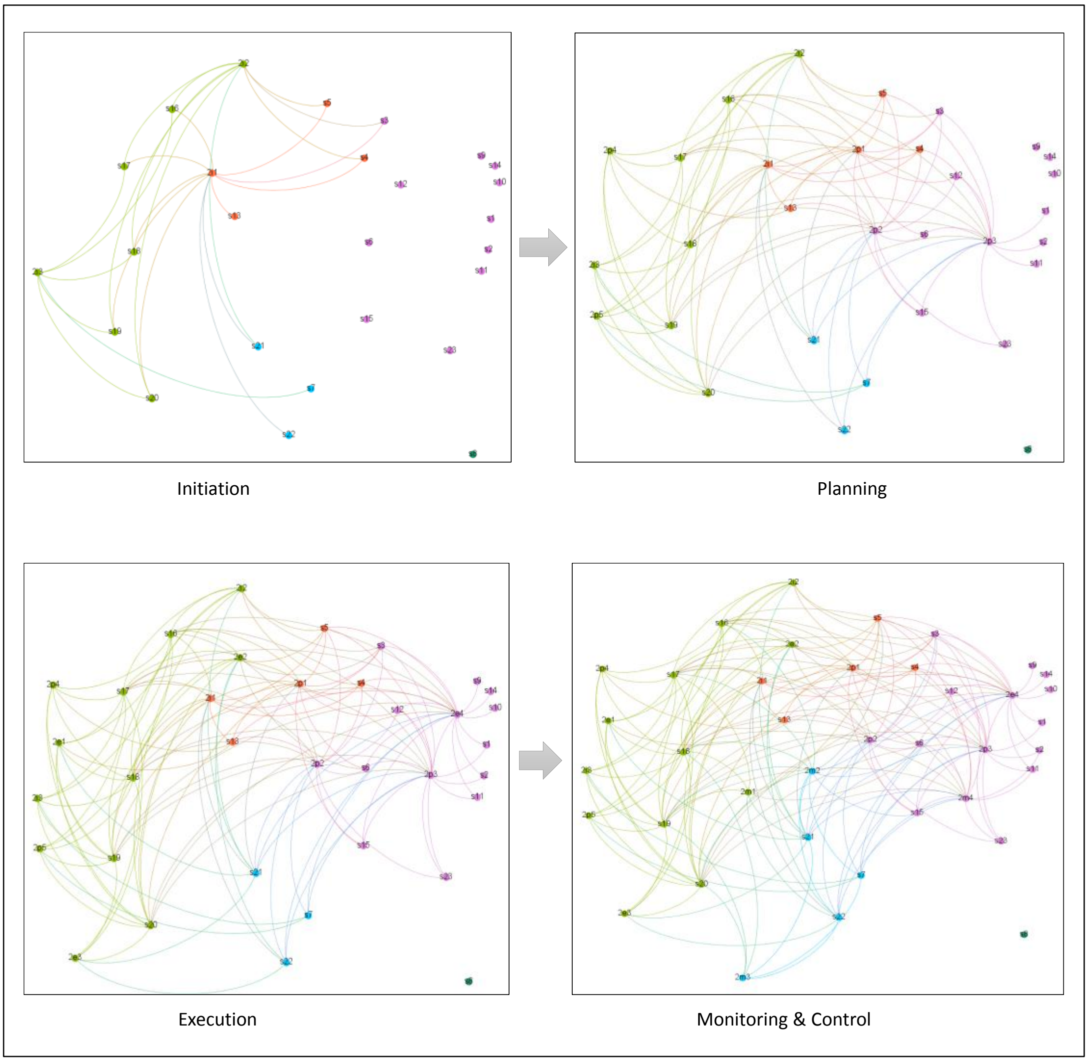


Figure 6.18: Year 2 deployment network growing over project life cycle phases

6.3.3.5 Year 3 deployment

The year 3 deployment witnessed some changes in response to new evolving priorities and in response to changes in the UAE public education sector. These changes included ministerial changes, a new MoE strategic plan, which included a new organisational structure, curriculum reforms, and several operation changes across the education public sector.

In terms of deployment, the roll-out plan was extended to cover grade 10, which brought an additional 61 schools from cycle 3. This scope accumulated to 202 schools, 1,719 classrooms, 6,825 educators, and 34,508 students. In addition, year 3 deployment witnessed higher collaboration and coordination between the MBRSLP and MoE IT, which was the start of migrating ICT infrastructure and operations to the MoE IT department, as part of the long-term strategic plan of MBRLSP.

For the year 3 deployment, the social network diagram consisted of 43 nodes and 241 edges, presented in Figure 6.19. The nodes are composed of 23 stakeholders and 20 project activities over the project life cycle phases. Over the next sub-sections, the following network analysis will be discussed:

A. The degree centrality analysis

B. Network modularity analysis

C. Network analysis by project life cycle phases.

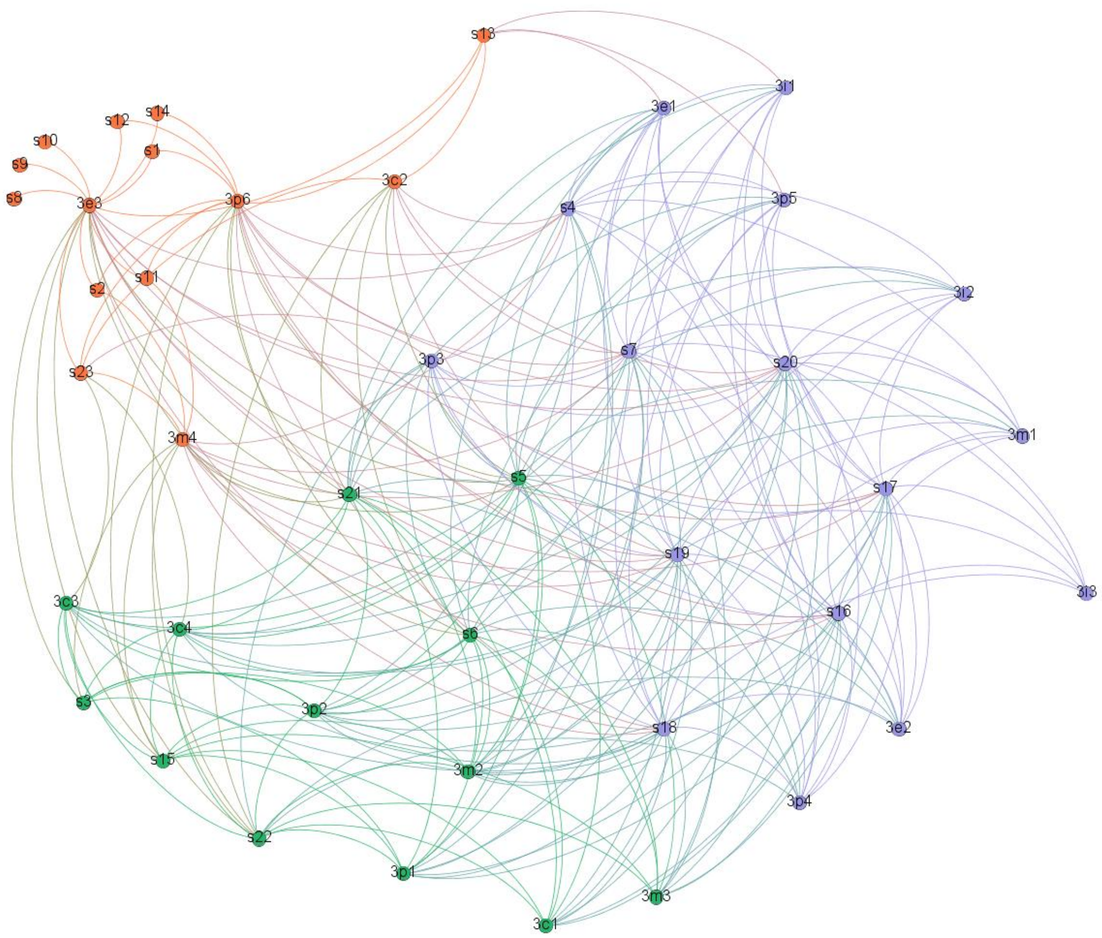


Figure 6.19: Year 3 deployment social network diagram

A. Year 3 deployment network degree centrality analysis

Year 3 degree centrality is summarised in Table 6.10. The year 3 deployment social network diagram's main observations are:

label	degree
s1	2
s2	3
s3	8
s4	15
s5	19
s6	16
s7	20
s8	1
s9	1
s10	1
s11	3
s12	2
s13	6
s14	2
s15	10
s16	17
s17	17
s18	19
s19	20
s20	20
s21	18
s22	14
s23	7

label	degree
3i1	10
3i2	9
3i3	6
3p1	13
3p2	14
3p3	12
3p4	11
3p5	11
3p6	19
3e1	11
3e2	11
3e3	23
3m1	9
3m2	13
3m3	11
3m4	15
3c1	11
3c2	10
3c3	11
3c4	11

Table 6.10: Degree centrality for year 3 deployment nodes

- **At MBRSLP inter-organisational stakeholders level, the main observations were:**

Stakeholders with the top five degree centrality scores for year 3 deployment witnessed a change in the normal pattern of the past three deployments, as the top stakeholder node was the MoE IT department (s7), with a degree of 20. This was followed by: MBRSLP operational team (s19), with a degree of 20; MBRSLP expert advisors (s20), with a degree of 20; MoE middle management (s5), with a degree of 19; and MBRSLP senior management team (s18), with a degree of 19. This indicates a shift in dynamics and interdependencies between stakeholders where MoE level stakeholders took a central role in year 3 deployment. This shift was a result of the process to hand over MBRSLP ICT infrastructure and operations to the MoE IT department. According to an MBRSLP interviewee:

> "*year 2 and year 3 we had more engagement with MoE across the deployment activities, especially with MoE IT department. We started*

> *integration of systems and services as part of MoE new strategic plan launched by the new minister*".

On the other hand, MBRSLP partners/vendors' involvement was noted to remain with the same density. However, from MBRLSP interviews, it was indicated that in year 3 deployment MBRSLP directly contracted with a larger number of vendors, which means less centrality for the prime system integrator vendor being in the last year of their three-year engagement.

On the other hand, a major change was observed for the support team members. Although they maintained high involvement during year 3 deployment, with a degree of 14, from the interviews with the support team it was noted that year 3 witnessed a major change in their operating model, where the focus was on IT technical support and their scope extended to support five to seven schools per member. According to a support team member:

> "*our name and role was adoption & support specialists during first two years, however in year 3 our role was changed to IT support specialist were our focus was IT technical support and we had to support around five schools at once.....this was sudden change and huge load…schools were not happy and we could not accommodate all requests like before*"

This indicates a shift in a one of the central stakeholders, who was considered a change champion. The impact of this change at school level was discussed under the dimension of resistance to change and also under the adoption behaviour AB1 and AB2.

Accordingly, at MBRSLP level, stakeholder power, legitimacy, and urgency remained the same as it was during year 2 deployment. Officially, the power and legitimacy attributes of stakeholder salience were in the hands of the MBRSLP higher committee, then the MBRSLP executive, and then the MBRLSP senior management team. As for the MBRSLP vendor/partners, their informal position of power was seen to be reducing, with the prime system integrator role reduced in year 3 deployment. The vendor's urgency was seen to be further reduced compared to year 2. This was noted by an interviewee from the system integrator vendor commenting on year 3 deployment:

> "*we were not sure what is happening, so many changes taking place and we are not being aware what is the new direction….more awareness could have helped us better align with MBRLSP new directions*"

- **At school level, the main observations were:**

At school level, degree scores indicated very similar results compared to year 2 deployment. Interaction with students and teachers' interactions remains limited. Interaction with school principals was marginal, with a focus on the same administrative activities for facilitating the deployment in their schools. In addition, schools noted that there were no major changes or enhancements to the provided ICT from year 1. Schools' perceptions were that year 3 deployment was below expectations due to a delay in deployment and a reduced level of support provided to schools. Year 3 deployment challenges were discussed in detail in the section on resistance to change. In addition, it was noted that the new MoE level changes did not directly address changes to support the smart learning initiative.

In terms of school level stakeholder salience, this is seen to be even higher in year 3 deployment compared to year 2 deployment. This is related to the fact that year 3 deployment witnessed several challenges affecting user acceptance for the new users in grade 10 and influencing continuation of adoption for cycle 2 schools. This makes school level views critical to measure the success or failure of the ICT diffusion.

- **At MoE federal level, the main observations were:**

For year 3 deployment, the MoE IT department (s7) was the highest degree stakeholder node. Figure 6.20 gives the s7 ego network diagram representing s7 involvement in the activities during the year 3 deployment. MoE middle management (s5) was among the top five stakeholder nodes in degree scores, which indicates the shift in their role and direct involvement in the ICT diffusion activities. According to an MBRSLP advisor interviewee:

"*during year 3 we focused on education change program…with the aim to increase the maturity of ICT use for education purpose….this was driven by the development of smart school transformation framework and the smart learning leadership development program developing specifically for school leaders….we worked closely with different MoE department including training, operations, accreditation and teacher licencing to make this happen*"

Another major observation for year 3 deployment is the introduction of cluster manager, which was part of the organisational changes at MoE level. According to an MoE middle management interviewee:

"*once cluster managers role was established we worked with MBRLSP to develop awareness program for the…. although most of them were previous principles but we saw this as important step*"

In regard to alignment with other MoE departments, compared to the progress made in year 2, year 3 was considered a change year where MBRLSP had to realign again in consideration of the new structuring, and new people came into MoE at different managerial and operation levels.

In terms of stakeholder salience, MoE top management still had high power and legitimacy. In terms of urgency, it was to be reduced and put on hold in response to the major changes affecting the core elements of the educational experience. According to an MBRSLP senior management team member:

"*with all these changes across MoE we thought it was reasonable to wait until things get clear and bit stable then we can resume our stakeholder engagement and realignment in line with the new roles, responsibilities and new MoE strategy priorities*"

MoE middle management was still seen to have low salience, since most of the organisation powers are in hands of heads of departments. As for the MoE IT department, it was seen to have even higher power since they are in the process of taking over IT operations and support, and failure in this domain might severely affect user experience and negatively impact adoption or continuation of adoption. Year 3 changes were discussed under usage behaviour, and under level of use and level of concerns, in sections 5.5.1 and 5.5.2.

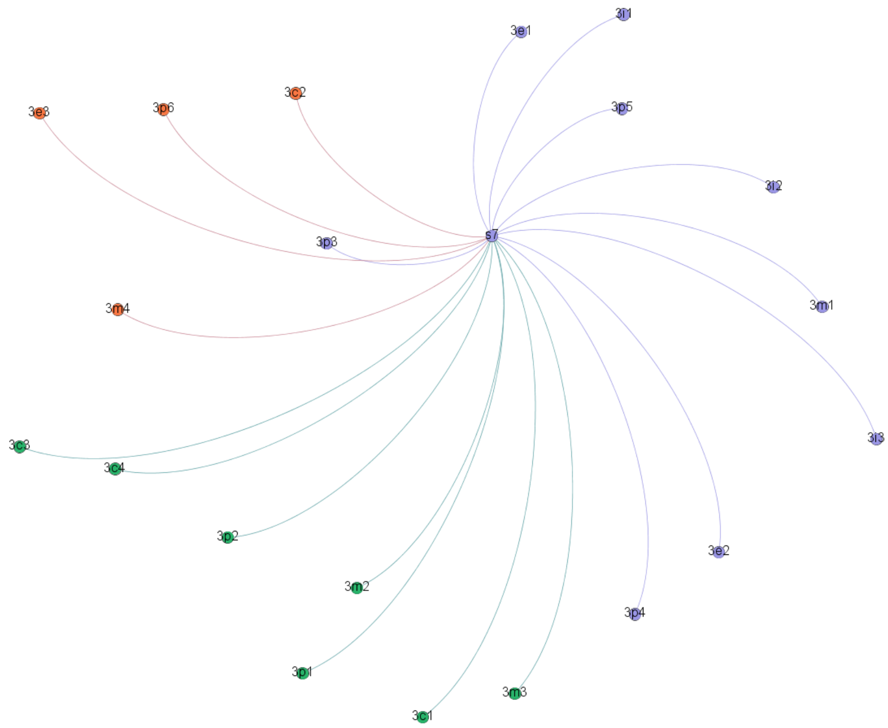


Figure 6.20: Year 3 deployment – highest connected stakeholder node ego network

- **At the local education level, the main observations were:**

At local education authority level (s9, s10), the status remained limited (degree = 1). Notably, from school and MoE level interviews, it was noted that the role of local education authorities, especially the education zone, changed under the new MoE structure. The new change reduces the education zones' authority at operation level, where cluster managers took over the operational authority at school level.

In summary, local education zones' salience was seen to be changed during year 3 deployment, with the formal power and legitimacy reduced because of the new organisational structure. The Sharjah Education Council position remains the same, as it does not follow federal structure.

- **At key stakeholders outside MBRLSP level, the main observations were:**

The interaction with parents (s11) remained similar to year 2 deployments. MBRSLP noted that more focus was given to cycle 3 parents since they are considered new stakeholders; however, this was with agreement that more needed to be done.

The engagement with the Prime Minister Office (s12) and TRA (s13) remained at strategic level. That said, PMO and TRA still maintain the same high power, legitimacy, and urgency.

- **Main observation on year 1 deployment project activities**

The degree centrality for the top five project activities were: develop roll-out initiation document (3e4), with a degree of 23; stakeholders engagement planning and communication planning (3p6), with a degree of 19; control stakeholders (3m4), with a degree of 15; roll out planning and scheduling (3p2), with a degree of 14; and scoping and roll-out approach (3p1), with a degree of 13. The highest degree for an activity node was node 3e4 = 23. Ego network analysis was carried out using Gephi. The findings are demonstrated in Figure 6.21. The figure is a star network diagram representing node (3e4) interdependencies with stakeholders during year 3 deployment.

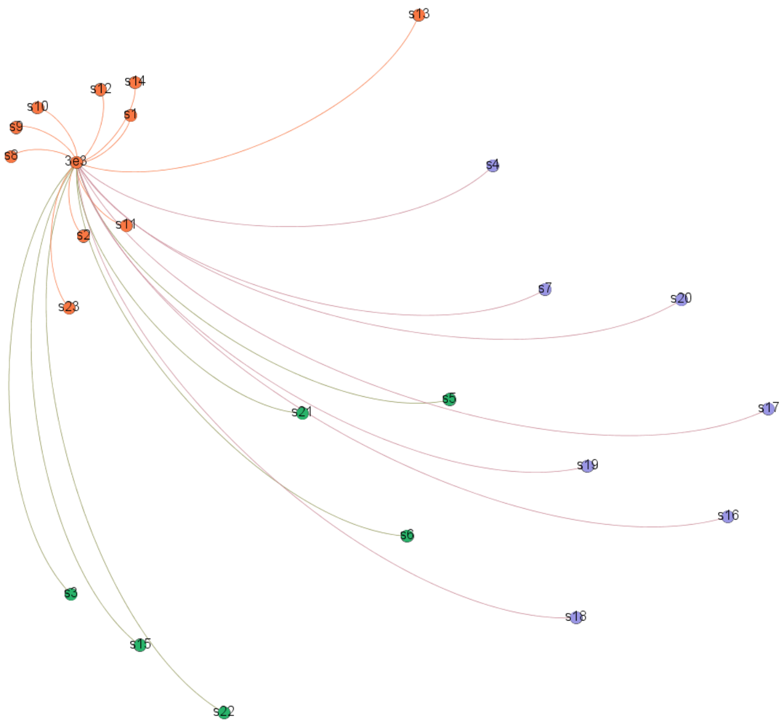


Figure 6.21: Year 3 deployment – highest connected activity node ego network

B. Modularity network analysis for year 1 deployment

From the year 3 deployment diagram, different colours represent clusters or communities, which visually display how the network is compartmentalised into sub-networks (or communities). Three clusters were identified for the year 3 deployment network, presented in three different colours for the nodes and edges. This was generated using a class modularity function with parameters randomize = on, use edge weights = on, and resolution = 1. Results provided modularity = 0.152 and number of clusters = 2. The main observations of the findings are:

- Three clusters were identified where the number of nodes per community was 13, 14, and 17.
- Filtering the network diagram based on communities can be seen in Figure 6.22. From the diagram, the main observations are:

- Modularity community (A) included a majority of the stakeholder nodes (s1, s2, s8, s9, s10, s11, s12, s13, s 14, s23). This community seems to group the stakeholders with the lowest degree. On other hand, the community grouped the activity nodes with the top three degree scores (3e3, 3p6, 3m4). The community also grouped the major stakeholder activities: stakeholders engagement planning and communication planning (3p6); manage stakeholders and perform communication activities (3e3); and control stakeholders (3m4). In addition, this community grouped two stakeholders with the highest salience: the Prime Minister Office (s12) and TRA (s13).

- Modularity community (B) grouped six various stakeholders (s3, s5, s6, s15, s21, s22). On the other hand, the community grouped activities related to project scoping and scheduling: scoping and roll-out approach (3p1); roll-out planning and scheduling (3p2); validate and control scope (3m2); control master schedule (3m3). In addition, community (B) grouped three main closing phase activities.

- Modularity community (C) grouped three of the top five stakeholder nodes in degree scores (s7, s19, s20, s18). In reality, this community seems to group the core teams' work on year 3 deployment. In addition, this community grouped stakeholders with the highest formal salience at MoE level – MOE top management (s4) – and at MBRSLP level – the higher and executive committees (s16, s17).

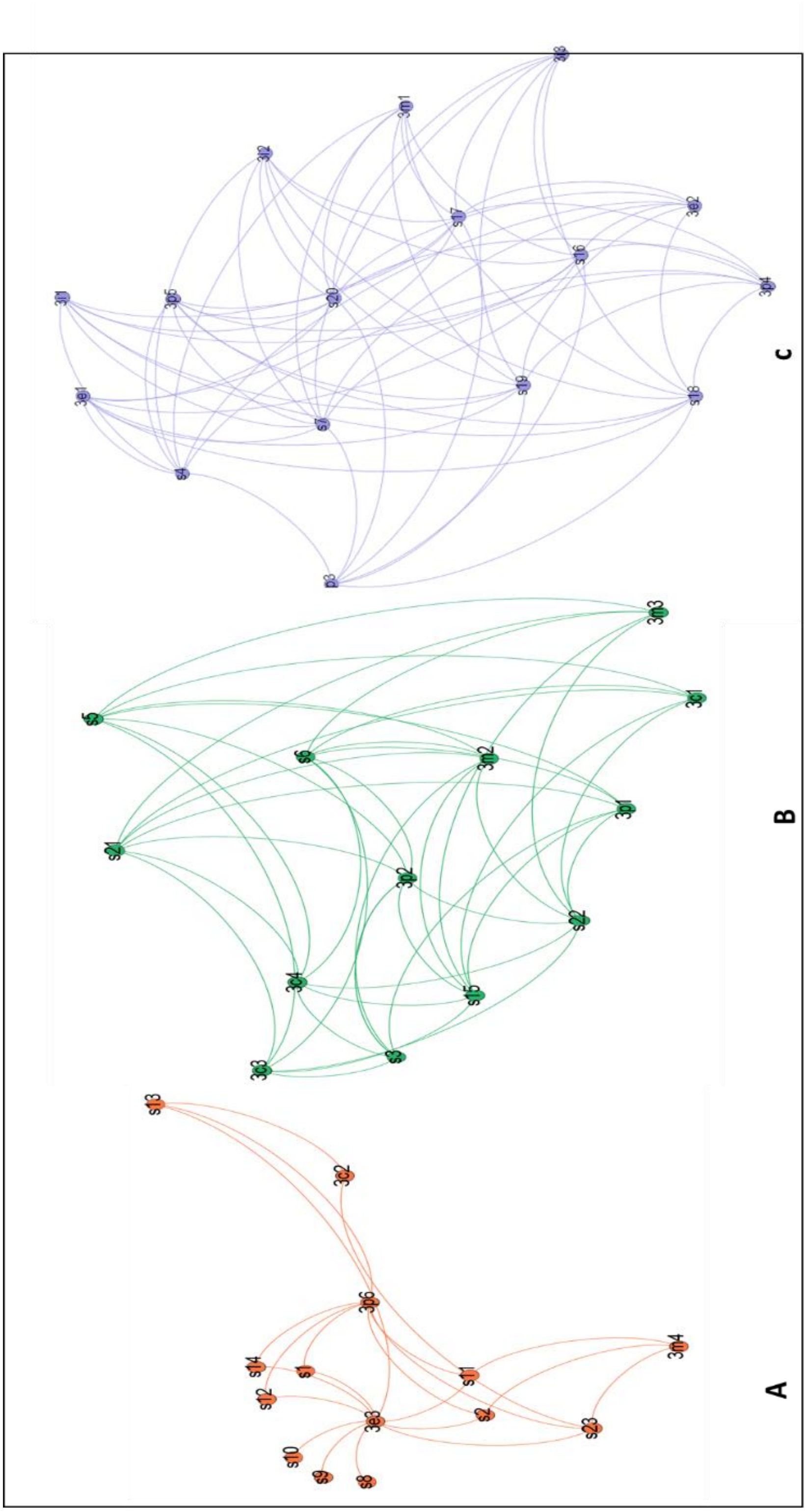


Figure 6.22: Year 3 deployment modularity communities

C. Year 3 deployment network by project life cycle phases

This section will review the year 3 deployment network using the project life cycle phase by phase. Figure 6.23 demonstrates how the year 3 deployment network grows, starting from the initiation phase through the planning, execution, monitoring and control, and closing phases. The approach allows us to clearly model for the dynamics of interactions and interdependencies across project life cycle phases. The main observations for each project phase will be discussed in the following sub-sections.

Initiation phase

The year 3 initiation phase was similar to year 2 in terms of the three main activities. In reality, there was higher emphasis on the scope, due to the changes in response to MoE's new priorities. The focus of activities 3i1, 3i2, and 3i3 was on re-confirming the new scope details and on new stakeholders signing off on the project initiation document (PID).

In addition, compared to year 2 deployment, a change in stakeholder dynamics took place by the high level of interaction with the MoE IT department, due to preparation for the ICT operation and support handover.

Planning phase

The year 3 planning phase included six main activities: scoping and roll-out approach (3i1), roll-out planning and scheduling (master planning) (3i2), resource planning and assignments (3i3), identify risks and mitigations plans (3i4), procurement planning and budget allocation (3i5), and stakeholder engagement planning and communication planning (3i6). The higher sophistication for year 3 deployment was justified in that, during year 3 deployment, MBRSLP directly awarded and managed all vendors with no sub-contractors under the prime system integrator. In terms of stakeholder engagement, the year 3 planning phase witnessed high involvement from all MOE level stakeholders except for cluster managers, which was a new role at that time.

Year 3 deployment was planned in 10 delivery tracks: civil mechanical and electrical provision, in-school infrastructure, connectivity, classroom interactive display solution, student devices, staff devices, imaging, learning management system, training, and operation and support. Compared to year 2, it can be seen that the e-content track was not taken forward, due to the change in curriculum. Comparing initiation to the planning phase network diagram, it can be observed that the network had grown notably from initiation to the planning phase, which indicated higher interdependencies.

Execution phase

The year 3 execution phase continued with a similar approach to year 2. It started with conducting procurement and awarding (3e1) activity, then managing teams and vendors at different work streams (3e2) – as, in this deployment, all vendors were managed by MBRSLP in addition to some tasks in support for MoE – and, finally, managing stakeholders and performing communication activities (3e3). The network grows naturally with the note of higher interaction with the MoE level stakeholder for the year 3 execution phase.

Monitor and control phase

The year 3 monitoring and control phase was based on the same approach used for year 2 deployment. A major observation was also the high involvement for MoE level stakeholders in response to close coordination about the new reform plans and ICT operations, and support migration to MoE.

Closing phase

The year 3 closing phase followed an approach similar to year 2, with the extra activity of documenting roll-out best practices (3c4), which was focused on going beyond lessons learned to developing best practice. According to an MBRSLP project management team interviewee:

> "*during year 2 we focused on developing our processes and procedures…for year 3 we focused on taking step further to document our*

experience and try to develop a best practice which can be use by others in the same domain"

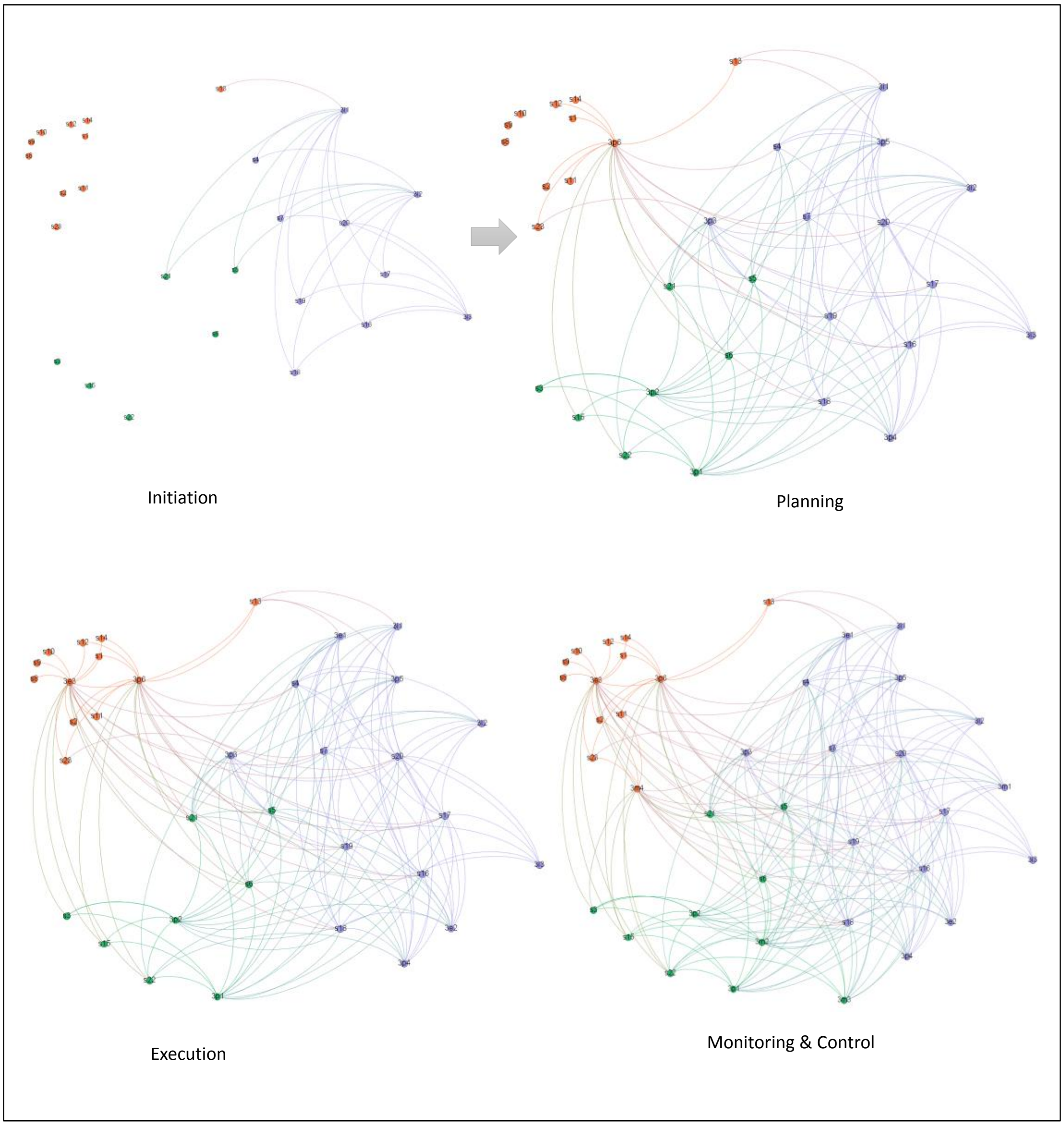


Figure 6.23: Year 3 deployment network growing over project life cycle phases

6.4 Chapter Summary

This chapter presented the stakeholders' interactions over the project life cycle phases. This started by discussing the process followed to develop a list of stakeholders and the project over the different years of deployment. Then, the chapter presented the data classification and analysis conducted using the DSM approach. After that, interdependency analysis was carried out to capture stakeholders' interactions and dynamics over the ICT deployment activities, using heat maps and social network analysis.

CHAPTER 7. DISCUSSION OF RESULTS AND THE ICT INNOVATIONS FRAMEWROK

7.0 Introduction

This chapter presents a discussion of the research results and how the thesis met the research aim by answering each of the three research questions. The chapter will also discuss the main research findings in addition to their contribution to knowledge and practice. Finally, the chapter will discuss the framework for ICT innovation diffusion in the UAE public schools.

7.1 ICT innovation diffusion dimensions

What are the most important ICT innovation diffusion dimensions for the UAE public education sector?

The first research question was answered via the literature review. From the literature, it emerged that the topic of ICT innovations diffusion in the education sector is witnessing rapid developments and a growing global acceptance, which has led to an increased interest in this area from both academia and industry. The literature also emphasised that managing ICT innovation diffusion projects implies uncertainties with regards to the process of potential target adopters, thus leading to a need to understand the process potential adopters go through as well as the factors influencing their decision to adopt or reject an innovation (Rogers, 2003; Vos and Achterkamp, 2006; Oliveira and Martins, 2011; Hameed, 2012; Postema et al., 2012; Xiao et al., 2013; Wisdom et al., 2014; Pichlak, 2016).

In addition, in order to understand the diffusion process better, the literature has emphasised the need to understand the context of ICT diffusion and the setting where the diffusion project takes place (Damanpour, 1991; Rogers, 2003; Hameed, 2012; Xiao et al., 2013; Wisdom et al., 2014).

The literature on IT innovation suggests integrating innovation theories and contextual frameworks for IT adoption. Several researchers conducted their studies in this way by integrating different theories to better fit the contexts of the research and meet their research aims, an approach which has been supported by a number of researchers (i.e. Rogers, 2003; Venkatesh et al., 2003; Greenhalgh et al., 2004; Hsu et al., 2006; Vos and Achterkamp, 2006; Hameed, 2012; Wisdom et al., 2014; Pichlak, 2016). The present study adopted a similar approach by integrating dimensions from different theories and frameworks in order to serve the research aim and objectives. In this sense, the research integrated knowledge from different disciplines in order to provide a wider multidimensional perspective and to analyse ICT diffusion within an educational context with a holistic view combining technological, organisational, and environmental dimensions.

Accordingly, the research framework was developed through the integration of diffusion of innovation theories and frameworks with stakeholder theories. The model developed is a combination of DOI (Rogers, 2003), TAM (Venkatesh et al., 2000), UTAUT (Venkatesh et al., 2003), TOE (Tornatzky and Fleischer, 1990), CBAM (Hall, Dirksen and George, 2006), and the Salience Model (Mitchell et al., 1997).

7.1.1 Findings

The identified dimensions were drawn from six constructs, three for the diffusion of ICT innovation (innovation characteristics, organisational/school characteristics, and environmental characteristics) and two constructs for the status of ICT diffusion and adoption in an educational context (ICT acceptance and adoption behaviour). The three diffusion of ICT innovation constructs were identified to assist in covering the different dimensions of technological innovation diffusion and adoption. On the other hand, there is a need to investigate the status of ICT diffusion and adoption to be able to feedback to diffusion plan and modify the plan accordingly. Thus, ICT acceptance constructs and adoption behaviour constructs were identified to assist in better understanding the status of ICT diffusion in an educational setting. Over the following sub-sections, each of the constructs and selected dimensions will be discussed further.

ICT innovation dimensions

The ‘technological’ construct refers to the dimensions related to ICT innovation itself. Since the focus of the study is on the diffusion of ICT innovation within an organisational setting, the aim was to identify the most important technological dimensions within an organisation setting. From the literature review, seven dimensions were identified for technological innovation constructs, six of which were derived from Roger’s diffusion of innovation theory: relative advantage (INN1), cost (INN2), complexity (INN3), compatibility (INN4), trialability (INN5) and observability (INN6). These six dimensions have been studied extensively in the research literature and have proved significant (Tornatzky and Fleischer, 1990; Iacovou et al., 1995; Rogers, 2003; Oliveira and Martins, 2011; Wisdom et al., 2014; Zhang et al., 2014). According to Rogers (1995; 2003):

> “*the five perceived attributes of innovations have been most extensively investigated and have been found to explain about half of the variance in innovations’ rates of adoption”*

In addition, these dimensions have also proved significant at organisational level (Rogers 2003; Oliveira and Martins, 2011; Wisdom, et al., 2014), which directly connects with the present research context. The seventh dimension - drivers of ICT diffusion in schools (INN7) - was a new dimension added for this thesis in consideration of the UAE context. In this sense, investigating the need to diffuse ICT in UAE schools from an interviewees’ perspective was seen as an important dimension for the research, and adding context related dimensions has been supported in the literature as a means of reflecting the local setting of an innovation diffusion project (Iacovou et al., 1995; Rogers, 2003; Greenhalagh et al., 2004; Lin and Lin, 2008; Wang et al., 2010; Hameed, 2012; Zhang et al., 2014; Hoti, 2015).

Organisational school dimensions

The 'organisational' construct, in our case the school, refers to the main descriptive measures of the organisation, such as scope, size, and structure. In this sense, five dimensions were identified for organisational construct: school size (ORG1), change champion (ORG2), centralisation (ORG3), importance of school need (ORG4), and re-invention (ORG5). These dimensions were selected in consideration of the UAE school context as an organisational setting and in consideration of the organisational diffusion of innovation literature (Iacovou et al., 1995; Van de Ven et al., 1999; Rogers, 2003; Greenhalagh et al., 2004; Peansupap, 2004; Damanpour and Schneider, 2006; 2009; Oliveira and Martins, 2011; Hameed, 2012). Upon the review at school level, and within the MBRSLP context, some interesting findings emerged.

Environmental dimensions

The 'environmental' construct refers to the settings where the ICT innovation is being diffused, which can include the industry, competitors, and government (Tornatzky and Fleischer, 1990; Damanpour and Schneider, 2006; Hameed, 2012; Pichlak, 2016). Five environmental dimensions were identified for this research in consideration of the research context and objectives: government support (ENV1), competition with other public sector organisations (ENV2), vendors' support (ENV3), cultural aspects (ENV4), and resistance to change (ENV5).

Competition with other public sector organisations was considered a new dimeson, and it revealed interesting findings specific to the UAE context. For the UAE context, it was revealed that a culture of positive competition existed among other governmental sectors in the area of diffusion of ICT innovations. The analysis revealed that the federal government's excellence programmes, such as the Sheikh Khalifa Government Excellence Program and the Smart Government Awards were key drivers. This conclusion is in line with the findings of Frambach and Schillewaert (2002), Damanpour and Schneider (2006; 2009), Hameed (2012), and Pichlak (2016).

Technology acceptance dimensions

The ‘technology acceptance’ construct reflects diffused ICT innovation acceptance and was based on the UTAUT model with four dimensions: performance expectancy (TA1), effort expectancy (TA2), social influence (TA3), and facilitating condition (TA4). In general, ‘technology acceptance’ dimensions have been comprehensively studied in the literature and have proved significant (Venkatesh et al., 2000; Venkatesh et al., 2003; Marchewka and Kostia, 2007; Struab, 2009a; 2009b; Wong et al., 2013; Oye, 2014; Venkatesh et al., 2016). By using the ‘technology acceptance’ dimension, this research gained a better understanding of the status of technology acceptance among schools, with a list of emerging themes discussed in Chapter 6.

Adoption behaviours dimensions

The ‘adoption behaviour’ construct reflects the use and adoption level in an education context and was based on the Concerns Based Adoption Model (CBAM) of Hall, Dirksen and George (2006). Two dimensions were identified for the ‘adoption behaviour’ construct: stages of concern (AB1) and level of use (AB2). The CBAM model emerged as an educational change model, and it has been referenced widely in the literature of educational change and ICT deployment in an educational context (Anderson, 1997; Surry, 1997; Griffin and Christensen, 1999; Mills and Tincher, 2003; Greenhalgh et al., 2004; Toledo, 2005; Trinidad et al., 2005; Hall, Dirksen and George, 2006; Straub, 2009).

Stakeholder dynamics dimensions

The ‘stakeholder dynamics’ construct reflects the use of the stakeholder salience model to analyse stakeholders’ interactions and their changes over project stages and years of deployment. The analysis conducted using DSM and social network analysis enabled visualising stakeholders’ interactions over the project’s activities, and the analyses using ‘power, legitimacy and urgency’ dimensions provided insights into the main drivers and most influential stakeholders over different phases of the project (Mitchell et al., 1997).

In summary, in order to answer the first research question, a total of 26 dimensions were identified for the MBRSLP case of ICT innovations diffusion in UAE public schools. All the identified dimensions guided this explorative research and facilitated significant findings that provide valuable insights into, and a better understanding of, the diffusion of ICT innovation in UAE public schools. The proposed approach for using the combination of DOI (Rogers, 2003), TAM (Venkatesh et al., 2000), UTAUT (Venkatesh et al., 2003), TOE (Tornatzky and Fleischer, 1990), and CBAM (Hall, Dirksen and George, 2006) was seen to provide a more holistic view of the main dimensions influencing the diffusion of ICT innovation within the research context. The completion of this research question build the theoretical foundation to feed into answering the first research question and achieving the overall research aim.

7.2 Diffusion of ICT innovations

What is the status of ICT diffusion in UAE public schools?

The second research question was answered through the findings of the qualitative data gained from the semi-structured school interviews. The interviews were guided by the 26 dimensions mentioned above in order to gain insights into the experience and status of ICT diffusion in the schools over a three-year period of deployment.

In order to carry out the analysis, the raw data gathered was organised based on the above 26 dimensions and analysed using a row data matrix to capture the school teachers' and principals' interview row data across the 26 dimensions. This allowed the researcher to conduct a careful review in order to identify and correlate the main emerging themes across all the dimensions. Accordingly, interpretation of the main observations took place to help in analysis of findings and results discussions. As a result, a rich picture of the status of ICT diffusion in UAE public schools was developed along with a set of emerging themes for each dimension, which were then analysed in light of the status of ICT diffusion in UAE schools (as presented in Chapter 6 and also in section 8.2).

The findings provide valuable insights into, and a better understanding of, the process and status of ICT innovation diffusion within UAE public schools, especially with regards the discussion of dimensions AB1 (stages of concern) and AB2 (level of use). Accordingly, these findings result in a persuasive response to the second research question and meet the overall research aim of the research.

ICT innovation dimensions

This research, using the seven technological innovation dimensions, revealed interesting findings from the explorative study within the MBRLSP case. The findings were summarised in a set of main emerging themes identified for each dimension, which were discussed in detail in Chapter 6. For example, in relation to the 'relative advantage' dimension, it was found that there was a concordance across school principals and teachers on the relative advantage of ICT use in schools. Cycle 3 school principals demonstrated a good understanding of the use of ICT in an educational setting, and although implementation had only recently started, there was also agreement across school principals and teachers that the MBRSLP initiative enabled schools to improve.

Analysing these findings, a general awareness and positive attitude towards technology was perceived, as it was seen as adding value to the school sector, thus resulting in an easier decision for individuals to adopt such technologies. At the organisational diffusion level, it helps management in planning and managing expectations amongst target adopters to ensure effective diffusion. For example, the first two emerging themes indicated the schools' motivation and desire to adopt ICT innovations; therefore, failing to meet and manage target adopters' expectations might lead to the rejection or lack of interest in sustaining usage, a finding that was supported by Tornatzky and Fleisher (1990), Iacovou et al. (1995), Rogers (2003), and Peansupap (2004).

Accordingly, an alignment of understanding and expectations from both sides - innovation diffusion management and adopters – is a critical element for an effective diffusion plan. This was seen from the analysis of the third emerging theme, where some cycle 3 schools indicated that diffusion in their schools was below expectation as the deployment plan assumed their current level of ICT use in education would be at a basic level. This assumption was based on the experience MBRLSP had with cycle 2 schools' deployment two years ago; however, it appeared that schools coped with ICT evolution around them in the UAE education sector, leading to higher levels of use and higher expectations.

On the other hand, two other emerging themes from the 'relative advantage' dimension were the discordance among school principals on how to describe the importance and relative advantage of ICT as well as the concordance and/or discordance between school principals and teachers. These findings highlight the importance of aligning understandings at school level between school principals and teachers, where in some cases the relative advantage of ICT use in educational settings was being described differently. In such cases, the need for common reference regarding what good practice looks like and the need for alignment across different levels of stakeholders was paramount. In general, 'relative advantage' has always been identified in the literature as one of the most significant factors driving the adoption of IT innovations in organisations within different contexts, and this research supports this position (Iacovou et al., 1995; Rogers, 2003; Greenhalagh et al., 2004; Peansupap, 2004; Hameed, 2012).

'Cost' was also an interesting dimension. Although most of the literature indicated that cost was a major factor in the diffusion and adoption of ICT innovations, within the MBRSLP case it was a much simpler dimension since all ICT innovations were provided to target adopters at zero cost. Accordingly, adoption decisions were much easier since there were no cost implications on target adopters.

At an organisational level, there were no cost implications on the Ministry of Education as the federal government established the MBRSLP initiative and allocated considerable funds for it to deliver this task. This was in line with the literature review finding that the less expensive the innovation, the more likely it will be adopted and used by target adopters or organisations (Downs and Mohr, 1976; Tornatzky and Klein, 1982; Rogers, 2003). Another interesting finding in regards to the 'cost' dimension, specific to the UAE and MBRSLP context, was that of no cost as a constraint. Some of the schools identified concerns about providing everything for free having negative aspects, as they noticed less care for the devices by some students, especially since all devices were covered by an insurance policy. The schools suggested applying some mechanisms to protect the devices and to embed accountability processes in order to deal with the inappropriate use of devices.

For the ‘complexity’ dimension, two emerging themes were prominent form the research: first, consistency across all schools on the quality of the training and professional development programs provided by MBRSLP to teachers and school principals, and secondly, the relationship between a support approach and perceptions on system complexity. It was noted that cycle 3 schools faced greater difficulties when compared with cycle 2 schools, and this was related to the lower level of support provided to cycle 3 schools.

Cycle 2 schools had one adoption and support member per school for the first two years whereas the support approach for cycle 3 schools was one member for five schools. This was one of the main reasons cycle 3 schools perceived their experience as below expectations; they were aware of what was taking place in cycle 2 schools, and they expected something similar. The literature has emphasised the positive relationship between training quality and effective diffusion and adoption of ICT innovations, especially during the implementation period (Mills and Tincher, 2003; Peansupap and Walker, 2005; 2006; Hsu et al., 2006; Wisdom et al., 2014). In addition, several researchers have emphasised the importance of the continuation of training programmes to ensure sustained adoption (Frambach and Schillewaert, 2002; Greenhalgh et al., 2004; Mitchell et al., 2010; Wisdom et al., 2014).

In analysing the ‘compatibility’ dimension, the main emerging themes chimed with the conclusion from the literature that the more provided ICT innovations were perceived as compatible with needs, existing values, and experience the less resistance will take place (Rogers, 2003). In addition, the emerging themes supported the relative advantage findings, where schools’ perceptions about using

ICT in teaching and learning were seen as a necessity and compatible with the overall national directions toward smart learning. Another interesting insight related to the positioning and naming of the ICT diffusion initiative, which was perceived as consistent with existing values in the UAE. Rogers (2003) has argued that the naming and positioning of an innovation directly affects compatibility:

> "*The name given to an innovation often affects its perceived compatibility, and therefore its rate of adoption. Inadequate attention has been paid to what innovations are called by potential adopters, and as a result many serious mistakes have been made*" (Rogers, 2003)

The ICT innovation diffusion, or what was called in the UAE the 'smart learning initiative', was positioned to be part of the UAE Vision 2021 National Agenda, and in this sense, it was perceived by most interviewees as a major compatibility for schools to align with the national agenda. In addition, all interviewees confirmed that giving the initiative the name of HH Sheikh Mohammed bin Rashid Al Maktoum reflected his highness' support for this change, and since he is a highly respected visionary leader locally and globally, teacher's adoption meant they were supporting HH's vision and initiative.

According to one teacher on the perception of the MBRSLP initiative:

> *"it is H.H. Sheikh Mohammed bin Rashid initiative and adopting smart learning is part of UAE vision 2021 and government directions toward smart government which we believe in and are committed to"*

Moreover, principal #2 indicated that:

> *"naming the initiative under H.H. Sheikh Mohammed bin Rashid was a very clear message of support and had a direct impact in increasing adoption, cooperation from all parties to support the initiative and also it helped reducing negative criticism"*

Observations on the 'trialability' dimension were less comparable than for other dimensions. In addition, since the decision to adopt ICT was taken by top management, and therefore users had no option but to adopt, trialability was limited to pilot deployment at the initial phase of the project and then to user trails during the training program. MBRSLP management noted how this pilot allowed them to gain detailed requirements from users to help develop what they really needed. In addition, teachers were provided with an opportunity to trial the provided ICT in training centres for one semester inside the school before providing the tablets to students. At school level, trialability can be increased by providing opportunities for trialling the provided ICT innovations at multiple occasions and locations (Jebeile, 2003). This is in line with the literature suggesting a positive relationship between 'trialability' and 'innovation adoption' (Rogers, 2003; Hall, 2010; Alruwaili, 2014).

The investigation of this dimension provided interesting emerging themes, such as all schools agreeing on educational benefits as a major driver, all schools agreeing that coping with the national direction and other sectors was an important driver, and all schools agreeing that governmental and political support were main drivers behind launching this initiative (given the focus on Vision 2021 and the support of HH Sheikh Mohammed Bin Rashid). All these emerging themes indicate the importance of linking such an initiative to a higher national agenda in order to result in a higher level of adoption and wider diffusion.

The findings of the 'observability' dimension review indicated a higher observability for cycle 2 schools when compared with cycle 3 schools, which is understandable considering that cycle 3 deployment only recently started. 'Observability' was mostly expressed in terms of positive results on students' attitudes to learning when using ICT in the classroom, and ICT enabled teachers to provide more interactive learning experiences. On the other hand, all schools asserted that better results would be observed once more alignment takes place with core educational elements, such as the curriculum, assessment, and school accreditation.

According to the MBRLSP and MoE interviewees, this will take place over subsequent periods, and first steps have already been put in place by aligning the schools' accreditation with smart learning requirements. This is in line with the positive relationship between ‘observability’ and the adoption of ICT innovations highlighted in the research literature (Jebeile, 2003; Rogers, 2003; Hameed, 2012).

Finally, the ‘drivers of ICT diffusion in schools’ dimension investigated the degree of need to diffuse ICT in UAE schools from the interviewees’ perspective. The main observation was that a key driver was coping with national directions and other sectors. The public education sector was perceived to be behind when compared with other national sectors such as health, infrastructure, and higher education. These findings support the ‘compatibility’ and ‘importance to manage expectations’ dimensions discussed earlier in this section.

Organisational/school dimensions

The organisational dimension and based on the review at school level and within MBRSLP context some interesting findings emerged. For the ‘size’ dimension, the main emerging observations were as follows: deployment phases were on a grade-by-grade basis, which made the roll-out of the initiative and support across the UAE geographically challenging; the assignment of support team members did not consider school size in term of number of beneficiaries, which led to discordant load distribution amongst support team members; and the third-year new support approach led to a very high load on support team members and less responsiveness to school needs.

With regards to the first observation, it was noted that the high level of support in terms of resources, leadership support, and dedicating tasks to specialised teams resulted in overcoming this challenge. On other hand, the second observation indicates the importance of balancing resources and the load allocation amongst target adopters. The literature confirmed the relationship between the size of deployment, availability of resources, the level of qualified expertise in delivery, and balancing the allocation of support resources (Damanpour, 1991; Peansupap, 2004; Zhu et al., 2006; Hameed, 2012).

In addition, it was found that UAE schools were homogenous and centralised under the scope of the MoE, which imposed the same curriculum, exams, school structure, hiring teachers, and policies. Accordingly, MRSLP provision of ICT innovation to schools was found to be homogenous, where all schools received the same ICT resources and services for each allocation. The homogeneity across public schools facilitated faster diffusion, and this conclusion was supported in the literature research, which hypothesised a positive relationship between organisational size and ICT innovations adoption, where larger organisations tend to adopt IT faster than smaller organisations (Iacovou et al., 1995; Rogers, 2003; Zhu et al., 2006; Hameed, 2012).

Change champion was reviewed from three perspectives: principle as champion, teacher as champion, and support and adoption team member as champion. Each perspective revealed insights from different angles: the adoption team was positioned as the main supporter for change on the ground within schools, especially during the early stages of deployment, as they were permanent in each school, providing support and advice to the new users and driving them to develop their capacity in ICT use. On the other hand, within the educational and school setting, the principal, being the school leader, and the teachers, being the classroom leaders, had vital roles to play in driving successful change.

The research revealed that the most important champions in driving successful ICT diffusion were the school principals as they have a leadership position and the power to drive or hinder change in their institution (Dooley, 1999; Baskin and Williams, 2006; Tondeur, et al., 2008; Davies, 2010). In this sense, school principals were able to play a more effective role after getting the professional development program, having permanent ICT support for each school was perceived as a key change facilitator across schools, and adoption team members were perceived more positively by principals when compared to teachers as in some cases teachers perceived adoption as over-instructive. Analysing these findings highlights the importance of planning and managing change champion roles over different project phases and levels of adoption. In addition, it sheds light on the importance of appropriately preparing change champions to take on this critical role and how they facilitate effective diffusion.

The last two organisational dimensions ('importance of school needs' and 're-invention') revealed interrelating findings, where the amount of 're-invention' at product or process level indicates responding to school needs by tailoring the innovation to meet current or evolving requirements. Van de Ven et al., (1999) describe 're-invention' as a process in which adopters modify an innovation to accommodate their local setting and deployment context. It was found that 'reinvention' is positively related to the adoption of innovations, and that 'reinvention' facilitates the transition of innovation ownership from the developers to the implementers (Rice and Rogers, 1980; Ven de Ven et al., 1999; Rogers, 2003; Sahin, 2006; Damanpour and Schneider, 2009). One final finding was the importance of defining clear communication and engagement channels for adopters to convey their issues and suggestions to the correct team concerned; as some schools noted, although they had permanent adoption team members in their school, he or she did not have the appropriate authority to make it happen and they just passed the information on. On the other hand, the lack of a formal process for capturing and processing user' issues, suggestions, and requests led to variable response rates and a lack of quality in managing these requests.

Environmental dimensions

For the 'environmental' dimensions, a major finding related to competition with other public sector organisations, which was considered a new dimension and revealed interesting findings specific to the UAE context. In the UAE context, a culture of positive competition was identified amongst other government sectors in the area of ICT innovations diffusion. The analysis revealed that federal government excellence programmes, such as the Sheikh Khalifa Government Excellence Program and the Smart Government Awards were key drivers, a conclusion which corresponds with many other researchers, such as Frambach and Schillewaert (2002), Damanpour and Schneider (2006; 2009), Hameed (2012), and Pichlak (2016).

ICT acceptance dimensions

For the ‘ICT acceptance’ dimensions, observations confirmed the significance of TA1 (performance expectancy) and TA2 (effort expectancy) as the main drivers for ICT adoption and use. The qualitative interviews revealed some interesting findings, including the concordance among principals and teachers that using ICT enables them to improve their job performance as educators, and that ICT skills should be accompanied by educational content, training, and changes at organisational and operation levels to achieve higher levels of performance. In addition, although ease of use was found to be a major driver in decisions to adopt ICT, it was found that teachers did not mind high effort since they believed in the value of deploying ICT in teaching and learning. This is in line with the findings of Venkatesh and Davis (2000) and Wong et al. (2013) as they affirm that effort expectancy affects behavioural intentions more saliently in the early stages of adoption, and that effort expectancy during later stages of use refers to adopters’ beliefs that adopting and using ICT innovation entail less effort and disturbances.

The main emerging themes from the ‘social influence’ dimension indicated a high social pressure towards adopting ICT in the UAE as a whole, and in the education sector more specifically. It was felt that education was not coping with the development of ICT in the UAE, a finding supported in the research literature by Venkatesh and Davis (2000), Frambach and Schillewart (2002), Venkatesh (2003), Wong et al. (2013), and Wisdom et al. (2014). Another aspect of social pressure was the naming of the MBRSLP initiative and listing it as part of the UAE Vision 2021 National Agenda. Statements from school interviewees included the following:

> “*ICT is the current language with students*”
>
> “*ICT is everywhere in our life today we need to cope with*”
>
> “*in UAE the government is smart, all services done using mobile phone, everybody has access to smart technologies, it is a reality*”

For the ‘facilitating conditions’ dimension, the main findings supported some earlier findings, including government support, naming of the initiative, having support and adoption team member in schools, and the need for ongoing alignment and integration with the MoE to ensure sustainable use and a higher level of impact.

Adoption Behaviour dimensions

Using the ‘adoption behaviour’ dimensions adapted from the CBAM model enabled the researcher to diagnose the status of ICT innovations diffusion from a school (end-user) perspective. The findings provided a clear view of each of the school’s current status of adoption and the transitions happening over years of usage. The main emerging themes for AB1 (stages of concern) were as follows: cycle 2 schools are more towards impact level, but recent challenges have pushed them back to process and tasks concerns level again whereas cycle 3 schools believe in ICT diffusion in education, but their concerns come from other changes taking place and how they can align and satisfy all these new requirements at the same time.

These two findings reinforce the importance of the dynamic nature of ICT innovation diffusion and that project management needs to actively review implementation plans and the status of diffusion, especially after changes in the implementation environment, which in this case represented changes in the educational environment which impacted on end-users level of readiness or commitment towards sustaining adoption, a view highlighted by Bourne and Walker (2005) and Vos and Achterkamp (2006) and discussed in Section 2.2.3. These changes impacted upon users’ behaviour towards ICT innovations; in this sense, unless the innovation was positioned as helping or serving to deal with new realities and priorities, users had more pressing priorities to deal with. This third observation supported the first two in terms of the need to engage with all the schools again in considering recent changes in the education sector. It also highlighted the need to reposition how ICT could help overcome different personal concerns or even introduce changes to the innovation itself or the organisation so as to serve users better under the new changes. This connects with the concept of the ‘reinvention’ dimension discussed earlier.

The main findings for the AB2 (level of use) dimension help in better understanding the status of diffused ICT innovations and status of actual use. In this sense, cycle

2 schools seemed to have established a level of use and they had started to focus on refinement and renewal. This finding supports the importance of managing expectations as an evolving task, where cycle 2 schools seemed to be in a position to move to a higher level of use, where program management and policy leaders need to engage with them accordingly by introducing more advanced educational innovations or practices.

On the other hand, some cycle 2 schools perceived the challenges as major obstacles towards moving to a higher level of use, possibly leading them back to a lower level; in addition, all cycle 3 schools lack of an established pattern of use was related to the issue of implementation. This finding reinforces the conclusions from AB1 (stages of concern) that the level of use is directly influenced by stages of concerns.

Stakeholder Interactions

The ‘stakeholder dynamics’ construct reflects the use of the stakeholder salience model in analysing stakeholders’ interactions and their changes over project stages and years of deployment. The analysis conducted using DSM and social network analysis enabled visualising stakeholders’ interactions throughout the project activities, and the analysis using ‘power, legitimacy, and urgency’ dimensions provided insight into the main drivers and most influential stakeholders over different project phases (Mitchell et al., 1997).

DSM was used to map out stakeholder’s interactions over the main project activities and over the different years of MBRSLP ICT deployment in UAE public schools (Browning, 1998; Danilovic and Browning, 2007). Social network analysis has gained a significant following in recent years and is now used across the physical and social sciences (Bryson, 2004; Borgatti, 2009; Reed et al., 2009; Lienert et al., 2013).

7.3 The role of stakeholder dynamics over the lifecycle of the ICT diffusion project in the UAE

What is the status of stakeholder dynamics over the lifecycle of the ICT diffusion project in the UAE (MBRSLP)?

The third and final research question was answered through the findings and analysis of the qualitative research data gained from the school and multi-level stakeholder interviews. As detailed in Chapter 6, the row data was classified based on the standard project lifecycle phases of initiation, planning, execution, monitoring and control, and closing. This approach enabled an analysis of the dynamics of stakeholder interactions and perceptions over the different project phases within a year of deployment and over the four different years of the MBRSLP ICT innovations diffusion project. After this, the research adopted the Dependency Structure Matrix (DSM) technique to capture and analyse the stakeholders' interdependencies and interactions over the project lifecycle phases. DSM allowed the researcher to construct a simplified visual representation capturing the changing dynamics in stakeholder interactions over the project stages, thus enabling an improved analysis into the reasons behind certain trends and possible justifications.

The DSM approach is being increasingly applied in different areas of research (Browning, 1998; Charlesraj et al., 2004; Bartolomei, 2007; Bartolomei et al., 2007; Lee et al., 2010; Browning, 2016). According to the recent DSM review by Browning (2016):

> "*DSM methods are becoming more mainstream, especially in the areas of engineering design, engineering management, management/organization science, and systems engineering. Despite significant research contributions, however, DSM awareness seems to be spreading more slowly in the realm of project management*"

The findings from the DSM matrix were further analysed using a heat map matrix and graph theory using social network analysis in order to provide more insights into the stakeholder engagements and dynamics over the years of deployments, project lifecycle stages and different stakeholder levels. The use of social network analysis for further synthesis and analysis of DSM was seen to be fruitful and was supported by several scholars (e.g. Battalls and Yassine, 2006; Bartolomei, 2007; Browning, 2016).

In this sense, findings from each deployment were identified, along with the ability to capture and visually analyse stakeholders' dynamics over the years of deployment. Examples of the findings are demonstrated in Figure 7.1, which visually demonstrates the stakeholders' degree centrality using a heat map matrix. From the centrality heat map, stakeholders with the highest centrality each year were easily identified, thus indicating the important or central stakeholders (where all activities flow through them) and how this has changed over different deployments. Compared to stakeholder salience, degree centrality identifies the most important stakeholders in terms of being central to most activities. On the other hand, stakeholder salience refers to the most important stakeholders based on attributes of perceived power, legitimacy and urgency (Mitchell et al., 1997). Accordingly, the analysis in Chapter 6 used the findings from the degree centrality analysis and compared them to stakeholder salience perceptions to analyse how they reflect on the research under investigation.

The stakeholder dynamics and shifts in stakeholder salience over the years of deployment based on centrality are visually demonstrated in Figures 7.2 and 7.3. From the diagrams, it can be noted that stakeholders s1 (students), s8 (cluster manager), s9 (education zone), s10 (local education council), s11 (parents), and s14 (other government entities) had less than 5 degrees of centrality over the four deployments. Analysing these findings, three major observations can be identified. First, students need to be more engaged in the innovation diffusion process as they are considered the centre of any educational reform (Lavin 2010; Zhu and Engels, 2014). In the same way, Thomson (2010) advocated the role of student engagement as follows:

> "*There is growing international interest in the practice of involving children and young people in educational change…. There are distinctive traditions of youth educational involvement in various countries – for*

example, in Britain as "pupil voice", student governance and school improvement; in Australia via student participation and active citizenship and in the United States where student perspectives have been integral to some national school reform programmes"

Secondly, local education authorities are perceived to have high power, legitimacy, and urgency, but in reality, their centrality was amongst the lowest, indicating their minimal involvement and engagement. From a stakeholder management perspective, such groups are classified as stakeholders with a high capacity, where project management will engage with them to influence their positon as actively supportive stakeholders who will facilitate sustained diffusion. This finding is not in keeping with the literature, and therefore they should be involved as advocated by Savage et al. (1999), Postema et al. (2012), and Aaltonen et al. (2015) (further details in Section 2.4.4).

In addition, stakeholders s16 (MBRSLP higher committee), s17 (MBRSLP executive committee), s18 (MBRSLP senior management team), s19 (MBRSLP operational team), and s20 (MBRSLP expert advisors) had what can be considered a consistently high centrality over the three years of deployment, which indicates the importance and influence of these stakeholders as well as their high stakeholder salience.

On the other hand, stakeholders s4 (MoE top management), s5 (MoE middle management), s6 (MoE operational teams), s7 (MoE IT Department), s21 (Support team), and s22 (adoption team) report a pattern of shift or spike in degree centrality over the deployments years, which indicates a shift in power and influence. The same can be noted from the stakeholders' degree centrality chart per deployment in Figure 7.4. Analysing these findings, and keeping in line with the literature findings as reported in section 2.4, these stakeholders require close attention due to their dynamic nature. In addition, project management needs to revise the status and engagement with each of these stakeholders over the stages of the project and in the case of major changes to the project scope or the diffusion environment.

All these findings, as well as the main emerging themes, were discussed in detail in Chapter 6, with emphasis on the changing stakeholder dynamics over project phases and over the three years of deployment. The findings provided valuable insights into, and a better understanding of, the status of stakeholder dynamics over the lifecycle of the MBRSLP ICT innovation diffusion project within UAE public schools. In this sense, the third research question was answered.

Degree centrality per deployment

			pilot	year1	year2	year3
schools level	students	**s1**	4	1	2	2
	teachers	**s2**	4	1	3	3
	principals	**s3**	5	5	10	8
MoE level - federal	MOE top management	**s4**	6	4	7	15
	MOE middle management	**s5**	9	7	10	19
	MOE operational teams	**s6**	5	6	9	16
	MOE IT Dept	**s7**	10	9	11	20
	cluster managers	**s8**	0	0	0	1
local level	Education zone management	**s9**	1	2	1	1
	Education council management	**s10**	0	1	1	1
Key stakeholders	Parents	**s11**	3	1	3	3
	Prime Minister Office	**s12**	7	1	4	2
	Telecom Regulatory Authority	**s13**	9	5	7	6
MBRSLP inter-organizational key stakeholders	other Gov entities	**s14**	0	0	1	2
	Connectivity Services Provider (Etisalat)	**s15**	5	6	8	10
	MBRSLP Higher committee members	**s16**	11	12	14	17
	MBRSLP Executive committee members	**s17**	12	12	16	17
	MBRSLP Senior Management Team	**s18**	15	16	18	19
	MBRSLP operational team members	**s19**	14	16	19	20
	MBRSLP expert advisors	**s20**	14	16	19	20
	MBRSLP partners/vendors	**s21**	13	6	16	18
	Support Team	**s22**	4	5	13	14
	Adoption Team	**s23**	4	2	6	7

Figure 7.1 Stakeholders' degree centrality for each deployment

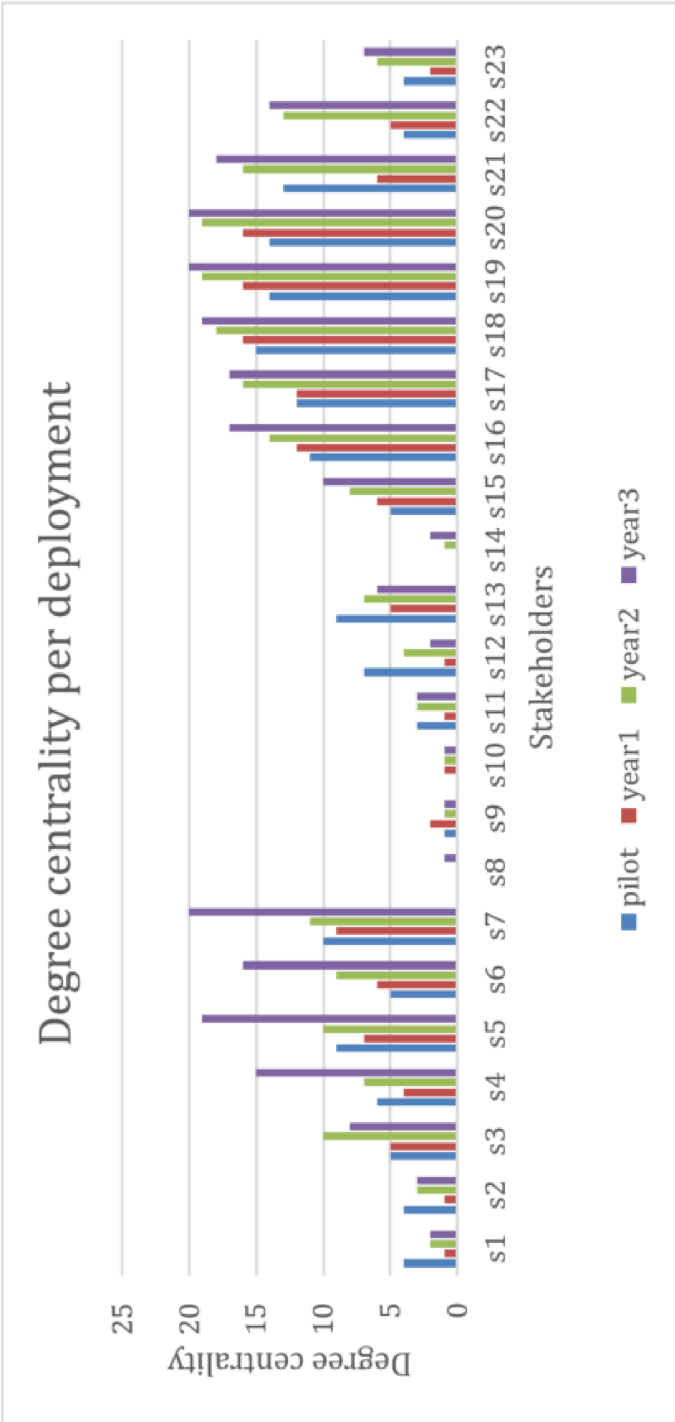


Figure 7.2 Stakeholder degree centrality per deployment

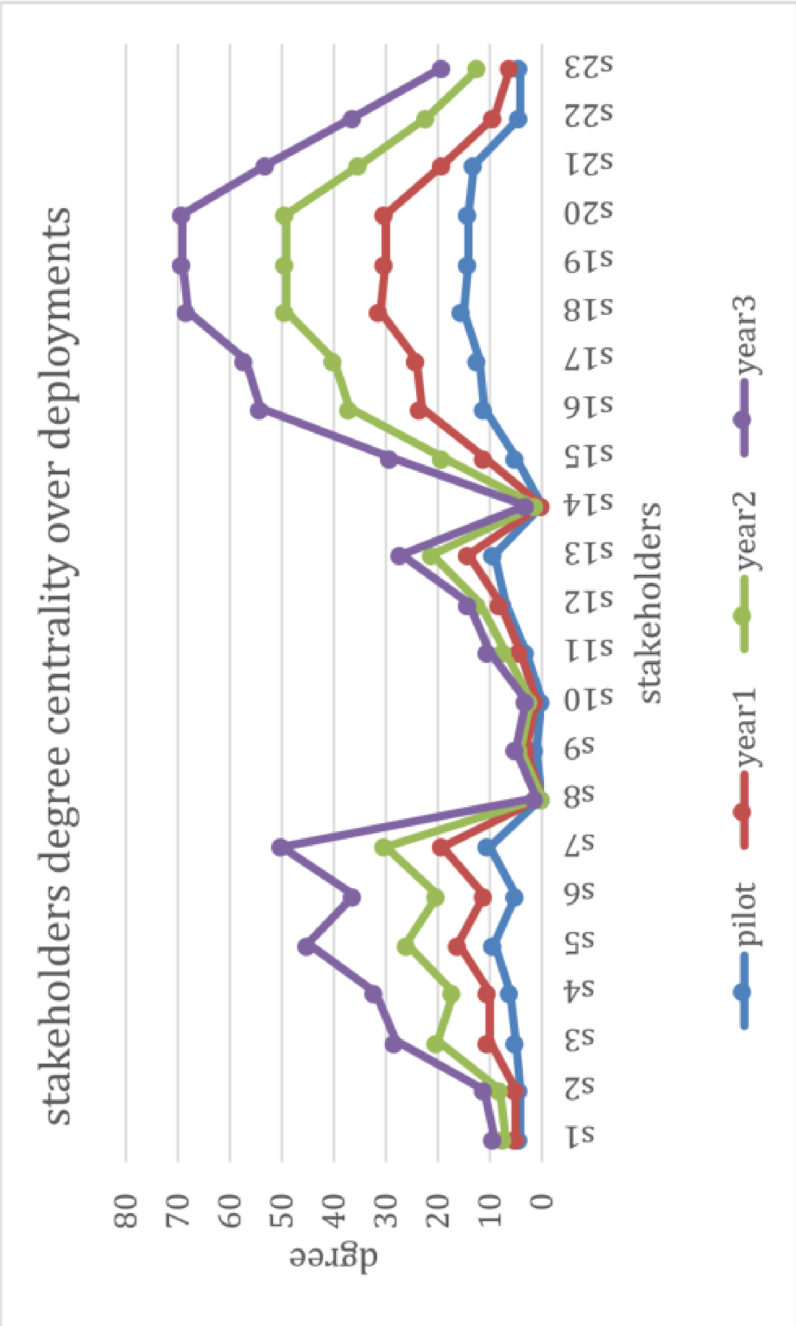


Figure 7.3 Stakeholder degree centrality over deployments

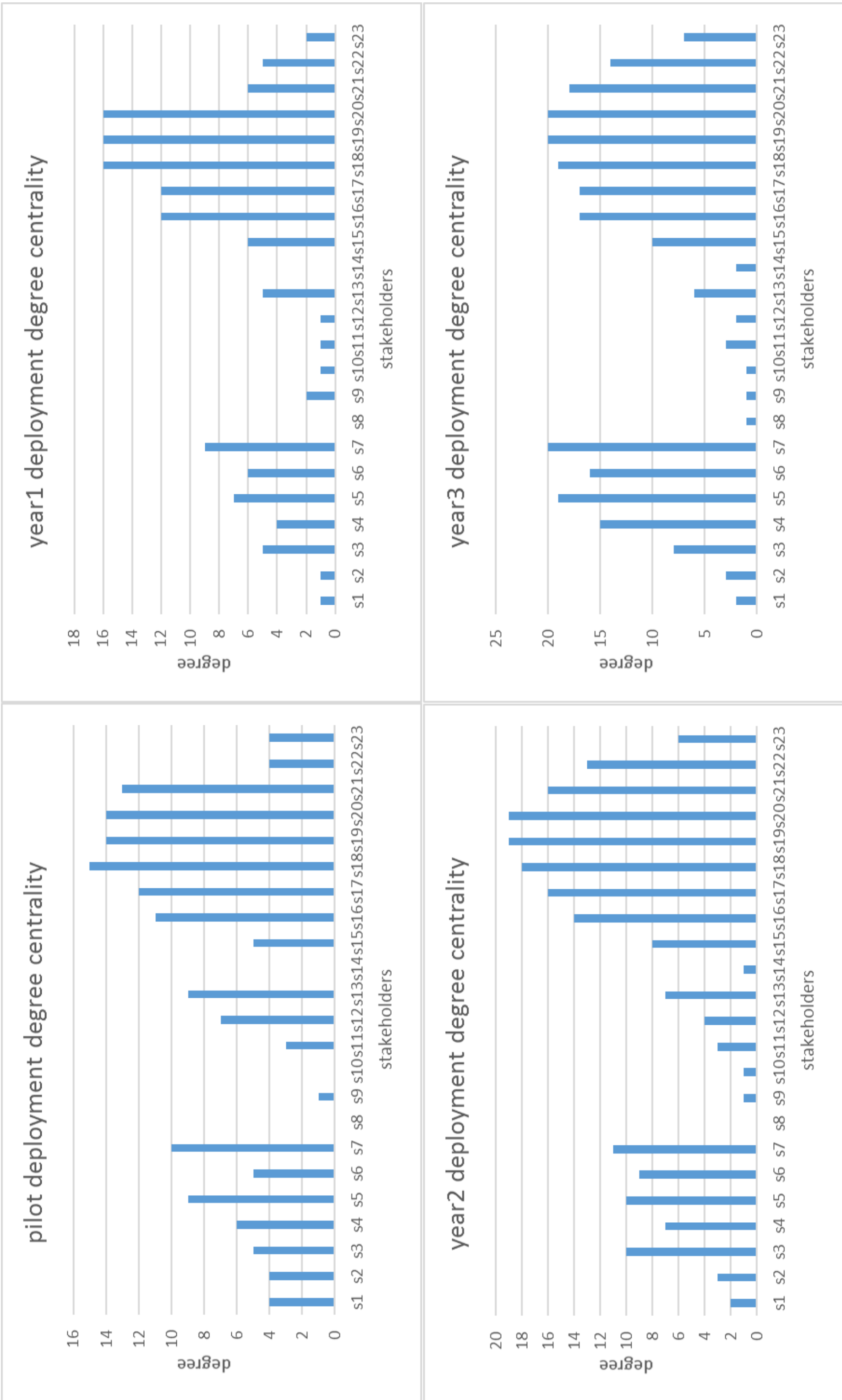


Figure 7.4 stakeholder's degree centrality chart per deployment

7.4 The ICT Innovation Diffusion Framework for Public Schools in the UAE

The proposed framework developed in the research (figure 3.1) proved its significance providing a holistic framework to explore the process and status of ICT innovation diffusion in the UAE public schools. This was demonstrated as it enabled gaining insights and better understanding for the process and status of CIT diffusion in the UAE public schools as demonstrated in answering research second research question (section 7.2). In addition, the framework enabled capturing the stakeholders' dynamics over the different project phases as demonstrated in chapter 6. The framework can serve project managers as a holistic tool to help them in achieving effective delivery for ICT innovation diffusion project in the UAE public schools.

The framework was based on six constructs, composed of 26 dimensions extracted by integrating innovation theory, the UTAUT technology acceptance model, the TOE framework, the CBAM model, and stakeholder theories and frameworks. To capture the status of ICT innovation diffusion in education settings, dimensions were identified from CBAM (section 2.3.5) along with user ICT acceptance dimensions from the UTAUT model (section 2.3.3). Finally, to investigate and analyse different stakeholders' influence over the innovation diffusion process, three dimensions identified from Mitchell's salience model were adopted (section 2.4.2).

Although the framework was dedicated for the UAE public schools, however it can be utilised for ICT innovation diffusion in different school setting as most of the dimensions were generic opening new areas for further knowledge.

Following is a description of the proposed ICT innovation diffusion framework for public schools in the UAE (figure 7.5). The framework is designed to support effective diffusion of ICT innovations in UAE public schools by focusing on addressing the changing stakeholder dynamics over project phases. The framework is composed of two main elements, the ICT innovation diffusion process in the UAE public schools and the 26 dimensions used to capture the interactions between stakeholders.

The ICT innovation diffusion process in the UAE public schools is composed of the initiation phase and the implementation phase. The initiation phase is described as all the activities encompassing information gathering, conceptualising, and planning leading up to the decision to adopt and diffuse the identified ICT innovation. It is divided into two main stages, agenda-setting stage focus on the problem trying to solve and the identification of the need for an ICT innovation. The second stage is matching where the focus is on trying to identify and fit the most appropriate ICT innovation solution that is in-line with the organiaation and school context agenda. The initiation phase end whenever the organisation takes the the decision to adopt and diffusion an innovation to the schools marking the start of implementation phase.

The implementation phase is described as all of the events, actions, and decisions involved in putting the identified innovation into routine use within the school environment making it an ongoing element of the school's normal practice. The implementation phase is divided into three stages. The redefining/ restructuring stage is the first stage in implementation stage where is it expected that both the innovation and the organisation being the school or ministry will need to be changed in order to really fit the identified ICT innovation into the educational needs and processes. The next stage is clarifying whereas the innovation is put into wider spread and accordingly more communication and engagement is vital with different levels of stakeholders in order to ensure consistent and clear understanding on the innvovation and the changes taking place. Routinizing is the last stage of the implementation phase were the focus on sustaining the innovation adoption by embedding it into the school culture and the overall educational processes.

The dimensions are based on six main constructs grouped into diffusion of diffusion of ICT innovations, status of ICT diffusion and stakeholder dynamics. The diffusion of CIT innovations group focus on the main dimensions that influence the diffusion process and contains three constructs: the ICT innovation dimension, the school level dimensions and finally the environmental level dimensions. Secondly, group of dimensions enable evaluating the status ICT innovations diffusion in the UAE public schools. This group combine dimensions related to user technology acceptance and dimensions related to user’s level of adoption and stages of concern. Last group of dimension enable measure the stakeholder’s potential influence and potential acceptance at every stage or after every major change.

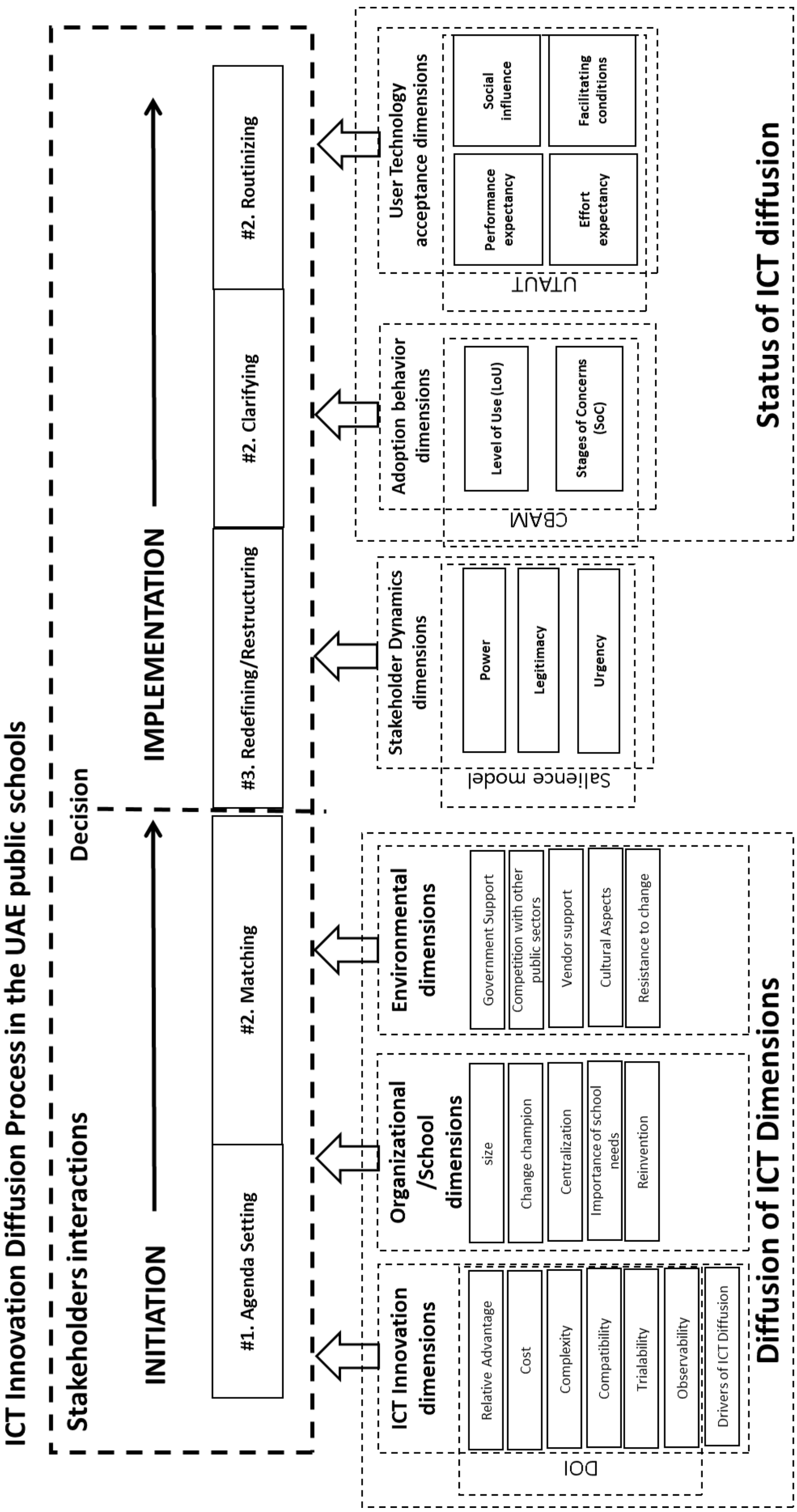


Figure 7.5 The ICT Innovation Diffusion Framework for Public Schools in the UAE

7.5 Chapter summary

This chapter has summarised how the research has answered each of the research questions and achieved the research aim to to develop a framework to support effective diffusion of ICT innovations in in UAE public schools that address the changing stakeholders dynamics over project lifecycle. The results from the investigation using the framework were presented and how it each of the research questions was answered contributing to knowledge

CHAPTER 8. RESEARCH CONCLUSION

8.0 Introduction

This chapter presents a brief summary of the research. First, the robustness of the adopted methodology will be presented. Secondly, the research objectives, and how they were achieved, will be reviewed. Thirdly, the limitation of the research will be set out. Fourthly, the contribution to knowledge will be presented, and finally areas for further research will be discussed.

8.1 The adopted research methodology robustness

The research methodology adopted in order to meet the research aims and objectives is presented in Chapter 4. Qualitative research methods were used in this investigation. The literature review was used to synthesis the existing knowledge, to identify gaps in the proposed research area, and to confirm and articulate the research questions and objectives.

Face-to-face semi-structured interviews were used as the main method of data collection. The semi-structured interview questions and themes were pilot-tested to make sure of the appropriateness of the questions, which were then refined based on the feedback. The research investigated the case of ICT innovation diffusion in UAE public schools, where the sample represented different levels of stakeholders within the case. A total of 55 semi-structured interviews were conducted. Whenever approved, interviews were audio recorded and transcribed, and in other cases, interview summaries were written up directly after the interview.

The first step was preparing the raw data from the interview transcripts, notes, and summary reports taken during the data collection period. Then, after careful reading and review of the data, a set of main emerging themes and sub-themes were identified. The data was analysed using a row data matrix to allow the researcher to carry out a careful review to identify the main emerging themes across the dimensions as well as interrelated themes, as presented in Chapter 5. For the stakeholders' interactions over the project's activities, the researcher used the DSM method and social network analysis tool (Gephi application) to capture stakeholders' interactions and dynamics over the project phases and years of deployment. This enabled the researcher to represent the stakeholders' interactions graphically, which allowed easier analysis and presentation of findings, as presented in Chapter 6.

8.2 Accomplishing the Research Objectives

1. *To review the literature on ICT innovation diffusion, with a focus on education.*

This research objective was achieved through the literature review presented in Chapter 2. Chapter 2 provided an extensive literature review for the concept of ICT innovation diffusion by reviewing the origins of innovation theory and the concept of innovation. Then, a review for the main diffusion of innovation and ICT innovation theories and models, including DOI, TRA, TPB, TAM, TAM2, and UTAUT, was carried out. After that, the process of ICT innovation diffusion was reviewed, with a focus on innovation diffusion in an organisation, by reviewing Rogers' (2003) model and the TOE framework. Finally, stakeholder theory was reviewed from a diffusion of innovation and project management perspective. The chapter concluded by synthesising the findings into themes drawn from the literature review in Section 2.5.

2. *To extract main dimensions for exploring the ICT diffusion process and status in UAE public schools.*

This research objective was accomplished through the literature review, where the research theoretical framework was developed in Chapter 3 based on the findings and conclusions drawn from the literature review in chapter 2. Accordingly, six constructs were identified (ICT innovation/technological, organisational/school, environmental, stakeholder dynamics, adoption behaviour, and user technology acceptance). A total of 26 dimensions (see Table 4.11) were identified and grouped into the theoretical framework (see Figure 3.1). The constructs were developed by integrating the DOI (Rogers, 2003), TAM (Venkatesh et al., 2000), UTAUT (Venkatesh et al., 2003), TOE (Tornatzky and Fleischer, 1990), and CBAM (Hall, Dirksen and George, 2006) models. The approach of integrating different models was assumed to overcome the limitation of applying only one individual model, and such an approach has been supported by Fichman (1992), Gallivan (2001), Peansupap and Walker (2005), and Hoti (2015). Further discussion was also carried out in Section 7.1.

3. *To explore the status of ICT innovation diffusion in UAE public schools.*

This research objective was accomplished through the qualitative data collection and analysis presented in Chapter 5. The data collection was conducted through semi-structured interviews with cycle 2 and cycle 3 schools across the UAE. The interviews were conducted with school principals and teachers and were guided by the 26 dimensions. The findings were analysed into emerging themes, as discussed in Chapter 5 and in Section 7.2. The adoption behaviour dimensions (i.e. 'stages of concern' and 'level of use') facilitated significant observations on the status of ICT diffusion in the interviewed schools.

4. *To explore the process of ICT innovations diffusion in UAE public schools.*

This research objective was also accomplished through the qualitative data collection and analysis presented in Chapter 5. The data collection was conducted through the semi-structured interviews with cycle 2 and cycle 3 schools across the UAE. The interviews were conducted with school principals and teachers and were guided by the 26 dimensions. To guide the process of ICT diffusion, the research adopted Rogers' (2003) innovation process in organisations. The process was further developed and adapted in this study's theoretical framework (see Figure 3.1) by adding the dimensions that influence the innovation diffusion process over the project stages, as demonstrated in Chapters 3 and 6.

5. ***Study the interactions between the stakeholders over the ICT innovation diffusion project life cycle activities.***

This research objective was achieved through the analysis of the gathered qualitative data from schools and different levels of stakeholders, as presented in Chapters 5 and 6. The row data was coded, processed and classified based on the standard project life cycle phases and the detailed activities that were mapped to the list of main identified stakeholder groups. This approach enabled analysis of the dynamics of stakeholder interactions and perceptions over the different project phases within a year of deployment and over the four years of deployment.

For further analysis of the stakeholder interactions and changing dynamics, the research adopted the DSM, heat maps, and social network analysis techniques. These innovative techniques allowed the researcher to create a simplified visual representation capturing the changing dynamics in stakeholder interactions over the project stages, which further enabled an improved analysis into the reasons behind certain trends and possible justifications. The analysis and details are provided in Chapter 6 and in Section 7.3.

6. ***Develop a framework to support effective diffusion of ICT innovations in in UAE public schools that address the changing stakeholder dynamics over project lifecycle***

This research objective was achieved as the developed framework enabled the research to gain deeper understanding for the process and status of ICT innovations diffusion in UAE schools as demonstrated in the results identified as part of the second, third and fourth research objectives. In addition, the changing stakeholder dynamics and interactions was captured in light of the research context using the stakeholder dynamics construct as demonstrated in the results for the fifth research objective. The developed framework provided holistic approach to explore the process and status of ICT innovation diffusion in the UAE public schools which supports project managers in effective diffusion of ICT innovation in UAE schools.

8.3 Core results emerging from data analysis and investigative work

[to summarize the findings part in sections 7.2/7.3]

This section will highlight the core results emerged from the research investigative work on the ICT innovations diffusion in the UAE public schools and data analysis which were detailed in chapter 5 and chapter 6. The main emerging results can be categorised into three core areas related to this research, the process, the status and the stakeholder dynamics of the ICT innovation diffusion in the UAE public schools.

First area is the main emerging results related to the process ICT innovations diffusion in the UAE public schools. Under this area the main observation was that in reality the project in UAE was faced with a very fast pace requirement and within a relatively short timeline for delivery. This was very clear for year1 deployment as the implementation started even before clearly defining the strategic plan for the ICT innovation diffusion in the UAE public schools. The drivers behind this fast-pace were understandably driven by government requirements, however the lesson is in such situation the implementation phase shall focus much more on the redefining (modify and reinvent the innovation to fit the organisation and organisational structure) and clarifying stags (focus on active communication and the relationship between the innovation and how it fits within the organisation more clearly). As described in the ICT innovation diffusion process (figure 7.5), the implementation phase is focused on redefining the innovation to fit actual schools needs and active communication to ensure clear understanding of the innovation and its use to level it becomes embedded into the school culture.

In regards to the status of ICT innovation diffusion in the UAE public schools, the main observation was the importance of ongoing assessment and evaluation of the status of ICT innovation diffusion among target users and also the status of different levels of stakeholders especially the most salient stakeholders. This will ensure better alignment during redefining/restructuring and clarifying stages by making the correct changes and interventions to the organisational process or the ICT innovation. The proposed framework (figure 7.5) was design to support this by using the dimensions related the status of ICT innovation diffusion (level of use, stages of concern, performance expectancy, effort expectancy, social influence, and facilitating conditions). In addition, the status of ICT innovation diffusion needs to assess the status of different levels of stakeholders and their potential influence or acceptance in regards to the implementation. The framework identified three dimensions' guide in identifying stakeholders position and anticipate their dynamics over project phases.

These observations were seen to be critical for the ICT innovation diffusion project in the UAE public schools in specific, however these observations can remain valid within other settings.

8.4 Thesis Contribution

The thesis contributes will be discussed in two ways: contribution to knowledge and contribution to practice.

8.4.1 Contribution to knowledge

The research contributes to knowledge in the area of ICT innovation diffusion by developing a holistic approach to explore the process and status of ICT innovation project diffusion in UAE public schools. The approach was based a framework composed of six constructs and 26 dimensions that were extracted by integrating the DOI (Rogers, 2003), TAM (Venkatesh et al., 2000), UTAUT (Venkatesh et al., 2003), TOE (Tornatzky and Fleischer, 1990), and CBAM (Hall, Dirksen and George, 2006) models. Doing so was seen to provide a more holistic view of the main dimensions influencing the diffusion of ICT innovation within the research context. All the dimensions guided this explorative research and facilitated significant findings, which provided valuable insights and a better understanding of the diffusion of ICT innovation in UAE public schools (details of which are provided in Chapter 3).

In addition, the thesis provides an original contribution to knowledge. According to Johnston (2008):

> Originality is associated with innovation, addressing new questions, producing new evidence and insights, and developing new syntheses of existing work.

Accordingly, the research originality was achieved through the following:

- A comprehensive literature review to identify gaps in existing knowledge in relation to the diffusion of ICT innovation in the UAE public school context. The literature review was original because of the integration of innovation theory, technology acceptance, stakeholder theory, and educational change models.

- Identification of six constructs composed of 26 dimensions from different disciplines to provide a holistic framework that is considered original with its focus on education.

- The qualitative investigation and analysis produced insights on the status and process of ICT diffusion in UAE public schools. The research analysis revealed a list of emerging themes and findings on the UAE case that were not available before.

- The use of DSM, heat maps, and social network analysis techniques in this research represent another aspect of originality and a new way of analysis for such a research domain.

8.4.2 Contribution to Practice

From a practical standpoint, the findings of this thesis contributed suggestions and conclusions that have implications on practice, policymaking, and future implementation stages of the MBRSLP in particular, and also for other implementations within similar contexts. The main lessons learned and suggestions included:

- The naming and positioning of the MBRSLP initiative had a direct impact on its greater adoption and acceptance among different stakeholders. Naming the initiative the Mohammed Bin Rashid Smart Learning Programme led to a higher commitment, and linking the initiative to the UAE Vision 2021 National Agenda ensured the sustained commitment of all stakeholders. This finding is important and should be considered in different contexts or countries.

- The importance of ensuring an alignment of understanding at school levels between principals and teachers. In addition, the importance of ensuring this alignment of understanding is extended to the different departments of the MoE.

- It is recommended that dedicated communication channels between schools, the MoE, and the MBRLSP should be developed with regard to smart learning topics. Although schools had a permanent adoption team member, they needed direct access to the MoE and the MBRSLP to pass on their suggestions and complaints.

- It is recommended to focus on engaging students in the innovation diffusion process, as they are the ultimate end users. Their high involvement during the pilot stage led to a higher sense of ownership and engagement.

- Is it recommended that the status of ICT diffusion should be re-evaluated before each deployment phase or after any major organisational change. This was seen as helping to refine the implementation plan to meet the actual up to date needs and expectations.

- The importance of continuous engagement with venders and suppliers and their level of readiness for such complicated and different types of projects being carried out in schools across the UAE.

- The research findings and recommendations contribute towards a more effective deployment of future ICT innovations in the UAE education sector.

- Although it was not part of the research objectives, the research findings indicated an ability to use the identified themes and constructs as a holistic approach to assess the status of ICT diffusion in UAE public schools.

8.5 Research Limitations

Each research project is based on assumptions that suit the context of the study. In addition, research projects are conducted within a specific time and within resource constraints, and this research project was no different. Thus, several research limitations have been identified:

- Although the total number of interviews was considerable, more interviews from specific levels could have added more clarity to some areas. For example, it was difficult to meet federal middle-level staff, as they were not confident of being allowed to do such interviews. In addition, some potential respondents were not interviewed (e.g. cluster managers) as they were a newly established role as part of the full transformation taking place at the Ministry level.

- The geographical limitations of UAE schools, as Abu Dhabi schools did not fall under the federal MoE of UAE.

- Parents were excluded from interviews even though they were considered a key stakeholder educationally and in the context of ICT in education.

- Students were excluded from interviews.

- Successful ICT diffusion was not linked to academic performance.

- The study was limited only to cycle 2 and cycle 3 schools.

- The financial performance of ICT was excluded as a return on investment.

- The inability to record school interviews may have led to a loss of valuable information.

8.6 Recommendations for Further Research

The original contribution to knowledge listed above serves as a solid foundation on which to build further research in this area. Thus, this thesis has identified a number of areas that would benefit from further research:

- Do further work to refine the extracted dimensions
- Conduct longitudinal research to further measure ICT diffusion in education
- Investigate the influence of ICT adoption on academic attainment
- Verify how the proposed framework could be adapted to be a diagnostic tool for project managers
- Quantify the dimensions using quantitative research methods
- Conduct a comparative study using the same dimensions in another country. This would be expected to reveal significant findings

REFERENCES

Aaltonen, K. (2011). Project stakeholder analysis as an environmental interpretation process. International Journal of Project Management, 29(2), 165-183.

Aaltonen, K., & Kujala, J. (2010). A project lifecycle perspective on stakeholder influence strategies in global projects. *Scandinavian Journal of Management*, *26*(4), 381-397.

Agle, B. R., Mitchell, R. K., & Sonnenfeld, J. A. (1999). Who matters to Ceos? An investigation of stakeholder attributes and salience, corpate performance, and Ceo values. *Academy of management journal*, *42*(5), 507-525.

Al-Senaidi, S., Lin, L., & Poirot, J. (2009). Barriers to adopting technology for teaching and learning in Oman. *Computers & Education*, *53*(3), 575-590.

Ananiadou, K., & Claro, M. (2009). 21st century skills and competences for new millennium learners in OECD countries (No. 41). OECD Publishing.

Anderson, S. E. (1997). Understanding teacher change: Revisiting the concerns based adoption model. *Curriculum Inquiry*, *27*(3), 331-367.

Baddah, A. (2016). The Direction of Change Management in United Arab Emirates. *International Journal of Business and Management*, *11*(9), 126.

Baker, J. (2012). The technology–organization–environment framework. In *Information systems theory* (pp. 231-245). Springer New York.

Barber, M. (2010). How government, professions and citizens combine to drive successful educational change. In *Second international handbook of educational change* (pp. 261-278). Springer Netherlands.

Barber, M., Donnelly, K., Rizvi, S., & Summers, L. (2013). An avalanche is coming: Higher education and the revolution ahead. *Institute for Public Policy Research*, *11*.

Barnard, M., & Stoll, N. (2010). Organisational Change Management: A rapid literature review. Bristol. http://www.bristol.ac.uk/cubec/portal/

Bartolomei, J., Cokus, M., Dahlgren, J., De Neufville, R., Maldonado, D., & Wilds, J. (2007). Analysis and applications of design structure matrix, domain mapping matrix, and engineering system matrix frameworks. *Massachusetts Institue of Technology*.

Bartolomei, J. E. (2007). *Qualitative knowledge construction for engineering systems: extending the design structure matrix methodology in scope and procedure* (No. AFIT-CI07-0059). AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF ENGINEERING.

Baskin, C., & Williams, M. (2006). ICT integration in schools: Where are we now and what comes next?. *Australasian Journal of Educational Technology*, *22*(4).

Batallas, D. A., & Yassine, A. A. (2006). Information leaders in product development organizational networks: Social network analysis of the design structure matrix. *IEEE Transactions on Engineering Management*, *53*(4), 570-582.

Bayne, S. (2015). What's the matter with ‘technology-enhanced learning’?. *Learning, Media and Technology*, *40*(1), 5-20.

Blaikie, N. (2009). *Designing social research*. Polity.

Bourne, L., & Walker, D. H. (2005). Visualising and mapping stakeholder influence. *Management decision*, *43*(5), 649-660.

Borgatti, S. P., Mehra, A., Brass, D. J., & Labianca, G. (2009). Network analysis in the social sciences. *science*, *323*(5916), 892-895.

Breckon, D. A. (2009). *Management innovation adoption in the federal government: Fad, fashion or strategic intent?* (Doctoral dissertation, University of Maryland University College).

Broadband Commission. (2013). Technology, broadband and education: Advancing the education for all agenda. [internet] Available at: http://www.broadbandcommission.org/documents/publications/bd_bbcomm-education_2013.pdf

Brown, T. H. (2015). Exploring New Learning Paradigms a Reflection on Barber, Donnelly, and Rizvi (2013):" An Avalanche Is Coming: Higher Education and the Revolution Ahead". *International Review of Research in Open and Distributed Learning*, *16*(4), 227-234.

Browning, T. R. (1998). *Use of dependency structure matrices for product development cycle time reduction*.

Browning, T. R. (2016). Design structure matrix extensions and innovations: a survey and new opportunities. *IEEE Transactions on Engineering Management*, *63*(1), 27-52.

Bryman, A., & Bell, E. (2015). *Business research methods*. Oxford University Press, USA.

Bryson, J. M. (2004). What to do when stakeholders matter: stakeholder identification and analysis techniques. *Public management review, 6*(1), 21-53.

Bunn, M. D., Savage, G. T., & Holloway, B. B. (2002). Stakeholder analysis for multi-sector innovations. *Journal of Business & Industrial Marketing*, *17*(2/3), 181-203.

Cao, Q., Baker, J., Wetherbe, J. C., & Gu, V. C. (2012). Organizational Adoption of Innovation: Identifying Factors that Influence RFID Adoption in the Healthcare Industry. In *ECIS* (Vol. 94).

Carter, L., & Bélanger, F. (2005). The utilization of e- government services: citizen trust, innovation and acceptance factors. *Information systems journal*, *15*(1), 5-25.

Charlesraj, V. P. C., Maheswari, J. U., Kalidindi, K. N., & Varghese, K. (2004, September). Knowledge management for planning construction projects using dependency structure matrix. In *20th Annual ARCOM Conference* (pp. 1-3).

Condie, R., & Munro, B. (2007). The impact of ICT in schools: Landscape review.

Cooper, J. R. (1998). A multidimensional approach to the adoption of innovation. Management decision, 36(8), 493-502.

Creasey, T. (2007). Defining change management. *Prosci and the Change Management Learning Center*.

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Creswell, J. W. (2012). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

Crook, C., Harrison, C., Farrington-Flint, L., Tomás, C., & Underwood, J. (2010). The Impact of Technology: Value-added classroom practice.

Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of management journal*, *34*(3), 555-590.

Damanpour, F., & Schneider, M. (2006). Phases of the adoption of innovation in organizations: Effects of environment, organization and top Managers1. *British Journal of Management, 17*(3), 215-236.

Damanpour, F., & Schneider, M. (2009). Characteristics of innovation and innovation adoption in public organizations: Assessing the role of managers. *Journal of public administration research and theory*, *19*(3), 495-522.

Damanpour, F., & Evan, W. M. (1984). Organizational innovation and performance: the problem of" organizational lag". Administrative science quarterly, 392-409.

Damanpour, F., & Gopalakrishnan, S. (1998). Theories of organizational structure and innovation adoption: the role of environmental change. *Journal of Engineering and Technology Management*, 15(1), 1-24.

Damanpour, F., & Schneider, M. (2009). Characteristics of innovation and innovation adoption in public organizations: Assessing the role of managers. *Journal of public administration research and theory*, *19*(3), 495-522.

Danilovic, M., & Browning, T. R. (2007). Managing complex product development projects with design structure matrices and domain mapping matrices. *International journal of project management*, *25*(3), 300-314.

Davies, P. M. (2010). On school educational technology leadership. *Management in education*, *24*(2), 55-61.

de Bussy, N. M., & Kelly, L. (2010). Stakeholders, politics and power: Towards an understanding of stakeholder identification and salience in government. *Journal of Communication Management*, *14*(4), 289-305.

Deffuant, G., Huet, S., & Amblard, F. (2005). An Individual-Based model of innovation diffusion mixing social value and individual benefit 1. *American Journal of Sociology*, *110*(4), 1041-1069.

Donaldson, T., & Preston, L. E. (1995). The stakeholder theory of the corporation: Concepts, evidence, and implications. *Academy of management Review*, *20*(1), 65-91.

Dooley, K. E. (1999). Towards a holistic model for the diffusion of educational technologies: An integrative review of educational innovation studies. *Educational Technology & Society*, *2*(4), 35-45.

Drucker, P. F. (1998). The discipline of innovation. Harvard business review,76(6), 149-157.

Dulaimi, M. F., Ling, F. Y., & Bajracharya, A. (2003). Organizational motivation and inter-organizational interaction in construction innovation in Singapore.Construction Management and Economics, 21(3), 307-318.

Earle, R. S. (2002). The integration of instructional technology into public education: Promises and challenges. EDUCATIONAL TECHNOLOGY-SADDLE BROOK THEN ENGLEWOOD CLIFFS NJ-, 42(1), 5-13.

Edler, J., & Yeow, J. (2016). Connecting demand and supply: The role of intermediation in public procurement of innovation. *Research Policy*, *45*(2), 414-426.

Edmondson, A. C., Bohmer, R. M., & Pisano, G. P. (2000). Learning new technical and interpersonal routines in operating room teams The case of minimally invasive cardiac surgery. In *Research on managing groups and teams* (pp. 29-51). Emerald Group Publishing Limited.

EdTechXGlobal (2016). available at: http://edtechxeurope.com/ (Accessed: 10 February 2017)

Elliott, R., & Timulak, L. (2005). Descriptive and interpretive approaches to qualitative research. *A handbook of research methods for clinical and health psychology*, 147-159.

Rogers, E. M. (2003). Diffusion of innovations, edn. *Free Pres., New York*.

Farhat, N. (2009). *The Impact of Technology on Teaching and Learning in High Schools in the United Arab Emirates* (Doctoral dissertation, University of Leicester).

Ferlie, E., Fitzgerald, L., Wood, M., & Hawkins, C. (2005). The nonspread of innovations: the mediating role of professionals. Academy of management journal, 48(1), 117-134.

Frambach, R. T., & Schillewaert, N. (2002). Organizational innovation adoption: A multi-level framework of determinants and opportunities for future research. Journal of Business Research, 55(2), 163-176.

Freeman, R. E. (1984). Strategic management: A stakeholder approach. *Boston*: Pitman.

Frooman, J. (1999). Stakeholder influence strategies. *Academy of management review*, *24*(2), 191-205.

Gaad, E. (2011). A case study on the United Arab Emirates: Women, disability and sport. Muslim Women and sport, 211-21.

Gall, J. P., Gall, M. D., & Borg, W. R. (1999). Applying educational research: A practical guide. Longman Publishing Group.

Geoghegan, W. (1994). Whatever happened to instructional technology?. In *Paper presented at the 22nd Annual Conference of the International Business Schools Computing Association*. International Business Schools Computing Association.

George, A. A., Hall, G. E., Stiegelbauer, S. M., & Litke, B. (2008). *Stages of concern questionnaire*. Austin, TX: Southwest Educational Development Laboratory.

Glesne, C., (2011). *Becoming qualitative researchers: An introduction*. 4th edn. Boston: Pearson.

Goktas, Y., Yildirim, S., & Yildirim, Z. (2009). Main Barriers and Possible Enablers of ICTs Integration into Pre-service Teacher Education Programs. Educational Technology & Society, 12(1), 193-204.

Green, A. O., & Hunton- Clarke, L. (2003). A typology of stakeholder participation for company environmental decision- making. *Business strategy and the environment*, *12*(5), 292-299.

Griffin, D., & Christensen, R. (1999). Concerns-based adoption model (CBAM) levels of use of an innovation (CBAM-LOU). *Denton, TX: Institute for the Integration of Technology into Teaching and Learning*.

Griffith, T. L., Zammuto, R. F., & Aiman-Smith, L. (1999). Why new technologies fail: Overcoming the invisibility of implementation. *Industrial management*, *41*(3), 29-34.

Groff, J. (2013). Technology-rich innovative learning environments. *OCED CERI Innovative Learning Environment project*, 1-30.

Hall, G. E., & Loucks, S. (1978). Teacher concerns as a basis for facilitating and personalizing staff development. *Teachers college record*, *80*(1), 36-53.

Hall, G. E., Dirksen, D. J., & George, A. A. (2006). *Measuring implementation in schools: Levels of use*. Southwest Educational Development Laboratory.

Hameed, M. A., Counsell, S., & Swift, S. (2012). A conceptual model for the process of IT innovation adoption in organizations. *Journal of Engineering and Technology Management*, *29*(3), 358-390.

Harrison, J. S., & John, C. H. S. (1996). Managing and partnering with external stakeholders. The Academy of Management Executive, 10(2), 46-60.

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. Educational Technology Research and Development, 55(3), 223-252.

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. Educational Technology Research and Development, 55(3), 223-252.

Hord, S. M., & Hall, G. E. (2006). *Measuring Implementation in Schools*. Southwest Educational Development Laboratory.

Hsu, P. F., Kraemer, K. L., & Dunkle, D. (2006). Determinants of e-business use in US firms. *International Journal of Electronic Commerce*, *10*(4), 9-45.

Huang, C., Fisher, N., Spreadborough, A., & Suchocki, M. (2003). Identifying the critical factors of IT innovations adoption and implementation within construction industry.

ITU, (2012). Technology Watch Report September 2012. ITU. http://itu.int/techwatch.

Jebeile, S. (2003). The diffusion of e-learning innovations in an Australian secondary college: Strategies and tactics for educational leaders. *Innovation*, *8*(4).

Johnston, R. (2008). On structuring subjective judgements: originality, significance and rigour in RAE2008. *Higher Education Quarterly*, *62*(1- 2), 120-147.

Jongbloed, B., Enders, J., & Salerno, C. (2008). Higher education and its communities: Interconnections, interdependencies and a research agenda. *Higher education*, *56*(3), 303-324.

Keengwe, J., Onchwari, G., & Wachira, P. (2008). Computer technology integration and student learning: Barriers and promise. Journal of Science Education and Technology, 17(6), 560-565.

Khairieuum, (2012), 'Qualitatvie data analysis'. Available at https://www.youtube.com/watch?v=B-aIq_36MAQ (accessed 12 Jan 2017)

Kuo, L. H., Wei, H. M., Hu, W. C., & Yang, H. J. (2013). Applying Innovation Theory in Observing Emerging Technology Acceptance. *innovation*, *4*, 5.

Kvale, S., Brinkmann, S., (2008). Interviews: Learning The Craft of Qualitative Research Interviewing. California: Sage

Laplume, A. O., Sonpar, K., & Litz, R. A. (2008). Stakeholder theory: Reviewing a theory that moves us. *Journal of management*, *34*(6), 1152-1189.

Laurillard, D. (2007). Modelling benefits-oriented costs for technology enhanced learning. Higher Education, 54(1), 21-39.

Lee, J., Deng, W. Y., Lee, W. T., Lee, S. J., Hsu, K. H., & Ma, S. P. (2010). Integrating process and work breakdown structure with design structure matrix. *simulation*, *7*, 8.

Levin, B. (2010). How to change 5,000 schools. In *Second international handbook of educational change* (pp. 309-322). Springer Netherlands.

Lewis, L. K., & Seibold, D. R. (1993). Innovation modification during intraorganizational adoption. Academy of Management Review, 18(2), 322-354.

Lienert, J., Schnetzer, F., & Ingold, K. (2013). Stakeholder analysis combined with social network analysis provides fine-grained insights into water infrastructure planning processes. *Journal of environmental management*, *125*, 134-148.

Lim, C. P. (2002). A theoretical framework for the study of ICT in schools: a proposal. *British Journal of Educational Technology*, *33*(4), 411-421.

Lim, C. P., & Khine, M. S. (2006). Managing teachers' barriers to ICT integration in Singapore schools. *Journal of technology and Teacher Education*, *14*(1), 97.

Lim, C. P., Zhao, Y., Tondeur, J., Chai, C. S., & Tsai, C. C. (2013). Bridging the gap: Technology trends and use of technology in schools. *Educational Technology & Society*, *16*(2), 59-68.

Lin, H. F., & Lin, S. M. (2008). Determinants of e-business diffusion: A test of the technology diffusion perspective. *Technovation*, *28*(3), 135-145.

Love, P. E., Irani, Z., Li, H., Cheng, E. W., & Tse, R. Y. (2001). An empirical analysis of the barriers to implementing e-commerce in small-medium sized construction contractors in the state of Victoria, Australia. *Construction Innovation*, *1*(1), 31-41.

Luckin, R., Bligh, B., Manches, A., Ainsworth, S., Crook, C., Noss, R., (2012) Decoding Learning: the proof, promise and potential of digital education, NESTA.

Lyytinen, K., & Damsgaard, J. (2001). What's wrong with the diffusion of innovation theory? (pp. 173-190). Springer US.

Markus, M. L., & Benjamin, R. I. (1997). The magic bullet theory in IT-enabled transformation. *Sloan Management Review*, *38*(2), 55.

MBRSLP (2016). MBRSLP Annual Report. available at: http://smartlearning.gov.ae/wp-content/uploads/2016/06/MBRSLP%20Annual%20Report%202015.pdf (Accessed: 15 February 2017)

Medlin, B. D. (2001). The factors that may influence a faculty member's decision to adopt electronic technologies in instruction (Doctoral dissertation, Virginia Polytechnic Institute and State University).

Missonier, S., & Loufrani-Fedida, S. (2014). Stakeholder analysis and engagement in projects: From stakeholder relational perspective to stakeholder relational ontology. *International Journal of Project Management*, *32*(7), 1108-1122.

Mitchell, R. K., Agle, B. R., & Wood, D. J. (1997). Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts. Academy of management review, 22(4), 853-886.

Nour, M. A., & Mouakket, S. (2013). A classification framework of critical success factors for ERP systems implementation: A multi-stakeholder perspective. In *Competition, Strategy, and Modern Enterprise Information Systems* (pp. 98-113). IGI Global.

OECD (2008). New Millennium Learners, “Initial findings on the effects of digital technologies on school-age learners”

OECD (2012), Connected Minds: Technology and Today’s Learners, Educational Research and Innovation, OECD Publishing.

OECD (2014). Trends Shaping Education 2014 Spotlight 5. OECD Publishing. Available: http://www.oecd.org/edu/ceri/Spotlight%205-%20Infinite%20Connections.pdf

OECD (2015), OECD Innovation Strategy 2015 An Agenda for Policy Action. OECD Publishing.

OECD (2015). A strategic approach to education and skilss policeis for the United Arab Emirates. OECD.

Oldenburg, B. and Glanz, K., 2008. Diffusion of innovations. Health Behavior and Health Education-Theory Research, and Practice, pp.313-330.

Oliveira, T., & Martins, M. F. (2011). Literature review of information technology adoption models at firm level. *The Electronic Journal Information Systems Evaluation*, *14*(1), 110-121.

Oye, N. D., Iahad, N. A., & Rahim, N. A. (2014). The history of UTAUT model and its impact on ICT acceptance and usage by academicians. *Education and Information Technologies*, *19*(1), 251-270.

Pasmore, W. A., & Fagans, M. R. (1992). Participation, individual development, and organizational change: A review and synthesis. Journal of Management, 18(2), 375-397.

Peansupap, V., & Walker, D. H. (2005). Factors enabling information and communication technology diffusion and actual implementation in construction organisations. *Journal of Information Technology in Construction (ITcon)*, *10*(14), 193-218.

Pichlak, M. (2016). The innovation adoption process: A multidimensional approach. *Journal of Management and Organization*, *22*(4), 476.

Polley, D. E., Garud, R., & Venkataraman, S. (1999). The innovation journey. New York: Oxford University Press.

Postema, T. R. F., Groen, A. J., & Krabbendam, J. J. (2012). A method to evaluate the role of stakeholder dynamics in innovation adoption processes; the stakeholder-based innovation acceptance web (SIAW).

Postema, T.R.F., A.J. Groen, et al. (2011). A method to evaluate the role of stakeholder dynamics in innovation adoption processes; the stakeholder-based innovation acceptance web (SIAW). International Association for Management of Technology 2011 (IAMOT2011). Miami Beach, FL, USA.

Pouloudi, A. (1999, January). Aspects of the stakeholder concept and their implications for information systems development. In *Systems Sciences, 1999. HICSS-32. Proceedings of the 32nd Annual Hawaii International Conference on* (pp. 17-pp). IEEE.

Premkumar, G., Ramamurthy, K., & Nilakanta, S. (1994). Implementation of electronic data interchange: an innovation diffusion perspective. *Journal of Management Information Systems*, *11*(2), 157-186.

Quaddus, M., & Hofmeyer, G. (2007). An investigation into the factors influencing the adoption of B2B trading exchanges in small businesses. *European Journal of Information Systems*, *16*(3), 202-215.

Rahman, M. H., & Said, W. Y. (2015, February). Public Sector Performance and Leadership in the United Arab Emirates. In *3rd International Conference on Management, Leadership and Governance* (p. 224).

Ramamurthy, K. (1994). Moderating influences of organizational attitude and compatibility on implementation success from computer-integrated manufacturing technology. *THE INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH*, *32*(10), 2251-2273.

Reed, M. S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., & Stringer, L. C. (2009). Who's in and why? A typology of stakeholder analysis methods for natural resource management. *Journal of environmental management*, *90*(5), 1933-1949.

Richards, C., Sherlock, K., & Carter, C. (2004). Practical approaches to participation. In C. Carter & C. L. Spash (Eds.), SERP Policy Brief No. 1. Aberdeen, UK: Macaulay Institute.

Riege, A. M. (2003). Validity and reliability tests in case study research: a literature review with "hands-on" applications for each research phase. *Qualitative market research: An international journal*, *6*(2), 75-86.

Robinson, L. (2009). A Summary of Diffusion of Innovations. http://www.enablingchange.com.au/Summary_Diffusion_Theory.pdf

Rockart, J. F. (1979). Chief executives define their own data needs. *Harvard business review*, *57*(2), 81.

Rogers, E. M. (2002). Diffusion of preventive innovations. Addictive behaviors, 27(6), 989-993.

Rogers, EM. (2003). Diffusion of Innovations, 5th Edition. Free Press. Kindle Edition.

Rose, K. H. (2013). A Guide to the Project Management Body of Knowledge (PMBOK® Guide)—Fifth Edition. *Project management journal*, *44*(3), e1-e1.

Sahin, I. (2006). Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory. The Turkish Online Journal of Educational Technology, 5(2), 14-23.

Salado, A., & Nilchiani, R. (2013). Contextual-and behavioral-centric stakeholder identification. *Procedia Computer Science*, *16*, 908-917.

Sancho, J. M. (2010). Digital technologies and educational change. In *Second international handbook of educational change* (pp. 433-444). Springer Netherlands.

Savage, G. T., Nix, T. W., Whitehead, C. J., & Blair, J. D. (1991). Strategies for assessing and managing organizational stakeholders. The executive, 5(2), 61-75.

Schwab, K. (2017). *The fourth industrial revolution*. Penguin UK.

Shaikh, A. A., & Karjaluoto, H. (2015). Mobile banking adoption: A literature review. *Telematics and Informatics*, *32*(1), 129-142.

Sheng, M., Keyi, W., & Jian, W. (2011). The corporate stakeholder management integrated model research: A conceptual framework and theoretical approach review. Convergence Inform. Technol, 6, 415-424.

SKGEP, (2017). Sheikh Khalifa Government Excellence Program.

Spitzeck, H., & Hansen, E. G. (2010). Stakeholder governance: How stakeholders influence corporate decision making. *Corporate Governance: The international journal of business in society*, *10*(4), 378-391.

Stake, R. (1995). The art of case study research. California: Sage.

Staples, A., Pugach, M. C., & Himes, D. J. (2005). Rethinking the technology integration challenge: Cases from three urban elementary schools. Journal of Research on Technology in Education, 37(3), 285-311.

Stewart, R. A., Mohamed, S., & Daet, R. (2002). Strategic implementation of IT/IS projects in construction: a case study. *Automation in construction*, *11*(6), 681-694.

Stewart, R. A., Mohamed, S., & Marosszeky, M. (2004). An empirical investigation into the link between information technology implementation barriers and coping strategies in the Australian construction industry. *Construction Innovation*, *4*(3), 155-171.

Straub, E. T. (2009). Understanding technology adoption: Theory and future directions for informal learning. *Review of educational research*, *79*(2), 625-649.

Surry, D. W., & Brennan, J. P. (1998). Diffusion of Instructional Innovations: Five Important, Unexplored Questions.

Thomson, P. (2010). Involving children and young people in educational change: Possibilities and challenges. In *Second international handbook of educational change* (pp. 809-824). Springer Netherlands.

Todnem By, R. (2005). Organisational change management: A critical review. *Journal of change management*, *5*(4), 369-380.

Toledo, C. (2005). A five-stage model of computer technology integration into teacher education curriculum. *Contemporary issues in technology and teacher education*, *5*(2), 177-191.

Tondeur, J., Van Keer, H., van Braak, J., & Valcke, M. (2008). ICT integration in the classroom: Challenging the potential of a school policy. *Computers & Education*, *51*(1), 212-223.

Trinidad, S., Newhouse, P., & Clarkson, B. (2005, November). A framework for leading school change in using ICT: Measuring change. In *AARE Conference. Sydney, Australia. Retrieved March* (Vol. 29, p. 2006).

UNITED NATIONS (2015). Transforming our world: The 2030 agenda for sustainable development. Sustainable development knowledge platform. Available at: https://sustainabledevelopment.un.org/post2015/transformingourworld (Accessed: 1 February 2017).

Van de Ven, A. H., Polley, D. E., Garud, R., & Venkataraman, S. (1999). The innovation journey. *New York*.

Van de Ven, A., & Engleman, R. (2004). Central problems in managing corporate innovation and entrepreneurship. Advances in Entrepreneurship, Firm Emergence and Growth, 7, 47-72.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: four longitudinal field studies. Management science, 46(2), 186-204.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS quarterly, 425-478.

Venkatesh, V., Rabah, J., Fusaro, M., Couture, A., Varela, W., & Alexander, K. (2016). FACTORS IMPACTING UNIVERSITY INSTRUCTORS'AND STUDENTS'PERCEPTIONS OF COURSE EFFECTIVENESS AND TECHNOLOGY INTEGRATION IN THE AGE OF WEB 2.0. *McGill Journal of Education/Revue des sciences de l'éducation de McGill*, *51*(1).

Vos, J. F., & Achterkamp, M. C. (2006). Stakeholder identification in innovation projects: Going beyond classification. European Journal of Innovation Management, 9(2), 161-178.

Wagner Mainardes, E., Alves, H., & Raposo, M. (2012). A model for stakeholder classification and stakeholder relationships. *Management Decision*, *50*(10), 1861-1879.

Walker, D. H., Bourne, L. M., & Shelley, A. (2008). Influence, stakeholder mapping and visualization. *Construction Management and Economics*, *26*(6), 645-658.

Ward, R. (2013). The application of technology acceptance and diffusion of innovation models in healthcare informatics. Health Policy and Technology, 2(4), 222-228.

Ward, S., & Chapman, C. (2008). Stakeholders and uncertainty management in projects. Construction Management and Economics, 26(6), 563-577.

WEF, (2012).The Global Information Technology Report 2012 Living in a Hyper connected World. World Economic Forum. www.weforum.org/gitr

Wisdom, J. P., Chor, K. H. B., Hoagwood, K. E., & Horwitz, S. M. (2014). Innovation adoption: a review of theories and constructs. *Administration and Policy in Mental Health and Mental Health Services Research*, *41*(4), 480-502.

Wisdom, J. P., Chor, K. H. B., Hoagwood, K. E., & Horwitz, S. M. (2014). Innovation adoption: a review of theories and constructs. *Administration and Policy in Mental Health and Mental Health Services Research*, *41*(4), 480-502.

Xiao, X., Califf, C. B., Sarker, S., & Sarker, S. (2013). ICT innovation in emerging economies: a review of the existing literature and a framework for future research. *Journal of Information Technology*, *28*(4), 264-278.

Yang, Z., Sun, J., Zhang, Y., & Wang, Y. (2015). Understanding SaaS adoption from the perspective of organizational users: A tripod readiness model. *Computers in Human Behavior*, *45*, 254-264.

Yeo, K. T. (2002). Critical failure factors in information system projects. *International Journal of Project Management*, *20*(3), 241-246.

Yin, R. K. (2009). Case study research: Design and methods (Vol. 5). Sage.

Zakhem, A. (2008). Stakeholder management capability: A discourse–theoretical approach. Journal of Business ethics, 79(4), 395-405.

Zhang, J., Yang, J., Chang, M., & Chang, T. (2016). Towards a Critical Understanding to the Best Practices of ICT in K-12 Education in Global Context. In *ICT in education in global context* (pp. 1-17). Springer Singapore.

Zhang, J., Zhao, J., Fan, L., Wu, D. (2015). Report of international development research on ICT in education (2014–2015) (pp. 20–27). Beijing: Beijing Normal University Press.

Zhu, C., & Engels, N. (2014). Organizational culture and instructional innovations in higher education: Perceptions and reactions of teachers and students. *Educational Management Administration & Leadership*, *42*(1), 136-158.

Zhu, C. (2015). Organisational culture and technology-enhanced innovation in higher education. *Technology, Pedagogy and Education*, *24*(1), 65-79.

Zhu, K., Kraemer, K. L., & Xu, S. (2006). The process of innovation assimilation by firms in different countries: a technology diffusion perspective on e-business. *Management science*, *52*(10), 1557-1576.

APPENDICES

Appendix A: Constructs Dimensions and interview themes

Code	ICT Innovation Construct Dimensions	Description	dimensions main themes
INN1	Relative advantage	The degree to which an innovation is perceived as being better than the idea it supersedes. 1. Using the system enables me to accomplish tasks more quickly. 2. Using the system improves the quality of the work I do. 3. Using the system makes it easier to do my job. 4. Using the system enhances my effectiveness on the job. 5. Using the system increases my productivity.	○ Better than before ○ Before / at present ○ Enabled me/us to …+ve / -ve ○ Better for edu / teaching/ students
INN2	Cost	The degree to which the cost and expenses incurred in the adoption and the implementation of the new innovation were of issue. The costs incurred in adoption of new technology include administrative, implementation, training and expenditure for maintenance. Cost is a critical factor in an adoption decision and a relatively easy characteristic to measure (Tornatzky and Klein, 1982; Zhu et al., 2006a). The literature suggests cost as an inhibitor to IT innovation adoption and the less expensive the innovation, the more likely it will be adopted and used by organizations (Downs and Mohr, 1976; Tornatzky and Klein, 1982; Rogers, 1995). The cost of computer hardware and software has rapidly declined in recent years; however, for organizations which operate in limited resources, the cost of IT is	○ Availability of resources / funding ○ Sustaining resources ○ Cost as a motivation (free prog.) ○ Cost as inhibitor (don't care as it is free…) ○ Administrative cost ○ Training cost ○ Implementation cost ○ Integration cost ○ Maintenance cost

		still a major impediment. The cost of an innovation is expected to be negatively affected the adoption and implementation of the innovation	
INN3	Complexity	The degree to which an innovation is perceived as relatively difficult to understand and use. 1. Using the system takes too much time from my normal duties. 2. Working with the system is so complicated it is difficult to understand what is going on. 3. Using the system involves too much time doing mechanical operations (e.g., data input). 4. It takes too long to learn how to use the system to make it worth the effort.	○ System is difficult/easy to understand ○ Support given to simplify adoption ○ Level of intuitiveness / ease of use ○ time to get used to the system ○ Training
INN4	Compatibility	The degree to which an innovation is perceived as being consistent with existing values, needs, and experiences of potential adopters. Naming an innovation and positioning it relative to previous ideas are important means of making an innovation more compatible. (Rogers) 1. Using the system is compatible with all aspects of my work 2. I think that using the system fits well with the way I like to work 3. Using the system fits into my work style	○ Compatible with work aspects ○ Consistent with existing values ○ Consistent with existing needs ○ Consistent with existing experience of adopters ○ Fitting with way I like to work / work style ○ Naming and positioning the innovation (national agenda, MBRSLP, mGov,..)
INN5	Trialability	Trailability is the degree to which an innovation may be experimented with on a limited basis. The trialability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption (Generalization 6-4)(Rogers)	○ Chance of experiments before implementation, testing by users ○ briefings & awareness before implementation ○ Pilots … ○ During initial stages

		• Trialability is important in the initiation stages of adoption. However, its implication will affect the usage of the innovation • Being able to try innovations before adoption reduces uncertainty of potential adopters and innovations that can be tried are more likely to be adopted (Tornatzky and Klein, 1982).	
INN6	Observability	The degree to which the results of the innovation are visible to others. • observability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption (Generalization 6-5) (Rogers, 2003) • Observability is sometimes referred to as "visibility" • The more visible or observable the usage and the outcome of the innovation, the more likely the innovation will be adopted and implemented in organizations (Tornatzky and Klein, 1982).	○ Results and visible outcomes / benefits ○ Usage visibility ○ Good practice is visible ○ Learning resources
INN7	Driver of ICT diffusion	the degree on the need to diffuse ICT in UAE schools from interviewee perspective The main drivers to diffuse and adopt ICT innovation within research context (UAE public schools). General view on the needs and why diffuse ICT in UAE schools from interviewee perspective. Why launch a national program	(high, medium, low) ○ Political ○ Educational ○ Economical ○ Social

Code	**Organizational/School Construct Dimensions**	**Description**	**dimensions main themes**
ORG1	Organization/school size	The degree to which the size of school, and deployment were of issue	To discuss school size dimension with the interviewees schools,

		Organisation size or in this case school size dimension refer to the relationship between organisation size and ICT diffusion and adoption Homogeneity / heterogeneity As size of an organization determines other organizational aspects, particularly slack resources, decision-making and organizational structure, organizational size is the most important factor influencing IT innovation adoption (Rogers, 1995). Some researchers have argued that flexible organizational structure and centralized decision-making in smaller organizations assists innovation adoption (Zhu et al., 2006b)	the focus was on following aspects: • School size in term of number of students and teachers • Roll-out size in term of size of each deployment phase by MBRSLP • Size of support in terms of ratio of number of support team members to beneficiaries per school.
ORG2	Change champion	The degree of change champion importance for innovation diffusion Change champion can be defined as an individual who performs the task of spreading knowledge of new technological innovation or promote and support the diffusion and adoption efforts within the organization The existence of a change champion	Within this study context, the focus was on the following: • Principal as champion • Teacher as champion • Support team member as champion • Adoption team as champion

		influences all stages of innovation adoption Change champion can be loosely defined as an individual who performs the task of spreading knowledge of new technology within the organization. • Rogers used term (champion, change agent) • CBAM used term (change facilitator)	
ORG3	Centralization	The degree to which centralization influenced diffusion and adoption The level of centralization of decision making in an organization the degree to which power and control in a system are concentrated in the hands of relatively few individuals in an organization (Rogers, 2003) More concentrated decision-making is associated with a centralized organizational structure. The organisation level of centralization and decision making in organization are important elements in understanding the level organisational innovativeness	To discuss centralisation dimension with the interviewees, the focus was following aspects across schools: • Centralised: all decisions and power are with MoE or MBRSLP. • Decentralised: all decisions and power is with the schools. • Hybrid: decision power and authority distributed between the school and MoE or MBRSLP
ORG4	Importance of school needs	The degree to how much school was involved in the diffusion process	To discuss importance of school needs dimension with the interviewees, the focus

		Since Schools are main adopters of the diffused ICT innovations	was following aspects across schools: • Schools are aware, consulted, involved, or not-involved in ICT diffusion process • How the school needs and requirements are attained? • How often the school needs and requirements are supported and satisfied • School needs and requirements go through clear channels of communication and engagement.
ORG5	re-invention (continuous improvement)	The degree to which an innovation was enhanced or modified to fit the local implementation setting. It can also include organisational changes to fit implementation setting. Both the innovation and the organization usually change and get modified during the innovation process to accommodate the different evolving needs. Reinvention is a process in which adopters modify an innovation to fit their local implementation	To discuss re-invention dimension with the interviewees, the focus was following aspects across schools: • The degree to which provided ICT innovations were modified or developed as it diffuses over the implementation period. • Any organizational changes took place to support innovation diffusion and adoption

		setting. Rice and Rogers (1980) found that reinvention is positively related to the adoption of innovations. Implementation deals with adopting and tailoring an innovation to the organization's specific needs and constraints (Van de Ven et al 1999). the degree to which an innovation is ***re-invented*** (defined previously as the degree to which an innovation is modified by adopters as it diffuses) is positively related to the innovation’s sustainability. When an organization’s members change an innovation as they adopt it, they begin to regard it as their own, and are more likely to continue it over time, even when the initial special resources are withdrawn or diminish *Sustainability of the innovation was related to:* (1) its degree of re-invention, (2) the fit between the intervention and the organization, and (3) the involvement of a local champion.	

Code	**Environmental Construct Dimensions**	**description**	**Dimensions main themes**

ENV1	Government support	the extent of government support in terms of funding, government initiatives and policies to promote IT adoption and use - extent of Government support - Extent of commitment of resource and support from the top management	To discuss government support dimension with the interviewees, the focus was following aspects across schools: • extent of Government support • Extent of commitment of resource and support from the top management • Extent of government pressure in driving ICT implementation in schools (Highly supportive, Supportive, Little support, Neutral, Against)
ENV2	Competition with other public sectors	the degree to which competition with other UAE public sectors was perceived as an influence for DICT Interviewees perception on the degree to which education sector is coping with other public sectors in ICT adoption coping with other UAE public sector in the adoption of ICT / smart government initiatives (behind, coping with, competing with, ahead)	coping /competing/ahead of other UAE public sector in the adoption of ICT / smart government initiatives (behind, coping with, competing with, ahead)
ENV3	Vendors support	the role of support and relationship with vendors and service providers involved in the ICT innovation diffusion.	To discuss vendor support dimension with the interviewees, the focus was following aspects: •Level of involvement •Phases of involvement •extent of relationship •Level of readiness •Level of satisfaction

		Level of engagement …their level readiness	
ENV4	Cultural aspect	the degree of influence of UAE school context, parents on ICT use for learning, and UAE culture toward ICT use. Cultural aspects refer the common patterns of thinking and feeling and potential acting shared among members of social environment (Hofstede, 2001). UAE school context Parents and ICT use for learning UAE culture toward ICT use	To discuss cultural aspects dimension within this research context, the focus was following aspects •UAE school context •Parents and ICT use for learning •UAE culture toward ICT use
ENV5	Resistance to change	Resistance to change refers to the degree of resistance in regards to ICT innovation diffusion in schools. The focus will be on the main challenges schools faced and resulted in resistance and negatively impacted effective diffusion main sources of resistance main challenges	To discuss resistance to change dimension, the researcher asked interviewees to share their views on main challenges, examples of resistance, and suggestions to sustain adoption.

Code	**Technology Acceptance Construct Dimensions**	**Description**	**Dimensions main themes**
TA1	Performance expectancy	the degree to which an individual believes that using the system will help him or her to attain gains	The researcher used different terms to facilitate better understanding from participants such as: •enable me to accomplish tasks more quickly

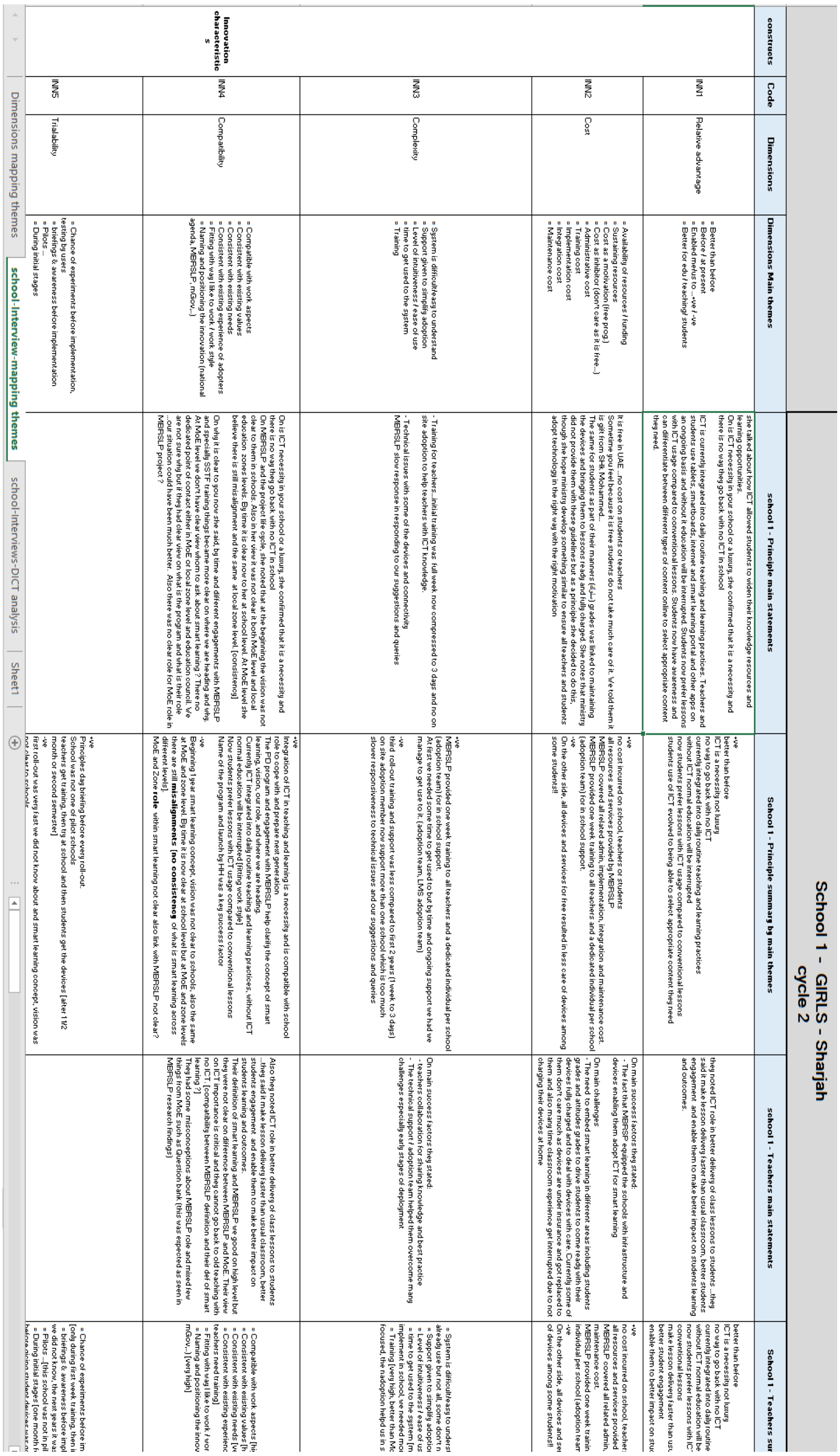
		in job performance as educator	•improve my job performance. •increase my productivity •enhance my effectiveness on the job •make it easier to do my job •the provided ICT is useful for my job •using ICT assist in my job as teacher
TA2	Effort expectancy	the degree of ease associated with the use of the innovation for teaching and learning	The researcher used different terms to facilitate better understanding from participants such as: •the ICT or system ease of use •the ICT or system is complicated to understand and take time to learn •using ICT for teaching and learning is easy or complicated
TA3	Social influence	The degree to which an individual feels social pressure to use a particular information technology	The researcher used different terms to facilitate better understanding from participants such as: •People who influence my behavior think that I should use the system. •Senior management of education sector, government supportive, promote use of ICT. •People who are important to me think that I should use the system. •The surrounding attitudes and culture, community, influence to use/not use ICT. •Proportion of co-workers who use ICT. •Using ICT perceived to enhance social image or status in the social system.
TA4	Facilitating condition (existing infra, training , support, adoption,)	the degree to which an individual believes that his or her organization is supporting the change. It can also include the objective factors within the specific environment that participants or viewers agree that it facilitated the change Objective factors in the environment that observers agree make an act easy to	The researcher used different terms to facilitate better understanding from participants such as: •guidance and training was provided •what good practice look like •specific person/group available to assist with any difficulties •have control over using the system •have the resources necessary to use the system •have the knowledge necessary to use the system •integration with other systems

		do, including the provision of computer support (Thompson et al. 1991)	

Code	**Adoption Behaviors Construct Dimensions**	**Description**	**Dimensions main themes**
AB1	SoC (stage of concerns)	The feelings and level of concern for individuals involved in change	adapted level from CBAM SoC from 7 levels to 4 levels 1- self / personal : from little awareness to seeking knowledge on innovation and demands of innovation. 2- process & tasks: Attention focused on the process and tasks of using the innovation and integrating into daily job. 3- impact : Attention focused on innovation and its use to impact on students 4- improvement: The focus on how to better implement innovation
AB2	LoU (level of use)	The level of innovation use and how individuals interacts with a new innovation operationally in practice. LoU dimension describes behaviors of innovation users and does not at all focus on attitudinal, motivational, or other affective aspects of the user. LoU does not attempt to explain causality. Instead, the LoU dimension is an attempt to define operationally what the user is doing	adapted level from CBAM LoU from 7 levels to 4 levels 1- Pre-use: from non use to initial awareness and preparation to use 2- Basic : User implementation is poorly coordinated and mainly superficial use 3- Established : User has established pattern of use with little thoughts on improving innovation use 4- Refinement & renewal: User is making

			deliberate efforts to increase impact and seeking more effective alternatives to the established use of the in novation.

Appendix B: School interviews matrix used for raw data coding, sorting, and themes identification



				School 1 - GIRLS - Sharjah cycle 2			
constructs	Code	Dimensions	Dimensions Main themes	school 1 - Principle main statements	School 1 - Principle summary by main themes	school 1 - Teachers main statements	School 1 - Teachers sur
	INN1	Relative advantage	= Better than before = Before / at present = Enabled me/us to ...+ve / -ve = Better for edu / teaching/ students	she talked about how ICT allowed students to widen their knowledge resources and learning opportunities. On is ICT necessity in your school or a luxury, she confirmed that it is a necessity and there is no way they go back with no ICT in school ICT is currently integrated into daily routine teaching and learning practices. Teachers and students use tablets, smartboards, internet and smart learning portal and other apps on an ongoing basis and without it education will be interrupted. Students now prefer lessons with ICT usage compared to conventional lessons. Students now have awareness and can differentiate between different types of content online to select appropriate content they need.	+ve better than before ICT is a necessity not luxury no way to go back with no ICT currently integrated into daily routine teaching and learning practices without ICT normal education will be interrupted now students prefer lessons with ICT usage compared to conventional lessons students use of ICT evolved to being able to select appropriate content they need	they noted ICT role in better delivery of class lessons to students ...they said it make lesson delivery faster than usual classroom, better students engagement and enable them to make better impact on students learning and outcomes.	better than before ICT is a necessity not luxury no way to go back with no ICT currently integrated into daily routine without ICT normal education will be now students prefer lessons with IC conventional lessons make lesson delivery faster than usu better student engagement enable them to better impact on stu
	INN2	Cost	= Availability of resources / funding = Sustaining resources = Cost as a motivation (free prog.) = Cost as inhibitor (don't care as it is free...) = Administrative cost = Training cost = Implementation cost = Integration cost = Maintenance cost	It is free in UAE ...no cost on students or teachers Sometime you feel because it is free students do not take much care of it. We told them it is gift from SHk Mohammed... The same for students as part of their manners (سلوك) grades was linked to maintaining the devices and bringing them to lessons ready and fully charged. She notes that ministry did not provide them with these guidelines but as a principle she decided to do this, though she hope ministry develop something similar to ensure all teachers and students adopt technology in the right way with the right motivation	+ve no cost incurred on school, teachers or students all resources and services provided by MBRSLP MBRSLP covered all related admin, implementation, integration and maintenance cost. MBRSLP provided one week training to all teachers and a dedicated individual per school (adoption team) for in school support. -ve On the other side, all devices and services for free resulted in less care of devices among some students!!	On main success factors they stated: - The fact that MBRSP equipped the schools with infrastructure and devices enabling them adopt ICT for smart learning On main challenges - The need to embed smart learning in different areas including students grades and attitudes grades to drive students to come ready with their devices fully charged and to deal with devices with care. Currently some of them don't care much as devices are under insurance and got replaced to them and also many time classroom experience get interrupted due to not charging their devices at home	+ve no cost incurred on school, teacher all resources and services provided MBRSLP covered all related admin, maintenance cost. MBRSLP provided one week trainin individual per school (adoption tean -ve On the other side, all devices and se of devices among some students!!
	INN3	Complexity	= System is difficult/easy to understand = Support given to simplify adoption = Level of intuitiveness / ease of use = time to get used to the system = Training	- Training for teachers...initial training was full week now compressed to 3 days and no on site adoption to help teachers with ICT knowledge. - Technical issues with some of the devices and connectivity MBRSLP slow response in responding to our suggestions and queries	+ve MBRSLP provided one week training to all teachers and a dedicated individual per school (adoption team) for in school support. At first we needed some time to get used to but by time and ongoing support we had we manage to get use to it. (adoption team, LMS adoption team) -ve third roll-out training and support was less compared to first 2 years (1 week to 3 days) on site adoption member now support more than one school which is too much slower responsiveness to technical issues and our suggestions and queries	On main success factors they stated: - teachers collaboration for sharing knowledge and best practice - The technical support / adoption team helped them overcome many challenges especially early stages of deployment	= System is difficult/easy to unders already use but not all, some don't = Support given to simplify adoptio = Level of intuitiveness / ease of us = time to get used to the system [m implement in school, we needed mo = Training [very high, better than Mo focused, the nadoption helpd us in s
Innovation characteristics	INN4	Compatibility	= Compatible with work aspects = Consistent with existing values = Consistent with existing needs = Consistent with existing experience of adopters = Fitting with way I like to work / work style = Naming and positioning the innovation (national agenda, MBRSLP, mGov,..)	On is ICT necessity in your school or a luxury, she confirmed that it is a necessity and there is no way they go back with no ICT in school On MBRSLP and the project life cycle, she noted that at the beginning the vision was not clear to them in schools. Also in her view it was not clear it both MoE level and local education zones levels. By time it is clear now to her at school level. At MoE level she believe there is still misalignment and the same at local zone level. [consistency] On why it is clear to you now she said, by time and different engagements with MBRSLP and specially SSTF training things became more clear on where we are heading and why. At MoE level we don't have clear view whom to ask about smart learning ? There no dedicated point of contact either in MoE or local zone level and education council. We are not sure why but if they had clear view on what is the program and what is their role ...our situation could have been much better. Also there was no clear role for MoE role in MBRSLP project ?	+ve Integration of ICT in teaching and learning is a necessity and is compatible with school role to cope with and prepare next generation The PD program and engagement with MBRSLP help clarify the concept of smart learning, vision, our role, and where we are heading. Currently ICT integrated into daily routine teaching and learning practices, without ICT normal education will be interrupted [fitting work style] Now students prefer lessons with ICT usage compared to conventional lessons Name of the program and launch by HH was a key success factor -ve Beginning 1 year smart learning concept, vision was not clear to schools, also the same at MoE and zone level. By time it is now clear at school level but at MoE and zone levels there are still **misalignments** [**no consistency** of what is smart learning across different levels]. MoE and Zone **role** within smart learning not clear also link with MBRSLP not clear?	Also they noted ICT role in better delivery of class lessons to students ...they said it make lesson delivery faster than usual classroom, better students engagement and enable them to make better impact on students learning and outcomes. Their definition of smart learning and MBRSLP we good on high level but they were not clear on difference between MBRSLP and MoE. Their view on ICT importance is critical and they cannot go back to old teaching with no ICT. [compatibility between MBRSLP definition and their def of smart learning ?] They had some misconceptions about MBRSLP role and mixed few things from MoE such as Question bank (this was expected as seen in MBRSLP research findings)	= Compatible with work aspects [hi = Consistent with existing values [h = Consistent with existing needs [v = Consistent with existing experienc teachers need training] = Fitting with way I like to work / wor = Naming and positioning the innov mGov,..) [very high]
	INN5	Trialability	= Chance of experiments before implementation, testing by users = briefings & awareness before implementation = Pilots ... = During initial stages		+ve Principles day briefing before every roll-out. School was not one of pilot schools teachers get training, then try at school and then students get the devices [after 1 1/2 month or second semester] -ve first roll-out was very fast we did not know about and smart learning concept, vision was not clear to schools		= Chance of experiments before im [only during first week training, then i = briefings & awareness before impl we did not know, the next years it wa = Pilots ...[this school was not in pil = During initial stages [one month f before giving student devices was a

Dimensions mapping themes | school-Interview-mapping themes | school-Interviews-DICT analysis | Sheet1

Appendix C: Matrix of analysis and emerging themes across cycle 2 and cycle 3 schools

			School 7 - GIRLS - Dubai Cycle 3			cross school analysis	
constructs	**Code**	**Dimensions**	**School 7 - Principle summary by main themes**	**school 7 - Teachers main statements**	**School 7 - Teachers summary by main themes**	**cycle 2 schools emerging themes**	**cycle 3 schools emerging themes**
	INN1	Relative advantage	= Better than before [better than before,] = Before / at present [before ICT use was ad-hoc and limited, now across G10] = Enabled me/us to ...+ve / -ve [enable better prepare for future university with similar learning styles, enable different learning resrouces, easier access and save time] = Better for edu / teaching/ students [enable different learning resrouces, easier access and save time]	- Save time - Enable teaching using different styles and media - Enable more fun - Help better engage students - Make classroom more interactive - makes it easier lesson - Students engaged ICT enabling motivating students ...math teacher gave example of car racing app to which teach math in more fun way	= Better than before [better than before,] = Before / at present [before ICT use was ad-hoc and limited, now across G10] = Enabled me/us to ...+ve / -ve [enable different learning styles, enable more fun, better engage, easier access] = Better for edu / teaching/ students [enable different learning styles, easier access, better engage studetns, motivate sutdents]	= Better than before = Before / at present = Enabled me/us to ...+ve / -ve = Better for edu / teaching/ students [in general, there is consistent theme across cycle 2 school on the relative advantage of the provided ICT in schools and it is perceived as being better than prevouse ad-hoc state for using ICT to enahce teaching and learning. all of them agree no way to go back with less or no ICT in schools. in addition, all schools perceive ICT to add value to teaching and learning process and add positive impact on students outcomes] [the level of enablment and integration of ICT in school processes, is varying depending on school level of adoption and extra personal efforts. in general ICT is now part of daily practice and lifestyle element of cycle 2 schools]	= Better than before = Before / at present = Enabled me/us to ...+ve / -ve = Better for edu / teaching/ students [in general, the views from cycle 3 schools are consistent across the interviewed schools on the relative advantage of the provided ICT being better than previouse ad-hoc state for using ICT to enahce teaching and learning. All achools agree no way to go back with less or no ICT in schools. In addition, all schools perceive ICT to add value to teaching and learning process and add positive impact on students outcomes] [on enablement, it is obvously at a different level as cycle 3 schools are at the early stages of implementation, however thier perceptions are very postivie and supportive to diffuse ICT in schools]
	INN2	Cost	MBRSLP provided resources and services		MBRSLP provided resources and services	= Availability of resources / funding = Sustaining resources = Cost as a motivation (free prog.) = Cost as inhibitor (don't care as it is free...) = Administrative cost = Training cost = Implementation cost = Integration cost = Maintenance cost [in general the views on cost dimension are consistent across cycle 2 school since MBRSLP is taking care of all cost related to providing devices, services, and related admin and training cost. there are no costs incured on schools at all which makes acceptance much more easier and strightforward]	= Availability of resources / funding = Sustaining resources = Cost as a motivation (free prog.) = Cost as inhibitor (don't care as it is free...) = Administrative cost = Training cost = Implementation cost = Integration cost = Maintenance cost [in general the views on cost dimension are consistent across cycle 3 school since MBRSLP is taking care of all costs related to providing devices, services, and related admin and training cost. There are no costs incured on school at all which makes acceptance much more easier and strightforward]
	INN3	Complexity	= System is difficult/easy to understand [medium, several teachers already ICT] = Support given to simplify adoption [training was done but compressed with a lot of other pressure, support team member did help] = Level of intuitiveness / ease of use [medium, most teachers already use ICT] = time to get used to the system [implementation was late so we did not have time to make full use or try everythings] = Training [training was compressed and need more support]	it was late implementation...we did not have yet enough chance to try all the features and options....we have a new curriculum to absorb and deliver to students ...and third semester is always busy one... On training.... They agreed they enjoyed the training ...their view for why it was enjoying included it beneficial and we see value in it...the location and set up was really good (in a 4/5 star hotel with great services), the trainers were qualified and professional,.... They were comparing to MoE trainings which seems to be conducted in less comfortable locations and with less services ...also they assumed MoE trainings as mandatory but no value and waste of time...also trainers are not qualified...	= System is difficult/easy to understand [did not have yet enough chance to try all the features and options, teachers already used tablet and ICT in classroom] = Support given to simplify adoption [training was percevied very positive and valuable, however compressed] = Level of intuitiveness / ease of use [medium, most teachers already use ICT, but did not have enough time to use all feature in practice] = time to get used to the system [implementation was late so we did not have time to make full use or try everythings.] = Training [training was compressed and need more support. also after training we went back to school to try in reality however implementation was not finished yet...by time it finished we did not have chance to practice]	= System is difficult/easy to understand = Support given to simplify adoption = Level of intuitiveness / ease of use = time to get used to the system = Training [on the complexity dimension, in general interviewed cycle 2 schools agree on average to high level ease to understand and use the provided ICT provison. This was regarded to the high level of support given to schools where they had permenant support engineer and weekly adoption team visit to help them with techncial issues and better usage of the system. In addition, the teachers training was percvied as very positive] **Main items**: **ease of use**: avarege good due to high support **teacher training:** very good first 2 years then reduced **support team:** very good first 2 years then reduce since they had to support multiple schools **adoption team:** very good for LMS, with some criticism from some teachers as they forced them to use the company solution even in non-relevent cases. **principles training**: general veiw it was too late. General agreement that SSTF training was very good in terms learning and added value to better undertand smart learning concept and good how good practice look like,thier role and how they can support ongoing improvement f or good practcie across the school. all principles requested demands to expand it to teachers.	= System is difficult/easy to understand = Support given to simplify adoption = Level of intuitiveness / ease of use = time to get used to the system = Training [on the complexity dimension, in general interviewed cycle 3 schools agree that using the provided ICT is not complex especailly most of cycle 3 teachers already use some ICT element in thier teaching, however thier view was that they did not have enough time to make full use of the MBRSLP solution due to the late deplyment, timing of roll-out being in last semester and that this year was a very busy year with several changes impacting core element of the educational experaince like curreculum, assessment and strucutre of school and teachers timing. on the proivded support, it was percevied as below expectaton as schools are aware of the implementation and support provided to cycle2 schools. This is regarded late implementation in during second and third semester, compressed training, no dedicated adoption and support team per school, no digital book provided, and huge pressure schools going through from major changes across the education sector such as curreculum, assessment, school structre, teachers timing, new subjects, and several new changes to cycle3] [on training, teacher training done during second and third semester over extended period of 5 weeks(once a week), this was taken negatvie by teachers as they said (by time they finish training they almost forget what we learned). also teachers hated that they had to go school 8-11 am then go to training center from 12 to 5 pm. on the other hand, teacher were very positive on the training quality, quality of trainers, venue, and planning.] [for principles training, cycle 3 trainers had chance to do professinal development program based on SSTF last year which was considered an advatage compared to late principle training happend in cycle2. on the other hand with the major changes and pressure on cycle 3 principles, some principles said they couldn ot attend and sent thier deputy instead.] **Main items**: **ease of use**: avarege level, however did not have enough time to practice and use **teacher training:** average satisfaction. main issues were compressed training over extended time, in school infrastrucure not ready to practcie right after sessions, teachers under a lot of pressure with several initiatives were some are mandatory and smart learning is not
Innovation characteristics	INN4	Compatibility	= Compatible with work aspects [high in general] = Consistent with existing values [high in general] = Consistent with existing needs [medium, they had higher expectations in term of digital content and apps, also they compared to support given to cycle 2 was more] = Consistent with existing experience of adopters [high, most teachers already have laptops] = Fitting with way I like to work / work style [yes] = Naming and positioning the innovation (national agenda, MBRSLP, mGov,..) [yes] [in general the deplyment of ICT in general quite recent and school did not have time to absorb this with all other changes and timing challenge, the school expected more based on what they heared on the program]	On their views on students perceptions...students were expecting MBRSLP implementation with a lot of excitement ....they were eager to get the new tablets....to be smart school...however since it was late and not much applications and no e-books it came below their expectations...	= Compatible with work aspects [high in general] = Consistent with existing values [high in general] = Consistent with existing needs [medium, they had higher expectations in term of digital content and apps, also they compared to support given to cycle 2 was more] = Consistent with existing experience of adopters [high, most teachers already have laptops] = Fitting with way I like to work / work style [yes] = Naming and positioning the innovation (national agenda, MBRSLP, mGov,..) [yes] [in general the deplyment of ICT in general quite recent and school did not have time to absorb this with all other changes and timing challenge, the school expected more based on what they heared on the program]	= Compatible with work aspects = Consistent with existing values = Consistent with existing needs = Consistent with existing experience of adopters = Fitting with way I like to work / work style = Naming and positioning the innovation (national agenda, MBRSLP, mGov,..) [in general, cycle 2 schools percevied the privded ICT innovations from MBRSLP initiative as highly compatible with existing needs, values, to be work style. this was regarded to general direction of UAE toward ICT adoption and smart services, smart government. the prevouse state laking consistent and strong ICT infrastucture and resource across all schools, made the MBRSLP initiative highly compatible with values and needs of the school sector in UAE.] [on the other hand, the limited ICT skillsand experaince across a large proportion of school teachers made the offering less compatible with thier experaince, however this is the actual change that need to take place and after three years a very positive outcomes resulted where as per teachers and principles ICT is now part of thier daily life style and they cannot go back with no ICT] [finally name and positioning of the MBRSLP initiative as a change program was percevied as a key driver making it compatible with values and work aspects. naming the program under HH MBR reflected his highness suport for this change and teachers adopted this vision]	= Compatible with work aspects = Consistent with existing values = Consistent with existing needs = Consistent with existing experience of adopters = Fitting with way I like to work / work style = Naming and positioning the innovation (national agenda, MBRSLP, mGov,..) [in general, cycle 3 schools percevied the provided ICT innovations from MBRSLP initiative as compatible with existing needs, values, to be work style. this was regarded to general direction of UAE toward ICT adoption and smart services, smart government. The prevouse state laking consistent and strong ICT infrastucture and resource across all schools, made the MBRSLP initiative highly compatible with values and needs of the school sector in UAE. however due to the issues faced with cycle 3 /G10 deplyment including late deplyment, no digital content, school less support (adoption, support team), unstable year due to several core changes in curreculum, school strcutre, teachers schedule leading high pressure on schools and teachers, lead to some to concieve compatability below expectation especailly when they compared thier situation with cycle 2 schools] [on the other hand, cycle 3 schools seem to have more ICT skills and experaince compared to cycle 2 school at the start phase, this was regarded to the fact that it is 3 years after lunacing the MBRSLP program and schools started to adopt ICT as the ICT use culture spreading across UAE schools. in addition, MAG school which one main initiatives in prevouse years introduced ICT to some cycle 3 schools. That said, cycle 3 schools had limited infrasture and resources and usage was mainly on ad-hoc and by personaly efforts (no consistneyc across schools). the schools percvied MBRSLP ICT offering as compatible with thier needs and aims to cope with the smart government directions by provided strong infrasture and resources to all schools.

Dimensions mapping themes | school-Interview-mapping themes | school-Interviews-DICT analysis | Sheet1

Appendix D: DSM Matrix development for stakeholder's interaction over project activities and years of deployment

Pilot deployment

	stakeholders involvement over rollout phases and main activities?	activities	establish joint committees	develop smart learning concept	Identify Stakeholders and Key Partners	Develop pilot Project Charter	pilot schools selection	vendors and partners engagement	Develop time plan	Develop procurement and budget plans	Conduct procurement and awarding	Oversee performed Work	Manage stakeholders engagement	Oversee Roll-out performance	Validate performed scope	continouse engagement and feedback from stakeholder	pilot Closure and recommendations reports
			Pilot Phase														
			initiation				planning				execution			Monitoring & Controlling			closing
	stakeholders	code	i1	i2	i3	i4	p1	p2	p3	p4	e1	e2	e3	m1	m2	m3	c1
school level	students	s1	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0
	teachers	s2	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0
	principals	s3	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0
MoE level - federal	MOE top management	s4	1	1	1	0	0	0	0	0	0	0	1	1	0	1	1
	MOE middle management	s5	1	1	1	1	1	0	0	0	0	0	1	1	0	1	1
	MOE operational teams	s6	0	1	0	1	1	0	0	0	0	0	1	0	0	1	0
	MOE IT Dept	s7	1	1	1	1	1	1	1	0	0	0	1	0	0	1	1
	cluster managers	s8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
local level	Education zone management	s9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Education council management	s10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Key stakeholders outside public	Parents	s11	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0
	Prime Minister Office	s12	1	1	1	1	0	0	0	0	0	0	1	0	0	1	1
	Telecom Regulatory Authority	s13	1	1	1	1	0	0	0	1	1	0	1	0	0	1	1
MBRSLP inter-organizational key stakeholders	other Gov entities (ministry of infra, ministry of interior, ..)	s14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Connectivity Services Provider (Etisalat	s15	0	0	0	0	0	1	0	0	1	1	1	0	0	1	0
	MBRSLP Higher committee members	s16	1	1	1	1	1	0	0	0	1	1	1	0	1	1	1
	MBRSLP Executive committee member	s17	1	1	1	1	1	1	0	0	1	1	1	1	0	1	1
	MBRSLP Senior Management Team	s18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MBRSLP operational team members	s19	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MBRSLP expert advisors	s20	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MBRSLP partners/vendors	s21	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1
	Support Team	s22	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0
	Adoption Team	s23	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0

Year 1 deployment

			Roll-out 1 (2013-14) project cycles															
			initiation				planning				execution			Monitoring & Controlling			closing	
	stakeholders involvement over rollout phases and main activities?	project lifecycle phases activities	Develop Statement of Work	Develop Business Case	Identify Stakeholders and Key Partners	Develop Project Charter	Develop detailed Requirements	Define Roll-out Scope	Develop ,time plan	Develop procurement and budget plans	Conduct procurement and awarding	Oversee Roll-out performed Work	Manage stakeholders engagement	Oversee Roll-out performance	Validate performed scope	Monitor Roll-out Risks and outcomes	Operation and Support Handover	Roll-out Closure reports
	stakeholders	code	1i1	1i2	1i3	1i4	1p1	1p2	1p3	1p4	1e1	1e2	1e3	1m1	1m2	1m3	1c1	1c2
school level	students	s1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	teachers	s2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	principals	s3	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	1
MoE level - federal	MOE top management	s4	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0
	MOE middle management	s5	1	1	0	0	0	1	1	0	0	1	1	0	1	0	0	0
	MOE operational teams	s6	1	0	0	0	0	1	1	0	0	1	1	0	1	0	0	0
	MOE IT Dept	s7	1	1	1	0	1	1	1	0	0	0	1	0	1	0	0	1
	cluster managers	s8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
local level	Education zone management	s9	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	Education council management	s10	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Key stakeholders outside	Parents	s11	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	Prime Minister Office	s12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Telecom Regulatory Authority	s13	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1
MBRSLP inter-organizational key stakeholders	other Gov entities (ministry of infra, ministry of interior, ..)	s14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Connectivity Services Provider (Etisalat	s15	0	1	0	0	0	0	0	0	1	0	1	0	1	0	1	1
	MBRSLP Higher committee members	s16	1	1	0	1	0	1	0	1	1	1	1	1	1	1	0	1
	MBRSLP Executive committee member	s17	1	1	0	1	0	1	0	1	1	1	1	1	1	1	0	1
	MBRSLP Senior Management Team	s18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MBRSLP operational team members	s19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MBRSLP expert advisors	s20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MBRSLP partners/vendors	s21	0	0	0	0	0	0	0	0	1	0	1	0	1	1	1	1
	Support Team	s22	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0
	Adoption Team	s23	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0

Year 2 deployment

				Roll-out 2 (2014-15) project cycles																		
2				initiation			planning					execution				Monitoring & Controlling				closing		
3		stakeholders involvement over rollout phases and main activities?	project lifecycle phases activities	Update and confirm Business Case for Roll-out	Re-confirm Stakeholders and Key Partners	Develop Roll-out Initiation Document (PID)	Scoping & roll-out Approach	roll-out Planning & Scheduling	Stakeholders Engagement Planning and communi	Procurement Planning	Identify Risks & Mitigations Plans	Conduct procurement and awarding	Oversee Roll-out performed Work	Manage Vendors at different work streams	Manage Stakeholders and perform communication activities	Monitor & Control work streams	Validate & Control Scope (in regards to vendors delivery	Control Master Schedule (overall roll-out details include	Control Stakeholders (manage expection in regards	Roll-out Handover to Operation	Roll-out Closure reports	Lessons Learned & Closure Report
4		stakeholders	code	2i1	2i2	2i3	2p1	2p2	2p3	2p4	2p5	2e1	2e2	2e3	2e4	2m1	2m2	2m3	2m4	2c1	2c2	2c3
5	school level	students	s1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
6		teachers	s2	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0
7		principals	s3	1	1	0	1	1	1	0	0	0	1	0	1	0	1	0	1	0	0	1
8	MoE level - federal	MOE top management	s4	1	1	0	1	1	1	0	0	0	0	0	1	0	0	0	1	0	0	0
9		MOE middle management	s5	1	1	0	1	1	1	0	0	0	1	0	1	1	1	0	1	0	0	0
10		MOE operational teams	s6	0	0	0	1	1	1	0	0	0	1	0	1	1	1	0	1	0	0	1
11		MOE IT Dept	s7	0	0	1	0	1	1	0	1	0	0	0	1	0	1	1	1	1	1	1
12		cluster managers	s8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	local level	Education zone management	s9	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
14		Education council management	s10	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
15	Key stakeholders outside	Parents	s11	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0
16		Prime Minister Office	s12	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0
17		Telecom Regulatory Authority	s13	1	0	0	1	1	0	1	0	1	0	0	1	0	0	0	0	0	1	0
18	MBRSLP inter-organizational key stakeholders	other Gov entities (ministry of infra, ministry of interior, ..)	s14	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
19		onnectivity Services Provider (Etisala	s15	0	0	0	1	1	1	0	0	0	0	0	1	0	1	0	1	1	0	1
20		MBRSLP Higher committee members	s16	1	1	1	1	1	1	1	1	1	1	0	1	0	1	0	1	1	0	0
21		BRSLP Executive committee membe	s17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0
22		MBRSLP Senior Management Team	s18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
23		MBRSLP operational team members	s19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24		MBRSLP expert advisors	s20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
25		MBRSLP partners/vendors	s21	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1
26		Support Team	s22	1	0	0	0	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1
27		Adoption Team	s23	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	1	0	1	1

Year 3 deployment

Roll-out 3 (2015-16) project cycles

stakeholders involvement over rollout phases and main activities?

		project lifecycle phases	initiation			planning						execution			Monitoring & Controlling				closing			
		activities	Update and confirm Business Case for Roll-out	Re-confirm Stakeholders and Key Partners	Develop Roll-out Initiation Document (PID)	Scoping & roll-out Approach	roll-out Planning & Scheduling (Master Planning)	Resource Planning & Assignments	Identify Risks & Mitigations Plans	Procurement Planning & Budget Allocati	Stakeholders Engagement Planning and	Conduct procurement and awarding	Manage Teams & Vendors at different work	Manage Stakeholders and perform communication	Monitor & Control work streams	Validate & Control Scope (in regards to vendors delivery	Control Master Schedule (overall roll-out details	Control Stakeholders (manage expectio	Roll-out Handover to Operation	Roll-out Closure reports	Lessons Learned & Closure Report	Document Roll-out Best practices
	stakeholders	code	3i1	3i2	3i3	3p1	3p2	3p3	3p4	3p5	3p6	3e1	3e2	3e3	3m1	3m2	3m3	3m4	3c1	3c2	3c3	3c4
school level	students	s1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
	teachers	s2	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0
	principals	s3	0	0	0	1	1	0	0	0	1	0	0	1	0	1	0	1	0	0	1	1
MoE level - federal	MOE top management	s4	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	0	0
	MOE middle management	s5	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MOE operational teams	s6	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
	MOE IT Dept	s7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	cluster managers	s8	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
local level	Education zone management	s9	0	0	0	0	0	0		0	0	0	0	1	0	0	0	0	0	0	0	0
	Education council management	s10	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Key stakeholders outside	Parents	s11	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0
	Prime Minister Office	s12	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
	Telecom Regulatory Authority	s13	1	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	1	0	0
MBRSLP inter-organizational key stakeholders	other Gov entities (ministry of infra, ministry of interior, ..)	s14	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
	Connectivity Services Provider (Etisalat	s15	0	0	0	1	1	0	0	0	1	0	0	1	0	1	1	1	1	0	1	1
	MBRSLP Higher committee members	s16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
	MBRSLP Executive committee member	s17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
	MBRSLP Senior Management Team	s18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
	MBRSLP operational team members	s19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MBRSLP expert advisors	s20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MBRSLP partners/vendors	s21	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
	Support Team	s22	0	0	0	1	1	1	1	0	1	0	1	1	0	1	1	1	1	1	1	1
	Adoption Team	s23	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	1	0	1	1	1