# Social Adoption of Innovation

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# Table of Contents

# Table of Figures

# Personal Statement

I certify that the research presented in this thesis is my original work and has not been submitted as part of the requirements for a higher degree to any other university or institution other than Macquarie University. I also certify that any assistance that I have received in the conducting of this research and the preparation of the thesis has been appropriately acknowledged. Additionally, I certify that all the information sources and literature used in this thesis are indicated. The research presented in this thesis was approved by the *Faculty of Human Sciences Human Research Ethics Sub-Committee* at Macquarie University, Sydney, Australia (**5201200313**) on 22nd March 2017.

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# Abstract

Successful adoption of innovation is critical to organisations' ability to improve their performance, and produce better outcomes. As organisations are under increased pressure to adapt to changing conditions due to disruptive innovations, shifts in sociocultural patterns and public expectations, they need to use a strategic approach based on a deeper understanding of the adoption of innovation process.

This interdisciplinary research project aims to identify the main factors that influence the process of adoption of innovation and propose a theoretical model that could later be used by organisations and individuals to take a more effective approach to adoption of innovations. In order to achieve these objectives, several studies have been conducted using a mixed research design that combines qualitative and quantitative research methodologies.

In the first two studies, an extensive literature review covering over one hundred years was conducted to establish the genesis and the main characteristics of the current thinking on adoption of innovation, followed by an in-depth analysis of reported experiences related to adoption of online Learning Design technologies in education. The literature review identified a strong marketing bias in the current dominant model of adoption of innovation, which is mostly designed to address innovators' concern around how to accelerate the adoption of their innovations by a large number of users, but with little insight into adopters' motivations and needs. The second study identified patterns of adoption challenges in a variety of organisational and individual settings and across a wide range of educational jurisdictions in Australia and overseas.

The results of these two studies have been used to create a new theoretical model of social adoption of innovation. The proposed model builds on the existing thinking on adoption of innovation, but with a new perspective. The fundamental hypothesis of this model is that adoption takes place in the context of three dimensions: social, cognitive and professional development. The model was named "social adoption of innovation" to reflect the observation that the social dimension has the strongest influence of the three. The model considers the challenges of finding information, understanding information and knowledge needs, overcoming cognitive obstacles, and acquiring professional skills, all of which are critical to the decision to adopt an innovation. The social adoption of innovation model offers an individual adopter's perspective, in contrast to the current thinking which is mostly a marketing model representing the interest of the innovator.

The third study examines the role of social connections in academic research based on analysis of references mentioned in research publications within the field of Learning Design. The study uses over eleven thousand links to generate several network graphs representing links between authors based on publication references using a method inspired by the field of social networks. The following in-depth research of the background history behind a selection of clustered links revealed a strong influence of the social connections on the selection of topics, adoption of ideas, emerging leadership and new fields of research.

The fourth study is based on an interview conducted at a large metropolitan university with the participation of academic, research and other professional staff to enquire into personal experiences in the adoption of innovation at various stages of adoption. This study uses a combination of qualitative and quantitative methods to analyse the influence of the factors predicated by the social adoption of innovation theoretical model. The findings of the study confirm the strong influence of social factors on the way innovations are discovered, communicated, understood, learned, and adopted. The qualitative analysis also revealed unexpected aspects that could be considered in future research studies.

The overall findings of this project support the model of social adoption of innovation. In contrast to the mainstream thinking based on the model of diffusion of innovation, the social adoption of innovation model emphasises the individual perspective, placing individual concerns at the centre of the adoption of innovation process. This research project found that individual motivation, personal and professional needs, knowledge behaviour, and social relationships have a significant impact on the process of adoption of innovation. Moreover, the individual can display different behaviours depending on the innovation being adopted and the stage of adoption, regardless of the application domain. This research found that adoption of innovation in early stages is associated with concurrent innovation: individuals innovate with innovations that are at an early stage. In addition, the study found that communities of practice are essential to innovation and adoption of innovation at early stages, more than the ubiquitous digital social networks. The Findings and Discussions chapters describe the ramifications of these findings, potential risks posed by social networks and new technologies that can have a high social impact, and consider new approaches to education and adoption of innovation in institutions.

# Chapter 1 Introduction

## Background

Education, like many other sectors, is facing the challenge of adopting new technologies not only to improve its *modus operandi*, but also to find new ways of teaching and learning. The adoption of technology in education occurs not only to be in step with the times, but also to explore pioneering projects that can provide guidance and support for advanced leadership. What sets education apart from other sectors when it comes to the challenge of adopting new technology is its organisational and cultural structures: a large, slow moving institutional base, coupled with nimbler individual organisations and people that make up the educational system that are under pressure to respond faster relative to the large system. There is the local autonomous organisation responsible to its immediate stakeholders for its actions and there is the large institution that has a different set of priorities and control strategies. The smallest part of the systems, the educators, often have to negotiate the conflict between personal and professional desires to adopt new methods and technologies and the required submission to the larger standard imposing imperative.

Adopting new technologies that satisfy both ends of the organisational spectrum in education is extremely challenging and the difference between success and failure can be costly in a significant way. Often, the adoption of technological innovation in education systems is associated with large top-down initiatives that are complex and take time to implement. Because of the size of these initiatives they capture the attention of decision makers, market participants and the public, while local initiatives conducted by dedicated individuals and small groups go largely unnoticed, even though they may have a large cumulated effect. Importantly, a thorough study of the adoption of innovation in education must consider both ends of the organisational spectrum.

As an active participant in one of the largest technology initiatives in Australia, the Learning Management and Business Reform program in NSW, I have experienced firsthand the challenges posed by adoption of technology in a large education system. This program started in 2006 and went far beyond the budget and timeframe initially planned. Criticism of the program at its final stage of implementation was still focused entirely on the technical and management aspects (Robertson, 2016), ignoring organisational and human behaviours that might have had an impact on the outcome. Organisational cultural issues evident at early stages of the program contributed to major issues resulting in costly adjustments (Bagshaw, 2016) and yet, in the end, the need for these adjustments was attributed solely to technical problems.

Many individual teachers actively dedicate their own time and effort to finding new ways to improve educational outcomes that go far beyond what is required by the system. Despite this, teachers' passion is often not fully utilised or recognised when new technologies are considered for adoption at system level. Does it matter if individuals are more or less inclined to adopt newly proposed solutions whether they like them or not?

While at Macquarie University I became familiar with LAMS, a Learning Design software aimed at helping teachers to design the learning process. This software had over five thousand registered users by 2011 across multiple countries. What was interesting was the

uneven distribution of users across systems, with a few clusters of large numbers of users grouped around institutions. Why was the software adopted in those institutions and not others? I was fascinated by that question, and given my earlier professional experience in the school system, and my personal interest on how we adapt to changing conditions and adopt new ways of thinking, I decided to pursue in-depth research into this phenomenon.

## Problem Statement

The current perspective on adoption of innovation is dominated by the concern about how to spread innovations as fast and as far as possible. Thus, the main preoccupation is how to find adopters, and how to help them adopt a product in large numbers. The process of adoption is seen as a product distribution leading to benefits and/or profit. Research work on innovation specifically aimed at education falls into the same solution pattern, resulting in recommendations on how systems should spend more money on technology, carefully allocate funds to selected projects and manage them efficiently to improve adoption rates (Christensen, Horn, & Johnson, 2008).

The problem with this approach is that it serves almost entirely a sales and marketing directive in a rather indistinct way. The tendency is to treat adoption using the law of large numbers to determine adoption stages using the diffusion of innovation model (Rogers, 1995) largely without considering differences between the types of innovations from the adopters' perspective. The current focus is on determining how the disseminator of innovation can improve the rate of successful adoption, and not on understanding how end-users should successfully adopt a product, a system or an idea that is most suitable to their particular interest or need. This is a problem because it offers little or no strategic and tactical support to adopters of innovation.

## Purpose Statement

The purpose of this study is to understand the fundamental factors that influence the adoption of innovation from the adopters' perspective. As explained in the problem statement above, this is a perspective that I believe needs more research to better understand the adoption of innovation and ultimately to provide a thinking framework that could assist those who want to improve this process in their respective organisations.

This study aims to understand the user's perspective on adoption of innovation from an individual point of view and reflect on implications for institutions that invest in technological innovations to adapt to a rapid changing socio-economic landscape.

Additionally, the study will propose and test a theoretical model that can be used to design a systematic approach to adoption of new technologies in education. On the basis of this model, the study will make recommendations that can be used in practice by educational systems in their efforts to adopt new technologies that teachers and students can benefit from in a more effective manner.

## Research Questions

The main research question: what are the major factors that influence the process of adoption of innovation at an individual and institutional level? This research tries to narrow this question to the context of education and frame it from the perspective of educators

and their institutions. Subordinate questions could be derived from the main question: What is the impact of the maturity of the innovation being adopted on the way users adopt it? This is a question highlights the importance of the user's personal experience and perception of what is being adopted: what is the norm in one field could be an innovation in another. Furthermore, are there different ways in which users view and experience the adoption process depending on their interest, social connections, and skills?

The second research question: from the perspective of an educational institution, could the factors that influence the adoption of innovation, as identified in this research project, be modelled into a theoretical framework that can be used as a decision tool to decide on the most effective way to explore new technologies? This would be a tool that institutions could use to decide on innovative experiments, pilot projects, or the implementation of organisation-wide programs that generate improvements with the most positive impact, minimum cost and disruption.

Sub-question to the second question: how to use a better understanding of the experience of adoption of innovation to help teachers, researchers, professors and students deal with the challenge of adopting new technologies in their respective professional fields.

## Conceptual Framework

This research has been driven by two divergent strategies: one with a narrow and disciplined focus as defined by its purpose and targeted research questions and one of spontaneous and unplanned research instigated by a combination of need and curiosity. While staying focused and disciplined was important to delivering on the initial objectives, the two strategies have been used in equal measure throughout the entire project, from beginning to end.

It was necessary to stay focused, but also to follow the threads of inspired ideas, given the broad spectrum of issues related to the subject. The diagram below represents the main areas of research and the adjacent domains that I travelled during this project (see Figure 1 – Conceptual Exploration Map).

The literature review study was heavily tilted towards the study of prior mainstream research on adoption of innovation: diffusion of innovation and its adjacent domains (sociology, anthropology, marketing, economics, behavioural economics, the nudge theory), entrepreneurship (democratisation of innovation). During this review study, I felt it was necessary to get more clarity in understanding the thinking on innovation from a business perspective (innovation business models, intellectual property), and get a deeper understanding of disruptive innovations (disruptive innovation, adoption of technology in education).

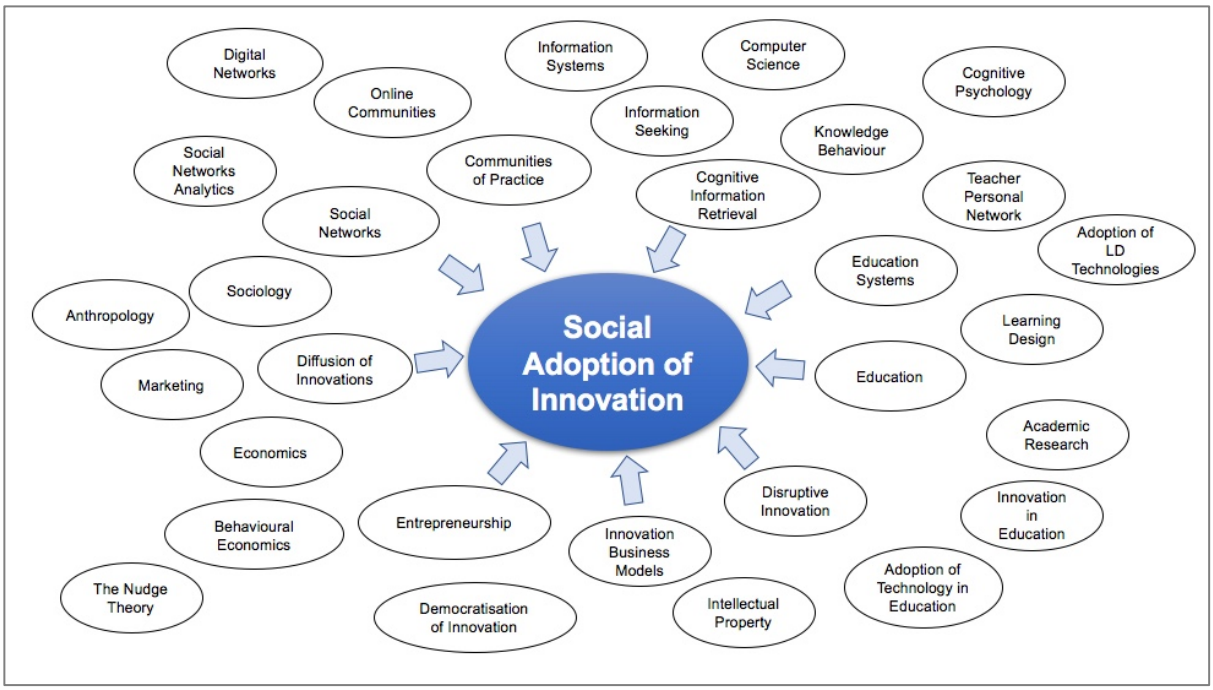


*Figure 1 Conceptual Exploration Map*

In parallel, I extensively studied the area of education and adoption of innovation in education. One of my research studies was entirely focused on reported issues on adoption of learning design, and learning design technologies (see Chapter 4 Multidimensional Adoption Patterns in Learning Design). This study was fundamental in the conception of the Social Adoption of Innovation theoretical model. In addition, during this project, I worked with a group of academic researchers on the definition of Learning Design as a distinct field in education and contributed as one of the founding signatories of the Larnaca Declaration (Dalziel et al., 2013).

The research on factors related to the three dimensions of the adoption of innovation led to an in-depth study of cognitive information retrieval theory and fields associated with knowledge behaviour and information seeking (information systems, computer science, cognitive psychology, and knowledge management) (see Chapter 5, Theoretical Model of Social Adoption of Innovation). Further, I extended the research into the study of communities of practice, online communities, social networks and social networks analytics and mathematical modelling of structures and influence. The following data collection research study on social influence in academic research was designed based on ideas inspired during this broad exploratory journey (see Chapter 6 Social Influence in Academic Research).

Finally, the interview study in higher education was designed based on the theoretical model of Social Adoption of Innovation and revisiting the findings that resulted during the literature review on adoption of innovation (see Chapter 7 Adoption of Innovation in Higher Education).

The writing of the discussion chapter involved the discoveries in the above-mentioned domains of research plus further (and limited) study of adjacent areas in arts history, social media, internet of things and artificial intelligence.

## Definitions of Key Terminology

Each chapter has an introductory subsection with definitions of key terminology. Throughout the dissertation there are a few terms that are key to this research and that have a special importance in the proposed theory. The nuances of these terms are specific to this research.

**Information Behaviour**: the sum of all activities that are part of the process of acquisition and use of information (Ford, 2005). These activities may lead to the transformation of information into knowledge. The main components of information behaviour are information seeking and information encountering.

**Knowledge Behaviour**: the sum of activities that are part of the process of evaluation of knowledge need and information behaviour (Ford, 2005).

**Skill**: used here as cognitive skill; when developed in the context of a professional practice it becomes a specialist skill strongly linked to the specific knowledge domain. Skill has levels of maturity (Dreyfus, 2004), each level of maturity adding a capacity to act with greater speed and accuracy, an aspect often ignored in the appreciation of the importance of practice and experience (Benner, 2004) (see Chapter 5, The Theoretical Model of Social Adoption of Innovation).

**Cognitive Space**: a context that captures the motivation and concerns of the user (Ingwersen, 1996). This is a virtual space in which user behaviour is seen as a more complex process in which the information seeker learns and adapts as result of the evaluation of the information needs and the influence of social, institutional and broader economic factors.

Terms created during this project (see Chapter 5, The Theoretical Model of Social Adoption of innovation):

**Social Space**: a virtual space made up of traditional face-to-face social structure and large social structures operating on the back of large and sophisticated computer networks, being simultaneously social communication gateways and generators of factual data feeding into the Information Space.

**Innovation Space**: concept of a virtual space containing both material and virtual elements with no precise boundaries. This space is a collection of everything that produces factual data, including sources that are independent of human activity. The Innovation Space is the overarching context in which the cycle of knowledge generation occurs. This is where innovators and adopters of innovation contribute to the creation of knowledge, playing simultaneously the roles of users of information and creators of knowledge.

**Information Space**: virtual space containing information systems, authoring agents, the collection of all semantic objects created by the authoring agents who/that interpret factual

data, and interfaces that allow humans to make enquiries as part of their information seeking process.

**General Knowledge Behaviour Equation**: a symbolic equation that shows that structural change of knowledge is equal to the change affecting current knowledge caused by the application of current skills and newly learned skills during the processing of information acquired for the purpose of achieving a goal.

**Information Seeking Skills Gap Equation**: a symbolic equation showing that a user adopting an innovation requires the development of information seeking skills across all three components: information systems seeking skill, social information seeking skill and professional (relevant to the work-task or domain of interest) information seeking skill.

**Synthetic Social Networks**: Synthetic Social Network is an amalgamation of networks resulting from the combination of the Internet of Things and Artificial Intelligence systems.

## Organisation of the Dissertation

The overall research project occurred between 2011 and 2018. The dissertation contains chapters on literature review, three data collection studies, one theoretical study, findings, discussion and conclusions. As some of the chapters (Chapter 4, Chapter 5 and Chapter 6) are presented in the same form they were published, it is appropriate that I give a historical account of the research journey and explain how the components fit together around the purpose of this project.

I have conducted the research combining a view informed by theoretical knowledge acquired directly through literature review, academic and professional relationships and a pragmatic view informed by the necessity to produce solutions that address the research question. This meant that while I constantly browsed purposefully the literature review to clarify my understanding of certain ideas, or simply follow the trail of concepts following the reference breadcrumbs, I participated to conferences, developed intermediate models and published conference papers and a peer review article in a well-recognised journal. How does all fit together? To address this question, I will provide a brief history below and explain later the relationships between studies from a design perspective in Chapter 3 Research Design. The details regarding the methodology and how the research studies are linked together to answer the research questions are discussed in the Methodology, Data Collections, Analysis and Representation and Limitation sections in Chapter 3.

The first output was generated by an initial foundation literature review. As my work brought me closer to the field of Learning Design, having the opportunity to present a paper on the adoption of LAMS, an online Learning Design software, I did the first study (Study 1, see Figure 2 Exploratory Design Stages) by collecting data from research publications focused on this topic (Badilescu-Buga, 2011). This study had a significant influence on the rest of the project because it brought to my attention the importance of the social and cognitive dimensions on the adoption of innovation. This study helped me flesh out the first model which opened up new and interesting perspectives.

The next period, I was involved in collaborative work on Learning Design which led to my participation, as a member of a group of researchers and academics from Australia and UK, to the development and publication of the Larnaca Declaration on Learning Design (Dalziel et al., 2013). This was a period of accumulation of knowledge through extensive literature review and development of a model for social adoption of innovation. The exposure to Learning Design was very useful because a key aspect of this concept is the sharing of lesson designs which in itself is a form of social act. This is one of the reasons why Learning Design is present in my first studies. However, as the research questions are not limited to this particular field of educational technology, I explored other related fields guided by each discovery I came across in this period. The main goal of the research effort at the time was to develop an extended theoretical model that I thought was necessary before undertaking any other data collection study. This model presents a unified view of the adoption phenomenon grouped around the idea of adoption of innovation influence by three dimensions of factors: social, cognitive and professional. A systematic research on the manifestation of each dimension, previous work on these topics led me to the exploration of other related fields. The result of this work (Study 2, see Figure 2 Exploratory Design Stages) is a paper published in the Information Processing and Management Journal (Badilescu-Buga, 2013).

The next study was based on an idea of testing the influence of social dimension using a quantitative research method: if it is true that social connections are an influential factor in the adoption of new ideas, then if we examine the connections represented through publications, the connections with a higher frequency should be more likely to indicate the presence of social connections between the corresponding authors. To test this hypothesis, I designed and developed a software application using Access database to automate the parsing of bibliographic text from electronic research articles. Because I was familiar with the field of Learning Design I used related publications from around 90 authors to generate a database with over 11,000 entries representing the citations. The results of the analysis of the social networks built on these citations and the verification of the existence of social relationships as indicated by these networks, were published as a chapter in a book on Learning Design published by Routledge (Dalziel, 2015). The findings were startling. In most of the cases, the size of the links between authors were reflecting strong social connections going back in time over many years. Other findings are discussed in Chapter 6 which replicates the published article.

The final study is based on qualitative research. It aimed to test the influence of the social, cognitive and professional dimensions on the adoption of innovation in a higher education institution (Study 4, see Figure 2 Exploratory Design Stages, Chapter 3). This is an interview study with questions designed based on the theoretical model produced by Study 2. The questionnaire was designed to capture personal experiences of adoption of innovation at all adoption stages by respondents with a variety of professional backgrounds working in a higher education institution. In the same time, the interview was open to any type of innovation: software, hardware, life style habits, ideas, concepts. The process of data structuring, coding and analysis was thought to match the theoretical model, but in the same time allow for the capture of any unexpected findings (see Chapter 7).

The last two studies are quite different from each other, not only from the perspective of their desired objective, but also from a methodological perspective. The unifying factor is Study 2, the theoretical model, and this is how the two studies should be considered. I provide further explanations in Chapter 3 in the Methodology and Approach sections. The presentation of overall findings (see Chapter 8) and discussion (see Chapter 9) integrates the findings of individual studies. Given the timing and the history of the project there are observable changes in style, although the pursuit of finding solutions to the proposed research questions remained unchanged.

The dissertation has the following chapters:

- Chapter 2: Literature Review, a study of the history of research into adoption of innovation
- Chapter 3: Research Design, detailing the methodologies used in this research
- Chapter 4: Multidimensional Patterns of Adoption of Innovation, a study of reported issues in the adoption of Learning Design technologies in educational institutions in Australia and overseas (published article).
- Chapter 5: Theoretical Model of Social Adoption of Innovation, a proposed social adoption of innovation theory (published article).
- Chapter 6: Social Influence in Academic Research, an analytical study of relationships between authors based on the references contained in their publications, using social networks representation and analytical tools (published article).
- Chapter 7: Adoption of Innovation in Higher Education, an interview study aimed at capturing individual experiences across all stages of adoption of innovation
- Chapter 8: Findings, integrated findings evaluation against the initial research questions.
- Chapter 9: Discussion, identifying bias, limitations, originality, and future directions of research
- Chapter 10: Conclusion

# Chapter 2 Literature Review


## Abstract

This chapter explores the published work on adoption of innovation, attempting to create an inventory of ideas, concepts and theoretical constructs, analyse and discuss them and present a rationale for the need for an expanded contribution that is the basis of this research project.


## Introduction

The key purpose of this chapter is to do a broad sweep of the literature dedicated to the adoption of innovation, identify the predominant concepts, and discuss their merits and critically assess potential areas for improvement. The review will also cover conceptual thinking regarding the process of innovation, transmission of ideas and influence in general, and related research work in education.

The domain is vast and can easily be expanded to a large amount of literature, which would be virtually impossible and certainly impractical to consider. Consequently, this chapter is designed to focus on some of the most referenced work in this field, relevant to the original research questions that are the basis of the larger research project: (i) what are the factors that have major influence on the adoption of innovation, and (ii) can we develop a framework that can assist institutions and individuals in general to adopt innovation more effectively, and educational institutions and individuals in particular. Literature that addresses issues related to change management and the implementation of innovation is out of scope and is not included in this review.

The history of the study of adoption of innovation is an amalgamation of schools of thought that have arisen within various traditions driven by curiosity, scientific interest and the need to understand how innovations spread. In addition, from the start I decided that this study would not be limited to adoption of innovation, but extended to understanding how innovations are made, as they are intrinsically inter-related. This may be less obvious when reviewing literature and trends that occurred a century ago, but more recently linking the two is a necessity.

The broad strategy for the organisation of the review process was driven by the problem statement (see Chapter 1, Introduction). In essence, the review will identify, analyse and discuss publications that facilitate a better understanding of the spread of innovation, the role of personal needs and interest in adoption of innovation, aspects of technological innovation, education, and broader concepts related to socio-economic needs that drive institutions and individuals to adopt innovation. As the research questions put the emphasis on the individual and institutional adopters' view of the world, the literature review is open to the investigation of cultural and psychological factors as processes that have an impact on adoption.

The literature review that follows is structured chronologically and grouped around major emerging patterns of interests and socio-economic needs, as this offered a clear alignment with the original research questions of this study.

## Early Days: Adoption as Social Imitation

One of the first published authors who observed the adoption of innovation as a notable social process was Gabriel Tarde. Tarde was one of the influential figures who led to the formation of sociology and social psychology as fields of study. He made his observations about adoption of innovations based on legal cases he came across during his career as a lawyer and judge, and later through his expanded research on history, spread of civilisations and language. The key element of his proposed generalisation was that innovations are transmitted following the "laws of imitation" (Tarde, 1903), a broad concept of evolution through replication, extension through imitation and counter-imitation. In his view, the adoption of innovation (Tarde refers to innovation as "invention") is an eminently social phenomenon.

Relying on statistics as a method of analysis, Tarde (1903)remarked how discoveries are being made and spread: "A slow advance in the beginning, followed by rapid and uniformly accelerated progress, followed again by progress that continues to slacken until it finally stops: these, then are the three ages of those real social beings which I call inventions and discoveries"(p. 127). The three stages are strikingly similar to the stages of innovators and early adopters, early majority, and late majority and laggards in modern terminology (see Diffusion of Innovations section). It is also worth noting an interesting observation that Tarde made in relation to the propagation of inventions: it is habits and convictions that hinder the progress of new ideas, as enemies of imitation and spread of inventions and discoveries ("every desire or belief [to imitate] has first to toil through a network of contrary habits or convictions") (p. 126).

In essence, the adoption of innovation, and through extension the process of innovation itself, is a social process which is seen as a driving force largely controlled by the upper class. In Tarde's view (1903), there are no technological tensions or economic imperatives, merely a social imitation from one class to another in which "all kinds of new and unforeseen things flowed out from, the class that governs, from the discoveries, and that among the class that is governed, the copyist, the things that are foreseen (which start, however, from the unforeseen) spread themselves out more and more uniformly and monotonously" (p. 138). Because the innovation is adopted as a limited social imitation process, Tarde erroneously concludes that in the future invention will become very rare.

Despite its limitations, adoption theory based on the "laws of imitation" has the merit of highlighting the role of social connections and the importance of data collection and statistical analysis as an objective way of measuring the rate of adoption (see Sociocultural Diffusion of Innovation section below).

Early anthropological studies looked into the phenomenon of diffusion of culture through social processes. Kroeber proposed the term "stimulus diffusion" to describe the conscious transmission of specific content belonging to an influential external culture (Kroeber, 1940). One of his examples, the adoption of porcelain manufacturing technology in Europe in the

eighteenth century, has a reasoning similar to elements of Roger's theory of diffusion of innovation (Rogers, 2003). In this case, the diffusion was triggered by a conscious decision to discover kaolin deposits, develop necessary technical skills and technology with the goal to "produce porcelain without the heavy expense of import from China". This parallels Tarde's laws of imitation in action.

## Sociocultural Diffusion of Innovation

An overarching sociocultural characteristic is that higher order functions develop out of social interactions (Tharp & Gallimore, 1991). Building on earlier work of pioneers such as Gabriel Tarde (see Early Days: The Laws of Imitation section above), the disciplines of sociology and anthropology have built a rich tradition in the study of diffusion of innovation as a mechanism of transmission and adoption of ideas through social connections.

Anthropological studies of diffusion of innovation are often based on direct data gathered through participant observation, a method representative of anthropological research. This method of data collection causes the researchers to align their perspectives with those of the adopters of innovation, rather than having potentially opposing views as representatives of organisations that have a vested interest in spreading the innovation. The researchers see the innovation through the eyes of the adopter, not through the eyes of the active diffusion agent.

One often cited example of anthropological research on adoption of innovation is the work of Steve Lansing in Bali, Indonesia on irrigation systems (Lansing, 1987). The failure to adopt the modern irrigation system is attributed to the strong religious organisation system used for hundreds of years in harmony with the wider ecosystem that was incompatible with the proposed modern irrigation system, not because of technological failure, but because people did not make the transition from the traditional thinking enmeshed with many aspects of their lives and beliefs to the new process management methods. The rejection occurred in their minds, in their view of the world, and in what they think works and solves their problems; a lesson that we will revisit over the course of this research. Lansing was able to have a deep understanding of the potential adopters by living in their environment for years, immersing into their culture, life and work practices.

Early sociological studies aimed to understand the process of social change caused by the adoption of an innovation. Running broad data collection, these studies used quantitative analysis to identify relevant patterns. Bowers conducted such a study (of "intensive analyses") by mailing questionnaires to ham radio operators across multiple regions and over several years to see factors that influenced their decision to purchase the equipment (Bowers, 1938). In this study, the use of extensive data collection and statistics to identify patterns of social change as an effect of innovation is notable.

A common feature of the research findings into diffusion of innovation was the presence of the S-curve representing the progression of the propagation of the innovation in time: slow at the beginning, then accelerating and then finally plateauing in the last stage.

It is also worth highlighting the prominent presence of a couple of hypothesises in the research on the diffusion of innovation in the period preceding WWII which were supported

by the findings at the time: linear progression and circular spatial characteristics. Citing the work of Willey and Rice (Willey & Rice, 1933), Bowers (Bowers, 1934), and Pemberton (Pemberton, 1936), Edgar C. McVoy noted these hypotheses had been used by anthropologists in studies of primitive tribes, and more recently (relative to 1940's) in sociological studies of "present-day 'civilized' society" relative to "diffusion of social inventions" (McVoy, 1940). These hypotheses are: 1) that inventions arise at the centre of a cultural area, and 2) that the inventions spread by degrees to the periphery of the area in concentric circles. Vincent Heath Whitney (1950) reasoned that this circular diffusion mimics the way the community expands: "Theoretically a growing community will expand outward in circular fashion from the core or nucleus of growth in such a way that the distance from centre to periphery is everywhere equal […] other things being equal, the diffusion of an invention will take similar form, spreading outward from the point or points of origin in an ever-widening series of concentric circles", although there are factors that can influence the spread (p. 247).

## Socioeconomic Diffusion of Innovation: Industrial Era

In the early 1940s, a seminal research study in rural sociology marked the beginning of a new type of research on the diffusion of innovation, one in which the researcher tries to find ways to ensure, and accelerate, technological transfer from one economic entity to a targeted customer base. This research, conducted by Bryce Ryan and Neal C. Gross, was funded by the Iowa Agricultural Experiment Station in 1941 with the main goal of investigating the spread of hybrid seed to Iowa farmers. The result of that investigation was published in 1943 in the Journal of Rural Sociology ("The Diffusion of Hybrid Seed Corn In Two Iowa Communities" (Ryan & Gross, 1943)) and had an enduring influence on research on diffusion of innovation over the next few decades. The study found that the key influencers in the adoption of the new seed were salesmen and neighbours, and the ability to experiment. The interesting finding was that salesmen had an important role in spreading knowledge or awareness of the new product, but not influence in adopting it widely. However, they played a key role in convincing the early adopters. Neighbours, on the other hand, had an increasingly important role in convincing others over the adoption period. The early adopters acted as a "community laboratory" for other neighbours who, after seeing the results, started experiments of their own. Another important finding was that the ability to trial the new product was critical to rapid adoption.

After the publication of this study, the funding of research on diffusion of innovation in agriculture increased significantly. This led to the transformation of rural sociology research to focus on the diffusion of agricultural technologies, with less emphasis on social consequences (Rogers, 2003). The implication was that funding of diffusion by large organisations altered the research and the way universities focused their research resources. Hightower flagged the unintended consequences and the necessity to "research for the consumer rather than the processor", that is, see the adopters, not only the innovators (Hightower, 1972).

In this period, the consensus was that innovation was mainly a product of large organisations. It is not that smaller enterprises or individuals lack the ability to innovate, but they lack the capacity to produce at scale. In his theory of innovation, Schumpeter, one of the authoritative thinkers in economics in that period, distinguished innovation from

invention on the basis of impact on production, defining innovation as "the setting up of a new production function"(Schumpeter, 1939). Because there is a high cost for innovation (production and distribution) only large enterprises are capable of innovation: "as soon as we go into details and inquire into the individual items in which progress was most conspicuous, the trail leads not to the doors of those firms that work under conditions of comparatively free competition, but precisely to the doors of the large concerns" (Schumpeter, 1950).

As the cost of innovation was prohibitive for small enterprises, the social process of innovation was seen often as an expression of the imposition of large capital strongly expressed in the article "Hard Tomatoes, Hard Time" published in the *Society Journal* (Hightower, 1972) . This power-centred innovation fits the concept of radial diffusion of innovation as a process driven from a central point and it can be coordinated for faster adoption through communication channels. The diffusion research methodology is structured to reflect a similar paradigm: ask the adopters of an innovation what they adopted, when, and where or from whom they obtained information about innovation (Rogers, 2003).

Many studies into adoption of innovation in education in this period follow largely the same methodology as the research on diffusion of innovation. Most of the early studies were completed at Columbia University's Teachers College under the leadership and influence of Dr Paul Mort (Rogers, 2003). As an example, one of the most cited studies using the method of diffusion of innovation concluded that funding per school student was the best predictor of innovativeness (Mort & Ross, 1957). One shared characteristic of these studies was the focus on innovation in education systems and diffusion initiatives funded by government agencies. Carlson noted that "Few studies have been completed with teachers (only one study was encountered in a search of the literature) as the unit of adoption, and only one study of school superintendents, in spite of their importance in school adoption decisions" (the citation is from a PhD dissertation (Christiansen, 1965) as no direct copy of the publication (Carlson, 1965) was found).

While the diffusion methodology has been applied in the context of many educational institutions, it was not the only approach to the study of adoption of innovation at that time. A useful reference is Terry N. Clark's analysis of four proposed models of institutionalisation of innovations in higher education (Clark, 1968). As the title implies, this refers to the adoption of innovation in the form of the creation of an institution. The four models analysed in this paper are: 1) the organic growth model, 2) the differentiation model, 3) the diffusion model, and 4) the combined-process model. The contribution of this paper is quite valuable, not only through its systematic review of the models used at the time, but because it discusses the exploration of the initial stage of innovation when the innovation has not emerged yet with clarity. This is important in the context of social institutions, such as education, and especially higher education. The organic growth model reflects on the activities of professionals who have the abilities, interests and opportunity to explore new ideas, discuss them, get together and gradually bring shape to a new "status" – that is, a new field, a new discipline. This innovation process is unplanned. It only becomes formal when the "status" reaches a certain stage of maturity and begins to be recognised by other professionals and attract the interest of others. This differs substantially from the

diffusion theory which relies on awareness campaigns, communication channels and agents of change. It is also worth noting the role of professional social networks in both the innovation process and the adoption of innovation. The formation of the new "status" does not seem to be confined to a central point from which the influence spreads in concentric circles, as the collaborating professionals could live in dispersed locations around the country or even across continents. Another notable observation is the positive correlation between decentralisation and innovativeness: "the more decentralised the decision-making structure, the more innovative the organisation" (Clark, 1968). This is a prescient comment, proven by the evolution of innovation over the next decades and into the next century.

## Socioeconomic Diffusion of Innovation: Modern Industrial Era

In the period between 1970 and 2000 technological advances begin to become synonymous with innovation, although not necessarily exclusive of other types of innovations. For example, John Pincus defined innovation in education in these terms: "an innovation is a technology which improves educational outcomes, improves working relationships or processes within the school system (or between the school system and the public), or reduces the costs of education without significantly reducing the quantity or quality of desired outcomes or processes" (Pincus, 1974). Moreover, technological innovations are demanded by the public: "At the same time society, including various constituencies of the schools, puts a positive value on 'progress', as measured by new technologies and improved outcomes" (Pincus, 1974).

Technological progress has gradually eroded the dominance over innovation held by large entities. This, in conjunction with increased social mobility, has a follow-on effect on the adoption of innovation, moving away from a centric model of diffusion that becomes less and less applicable. The transformation of the innovation process is due to increased collaborative relationships and globalisation. David J. Teece published a landmark paper in 1986 describing a new innovation paradigm, one in which innovators do not have to be large concerns to bring their innovations to the market by using contractual arrangements that give them access to complementary assets (Teece, 1986). However, these new "dynamic networks" open the doors to imitators; Gabriel Tarde's adopters re-appear in the industrial space, this time introducing themselves as innovators.

Because of the increased pace of innovation, innovators need to better understand their prospective users and find ways to influence them into adoption, in order to succeed. This is a departure from the classic diffusion model marking the rise of marketing as a systematic practice to understand and service existing markets, and even create new ones. Not only has the competitive landscape changed, but customers' attitudes and expectations too. The previous industrial era's dominance of supply-side driven progress has made way to a situation in which the customer has much more influence: "customers don't just want products; they want solutions to their perceived needs" (Teece, 2009). Changes in research studies reflect the new orientation toward using methods borrowed from marketing, individual and social psychology. Prospective adopters may reject an innovation because psychological barriers: the level of uncertainty is too high, they are required to change their routines beyond their perceived level of comfort, and there may be an image barrier, and this is even when "they believe that technology, if properly harnessed, can benefit them" (Ram & Sheth, 1989).

The rise of marketing in adoption of innovation was particularly strong in California, where high-tech industries had a meteoric rise between 1970 and 2000. One of the most influential publications in this period, *Crossing the Chasm* had a strong influence on the high-tech business community, and later in other industries and sectors (Moore, 2002). Using Rogers' diffusion of innovations model as a starting point (Rogers, 1995), Moore asserts that the key to broad adoption is the transition from early adopters to early majority. His main contribution is the differentiation between innovators, early adopters and the early majority, and consequently the different approaches to communication, dissemination of information and engagement at each of these stages (Moore, 2002). One of the features that differentiates Moore's model from the classic diffusion of innovation model proposed by Rogers is the adaptation of the innovator to each stage of adoption and market segment. This demands that the originator of the innovation changes its business processes, its marketing campaign, and even its business structure if necessary, to fit the psychographic profile of the adopter, which in turn changes with the adoption stage. Advancing from the early adopter stage to the early majority stage is the most difficult part of a successful adoption of innovation – this is the crossing of the chasm. This model tilts heavily towards high-tech marketing. In Moore's view, it is critically important, as this makes the difference between success and ruin, to identify adopters in the context of separate market segments, and know that adopters have different behavioural profiles and needs. Success in one segment does not translate automatically to success in another, but it is essential to make the transition from one stage to the next, and especially to cross the chasm (p. 26).

## Present Days: Post-Industrial Era, Start-ups and the Internet

Around the beginning of the third millennium innovation underwent another fundamental shift. Simultaneous diversification of products and services, expanded globalisation and the rapid spread of the Internet had a profound impact on innovation. From protection, to sharing of complementary assets, to an unprecedented level of collaboration, innovation has truly become public and open: "traditional business strategy has guided firms to develop defensible positions against the forces of competition and power in the value chain, implying the importance of constructing barriers to competition, rather than promoting openness. Recently, however, firms and even whole industries, such as the software industry, are experimenting with novel business models based on harnessing collective creativity through open innovation" (Chesbrough, 2004).

Collective creativity means two things: the innovation is social and the adoption of innovation becomes social. The common ground between the two is new means of communication facilitated by internet technologies. The key novelty of the new communication medium is its platform quality: instead of broadcasting from one to many, communication now takes place between many to many. In the early 2000's these new platforms become ubiquitous for generating, editing and sharing information in a process some called "emergent collaboration", where users did not have "any preconceived notions on how work should proceed or how output should be categorised or structured. Instead, they're building tools that let these aspects of knowledge emerge" (McAfee, 2006).

The new communication and information sharing platforms led to unpredictable forms of innovation involving non-professionals. This is perhaps one of the most notable effects of technology-enabled generation of knowledge and creation of new products, the "democratization of innovation", when many of the user innovators are individuals who modify and invent new products for themselves, but also are willing to make "active efforts to diffuse information about their innovations" (Von Hippel, 2005). The idea of sharing information towards a common innovation goal is not new. Robert C. Allen found examples of this phenomenon, what he called "collective invention", in the nineteenth century in the iron and steel industry (Allen, 1983) when information about a new technique used for the successful construction of an iron plant was shared with others who were free to adopt and improve the design. This phenomenon had not been recognised as significant until the arrival of computer technology and especially the wide adoption of the internet. During the early days of computer systems, similar to the case of the iron industry a century earlier, it was common practice for programmers to share their source code. The sharing process accelerated with the spread of Usenet in 1979, but it was the wide adoption of the internet that dramatically accelerated open source activity (Lerner & Tirole, 2002). Sharing and user innovation is not limited to the computer industry. A report published by the Kauffman Foundation in 2012 revealed that of 4,928 firms founded in US in 2004 10.7 percent survived for more than five years, and that 46.6 percent of these firms were founded in a wide range of industries by user entrepreneurs (Shah, Smith, & Reedy, 2012) with diverse educational backgrounds .

The diffusion of innovation methodology based on the model of one-directional communication and circular concentricity has become rather outdated and in need of upgrade. Rogers published the 5th edition of *Diffusion of Innovations* adding content related to the above-mentioned trends: new communication technologies "like the Internet and cellular telephones", opinion leaders, and marketing (Rogers, 2003). Despite acknowledging the new world, he dedicates less than one page to the Internet. The diffusion model is the same as it was forty years ago, relying on mass media and inter-personal communication, and change agents. Rogers attributes great importance to communication at early stages to raise awareness, with mass media having a bigger impact at the beginning of the diffusion process and inter-personal communication being more relevant at later stages. Using Hotmail as an example of the adoption of innovation in the Internet age, he notes how quickly this innovation spread, reaching twelve million users in eighteen months, but does not discuss how that happened in the absence of mass media. A key element of the diffusion process is the change agent who is the gatekeeper controller of communication, reminiscent of the industrial era when a central authoritarian style was more common. Rogers attempts to differentiate between various types of adopters using a list of 26 generalisations such as: "Generalization 7-12: Earlier adopters have more intelligence than do later adopters" (p. 289). In stark contrast to start-up culture, democratised innovation, and pragmatic and agile marketing approaches, Rogers sees innovation as a top-down decision-making process that starts with an agenda-setting stage which could take several years. Rogers acknowledges the importance of diffusion networks and their social characteristics, but he does not see adopters as anything other than targeted consumers that give nothing in return, although he recognises that users could be part of the innovation process: "In recent decades, the author gradually became aware of diffusion systems that did not operate at all like centralized diffusion systems. Instead of

coming out of formal R&D systems, innovations often bubbled up from the operational levels of a system, with the inventing done by certain lead users" (p. 395). To accommodate these new realities, Rogers proposes a hierarchical model in which decentralised diffusion systems sit under centralised diffusion systems.

In the case of large-scale innovations, co-ordinated diffusion is still useful, but in conjunction with using tools based on advanced psychology in which prospective adopters are presented with options and make personal decisions, that, if the persuasion works, lead to the desired adoption. After decades of research the Nudge theory (Sunstein & Thaler, 2012) gained recognition and has been adopted especially by government policy makers, although not without controversy, as it could be used as an instrument of manipulation (Baldwin, 2015) such as in the case of influencing potential organ donors to "choose" to donate (Davidai, Gilovich, & Ross, 2012). More sophisticated diffusion models target individual micro-level behavioural goals to connect and build, over time, an aggregate effect at population level that serves as a decisional context for individuals at a later stage (Kangur, Jager, Verbrugge, & Bockarjova, 2017).

Education systems also undergo fundamental change, albeit gradually, and adopt innovations that cultivate and benefit from the open and diverse socioeconomic environment. For example, the School Innovation report in Australia (Cuttance, 2001) remarked on an innovative approach to learning and teaching in which students are viewed as active interpreters and mediators of teacher behaviours, using meta-cognitive skills, self-regulation and collaboration. Christensen revives the question of bringing technology into schools that was raised by Pincus three decades earlier (Pincus, 1974): how can schools use technology to obtain better educational outcomes? (Christensen et al., 2008). In essence, Christensen uses a diffusion of innovation model with a twist: target disruption, use technology aimed at areas that are underserviced by incumbent suppliers. This makes reference to an innovation model in which disruptive innovation starts with a small user base by offering products that have new features, that would be too expensive for the incumbents to offer without significantly reducing their profit margins (Christensen, 2013). The solution for schools is to use computer technology to provide custom learning for home-schooling, online courses and students with special needs. Although Christensen relies on individual end-users to adopt technology for non-mainstream needs to generate aggregate demand, he still sees adoption as a large technology project between suppliers (Microsoft, Apple, Open Source companies and other contractors) and the government, school districts, school alliances and individual schools (p. 182). Reflecting the influence of Harvard Business School's thinking on management strategy, the adoption of innovation is a choreographed big implementation program which includes power tools, management tools, culture tools and leadership tools (p. 203). The preference for business management strategy reminiscent of balanced scorecard strategy methodology (project, process, people) is also visible in the proposed model of organisational design and innovation and organisational structures in public schools (p. 207). Incidentally, the report on innovation in education in Australia (Cuttance, 2001) indicated at the time that computer technology was mainly used for teaching information technology and for teaching students with special needs, confirming Christensen's view, at least for a while, that this was the starting point for the application of technological innovation.

The view which sees adoption of innovation in education through the lens of change management processes is represented in a rich section of literature that goes back decades. As mentioned in the introduction section of this chapter, change management is not in the scope of this review, however, as they are associated with adoption of innovation, it is worth mentioning a few of major thinking paradigms that fall into this category. The association is justified by the nature of the education systems. As large organisations, they have a tendency to resist change mainly because traditionally, given its industry characteristics developed over a period of over one hundred year, teachers and the teaching culture are slow to change (Cuban, 1984). One of the earliest models is the Concerns Based Adoption model which was developed by Hall (1979). The key characteristics of this model are based on the assumption that in educational organisations top-down decisions are driving adoption of innovations to achieve effective outcomes through change management.

Technology Acceptance Model (TAM) is another related concept which sees the adoption influenced primarily by the ease of use and perceived usefulness (Davis, 1989) and used mainly in educational settings to explain acceptance of computer technology. This model evolved over time into United Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003) in conjunction with other related theories (motivational model, theory of planned behaviour, PC utilisation model, innovation diffusion theory and social cognitive theory) to explain and improve the acceptance of information technology in organisations. The Technology-Organisation-Environment (TOE) framework developed in early 1990s is linked to adoption of innovation and innovative process, but in the context of organisational change. The research conducted under this framework is diverse with the tendency to identify and focus on unique set of factors that are specific to technology, organisations and regulatory environment (Baker, 2012), which makes them susceptible to rapid obsolescence. This model covers an area similar with a section of Roger's diffusion of innovation model related to organisational attributes and adoption variables (2003), which was not considered relevant to this study. Similarly, Technology-to-Performance Chain (TPC), which builds on Task-Technology Fit (TTF) and utilisation focus research (Goodhue & Thompson, 1995), or combination of the models mentioned above, such as TAM and TTF constructs (Dishaw & Strong, 1999) are concerned with issues of utilisation, technology fitness to the organisational needs and performance in the context of use of IT. A common feature of these models is a general top-down approach to adoption of innovation in an organisation driven by agents of change as seen in applications of these methodologies in a variety of educational institutions across a wide geographical spread: CBAM used as a diagnostic tool for understanding the process of change that occurs during the introduction of technology enhanced learning environments to high school chemistry teachers (Gabby, Avargil, Herscovitz, & Dori, 2017) , CBAM applied to create multi user profiles to inform educational leaders who make decisions on inclusive teachers professional development programmes (Yan & Deng, 2018), a review of 67 empirical studies about faculty online teaching at the University of Alabama highlights the use of TAM in the implementation of online learning environments in support of institutional goals and implementation of online programs, administrators and academic leaders (Wingo, Ivankova, & Moss, 2017), TAM and TTF used in the analysis of MOOC usage by Chinese students to make recommendations addressed to MOOC practitioners on how to manage their courses to be more attractive (Wu & Chen, 2017), and UTAUT used to examine the students'

behavioural intention in the use of animation and storytelling online tools resulting in recommendations to the university management and academics on the effective implementation of online learning technology (Suki & Suki, 2017). Another common trait is the focus on innovations that are at in their late stage of adoption.

The idea that social structures are important to innovation and adoption of innovation is not new, but in this period a plethora of multidisciplinary studies began to examine forms of social organisation from the perspective of efficiency of communication, knowledge creation and sharing, and propagation of ideas. Social research has been joined by mathematics and economics research in an attempt to create better models of knowledge management, innovation and planning.

It is important, and interesting, to notice how social structures that have been with us for centuries have a new application in the current technological context. As an example, "communities of practice" is one of the widely known recently defined social forms of organisation, but is not a new form at all. Originally the term was coined by an educational theorist and a social anthropologist while studying apprenticeship as a learning model (Wenger, 2009), but later it became a model used for knowledge management, learning and teaching, talent management, and innovation (Wenger & Snyder, 2000). Other forms of organisation defined in the context of computer networks and the internet are groups (as small organisational units), networks (connected distributed individuals) and collectives (emergent aggregations across networks based on transient characteristics and interests) (Dron & Anderson, 2007).

## Takeaways

Sociologists and anthropologists have had a big influence on the development of theories on adoption of innovation. Early studies involved observations related to cultural changes caused by accumulation of social processes (Tharp & Gallimore, 1991) , and reasoning based on numerical analysis of the adoption of innovation as a precursor to advanced statistical methods (Tarde, 1903). Our understanding of how ideas and knowledge are created may have greatly improved and advanced, but the core original concepts of social transmission mechanisms are still valid.

One of the most influential theories is the theory of diffusion of innovations (Rogers, 2003). This theory had a powerful influence in the period between 1940s and 1990s, and it helped shape current thinking on the adoption of innovation. The S-curve concept is still a widely used numerical tool to measure the degree of adoption. The stages of adoption (innovators, early adopters, early majority, late majority and laggards) are still being used today.

While sociologists and anthropologists in general see the diffusion of innovation as a latent and natural social phenomenon (with exceptions, such as Kroeger's "stimulus diffusion") in a cultural context, the diffusion of innovation in an economic context is largely seen as a coordinated effort to spread an innovation to as many adopters as possible. The landmark research study on the adoption of hybrid seed corn (Ryan & Gross, 1943) funded by federal grant is the first study to yield concrete methods that can be used in practice to accelerate diffusion. The success of that study stimulated the funding of similar research with to the goal of maximising outcomes for innovators. A pro-innovation bias (Rogers & Shoemaker,

1971) is present in the majority of the literature on socioeconomic innovations reviewed for this study. There is opposition to this bias (Hightower, 1972), but the overall pro-innovator bias is predominant, even when there are intentions to do social good rather than profiting (Baldwin, 2015).

Communication technologies and the ubiquitous use of the internet have had a significant impact on the way innovation is adopted. The notion of centrality and circular influence has made way to a large network of connections in which influence can spread in a non-linear fashion. This displaces the main tenet of the classic theory of diffusion of innovation, in which the spread begins at one point and spreads in concentric waves towards the periphery. Technology has made open innovation possible(Chesbrough & Appleyard, 2007) and has ushered in an era of user entrepreneurship (Von Hippel, 2005). Large social networks have a great impact on the influence mechanism, and while there are positives in accelerating the diffusion, there are concerns related to the ideas that are promoted, especially regarding the effect of the "commercial imperative" in education where it has "both a subtle and powerful mutually exclusive relationship to connectivist and '2.0 approaches' to learning" (Friesen & Lowe, 2012).

Most of the research reviewed is focused on the participation of organisations as actors in the diffusion process. The individuals receive attention either as members of representative groups relevant to the targeted market segments or as opinion leaders. Damanpour and Schneider flagged the lack of research in this area (Damanpour & Schneider, 2008). Their study showed that individuals are important in the process of adopting innovations demonstrating that managers can influence it. Nevertheless, the study is not ground-breaking, having remarkably similar hypotheses to the ones Christiansen used in his PhD dissertation 40 years earlier (Christiansen, 1965), such as "Managers' pro-innovation attitude will be positively related to innovation adoption".

The study of literature stretching over a century revealed a profound increase in complexity. To illustrate this, we need only compare the study on hybrid seed corn in the state of Iowa in 1943 (Ryan & Gross, 1943) and the study on the diffusion of electric vehicles in the Netherlands in 2017 (Kangur et al., 2017). Apart from the underlying technological innovations, the differences between the factors considered in the diffusion process are staggering. The first study considers the farmers' communities, relationships between neighbours, change agents, the publication of information through mass media, and the provision of seeds for experimentation. The second study considers a far wider range of issues that must be taken into account: global warming, oil-dependency, oil prices, energy-efficient technologies, market conditions, supply, consumer behaviour, preferences, infrastructure, charging times, locations, distance travelled, habits, etc. Not only is the list of considerations much longer, but the diffusion strategy is vastly different. The second study frames the diffusion in terms of policy design at several levels to influence adoption over the years integrating models of consumer behaviour, economic markets and ecological systems. The increased complexity of the diffusion process means that it is not sufficient to increase communication to attain full adoption, but there is a need to understand the consumers (adopters), their behaviour, their needs and the impact of adoption in a larger context. Perhaps a better example is to compare the original study on the adoption of hybrid seed corn with an investigation paper published in 2015 on the subject of innovation

in agriculture (van Duinen, Filatova, Jager, & van der Veen, 2016), in which the authors go far beyond the analysis of the diffusion process to examine the consequences of the adoption of irrigation systems under drought risk on patterns of development and economic welfare in the region.

## Overview of Areas Open to Improvement or Under-researched

The literature review identified areas where this research project has the opportunity to contribute through expansion of the subject, constructive criticism, alternative approaches, and novel theoretical modelling. These areas are: 1) the perspective of individual adopters, 2) rising complexity, 3) social creation and dissemination of knowledge, and 4) bias caused by stereotypical classification of adopters.

The research on adoption of innovation is heavily biased in favour of the innovator with little attention paid to the adopter as an individual with needs and aspirations. The consequence of this bias, known as the pro-innovator bias (Rogers, 2003), is that adopters have little or no support to guide them if they need to take a strategic approach to adoption of innovation and improve the odds of making the right choices. The same is true of organisations that would benefit from a better understanding of how individuals adopt innovations.

The increasing complexity of the elements and processes that make up our society, in all its aspects, has not been fully reflected in the dominant model of diffusion of innovations. In essence, the progression of an individual through the phases of adoption, starting with the awareness phase and ending with the final decision of adoption, largely assumes that there is no difference between adopting a quantum computing technology and adopting a new model of mobile phone, beyond the level of difficulty in executing the steps involved that are specific to their functional context. The increasing complexity is recognised insofar as diffusion is concerned, as a matter that affects the planning of marketing campaigns and the selection of tools that are used to influence potential adopters. To an adopter, complexity has a different impact, because adoption is a personal investment which needs to be considered wisely in the context of competing needs and interests, and especially when the supply of innovations is abundant.

The literature review revealed that the dominant thinking on adoption of innovation has little concern for the mental processes involved during adoption, processes that are related to finding information, understanding information needs, creation of knowledge, and sharing that knowledge. The dominant thinking recognises the role of human factors such as personality, communication behaviour and the influence of opinion leaders from a marketing perspective, but not from the individual's perspective of thinking and making decisions. According to that view, adoption is mainly a process of diffusion that is successful according to the outcomes of a simple stimulus-response model, in which the stimulus consists of marketing initiatives and the response is product feedback, aggregated number of adopters, and the S-curve that shows the timeline of the adoption numbers. The marketing view favours a pro-innovation bias that has a tendency to understate the adopter's perspective.

Finally, another area in the diffusion of innovations that was considered for research is the stereotypical profiling of the adopter. In general, the prevalent view is that adopters have one psychographic profile determined by the adoption stage. Diffusion models attempt to define adopters' features as universally unmovable regardless of other demographic, psychological or socioeconomic factors. These stereotypes are striking, especially when the profiles are made in reference to high-tech abilities and skills, the level of intelligence and educational background (see Chapter 2, Findings and Discussion). The missed opportunity here is not only one of moral address, but also one of realistic pragmatism: adopters present various dispositions, depending on the innovation and their own circumstances, which directly affect adoption outcomes. Thus, an adopter can display traits that are typically associated with an innovator towards a particular innovation and set of circumstances. But, the same adopter may show a high degree of scepticism towards a different innovation, in a different set of circumstances. Benefiting from this attitudinal flexibility, an organisation that operates in a non-technical socioeconomic space could tap into the talent and inclinations of some of its members who would otherwise be profiled by default as non-innovative. As an example, an organisational unit specialising in linguistics will miss the opportunity to be more effective in the adoption of technological innovations if it does not recognise individuals who have an interest and passion for the experimental use of technology.

## Discussion

The first matter that needs to be discussed is one of terminology: is diffusion of innovation the same as adoption of innovation? What is the difference? The reviewed literature highlights two distinct meanings of diffusion: one in which "innovation is communicated through certain channels over time among the members of a social system. It is a special type of communication." (Rogers, 2003), and one in which diffusion is synonymous with adoption, because adoption is the end step in the process of communication. Diffusion is a relentless process of persuasion that will continue as long as it takes until adoption occurs. A diffused invention is an adopted invention: "…two techniques whose diffusion account for most of the productivity growth" (Allen, 1983). Diffusion means spreading usage: "reflecting its widespread diffusion, Linux has attracted a large share of the commercial investment" (Lerner & Tirole, 2002).

The meaning of diffusion is important, because it is linked to the meaning of the research carried under that term and the goals associated with it. An overview of these meanings, and contexts in which the term has been used, suggests that diffusion is a term associated with a decision taken by the innovator to start marketing an idea, product or service with the goal of wide adoption. While Rogers (2003) refers to diffusion both as spontaneous and planned communications, he sees it as a decision outcome: "one of the most crucial choices in the entire innovation development process is the decision to begin diffusing an innovation to potential adopters" (p. 155). Damanpour and Schneider see diffusion from a similar perspective: "diffusion research mainly examines the adoption of innovation by individual decision makers" (Damanpour & Schneider, 2008). For clarity, this dissertation will not use the term diffusion as adoption, but as a process of communication. The adoption of innovation is a finite process, which includes diffusion as communication, with a

clear outcome based on the decision to adopt or not to adopt; we could have a successful adoption, or an unsuccessful one, either of which will be the result of a decision.

The importance of terminology is also one of positioning. As noted earlier, most research is focused on the success of adoption at a macro level. Individuals are rarely asked about what they want. Their goals are not discussed outside the main questions on what are their perceptions of the product and what they need to make the adoption successful. This dissertation proposes to examine the adoption process including the perspective of the adopter, not just the perspective of the innovator, although the same person could simultaneously play the same role. Seeing an innovation through the eyes of an adopter offers new perspectives. This is one reason why anthropologists have been able to better understand why the adoption of certain innovations fails as was the case in the application of modern irrigation systems in Indonesia (Lansing, 1987).

As remarked in the previous section, the research on adoption of innovation considers a uniform adoption base, differentiating adopters at stage level at best. Moore proposes a flexible marketing approach with adopters belonging to groups with "unique psychographic profile – a combination of psychology and demographics that makes its marketing response different from those of other groups" (Moore, 2002). This makes the assumption that adopters have one set of traits regardless of the innovation: innovators are technologists, early adopters are not technologists, but "are people who find it easy to imagine, understand, and appreciate the benefits of new technology", early majority are people "driven by a strong sense of practicality", late majority are not comfortable with technology, and finally, laggards are people who "don't want anything to do with technology" (pp. 15-17). Moore has not gone far beyond Rogers' description of late adopters as having less intelligence than the early adopters. This is a simplification that could lead to missing important aspects of adoption because individuals can simultaneously display different attitudes to different innovations. It is preferable to assume users/consumers/adopters are capable of innovation, but adopt different behaviour depending on their needs, attitudes, availability of tools and time relative to a specific innovation. This is a key assumption that I will be making in this study.

In what *The Economist* called "A Cambrian Moment" (Siegele, 2014), the rapid increase of data and the falling costs of computing power led to opportunities for many people to innovate in a manner that was impossible a few decades earlier: "According to a recent survey of 12,000 people aged between 18 and 30 in 27 countries, more than two-thirds see opportunities in becoming an entrepreneur. That signals a cultural shift". This means that the more people have the opportunity to innovate, the more the prospective adopters have to choose from. The challenge of choice is a challenge of understanding the innovation, and making an informed decision on what to adopt given finite time and other resources available to the adopter. This is a factor that will be examined in this study: what is the cognitive price that an adopter needs to pay in order to make a successful adoption? Following this line of thought, another factor that is worth examining is how personal social networks contribute to making good, or bad, decisions around adoption.

## Conclusions

The literature review found that the dominant thinking on adoption of innovation is based on the diffusion of innovations model. The focus of this model is how to spread innovations effectively, hence the emphasis on the diffusion of innovation, seen essentially as a controlled communication process. This study will have a different emphasis: instead of being mainly concerned with the innovator's interest in maximising the effect of the diffusion process, the study will focus on adoption from the perspective of the adopter.

The adoption of innovations is considered a finite process resulting in a decision to adopt or not adopt an innovation. This process includes diffusion as one of the communication activities that takes place during adoption, but not as the main concern of the study. The model of diffusion of innovation is still useful and this study will use the five stages of adoption as a fundamental structure of the process of adoption and as a key research tool.

Inspired by the work of sociologists, anthropologists and other social scientists mentioned in this chapter, this study will explore the cognitive processes that an adopter uses during the adoption process and try to understand other factors that influence the adopter to make a final decision, such as social relationships and skills required for a successful adoption. The research will reflect on the individual level and relate the findings to organisations that face similar challenges concerning the adoption of innovation, but at a much larger scale and complexity.

In contrast with the mainstream model of diffusion of innovations, this study will approach the research into adoption of innovation based on the assumption that individuals have different attitudes and dispositions depending on the object being considered for adoption, and anyone can be an innovator in the right circumstances.

# Chapter 3 Research Design

## Abstract

This chapter discusses the overall approach to the research design from a methodological and chronological perspective. As the topic of the research is of a multidisciplinary nature, the project will use a combination of quantitative and qualitative methodologies. This chapter explains the rationale for the approach and the selection of methodologies, the design of the data collection process, analysis and explores the limitations of this study.

## Methodology

The nature of the research questions in this study led to the adoption of a mixed-methods approach.

The main research question refers to finding the major factors that influence the adoption of innovation. A quantitative method could be used to design the research to finding answers to this question, but this would be too restrictive and present the risk of missing important aspects of the phenomena. This risk becomes evident when considering the sub-question that refers to personal experiences, perception, interest, social relations and skills. The second research question regarding the design of a theoretical framework implies the adequacy of qualitative methods, while the testing of the theory could employ the application of both quantitative and quantitative methodologies.

The mixed-methods research has emerged as a distinct design in recent years along traditional approaches and considered by some as a third major research paradigm (R. B. Johnson, Onwuegbuzie, & Turner, 2007). Creswell recommends this design when both methods converge to provide a better research outcome than by the use of either type. Quantitative data is useful to produce results that can be analysed to assess frequency and trends related to a large number of people, while qualitative data provide words that offer many perspective on the topic, especially in complex situations (Creswell, 2008).

The combination of quantitative and qualitative approaches supports the main goal of this research which is to identify factors that have a consistent influence on the adoption of innovation outcomes and create a model that can be used in practice with predictive attributes. The qualitative approach is appropriate for testing the theoretical model through the analysis of narratives that describe personal experiences of adopting innovations. This approach creates opportunities for identifying other factors that escape quantitative methods. These factors may enhance the model, extend the model, or help provide important lessons that may lead to other research studies. The quantitative approach was used in the analysis of large data sets generated from bibliographical information to reveal social patterns and trends in the adoption and development of innovation in academic research.

From the beginning of this study it was clear that a dual approach was most suitable. However, while the research questions remained largely unchanged, the detailed design of

the research studies was sequential, each study informing the design of the next. The rationale for this approach, was to maintain a constant focus on the main research objectives, while allowing discoveries of facts and improved understanding of issues to guide the design decisions by using a common set of goals. In doing so, this approach largely helps to address the issue of integration of findings, which is one of the major challenges in the application of the mixed-methods research (Bryman, 2007). Many studies found that while authors indicate the fact that they were using both research methodologies, they have a tendency to report mainly the quantitative or qualitative data, with a strong preference for one or the other (Bryman, 2007). To address this issue, the overall findings are presented in a distinct chapter by bringing together the discoveries resulted from individual studies in reference to the permeating research questions in an unifying manner.

The overall project was conducted using a pragmatic strategy, which was central to deciding on using a mixed methods approach, with individual research studies designed sequentially as knowledge was learned and generated in the process. The strategy is effective, but it poses the risk of incompatibility between the quantitative and qualitative methods causing a loss of coherence (Hathcoat & Meixner, 2017). This risk is potentially exacerbated by the time gaps between studies and changes in the context in which these studies are conducted.

Mitigating the incompatibility risk involves the adoption of mental models and philosophical positions that are transparent and consistent across the project (Hathcoat & Meixner, 2017). In the case of this project, Study 1 adopted an exploratory procedure to generate ontological hypotheses which the Study 2 used as the basis for developing a theoretical model. The goal of creating this model was to propose an answer to the second research question, but this model was also crucial to the design of the following two studies, as it provides an enquiry framework aligned with the main research questions. Study 3 uses a formative measurement model in which data is collected and analysed to evaluating a pre-determined variable, the researcher's social connections, and its impact on adoption of innovation process. Study 4 has a dual purpose, to test the theoretical hypotheses and to allow the exploration of additional variables that have an impact on the adoption of innovation.

## Approach

The style of mixed methods used in this project was based on *exploratory design*. This is a design that is suitable when it is necessary to conduct an initial qualitative study to explore the phenomenon and then follow up with further studies to explain the findings (Creswell, 2008). In the case of this research, the initial exploratory study was followed by the development of a theoretical model and then by two studies, one quantitative and one qualitative (see Figure 2 Exploratory Design Stages). The sequence of these studies was not determined entirely *a priori*. Although there was an initial blueprint based on the purpose statement and the targeted research questions, which remained unchanged during the overarching project, the approach to the research was to allow a process of discovery to help determine the best course of action based on the outcomes of each completed study

following a “data analysis spiral” with progressive adjustment of the investigation strategy (Creswell, 2003).

The table below provides a list of the four studies in chronological order and the methodologies used for their design, data collection and analysis. A more detailed explanation is provided subsequently.

| Study | Methodology | Description |
|---|---|---|
| Multidimensional Adoption Patterns in Learning Design (Chapter 4) | Qualitative research inspired by a phenomenological approach | Examine documented reports on issues encountered in the adoption of online learning design, description of experiences of adopters of a new learning design tool. |
| Theoretical model of social adoption of innovation (Chapter 5) | Proposition of a theoretical model inspired by a grounded theory approach | Create a theoretical model based on the outcome of the Chapter 4 study, literature review and further extended research |
| Social Influence in Academic Research (Chapter 6) | Quantitative research inspired by a method used in field of social network analysis | Collect data from research publications using custom designed software to identify links between researchers based on cited publications. |
| Adoption of Innovation in Higher Education (Chapter 7) | Qualitative research based on an interview | Design an interview aimed at capturing personal experiences in adoption of innovation of staff from a selected academic institution. |

*Table 1 – List of studies and research methodologies*

The overall organisation and flow of research processes is shown in Figure 2. The literature review was included in stage 1 of the exploratory design as it was important in the planning of Study 1 and the development of the theoretical model in Study 2 (which led to further literature review). The literature review did not stop after Study 2, but it had far less influence to the research conducted in Stage 2.

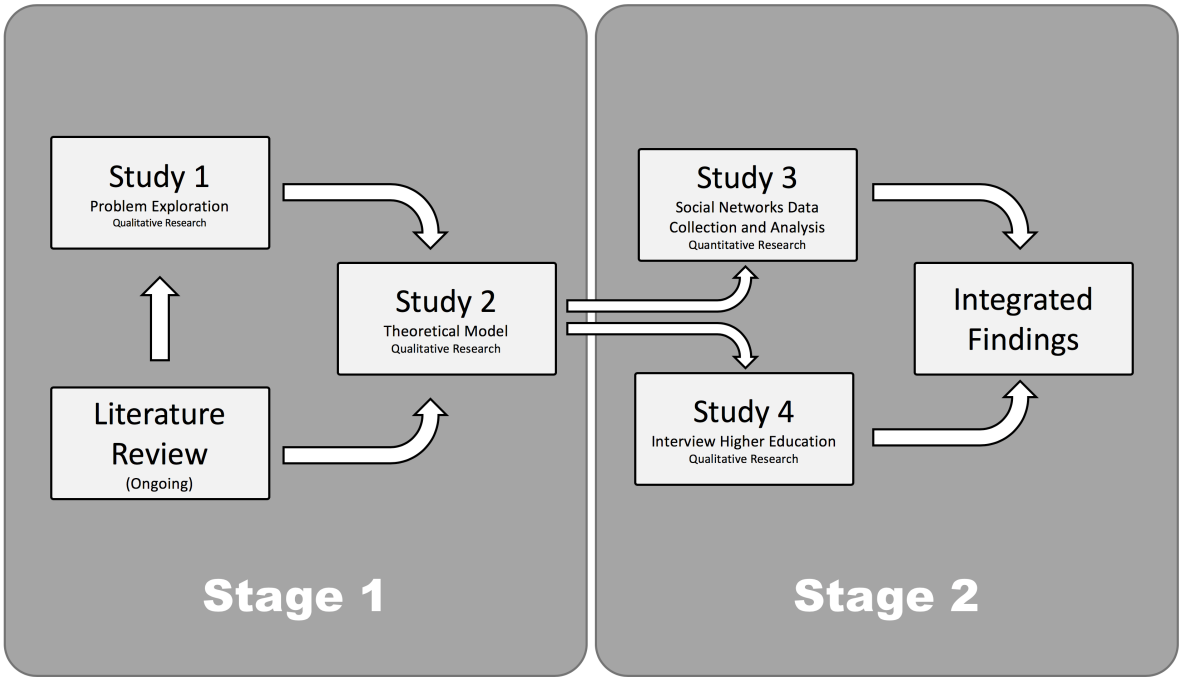


*Figure 2 Exploratory Design Stages*

Study 1 was mainly focused on the first research question to finding factors that influence the adoption of innovation. Study 2 took the findings from the first study and the literature review to develop a theoretical model that formalises a position regarding the first research question and address the second research question. The following two studies are designed to collecting data aiming to test the theoretical assumptions and help provide a more granular response to the two main questions and their sub questions (influence of the maturity of innovation on the adoption process, the importance of personal interest, social connections and skills, the usage of the theoretical model as a tool to assist individuals and educational institutions toward a more effective adoption of innovation).

Chapter 4- Multidimensional Adoption Patterns in Learning Design

Given the broad scope of the problem, it was appropriate to conduct a conceptual exploration study. This first step can help us frame the essential statements (Colaizzi, 1978) that define the adoption of innovation. The goal of this study is to focus the research on a case of adoption of innovation that is related to the same product, with a similar scope of application across a wide geographical area, educational systems and cultures. Such study presents the advantage of exploring issues related to the same innovation in a wide range of situations. LAMS, a learning design online software tool, suited this study as it was at a time of considerable interest in Australia and overseas and it had already a rich history of a variety of applications and documented experiences of adoption. The study reviewed published documents that covered this narrow field with the intention to collect factual

data related to the specific adoption of the innovation as distinct from a traditional literature review.

This involves the collection of research articles, reports, conference presentations and other publications that describe experiences, analyse, and discuss cases of the adoption of innovation in education. The essential statements provide a more precise direction for the next stage in the research and help make decisions on the selection of literature, focus the theoretical thinking and modelling, and design the data collection studies. To ensure consistency for effective comparison purposes, the conceptual study will focus on a narrow field of education and the adoption of a similar technological innovation. This step involves the use of research articles, reports and other publications to produce a problem map, followed by an in-depth analysis to extract essential definition statements aimed at identifying patterns of factors that influence the adoption of innovation.

Chapter 5- Theoretical Model of Social Adoption of Innovation

Using the findings of the first study and the literature review, the this qualitative research study is designed to build a general theoretical model of adoption of innovation that can be broadly applied in education. The model is created by studying the factors that are most likely to have a major influence on adoption and explore significant relationships between their attributes and individual adoption stages. The aim of this project is to create a model with potential practical value in the improvement of adoption of innovation to interested educational (and even non-educational) organisations.

The theoretical model is built around adoption stages. The attributes and assumptions are organised in a matrix of terms and relationships that are to be tested in the next two studies. The continuity of the research is maintained by using the key terminology and concepts that were developed in the first study that are taken to the next level as a theoretical model.

From a methodological perspective this study is still part of the first stage of the exploratory design in the mixed methods approach. It builds on the first qualitative study by expanding the theoretical exploration of research in related disciplines relevant to the purpose of this project. The advantage of this approach is that it allows the identification of measures grounded in the earlier findings which will be a key component in the design of data collections in future studies (Creswell, 2008).

Chapter 6- Social Influence in Academic Research

This study is focused mainly on the question of the importance of social dimension on adoption of innovation. The research was designed to test the findings produced in the earlier exploration studies and the assumptions made in the theoretical model in relation to the impact of social connections. The design was influenced by the reflections over my participation in the collaborative research work on defining Learning Design as a distinct field in education (Dalziel et al., 2013). As a new field, this was an opportunity to examine the adoption of new ideas and observe how the formation of new trends is influenced by personal social relationships. This study uses a quantitative approach to data collection and analysis of the role of social connections between academic researchers on adoption of ideas as reflected in their publications. The data collection in this field was a natural match

and a continuation of the previous research as this quantitative study overlapped well the problem domain covered buy the first qualitative study, but with a narrower focus. The study uses social networks analytical tools to identify social relationships using publications reference data (see more details in the Data Collection section below).

Chapter 7- Adoption of Innovation in Higher Education

This qualitative study collected data by conducting in-depth interviews. The interview questions are structured based on the theoretical model by using a coding system (Creswell, 2003) derived from the key definitions and assumptions designed to test its validity. The interview sessions are on average fifty minutes long and were conducted at locations that were agreed with the respondents, mostly at their offices. The interview allowed the participants to describe their experiences in a free flowing story format. The resulting content was analysed and parsed into components that were mapped against the key definitions in the theoretical model. The frequency of their occurrences informed, were possible, on the validity of the model.

In its final stage, the project will present detailed findings, an in-depth discussion which will attempt to critically assess these findings, their potential limitations and, based on the overall experience of this project, explore future research directions.

Relevant text was extracted, analysed and the determination of categories and themes the emerge from the data.

## Data Collection

### *Study 1 and 2 Data Collection*

The first study (see Figure 2) involved gathering data in text format by processing published reports on issues encountered during the process of adoption of innovation. The sole purpose of this process was to select text relevant to the adoption of LAMS, an online learning design tool used by a large number of academics, researchers and school educators in Australia and overseas. There was no attempt to establish any conceptual positioning that would link the experiences to theories or methods related to adoption of innovation or education. The goal was to find what is reported as problem or success, what did users and researchers experience and thought of their experience related to the process of adoption of the learning design tool. The findings were organised in a list of texts linked to individual adoption cases. The same data was used in the second study for the development of the theoretical model.

### *Study 3 Data Collection*

The third study (Study 3, see Figure 2) generated data by using software automation to process a collection of selected research articles. For continuity, the scope of research publications was similar to that in Study 1 (see Figure2). This study used a quantitative research design to analyse data representing relationships between published authors. While the qualitative research revealed major factors that influence the adoption of innovation, the Study 3 focused on testing the assumption that social dimension is a key influencer in adoption of innovation in form of ideas. The research is addressing directly the question: are social connections a major factor of influence in adoption of ideas represented by the propagation of research concepts across the academic spectrum in the field of

Learning Design? If this is true, then the analysis of the connections represented by publication references will show that the underlying factor that influences the choice of ideas and research objectives is based on the strength of social relationships. The data collection occurred in three phases: software design and development, collection of publications in electronic format, processing and data generation, and finally generation of social network diagrams. In the first phase, I designed and implemented a software programmed in Access Visual Basic to parse publications text to extract citations. In the second stage, I collected over 30 research publications in electronic format and extracted the reference sections from each of them to feed it as input into the parsing software program. Although the initial data set is not large, the underlying connections are substantially larger revealing complex relationships between authors, far beyond the initial Learning Design domain of research. In the third phase, I generated social networking graphs with Gephi, an open-source networks visualisation software, to illustrate the relationships between the authors using the links generated in the previous phase.

### *Study 4 Data Collection*

The fourth study used an interview questionnaire to capture the influence the factors listed in the theoretical model have on the process of adoption of innovation at each stage of adoption. The design was intended to test the hypotheses of the theoretical model of social adoption of innovation according to which three dimensions of factors influence the adoption in different ways, depending on the stage of adoption: social structures varies from one stage to another, cognitive requirements change with each stage, and professional development is more pronounced at later stages. The interview also attempted to test the assumption that individuals display different behavioural characteristics depending on the adoption stage, greatly influenced by their interest, motivation and needs. To achieve this goal the questions invite the participants to recount experiences that are related to each adoption stage. The questions were designed to match the main structures of the theoretical model so that the answers could be linked with minimum ambiguity, but they also allowed the participants to tell their personal experience in an open format, story-like (see Appendix A – Questionnaire). The reason for this design was to set broad boundaries while encouraging the participants to elaborate thus creating the opportunity to capture unexpected findings.

The selection of participants was based on a profile influenced by Study 1 and Study 3. This supports the continuity and coherence of the research in limiting the number of high level variables that each study introduces in the research process. In broad terms, these are the participant profile preferences:

1. Has been part of a project aimed at evaluating, trialling and implementing a relatively new system (3-5 years old) within the organisation.
2. Has been part of, managed, or attempting to devise and implement an organisational change, such as changing the culture through a different work place arrangement, a new management structure, new collaboration system, etc.
3. Has been part of, managed or govern (as in the process of governance) as a member of an overseeing committee for the implementation of a large, widely adopted standard system (technological, administrative, performance management process, etc.).

4. Has changed a professional belief, a fundamental theoretical/conceptual principle, sometime during his/her professional career. I know this is hard, but it would be great to interview a person with a defining experience such as this.
5. Was/has been a member or as a leader, actively working on an innovation, exploring of a new thinking, or conceptual territory using emerging systems/tools/methodologies (including those borrowed from other disciplines).
6. Involved in projects where new technology or innovative use of technology is an important part of work.

The profile preferences show an inclination toward technological innovations, as the previous two studies were focused mainly on the adoption of online technology, but it doesn't preclude non-technical respondents to participate in the interview. The targeted participants were selected from academic researchers, professional staff and educators working in a major higher education institution.

The interview encouraged the participants to recall personal experience of adoption of an innovation in each stage: innovators, early adopters, early and late majority. For example, a researcher may be an innovator working on a ground-breaking new theory, but the same person could be a late adopter when it comes to the adoption of a new gadget or a software system. The questions try to ascertain the quality (how sustainable is the adoption?) of adoption by encouraging the subjects to describe how new habits are formed by identifying the three elements of a habit: cue, routine and reward.

Each interview session was audio recorded. After the entire interview process was completed the audio files were transcribed by a professional transcription services organisation into text files for data analysis. The names of the participants were removed from text to preserve their anonymity.

## Analysis and Representation

### *Analysis Study 1*

The analysis of the narrative that described the experiences of adoption of the online tool resulted in a collection of texts which captured problem patterns in the adoption process as reported in the selected research literature. The organisation of the initial data was followed by open coding (first data analysis and segmentation into categories), axial coding (establishing relationships between categories of information and the central concepts), selective coding (validating relationships and selecting the principal categories) to identify essential statements that describe the phenomenon of adoption. The application of this method resulted in a set of coded common patterns (see Figure 17). Final analysis converged the coded problem patterns into three major distinct areas of concern (dimensions) mapped against the widely used concept of stages of adoption of innovation developed under the diffusion of innovation theory (Rogers, 2003). This study was essential to the development of key definitions and terms that have been used throughout the entire project. The three dimensions are an important part of the main proposed theoretical according to which these dimensions represent major factors that influence the process of adoption in synchronicity with the stages adoption cycle.

### *Analysis Study 3*

The goal of the data analysis in this study was to examine the social relationships using the social network visual representation in relation to the first main research question (major factors of influence on adoption of innovation) and its sub question related to the influence of personal social connections. Gephi uses sophisticated mathematical algorithms to organise the networks in intuitive visual representations which were useful in showing the strength of reciprocal citations between authors and the referred literature. While this was the initial intended design, I had an open mind to exploring other relationships that may be relevant to the adoption of innovation. This resulted in a few extra unplanned rounds of analysis with interesting observations.

The first round of analysis of the social networks graph, which was created from the author-publication-author relationship list extracted from the reference database, revealed the authors who are connected to each other at a much higher strength level than others. The next round of analysis was to explore the nature of these relationship: are they based on real life personal and professional relationships? This analysis involved in-depth research using information publicly available on the internet: biographies, resumes, projects, programs, participation to conferences. This analysis confirmed that the majority of the strong links in the social networks are in fact based on personal relationships that extend in time far beyond the boundaries of research projects, some of them going back to early years when researchers met as students at the same institution in another country. These findings supported the assumption that social relationships have a strong role in adoption of innovation, even when these relationships are formed outside professional settings. Working on the same team does not mean the relationships are strong. The analysis of a couple of author-nodes that looked strong but seemed to be oddly isolated, found that the nature of the relationship between authors was one between student and institutional authority without any follow-up.

The next round of analysis looked at the literature cited by authors in the context of their relationships with other authors. This analysis showed the shared interest which is believed to be influenced by their relationships and shared ideas. This representation is useful for identifying strong social relationships and the evolution patterns of emerging fields of research that form under the influence of these relationships. To test this hypothesis I generated social network graphs over time and observed the evolution of author-to-author links and the apparition of referenced literature. By analysing the topics and the context of publications it started to become clear how areas of research appear around these relationships. This suggests that the social connections play an important role in the choice of research literature, but also in the adoption of new ideas that gradually lead to the formation of new fields.

### *Analysis Study 4*

The analysis in this study followed the steps recommended by Creswell for qualitative data analysis: transcription, data organisation, manual and computer analysis (2008).

The first step involved a manual analysis of the set of Word documents produced in the data collection stage (see above section). This consisted in reading the text, divide the text into

segment of information, interpret and link relevant entries to codes sourced from the theoretical model where appropriate in separate document, as in the example below (see Question 5 in Appendix A, Questionnaire):

| 5 | How did you interact with other people? | |
|---|---|---|
| 10:40. Interaction in a professional setting. Direct face-to-face with the supervisor, colleagues and friends on working on PhD projects. Interaction with known academics (experts in psychology) outside the personal network (email/phone).<br>The participant interacted with the supervisor, other researchers that were not part of the personal network | | |
| **Social Interactions** | **Type** | **Narrative** |
| Face to face | Close collaborators | The supervisor was the main collaborator. |
| Email | Outside personal network | Sent emails to "big names" in psychology to ask for advice |
| Face to face | Users | Children parents |
| Face to face | Friends | |

The first step converts the transcription into a data object in which the text is organised using codes aligned with the theoretical model, but also using codes that were created based on the analysis of the original text. These codes were added to accommodate unexpected findings based on the frequency of occurrence and their perceived importance to the participants' experience. This approach attempted to establish a balance between maintaining consistency and allowing the capture of facts that fall outside theoretical expectations.

The next step involved the creation of a spreadsheet with interview participants and adoption stages organised as rows and the questions as columns. Data created based on the identified codes was added to each corresponding interview and columns. Subsequently the data was normalised (as in a relational database sense, with each row having allocated a question ID and adoption stage) and colour coded for easier visual identification of data related to specific adoption stages. The normalised colour coded spreadsheet was the baseline from which data was extracted using pivot tables to do in-depth analysis and generate charts (see Chapter 7). The data analysis process was designed to be consistent with the previous studies and the theoretical model.

In addition to encoded data analysis, the interview study presents observations that resulted from qualitative analysis of the experiences narrated by the participants. These observations reflect on how the study tested the initial hypotheses and comment on unexpected findings that fall outside the scope of the theoretical model.

## Ethics

An important aspect of this research was the adherence to high ethical standards throughout the entire project. One of the critical stages of the project that requires careful consideration of ethical aspects is the data collection. In addition to following a formal process of obtaining the approval from the ethics committee, the approach was to be guided by widely recognised ethical principles, based on respect toward participants, creating a sense of trust, protection of privacy and minimum disruption (Creswell, 2008).

The notion of ethics is not limited to the procedural aspect of ethics, but it includes their application in practice, which requires a purposeful attitude involving reflexivity as a "process of critical reflection both on the kind of knowledge produced from research and how that knowledge is generated" (Guillemin & Gillam, 2004). In the case of this project, the "ethics in practice" meant continuous self-scrutiny, critical evaluation of the quality of research, and recognition of limitations.

In the interview process the selection of participants in Study 4 was based on criteria designed with the purpose of testing the theoretical model. The actual selection process separated the researcher from the decision of which potential respondents the invitation should be extended to. The interview was conducted with the first batch of participants who accepted the invitation, with no subjective preference. The interview was conducted at a location in agreement with the participants and each session was preceded by a detailed explanation of the research project and its purpose. To ensure a maximum level of objectivity and authenticity, the participants were encouraged to feel free to choose any example of adoption of innovation that would fall into each adoption stage. The successful application of measure is reflected in the wide range of examples of innovation, some could be even considered surprising, and the fact that they lead to unexpected findings which may become subject to future research studies.

Although Study 3 is a quantitative research project which did not involve a direct contact between the researcher and the authors considered in the study, it was given the same ethical considerations as to a qualitative research study. The data collection was limited to electronic information gathering and processing, however the data analysis involved extensive manual research that involved the collection of personal information. This activity was conducted in the public domain using internet search engines and it involved long hours of data gathering, cross-referencing, and reading articles and reports to endorse the quality of the research findings. Although the data gathered during this process was entirely public, the details of the social connections and the context in which they occurred was kept private because of the potential risk of erroneous interpretation and potential concerns of privacy of those considered in the study.

## Limitations

This research project attempted to find answers to difficult research questions. The difficulty is caused not only by the complexity of the subject, but by its breadth. This is the first limitation that must be acknowledged as it had an impact on the scope of the individual studies involving data collection. The scope of Study 1 and Study 3 were limited to the adoption of Learning Design and related technologies, teaching, academic research in Learning Design. Study 4 is an interview study conducted in a higher education institution using a sample size big enough to allow a pertinent and useful data analysis, but small considering the scale of the research subject. The findings sections of individual studies discuss the inherent limitations, and the overall findings (see Chapter 8, Findings) analysis include remarks considering future studies to address this issue. The literature review has also been limited to a subset of the entire knowledge domain related to innovation. While I made an effort to capture the most important aspects related to the spread of innovation, influence and adoption of innovation as documented in publications spanning over a

hundred years, I may have missed publications that should have been included in the review and that could have had an impact on the following studies and the proposed theoretical model.

Although the studies are complementary, allowing for cross analysis and covering a wide range of scenarios, they provided a limited exploration of the adoption of innovation phenomena. A decision that I made early on was to focus the research on social and cognitive factors mostly related to influence, discovery and learning, and not include specific elements that contribute to the final decision of adoption (such as cost, compatibility, suitability, etc.) or change management. These elements fall into an area that is outside the scope of this project, an area that would require extensive research needing to take into account characteristics of individual industries, technologies, project management standards, and organisational change management.

A key influential factor in determining the course of this research is my subjective view of this topic. As I mentioned at in the Introduction (see Chapter 1), my personal experience was a source of motivation and inspiration that led me to take on this project. This bias is reflected, for instance, in the selection of innovation case studies, which in early studies are focused on Learning Design, and the choice of the institution in the interview study. While I believe that I followed an objective path driven by rational decisions, it is reasonable to assume that my educational and professional background has influenced my research in ways that I may not be aware of. This creates 'blind spots' that have been overlooked, affecting the course of exploration, the design of data collections, analysis, findings and ultimately the final conclusions.

# Chapter 4 Multidimensional Adoption Patterns in Learning Design[1]


## Abstract

The Learning Activity Management System (LAMS) has been trialled and used by users from many countries around the globe. Despite positive attitude towards its potential benefits in pedagogical processes its adoption in practice has been uneven, reflecting how difficult it is to make a new technology based concept an integral part of the education system. In order to investigate and determine the elements that block the adoption of learning design tools in general, the study will analyse research papers that have been published in recent years on this subject, especially LAMS. The study will identify and discuss patterns of critical aspects related to adoption of learning design tools and derive a framework that can be used in follow-up studies aimed at collecting relevant empirical data from practitioners to identify key progress measures of the adoption process. These measures may be used later to devise strategies that will see increased adoption of online learning design tools such as LAMS in school systems and higher education institutions.



Keywords: learning design, LAMS, adoption life cycle, social network, information cognitive structures


## Introduction

Learning design is a "descriptive framework of activity structures that are designed following many pedagogical methods" (Dalziel, 2010)**.** The most important promise of learning design is the sharing of good teaching and learning ideas (Dalziel, 2010). The Learning Activity Management System (LAMS) implements a learning design framework using open source software for product development. The framework, the product and the platform architecture are based on the fundamental belief that progress is achieved through social sharing and creative participation. LAMS was initially adopted by pioneering users who tried the product and identified their own innovative ways in which they used it in the context of modern professional practice, similar to the case of other innovations (Christensen et al., 2008).

Broad adoption of learning design framework with LAMS depends largely on the spread of relevant knowledge throughout the teaching community. This study will focus on analysing the literature published on LAMS and learning design and then discuss the findings and propose a framework for understanding what works best for accelerated diffusion and broad adoption of learning design tools.

## Method

This study will analyse papers published at LAMS conferences or elsewhere in recent years to identify markers that provide clues about factors that have influenced the adoption of LAMS in practice. The study will use as its starting point Spence's (1994) description of the

[1] This is a published article (Badilescu-Buga, 2011) with minor editing changes.

spreading of innovative solutions as a series of steps: awareness, interest, evaluation, trial and adoption. Awareness, interest, and evaluation are part of the diffusion process where ideas are being discussed and opinions changed before actual action is taken to invest more time in evaluating and trying a new product. These three steps are very social in nature and they play a crucial role in reaching across a large user base. The last two steps in Spence's definition are considered together as one step in the adoption process.

The study refers to adoption of innovation as a general term in which new concepts are accepted and implemented into current practices with no consideration of detailed processes that need to take place in adopting organisations; this is what change management typically studies and it is outside the scope of this paper. This review will look at the adoption of innovation in a broad social context, rather than examining product features and detailed aspects of technical design. Following analysis of the publications, the study will identify major patterns of adoption challenges and examine ways of conducting further investigations to improve understanding of various aspects of diffusion and adoption of LAMS, and formulate strategies for accelerated adoption.

## Adoption of Learning Design Experience Analysis

The analysis includes articles published at LAMS conferences in 2010 (Dalziel, 2010) and 2011 (Alexander, Dalziel, Krajka, & Kiely, 2011) in which the issue of adoption or factors that influence adoption are discussed. The approach adopted was to analyse the research papers published in chronological order because there were no ex-ante criteria for grouping them. This approach has a practical advantage in that it eliminates any bias towards conclusions regarding perceived common challenges as they are flagged across the research activities conducted by the authors of the reviewed publications, unrelated to a particular topic or preferred point of view. The intent is to demonstrate that while individual research efforts concentrate on particular aspects of learning design they share common challenges around adoption. The observations made during the analysis process are pertinent to the issue of successful adoption and they are grouped in subsections below under headings that describe the original focus of the research activities. The Discussion section will interpret the observations and identify the main themes for adoption challenges. The Analysis section will go a step further and propose a conceptual framework for adoption of learning design tools that can be used for designing data collection strategies in subsequent research.

### *Learning Design and LAMS*

In a study conducted at the Faculty of Education, Edith Cowan University, Eva Dobozy raises the issue of the difficulty in motivating students (pre-service teachers) to engage in deep learning using online collaboration tools (Dobozy, 2009). The study found that although the majority of students participated in learning design tasks with LAMS, their contribution was presented mostly in the form of simple statements. More sophisticated contributions in the form of inquiry-based argument or evaluative, evidence-based position-taking represented a much lower proportion of the student contributions.

The study revealed that there are two aspects that have a big impact on the students' level of intrinsic motivation: the online activities are non-assessed learning tasks and the effort required to create engaging tasks using the online tools is very high, lowering their motivation. The research found that merely providing flexible online collaborative tools is

not sufficient for motivating students when the tasks are not assessable to test their understanding of pedagogy, confirming the findings of Goodyear & Ellis (2007) . One student said that he could not contribute more because he could not find a reason as to why he should spend more time on this task rather than on his maths assignment which was worrying him a lot more. He did not need to use LAMS, so he did not, despite the fact that he liked it. The students' feedback had an impact on what the teachers thought of using LAMS as part of their pedagogical toolset. The fact that LAMS is not included in the institution's formal requirements it makes it very hard for teachers to believe that the idea of adopting LAMS is feasible, despite positive opinion about the product.

### *Sharing Across Communities*

Sharing takes place in communities. Simon Walker and Liz Masterman conducted a study to investigate how teachers apply in practice their intention to share and re-use others' materials (Walker & Masterman, 2010). The study affirms that community based sharing needs to meet three essential requirements: the learning design is based on sound pedagogical principles, it promotes sharing of expertise, and it supports the community through available support services. It was found that sharing works effectively in small communities of practice (as defined by Wenger (2009)), where members know each other very well and have many face-to-face interactions. In the context of large online communities (also known as "quasi-communities" (Hung & Nichani, 2002b)) where members are scattered around the globe it is difficult to instil a culture of effective sharing and reuse practices. To compensate for the low level of social ties between members of quasi-communities, Walker and Masterman proposed the use of the CAMEL (Collaborative Approaches to the Management of E-Learning) model where teachers are offered "scaffolding" into the practice of sharing. Their research indicates that teachers have a preference for using models as an inspiration for creating learning designs that suit their own style and context rather than simply copying the shared samples.

### *Learning Design Templates*

Cameron (2010) discusses the use of generic learning design templates for sharing and reusing good practice. Although there is a strong argument for and expressed interest in reusing practice exemplars, teachers are often reluctant to use expert advice. Heathcote (2006) found that a major obstacle to teacher adoption of learning designs is an insufficient level of the pedagogical understanding required to make use of resources. Although the value of sharing is well understood and accepted by users as a way of saving time and effort, "technical" barriers prevent it from happening at a larger scale (Philip & Cameron, 2008). The barriers include an inability to easily customise learning designs and difficulty in searching and finding resources.

Research studies that were considered in this study confirm the view that reusability is effective when shared learning designs are well specified, have a good pedagogical scaffold and can be reused by adapting the resources (Boyle, 2006) or can be uses as design models (Philip, 2007). Laurillard & McAndrew ( 2002) suggest that learning designs are more transferable if they are not de-contextualised and have sufficient detailed information regarding the learning conditions. It was also found that sharing and reuse work better if users provide honest feedback attached to shared learning designs, not just positive commentary.

Cameron (2010) notes that current expectations of teaching practice require teachers to master a variety of techniques and adapt them to a multitude of learning conditions in a challenging environment characterised by budgetary constraints and students' diverse cultural backgrounds. This, in turn, demands the adoption of pedagogical guidelines in the production of shared learning designs through the use of planning tools, the production of generic templates that can be easily adapted, and quality content. While the use of generic templates increases productivity it may be difficult for educators to interpret the intent of the templates (Bennett, Lockyer, & Agostinho, 2004) and their excessive use runs the risk of students becoming bored because of repetition.

### *Adoption of LAMS*

From its inception in 2003, LAMS has grown continuously and by April 2010 it had been used in over 80 countries, translated into 30 languages and its community had 5,753 members with over 500 shared designs (Dalziel, 2011). The idea of sharing ranks high on the wish list of many teachers, as is often revealed whenever they are asked in interviews or workshops what factors would help them make better use of technologies for learning (Beetham & Sharpe, 2007). While the interest is high, LAMS is seen as a niche rather than a mainstream technological product and successful trials have not led to broad systematic adoption (Masterman & Lee, 2005). In a practitioner trial of LAMS conducted over eight months, Masterman and Lee (2005) found that although the system is capable of supporting a range of pedagogical approaches, there are obstacles posed by technical and cultural issues, particularly the increased work load associated with adoption.

### *Diffusion of Learning Design through Professional Social Networks*

In an attempt to encourage the sharing of ideas, designs and resources the Open University UK (with support from the Joint Information Systems Committee - JISC) created a social networking web site called Cloudworks (Galley, Conole, Dalziel, & Ghiglione, 2010) . One of the key objectives of the web site was to promote sharing of learning designs.

Cloudworks has concentrated its development effort on addressing two issues that prevent productive sharing from occurring: allowing LAMS sequences to be ported to external web pages and identifying the best learning design "pedagogical wrapper" for providing contextual information to practitioners who want to re-use LAMS sequences. Research on the use of Cloudworks has identified aspects that have an impact on the quality and ultimately on the likelihood of sharing occurring: matching the user's needs, usability, presentation friendliness, level of detail (Conole & Culver, 2009, 2010), and the perceived sustainability of repositories.

Cloudworks has been built around Engeström's (2005) object-centred sociality concept which is based on the idea that objects are at the centre of developing new social networking services. In this case, the object is a "Cloud" defined as content related to learning and teaching. The social aspect is given by bookmarking, feedback, and tagging features which were designed using Bouman's (2007) framework and Conole & Culver's (2009) theoretical underpinnings.

The Cloudworks project team concluded that a LAMS "pedagogical wrapper" improves the experience of sharing case studies of good practice, networking and discussing ideas with others. The wrapper would include essential details describing the shared LAMS design: context, transferability, academic references, and reflections of the designer, links to other designs, supporting resources and technical support and a glossary of terms.

### *Pedagogical Properties of Learning Design*

The sharing of professional practice through learning design can be enhanced if it is based on patterns that encapsulate the critical pedagogical properties of the design (Ljubojevic & Laurillard, 2010). Without a pedagogical model, it is very difficult to establish a common set of references needed in the dialogue of practice sharing. Ljubojevic & Laurillard (2010) created the Conversational Framework as a set of requirements of what it takes to learn and used it to build representations of pedagogical patterns for learning designs. Good learning design rules can be categorised by source: theoretical, practice or patterns of learning design, or by contributing elements of design: epistemological, curricular or logistical (Koper & Tattersall, 2005).

Ljubojevic & Laurillard (2010) argue that the sharing of professional practice needs to consider the fact that pedagogical approaches are influenced by theories of learning which are reflected in classroom activities. There are differences between various theories of learning which could be grouped into categories such as natural learning (Theory of Learning) and instruction based learning (Instructional Design Theory) (Reigeluth, 1999); (Simon, 1996). The theories of learning need to be operationalised by expressing them in terms that not only help in understanding the "how", but also in terms of "why", so that teachers can adapt models to particular conditions

A three-year project titled A Learning Design Support Environment (LDSE) proposes to create a pedagogical pattern template for design description called *learning score* that can be used to encourage sharing by using 14 cognitive activities and a set of standard meta-data fields that promote a protocol for documenting design practices using online tools such as LAMS (Ljubojevic & Laurillard, 2010).

### *Adoption of Innovation by Institutions*

Fresen (2010) found that the factors that influence a successful implementation of web-supported initiatives could be grouped in a taxonomy with six categories: institutional, technical, pedagogical, instructional design, lecturer, and student. A useful alternative view of how the lecturer views the adoption of technology in education in the context of personal attitudes is offered by placing the taxonomy in the context of the cognitive information retrieval theory (Fresen, 2010). Information generation is based on institutional, instructional design and technology factors, while the reception of the information (and its use in the pedagogical process) is based on student, lecturer and socio-organisational environment factors (Ingwersen, 1996).

### *Learning Design Tools Usage Patterns*

A survey of 68 teacher education students showed that learning design is not uniformly understood, with perceptions ranging from misconstruction to highly developed understanding (Bower & Wittmann, 2010). The study discovered that pre-service teachers

need technical training on how to use the tools but they also need training to help them understand how to use the tools to achieve pedagogical goals. A two-hour lab-based tutorial was not sufficient to give the technical and pedagogical skills needed to create learning design for activity-based lessons and long-term courses.

### *Learning Design for Teacher Education Students*

A study that looked into how pre-service students learned to use ICT tools for learning design by undertaking a course aimed at teaching technical skills in a pedagogical context found that the course has long-term value if it promotes generic technology skills and if the students are introduced to a broad range of related philosophical and pedagogical issues that arise from the integration of technology into the classroom teaching and learning processes (Campbell & Cameron, 2011) and (Oliver & Herrington, 2002). It was found that the lack of practicum experience has a negative effect on the learner's ability to connect the theory to the reality in the classroom (Loughran, 2007).

## Discussion

Analysis of research studies on adoption of learning design technology found patterns of overlapping adoption challenges that broadly identify the major areas of concern. Many studies included in this study found that there is consensus among teachers that sharing of practice exemplars with online tools improves productivity. This improvement is achieved by being able to reuse learning designs, lesson plans and new pedagogical methods from a vast pool of shared resources. These studies reveal particular aspects that contributed to successful implementation, but they also highlight specific issues that prevented the adoption of LAMS. The studies complement each other and can be used in combination to create a more comprehensive image of the overall adoption life cycle.

Previous work by Moore (2002) found that a very small proportion of the population (2.5%) are innovators who will experiment using new technologies, followed by early adopters (13.5%) who will use new technologies with little or no support. Newton (2003) conducted extensive research in the UK and found that "developments are often led by the enthusiasm of individuals with little extrinsic reward structure to encourage these innovations". The adoption of technology by the majority of customers requires substantial support in the form of end-user support groups, guides, consultation sessions, and demonstrations (Moore, 2002).

In general, adoption is accelerated when users perceive that there is a clear long term benefit from using the innovative product and when the network effect is occurring (Teece, 1986). Wider adoption of online learning design tools will be reached when the overwhelming majority of teachers have online access to a large number of learning design resources, understand the conditions in which they have been created and applied, reuse them easily as-is or modify them to suit specific pedagogical conditions, and share their experience using broadly accepted pedagogical terminology and data structures.

The act of sharing and the adoption of online tools that facilitate sharing involve several aspects which were considered by various research studies. If we group these aspects by distinct discipline domains, we are able to simultaneously investigate what works within each domain and explore the relationships between the domains that impact adoption as an

overarching process. A further study aimed at defining strategies that can be used for achieving a successful adoption, could employ a combination of approaches derived from theories and methodologies specific to these domains of research. This requires greater effort, but would be more effective than trying to find ways to successfully adopt learning design technologies through the lens of one discipline. For instance, perfecting the pedagogical framework in isolation will not be sufficient to achieve successful adoption.

This study identified four domains that cover the major aspects related to the adoption of online learning design sharing tools: innovation adoption life cycle, social sharing, cognitive structures, and professional development.

### *Innovation Adoption Life Cycle*

Moore's theory of the life cycle of adoption of disruptive innovations is built on earlier work by Rogers (1995), and it is based on statistical analysis of data collected from many industries that describes the process of adoption from a quantitative perspective: time and number of users adopting a particular innovation, regardless of the industry in which the innovation occurs. Moore suggested that a critical stage in the adoption of innovation, which he calls "chasm", is the transition from first two stages of adoption to the early majority stage (Moore, 2002). This is an excellent tool that allows us to objectively evaluate the adoption stage of LAMS, however it does not tell us what methods we should use to accelerate adoption or the reasons why adoption follows a certain path. Based on the same historical data, Christensen proposes the use of an additional tool, the Substitution Curve, which indicates whether a particular innovation is on the right adoption track (Christensen et al., 2008).

### *Social Dimension*

Adoption of online learning design tools takes place in a social context. The role of social interactions is even more important when a new field emerges, as in the case of learning design, and when the practice has not yet reached a level of broad consensus. Tools related to this domain specialise in understanding social interactions, organisation and behaviour of communities, digital network structures and group behaviour in large digital communities. We can better understand the process of adoption of innovation by using these tools and generate ideas inspired by theories and models developed in the field of social sciences.

### *Cognitive Dimension*

The sharing of ideas and experiences, the participation of community members as both content creators and content users, the diversity of contexts in which learning designs are applied, the variety of institutions involved, the multitude of policies and socio-economic and cultural backgrounds; all of these factors pose significant challenges from the point of view of the knowledge organisation, access, discoverability, presentation and processing. To respond to these challenges, we need to define a model of cognitive structures that enables the generation of information, creation of a clear communication interface and the effective use of information in the socioeconomic, cultural and institutional context in which the user operates. The work of Ingwersen on cognitive and information retrieval theory (Ingwersen, 1996) could be applied to create methods and tools that help address challenges specific to this dimension.

### *Professional Dimension*

This dimension is deeply anchored in pedagogy. This is the core that represents the interest, the problem and the solution for the end-user as a teacher, a principal, a learning consultant, indeed for everyone who wants to use online learning design tools for the purpose of solving a teaching and learning problem. The challenge of this dimension is that it needs to respond to users' needs in a specific pedagogical context, while at the same time it needs to present the contribution of many practitioners in a generic pedagogical frame that can be easily understood and adapted for local use. The analysed studies identified the pedagogical aspect as a critical element in the successful adoption of online learning design tools. The professional dimension is about supporting teachers' desire to improve their professional performance and use learning design tools in alignment with formal pedagogical requirements. This brings confidence that the effort invested in adopting the tools is beneficial from the perspective of personal career development and from the perspective of the institution in which teachers operate.

## Analysis

Among the four identified domains, the innovation adoption life cycle is fundamental; it describes the broad process of the adoption of learning design. The other three domains describe specific conditions that need to be met in order to successfully take learning design tools, such as LAMS, from the innovators stage to complete adoption. The literature review (see Chapter 2) suggests that most effort aimed at improving the adoption of innovation has been focused on the technical aspects of the adoption life cycle without in-depth consideration of aspects related to other domains.

This study proposes an adoption of innovation framework based on the view that that adoption takes place in stages where milestones are achieved under the influence of factors that have characteristics specific to each individual stage. These factors are quasi-synchronised and are linked to the four dimensions described in the prior sub-sections: innovation, social, cognitive, and professional (see Figure 3).

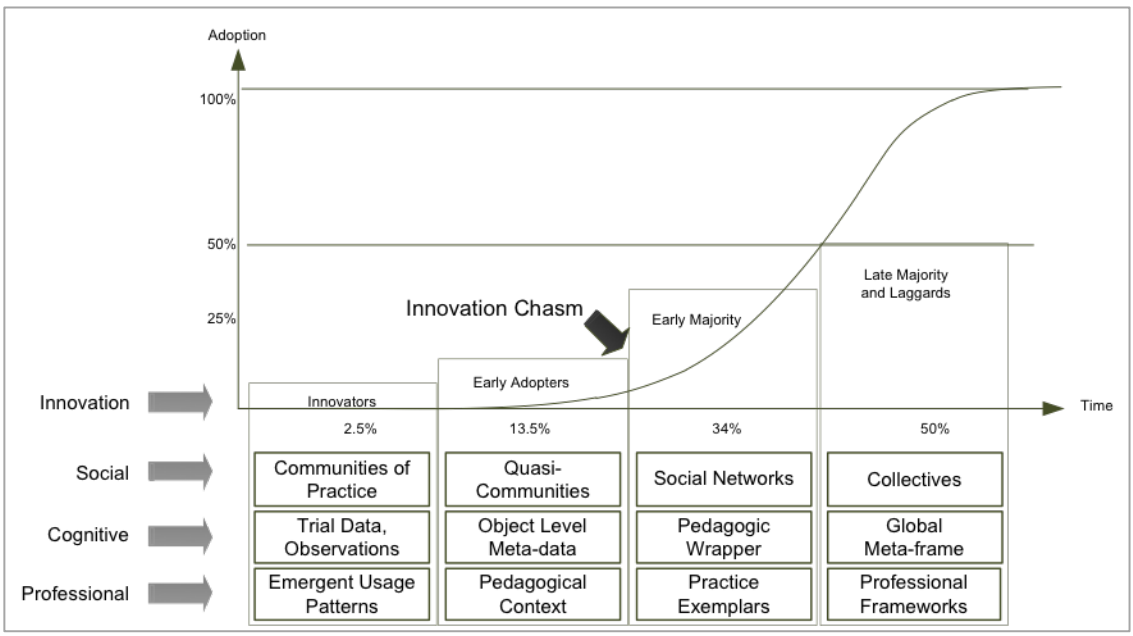


*Figure 3 Adoption Stages*

The synchronisation reflects the interdependence between the dimensions. Thus, innovation cannot advance successfully to the next level of adoption if ideas are not diffused through appropriate social structures, if the generation of information and the use of information do not involve appropriate cognitive structures and if the innovation is not reflected in an adequate pedagogical form.

### *Innovators Stage*

The earliest stage occurs in a community of practice, as defined by Wenger (2009), where the focus of its members is on innovation-related activities through an intense process of collaboration, face-to-face interaction and execution of tasks aimed at reaching a high-risk innovation goal. The innovators try new products, services and concepts to transform the current practice.

The explicit cognitive structures are not fully developed at this stage as the generated information is shared based on trust and implicit rules borne out of a long history of cooperation, face-to-face interaction and ad-hoc creative activities. Trial data and related observations are generated and presented in pedagogical terms and other minimal cognitive items are shared through mostly informal conversations among members of a community of practice.

Professional practice relies on the knowledge and skills of members of communities of practice who learn by doing and participating in the innovation process. Innovators may share the acquired knowledge and experience with the broader professional community and interact with others interested in the new development.

### *Early Adopters*

Walker and Masterman (2010) found that small communities of practice are early adopters of innovation. It is important to make the distinction between the communities of practice of innovators and early adopters. Early adopters are part of a network of distributed communities that are loosely connected, aiming to adopt new tools and processes made available by the original innovators. These networks are referred to by Hung and Nichani as quasi-communities characterised by loosely-knit relationships, bound by indirect explicit flow of information, with members largely unknown to each other and in general exhibiting low organisational trust (Hung & Nichani, 2002b). The online quasi-communities are built ad-hoc in spaces created by a hosting public infrastructure, which could be generic (wikis, Yahoo, Facebook) or more specialised (LAMS communities, CloudWorks).

The characterisation of learning in a community of practice by Hung and Nichani: learning is demand driven, it is social, and it is identity forming. These characteristics may be used to differentiate between formal school learning communities and “real-life” communities, as Hung and Nichani describe (Hung & Nichani, 2002a). Teachers join the quasi-communities because of their intrinsic motivation, seeking to learn and be inspired by what they find, cultivate relationships with other members based on common interests and needs, and in the process, share their own experience.

The artefacts generated by innovators need to be gradually organised distinctly as an information source that is made available to others through an interface that communicates

messages in a linguistic form with lower semantic levels (Ingwersen, 1996). This loss of meaning is a barrier to adoption because it requires teachers to invest time and effort in using cognitive structures, based on their perception and interpretation of their current cognitive state, to access information that is necessary to perform their pedagogically contextualised work tasks. Early adopters need to have appropriate cognitive structures that help them access information that matches their needs and use it effectively for problem-solving purposes.

Social cognitive structures raise the level of trust in quasi-communities through an open and transparent feedback system that participants can use to rank learning design objects, providing commentary and making recommendations (Cohen & Prusak, 2001). Over time these cognitive structures will build implicit trust similar to organisational trust that binds together members of communities of practice (Hung & Nichani, 2002b). Based on previous observations, the study recommends that to increase the likelihood of an increased adoption the architecture of the learning design tools needs to embed social and cognitive structures into the product platform and product to facilitate social interactions and provide more information needed to understand the learning design. If cognitive support is low, early adopters will try to use the learning design tools and attempt to integrate them into their practice, but they will find it difficult and time consuming to discover the appropriate resources and reuse them, and consequently they are more likely to discontinue their adoption efforts.

Shared learning designs need to be based on sound pedagogical principles (Walker & Masterman, 2010) which should be supported by the learning design tools. As online tools are adopted by an increasing number of users, a professional framework needs to be put in place for two purposes: 1) to educate users about learning design based on pedagogical principles, 2) to facilitate adoption in alignment with pedagogical goals set at institutional level. Pedagogical techniques need to be shared online and linked to learning design objects to enhance the sharing and re-use experience (Cameron, 2010). Where clusters of users are formed resembling communities of practice within the larger quasi-community, focused professional support can be provided through face-to-face meetings led by leading innovators and experienced users. These demand-driven, problem-solving educational sessions can be organised using an approach such as CAMEL (Masterman, Manton, & Balch, 2008) that offers scaffolding of the practice of learning design, sharing and reuse.

### *Early Majority*

The critical moment in the innovation adoption life cycle occurs when the innovation has been trialled, tested and is successfully used by early adopters with positive results and an increasing number of users are attracted by the benefits resulting from the implementation of the innovation (Moore, 2002). The gap between the two stages of adoption, which Moore calls the Innovation Chasm, represents a jump in the adoption rate from 16% to 50% with transformational impact on professional practice.

The social context in which large-scale adoption occurs in an online world undergoes some significant changes. The term quasi-community gradually becomes an inaccurate description of the user base because participants have higher expectations from their interaction with the community in the sense that the community needs to be richer, with more

opportunities for learning, and id needs to be easy to find resources needed to solve problems. We use the term “social network” based on the term “network” by Dron and Anderson (Dron & Anderson, 2007) to describe the social nature of this type of online community, but with a professional element attached to it as we are referring to a community built around the use of learning design tools in particular and pedagogy in general.

A social network is a system that emerges from quasi-communities of successful early adopters with new members joining in according to their professional interest, need, and desire to learn from and meet new colleagues. The social network is one of the fastest platforms for sharing objects of interest, knowledge and skills and learning through the experience of others. It is assumed that by now the tools (products) have reached a higher level of maturity based on feedback and experience accumulated at earlier stages. The social network encourages the participation of its members through reward mechanisms with multiple benefits: peer review/ranking and recognition of both formal and informal contributions, learning, and identification of professional opportunities (Dron & Anderson, 2007).

The embedded reward mechanisms further encourage the sharing and reuse of learning designs and templates. Identity formation through social acts lead to emergence of ad-hoc groups based on affiliations, helping users learn “about” (how do I do this task) and “to be” (who am I, who do I want to become and interact with), influencing their personal formation and professional development (Brown & Duguid, 2002). This thinking takes the social network beyond Engeström’s object-centred sociality concept (Engeström, 2005) because it highlights the importance of the social element that motivates individuals to join a community. Networks with identity-centred sociality have better opportunities for maintaining vibrant communities where members converse about new ideas and share not only objects but experiences as well. The success of adoption through a social network depends largely on the level of trust representing social capital accumulated over time (Cohen & Prusak, 2001).

Despite advances in technology, human interaction in a social context is still needed to gain complex knowledge, especially implicit knowledge that cannot be fully described and stored explicitly in digital form (Polanyi, 1962). Consequently, this increases the importance of the diffusion process in highly trusted social communities where discussions of issues and sharing of information can help address problems that escape even the most careful system design.

Large-scale adoption of learning design tools requires sound pedagogical principles as a foundation for sharing of learning designs (Ljubojevic & Laurillard, 2010). The development of the pedagogical framework needs time and the participation of professionals from various educational jurisdictions to create rich general pedagogical structures that can be used as a template for localised adaptation and for support of professional development programs. Further research is needed to investigate which forms of pedagogical structures are suited to accompany learning designs representations (e.g. the application of the Conversational Framework to patterns described in the LDSE project).

### *Late Majority and Laggards*

Adoption at this stage is a continuation of the adoption process in the Early Majority stage. Depending on the size of the social network, its evolution creates historical data and behaviours that may gradually lead to the formation of Collectives, which are aggregates based on actions taken by individual members (Dron & Anderson, 2007). This could be referred to as collective intelligence and it manifests as emergent behaviour. At this level, social interaction between members is rich and fluent and the relationships formed between members are based on interest, likes, professional affiliation, location and type of institution. It is too early to say how a network of teachers sharing learning designs could evolve, and if it will evolve in a fashion similar to Facebook, Google +, Quora or other current networks.

Wide adoption of innovation requires substantial professional and technical support (Moore, 2002). If experience of any other products and services with large-scale adoption can be used as an indication, support needs to have centres of dedicated human resources who will ensure the efficient operation of the learning design platform within educational organisations.

## Conclusion

This study analysed published literature on learning design tools in general and LAMS in particular to identify issues that affect the adoption of online learning design tools in pedagogical practice.

The study proposes an adoption framework in which the adoption life cycle is considered in the context of three dimensions: social, cognitive and professional. Using Moore's (2002) definition of the innovation adoption life cycle as a guiding map, advancing from one stage to another occurs when conditions evolve synchronously within each of the three dimensions.

The study emphasises the importance of placing product development and adoption of new ideas in the right social context. Each stage of adoption occurs in the context of certain types of community structures. Products and online platforms should have embedded social features that match the community type of the audience they are addressing. Notions of trust and identity formation also need to be considered in further research.

Using LAMS as a case study, a potential research path would be to conduct follow-up studies with enquiry strategies customised for each stage of adoption by carefully designing surveys and questionnaires aimed at collecting data in each of the three dimensions in the proposed adoption stages framework (Figure 3).

The collected data will be used to refine the framework and create instruments that can be used to evaluate the adoption process and issue strategic recommendations for product development and support initiatives. The same instruments could be used by end-users to evaluate the quality of adoption and make decisions regarding the timing and the size of the effort they intend to invest in adopting a particular innovation.

# Chapter 5 Theoretical Model of Social Adoption of Innovation[2]


## Abstract

A key element in the adoption of innovation is addressing the knowledge gap caused by its introduction in practice. This study looks at the context in which information is searched for, found and retrieved, reviewing previous related research work especially in the area of cognitive information retrieval. As a result of an extensive review of research literature on the adoption of online learning design systems in education, and on information behaviour, the study proposes a Social Adoption of Innovation model, which includes information systems and social networks, and where innovators and adopters of innovation influence each other and participate simultaneously in the process of knowledge generation. The study also proposes two symbolic equations for general knowledge behaviour and information seeking skills gaps that reflect the contribution of multiple sources of information and the type of skills that are needed as part of overall knowledge behaviour.



Keywords: social adoption of innovation, innovation space, social space, knowledge behaviour, information behaviour, information need, cognitive gap, cognitive skills


## Introduction

The modern world often associates innovation with technology. While the creation of innovation might not always involve technology, its adoption very likely does. A sculptor could create a new style of art with no involvement of technology and still be regarded as having innovated in the art sphere. Today, however, it is inconceivable that the new style of art would be broadly adopted without the support of technology, especially when it comes to communication, sharing of data, opinions, discussions, presentations, and collaboration.

In this paper, the term innovation refers to disruptive creations that require radical changes in the way things are done. A disruptive innovation always has a small initial footprint and it is addressed to non-consumers, people who find mainstream products are not satisfying their needs (Christensen et al., 2008). This is in contrast to breakthrough improvements which are referred to sometimes as sustaining innovations. As an example, the iPad was initially addressed to users who wanted a simple way to enjoy the consumption of content using a light device that could be easily carried around. While PC manufacturers have continuously improved their products, they never addressed this demand in the same way. Apple sold 40 million units in 2011 and they were estimated to sell 60 million units in 2013, (Gallagher, 2012) posing a serious threat to PC manufacturers. Following the path of adopting disruptive innovation, while the initial use of the iPad was informal and casual, the new product is being rapidly adopted in many sectors ranging from education to health, the auto industry and finance, and is disrupting the traditional market. In this context, the latest improved version of the laptop, the ultrabook, is the product of a sustaining innovation.

[2] Published article (Badilescu-Buga, 2013), with minor editing changes

The adoption of innovation causes an initial knowledge gap between current knowledge and the knowledge needed to use the innovation effectively. Addressing the knowledge gap is a key challenge in the adoption of innovation, which translates into an information need that needs to be satisfied in order to solve the problem posed by the application of the innovation in practice.

One way to address this issue is by using information systems to find the needed information. Considerable effort has been put into the development of information systems as an efficient means of information storage and management, and into the design of intelligent interfaces that help users identify and access the necessary resources. Cognitive Information Retrieval (CIR) theory captures the challenges posed by the need to access the right information for successful problem solving and recognises the importance of understanding the socio-economic context of the user (Ingwersen, 1996).

However, although CIR theory has contributed significantly to advancements in the field of information retrieval, the theory is limited to analysing ways in which access to information can be improved through better design of information systems. Despite attempts to connect the realms of systems and users through multidisciplinary concepts such as the polyrepresentation continuum, multitasking framework, and models for information searching and seeking (Spink & Cole, 2005b), the theory remains faithful to its original intent, which is to focus on improving the experience of searching for information in library systems. This study discusses an opportunity to build on some of the work done in CIR by considering the broader social context in which knowledge is being generated and used.

This research will demonstrate the critical role of social processes in the generation and acquisition of knowledge and how the relationship between social and cognitive structures is facilitating the adoption of innovation, complementing traditional approaches to addressing the knowledge need through information system design. Advances in media technologies, the significant increase of computing power available to the public in the form of personal devices, and the very low cost of communications through the internet and mobile networks have radically transformed the way social structures are formed, how content is created, and how ideas spread. The study proposes a model in which social structures play the role of information sources side-by-side with information systems. The social structures, in the form of social networks, are seen as a hybrid formed by fusing together human and technological communication networks into one entity with a significant role in knowledge behaviour and adoption of innovation.

The study extends Brookes' (1980) equation for information science by proposing two symbolic equations which highlight the contribution to addressing the knowledge need of both social structures and information systems, and the fact that in the face of an overwhelming amount of information and constant knowledge generation, innovators and adopters of innovation alike need to evaluate their technical, social and professional skills to support their ability to find information, understand it and use it to create knowledge.

## Approach

This study is proposing a theoretical concept of knowledge behaviour and social adoption of innovation. Building on previous research on the adoption of innovation (Badilescu-Buga,

2011), the project expands the research literature review to examine the process of addressing the knowledge need as a key component of the adoption of innovation. This study uses a multidisciplinary approach to bring together theories and concepts relevant to individual aspects of the adoption process, and integrates them into a unified framework of adoption of innovation.

## Analysis and Findings

### *Information Behaviour in the Context of Adoption of Innovation*

#### *Key Definitions*

To create a set of common references needed for the understanding of the following analysis and discussion, it is appropriate to establish a few working definitions related to factual data, information and knowledge.

First of all, we need to highlight the difference between factual data and information. **Factual data** is the what-is generated by occurrences that take place in the "real" world: social, economic, cultural, environmental, and physical, etc. It is the equivalent of the Physical World in Popper's ontological scheme of the entire world of knowledge (Popper, 1972). Authors, humans and machines interpret factual data to produce semantic objects in accordance with their goals and store them in information systems. When semantic objects and factual data are subjected to manipulation and interpretation by users, the understanding of their meaning represents information to the user. Therefore, **information** is the subjective meaning that is produced through a process of interpretation of "potential information" by a knowledge structure (Brookes, 1980).

**Information behaviour** is the sum of all activities that are part of the process of acquisition and use of information. These activities may lead to the transformation of information into knowledge. The main components of information behaviour are information seeking and information encountering (Ford, 2005).

**Knowledge** is a system that enables the human, or machine, to act in the world. This is a complex term with hotly debated definitions, but in the context of this study, knowledge is the synergistic sum of information, cognitive and emotional skills; the know-how that enables action (Ford, 2005). Knowledge behaviour is the sum of activities that are part of the process of evaluation of knowledge need and information behaviour. This is about understanding information and its transformation into knowledge as needed.

#### *The cognitive context of adoption of innovation*

Addressing the knowledge gap associated with the adoption of innovation requires the evaluation of the knowledge need and an assessment of information behaviour (Ford, 2005) which includes information seeking activities. The relationship between the user and the information, or more broadly the knowledge, is one which traditionally has been dealt with as an issue of information systems design. The user perspective has gained traction among researchers and influenced information systems design in recent years.

Efforts have been made to bring together Computer Science and Information Science with a Social Science background to create a better information seeking model, albeit without

much success (Vakkari & Järvelin, 2005). One of the reasons for this reluctant relationship is the gap between approaches to information seeking specific to each field (Information Science and Computer Science). One approach (preferred by Computer Science researchers) focuses on system design, realistic, but inflexible; the other is closer to the user's need and reality, but perceived as unrealistic (Vakkari & Järvelin, 2005). Ford (2005) also found that the influence of user studies on major aspects of general system design has been small. This is because human aspects are so complex, Ford referred to them collectively as "dark matter" (Ford, 2000).

CIR's contribution was to expand the context in which information seeking activities occur to include, in addition to the information space, a context that better captures the motivation and concerns of the user, which Ingwersen (1996) calls the cognitive space. User behaviour associated with information seeking does not occur strictly as an isolated process of interaction with a system interface for query purposes, but as a more complex process in which the information seeker learns and adapts as result of the evaluation of the information needs and the influence of social, institutional and broader economic factors (Spink & Cole, 2005b).

From a CIR perspective, the evaluation of knowledge need, which in the case of disruptive innovation represents the knowledge gap created by the necessity of doing things using a radically different approach, necessitates interaction with information systems that can assist in finding and retrieving the appropriate information. In the cognitive context, the knowledge gap problem needs to be framed in terms of a work-task/interest situation, which is primarily the goal of the information seeking (Larsen & Ingwersen, 2005). Byström and Järvelin (1995) studied information seeking processes from the perspective of task complexity whilst Ingwersen (1996) discussed the role of work tasks from a cognitive perspective. Kuhlthau (1991) analysed information seeking from a user's perspective and in doing so he highlighted the importance of the usefulness of information for the resolution of the problem that is being solved. Belkin (1984) also analysed the problem context in which information seeking occurs. The context is pragmatic, one in which the user wants to solve concrete problems and in which the users "realize that their knowledge is insufficient for effective management of the problem".

### *Limitations of a system-centric view of information behaviour*

Recent trends in CIR research indicate that efforts are being made to conceptualise information seeking at human-computer interaction level and at organisational/societal level (Spink & Cole, 2005b). Despite the consideration of other human factors such as emotional states, information behaviour, and through extension knowledge behaviour, remains largely an information systems design affair focused on the quality of the human-computer interface and effectiveness of information management systems. Saracevic (1997) developed a model in which he proposes a map of two strata linking users' cognitive, affective and situational process levels to corresponding system levels. However, the model is aimed at finding ways of improving the design of a system rather than helping with strategies for improving overall knowledge behaviour.

Belkin (1984) noted that it is much more difficult to build a model of cognitive and affective aspects of a user's situation, than to build a model of knowledge resources. The user

cognitive space is vastly more complex than what system design models can take into account, at least at the current stage of technological capabilities. Recent models of human information behaviour highlight the nature of fuzziness of notions of relevance and retrieval effectiveness and how difficult it is to map user characteristics onto the parameters of information retrieval systems (Ford, 2005). Given these difficulties, the exclusive focus on system design as a way of responding to information needs limits the range of opportunities that support effective knowledge behaviour.

## *Knowledge Behaviour and Social Adoption of Innovation Modell*

### *Need for a Broader Context of Adoption of Innovation*

A previous study (Badilescu-Buga, 2011) proposed that adoption of innovation takes place in stages where milestones are achieved in a quasi-synchronised manner across three dimensions: social, cognitive, and professional. Successful adoption requires structures specific to each of the three dimensions to evolve simultaneously stage by stage. The stages of development have characteristics specific to each group of adopters in the adoption life cycle as they have different behaviours, priorities and goals. Because information seeking activities are strongly influenced by factors specific to each of the three dimensions, it is useful if we look at the way the user manages the information seeking process in a broader view that goes beyond the boundaries of one single information system.

Information seeking is a coordination process aimed at managing the user's cognitive and affective states using multiple sources of information (Spink & Cole, 2005a). The aim of the process is to take the user's current state to a selection state in which the knowledge need is understood and the action path is clear. The user goes through an iterative process of information need evaluation until the selection state is reached (Larsen & Ingwersen, 2005). In the past, information seeking would have been mostly limited to one information system servicing an entire organisation. As computing and communication costs drop with technological advances and improved public availability, the user increasingly attempts to find information by using a mixture of other systems and human information sources. Sun's (2012) research shows that users select search tools from a range of information systems, starting from those available internally within the boundaries of their organisations and then moving on to public and free systems accessible over the Internet.

While the array of information toolsets broadens, users adopt nonlinear information behaviour strategies. Foster (2004) discusses information seeking behaviour using a nonlinear model. According to this model, progression from the current cognitive state to one where the user has a clear understanding of the knowledge need is rather unpredictable, with the user adopting different methods on an ad-hoc basis.

It is important to make the distinction between information behaviour and knowledge behaviour (see previous definitions). The evaluation of the knowledge need is more than just appraisal of the result returned by information seeking activities. This process is also about evaluating the user's skills that would enable the creation of new knowledge by acting on the information discovered (Ford, 2005). If the same information is presented to two users with different skills or levels of skill, the capacity to act on that information will be different. Larsen and Ingwersen talk about cognitive-emotional variables that impact on

what is known about the unknown and the definition of the problem statement (Larsen & Ingwersen, 2005). Users learn during the information seeking process, but the learning is not limited to understanding the information needs. Users may also identify the need for a different set of cognitive and emotional skills (such as the ability to handle uncertainty, dissatisfaction, coping with pressure and other external negative influences, being positive, motivated, perseverant, etc.) required to address the knowledge gap (Ford, 2005). This aspect is implicitly recognised by CIR, however there isn't sufficient explicit analysis of how levels of cognitive and emotional skills influence knowledge behaviour. The information system-centric view considers that responsibility for determining requirements for further training, self-teaching, or professional development sits entirely with the individual user. This paper proposes that these aspects should be considered by both innovators and adopters of innovation because they have significant influence on knowledge behaviour, and ultimately on the successful adoption of innovation.

Foster (2004) found that one of the most significant aspects of information seeking is the use of social networks: "information-seeking was dependent upon goodwill networks between individuals from a variety of backgrounds, status and disciplinary origins collaborating to share information". Foster also identifies serendipity as an important part of information seeking process. This is a significant aspect because it highlights the valuable role of the social networks in effective information behaviour. Ford (2005) highlights the importance of information encountering as complementing information seeking activities in the process of the evaluation of the information need. This form of information retrieval often occurs in a social networking environment and it is useful not only for information need re-evaluation but also for learning about other knowledge, skills and problem-solving opportunities.

Overall, the above research findings reveal that social interactions act as a very sophisticated interface that provides the user with access to knowledge of individual social members and, through extension, to a variety of information systems that may be referred to during the social engagement process. In contrast to standard human-computer system interaction, socially facilitated information behaviour supports the creation of a bidirectional information exchange which is more reflective of the multi-faceted flow of information that characterises the innovation process.

As information seeking involves multitasking, the use of multiple sources of information, social interactions and feedback for the purpose of identifying successful knowledge behaviour, we need a broader model that captures the relationship between sources of information, the user's cognitive space, and the socioeconomic environmental context. This study proposes a model of social adoption of innovation (Figure 4) with multiple sources of information and in which the process of knowledge generation is considered in a holistic way.

### *The Innovation Space*

Information is being produced on the basis of factual data, the what-is, occurrences that take place in the "real" world: social, economic, cultural, environmental, and physical, etc. Authors-humans and machines - interpret factual data to produce semantic objects and store them in information systems. From a CIR perspective, the information system is the

most reliable source of information and it sits there to be utilised by users, as required by running queries. Ideally, users would not only have access to semantic objects, which are created by interpreting factual data and other semantic objects, but also to other relevant factual data that has not yet been captured or represented in the information systems in a ready-to-use form. The other factual data needs to be discovered through other means such as direct investigation or interaction with other people (colleagues, friends, other professionals, experts, etc.).

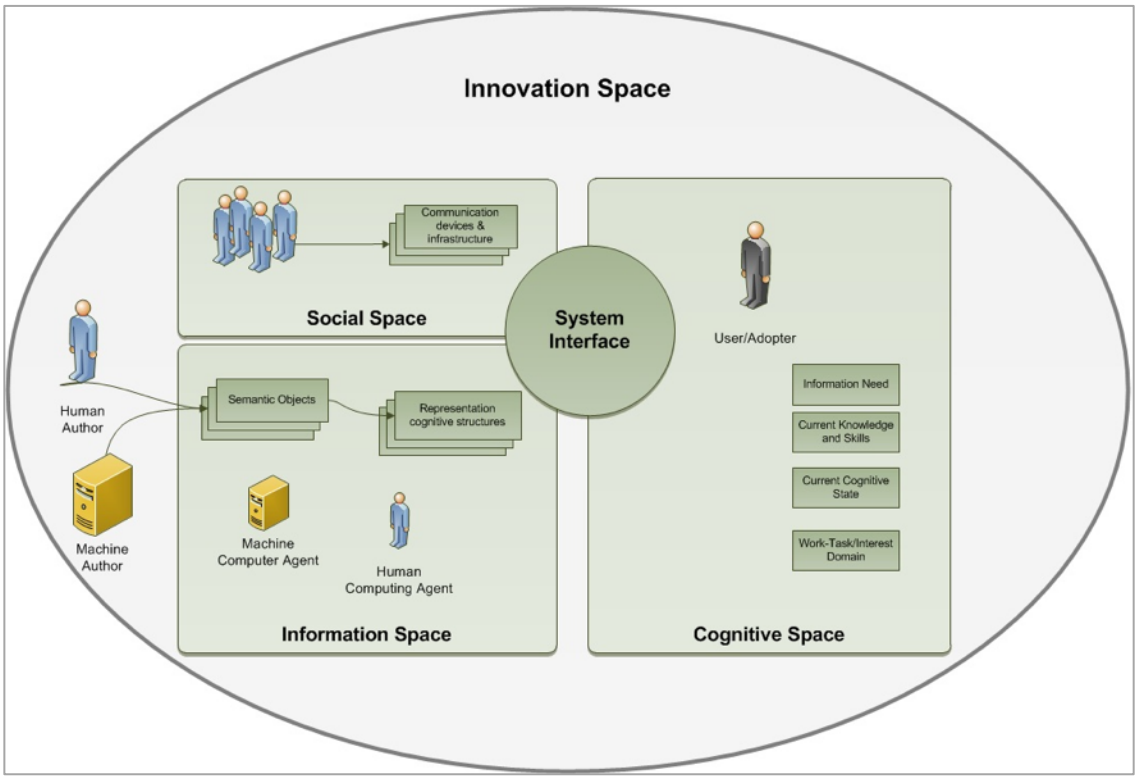


*Figure 4 Innovation Space*

In this model both the innovator and the innovation adopter play the role of information users. The adopter of innovation seeks information to address the issue of the knowledge gap (see the Information Behaviour in the Context of Innovation section) and applies cognitive and emotional skills, and current knowledge to process needed information to produce knowledge with the purpose of solving a problem. During this process, as result of the user's actions new facts will be created which will contribute to the growth of the factual data. Some of this data will form the basis of information need the innovator will take it into consideration to further improve the innovation product or create new innovations. In this case, the innovator plays a similar user role, but with a different knowledge need. That is, the innovator is a user who needs to process feedback from the adopters of innovation, factual data related to the use of innovation or other factors that have an impact on theoretical and practical assumptions made during the innovation process.

Social structures provide a gateway to factual data which is scattered across information systems, in the natural environment and in people's memories. They may provide information which leads to writing better queries but they also facilitate access to information which is not yet fully captured in a semantic form in any of the information

systems as known by the user. In the context of innovation and the contemporary environment, these social structures rely on information systems to communicate and function. From small communities of practice, to large quasi-communities and social networks, from local to global planetary scale, these structures operate on information systems that transmit messages and store information across a vast array of databases (Dron & Anderson, 2007). This makes social structures play a dual role, as pure social systems acting as a network providing emotional support necessary for a healthy working environment and as structures inseparably enmeshed into information systems, acting as information providers with an important role in information seeking and knowledge creation processes.

The Innovation Space is the overarching context in which the cycle of knowledge generation occurs. This is where innovators and adopters of innovation contribute to the creation of knowledge playing simultaneously the role of the user of information and creators of knowledge.

The Innovation Space is a concept containing both material and virtual elements with no precise boundaries. This space is a collection of everything that produces factual data, including sources that are independent of human activity. The reason this space is not limited to one or more information systems is because it captures all sources of factual data to represent the true picture of knowledge creation that takes place during the innovation and adoption of innovation processes. Factual data is filtered and processed within information systems and social structures resulting in semantic objects, which will be subsequently used at a later stage as information to create knowledge. As an example, if a class of students studies astrophysics using an innovative 3-D exploration tool, they will be using information about the vast cosmic space. How was that information produced? Factual data generated by far away stars and captured by sophisticated sensors, processed by computers and analysed by authors or machines will become the text, the videos, the images used in the astrophysics classes. But the study is not limited to the use of semantic objects obtained through accessing information systems. Students may use direct observations by studying the sky, or discuss with colleagues or students from other countries other observable aspects which have not been yet represented in electronic form.

### *Knowledge, Information and Skills*

In a research literature review (Cole, Beheshti, Leide, & Large, 2005) it was found that there are two cognitive approaches to research in CIR: one representing the point of view of the user's task and the other using concepts and models borrowed from psychology looking into how the user acquires information. The second approach revealed the importance of complex thinking activities that determine the user's actions for information seeking and how information is utilised. Ignoring the way thinking processes operate from a psychological perspective leads to systems designed with the assumption that users know what their information needs are, which is not always the case. Belkin and Cool (1995) formulated the opinion that asking users to specify their information needs is unrealistic. Not only is the user not fully aware of the actual information need, but the information seeking activity has a dynamic impact on the user's knowledge structure, so that the user's attitudes and understanding of their information need changes during the information

discovery. Brookes (1980) captured symbolically the impact of information on knowledge structures into a fundamental equation for information science:

$K[S] + \Delta I = K[S + \Delta S]$,

Where: K[S] represents knowledge structures, $\Delta I$ is the new information, and $K[S + \Delta S]$ is the final knowledge structure as result of processing the new information.

Brookes asserts that the impact of the information depends on the existing knowledge structure and how it is subjectively interpreted. Todd (1999) applies this equation to the selection process to highlight the learning effect that takes place during the transition process that takes the user from the initial cognitive state to the selection state. As mentioned earlier, the process is nonlinear and social, especially when the information need is complex (Foster, 2004) and is potentially multitasking (Spink & Cole, 2005a). Saracevic (1997) developed a model for information retrieval in which cognitive and affective factors influence the information seeking process. Ford (2005) emphasises the cognitive aspects of information behaviour.

### *General Knowledge Behaviour Equation*

From an adoption of innovation perspective, if utilisation of the same information can cause different knowledge structures, it is important to understand the relationship between factors that influence the conversion process. The fundamental equation expressed by Brookes describes the relationship between information and change of knowledge structure but it does not offer more details about the factors involved. Research in the field of information retrieval, information seeking and knowledge behaviour has studied various aspects in isolation, mostly focused on information seeking, having investigated to a lesser degree the generation of knowledge in its larger social context. Bringing together ideas from previous research, this study proposes a symbolic equation for general knowledge behaviour that captures the main factors engaged in the process:

$\Delta K = \sum (Sc + \Delta S) \rightarrow Kc + (\Delta Ii + \Delta Is)$,

Where: $\Delta K$ is the knowledge structural change, Sc is current skill, $\Delta S$ is the newly learned skill, $\Delta Ii$ is the information retrieved from the information space, $\Delta Is$ is the information retrieved from the Social Space, and Kc is current knowledge. As in the case of Brookes' fundamental equation of information science, this is a symbolic equation aimed at expressing in a concise form the relationship between knowledge structural components and it shouldn't be looked at in absolute quantitative terms. The equation for general knowledge simply states that knowledge structural change is the result of the sum of current skills and newly learned skills $(\sum (Sc + \Delta S))$ being applied $(\rightarrow)$ to current knowledge (Kc) and retrieved information $(\Delta Ii + \Delta Is)$.

Like knowledge, the term skill is complex and has multiple meanings from the perspective of a variety of disciplines. The research studies referenced above mention the role of cognitive and emotional skills in knowledge behaviour, but they are too vague and too generic. The equation incorporates these skills as essential tools for information processing, but it also includes skills that are specific to the knowledge domain in which the information seeking activity is conducted. It is difficult, if not impossible, to make a clear distinction between the

types of skills not only because they influence each other, but also because sometimes their classification depends on the domain knowledge in which they are referred to.

Practice enhances skills developing the ability to solve problems in more effective ways. Dreyfus (2004) refers to intuitive expertise as a skill level that is acquired in the fifth stage of skill acquisition as the ability to make spontaneous decisions without explicit conscious thinking. In its generic sense, this is a cognitive skill, but when developed in the context of a professional practice it becomes a specialist skill strongly linked to the specific knowledge domain. The same person will be at a different level of skill in a different area of practice based on experience and knowledge (Benner, 2004). A skill has a procedural aspect and a judgmental, character-based, practical aspect based on practice within a community of practitioners (Benner, 2004). Calderhead (1991) noted that "knowledge that guides the action has been viewed as oriented towards problem solving and qualitatively different from the knowledge of facts and subject matter that informs the content of teaching".

The inclusion of skill in the equation has important significance: users with the same knowledge will process information in different ways and with different levels of proficiency and speed depending on the skill level. From the point of view of information behaviour the importance of this assertion is that users will have different experiences and achieve different outcomes. A significant cognitive gap caused by the lack of an adequate level of skill will greatly impact in a negative way the information seeking process, because of the inability to process the information effectively. As Vakkari and Järvelin (2005) noted, the costs of IR systems "should be justified by the quality of the deliverables for some necessary and important work tasks". A cognitive gap that is not recognised and addressed will lead to low quality deliverables, with a negative impact on the adoption of innovation.

### *Information Seeking Skills Gap Equation*

As information seeking activities are nonlinear, multitasking, and social, extending beyond the boundaries of one information system, the skills required for effective querying of various sources of information (Figure 4) are an important element in a successful information seeking strategy (Sun, 2012). Thus, the skills required to address the knowledge gap concern not only the knowledge domain in which the innovation is applied, but also the effective operation in the Information Space and the Social Space. The relationship is expressed in the equation for information seeking skills gap below:

$\Delta S = \Delta Si + \Delta Ss + \Delta Sp,$

In this equation, the components are: $\Delta Si$ is the skill improvement needed to operate in the Information Space, $\Delta Ss$ is the skill improvement needed to operate in the Social Space and $\Delta Sp$ is the need for professional skill improvement relevant to the work task or domain interest.

The information seeking skills gap equation shows that for a user adopting an innovation, skill development may be required for effective information seeking. This has profound implications for diffusion of innovation strategies. Innovators will have to understand very well who the users of their innovations are and estimate their cognitive gap in regards to the proposed innovation. Armed with that understanding, the innovators need to provide adequate cognitive support to their adopters to help them overcome challenges of knowledge behaviour.

If the complexity of the knowledge gap is low, which indicates that users' information need is simple, a good system design may be sufficient to address the cognitive gap with the inclusion of smart cognitive structures and algorithms. Ford (2005) refers to the prominent role of the system design as "supplanting cognitive activity". However, in the context of complex information needs, users need to make decisions by themselves and select suitable information retrieval (IR) components. Ford continues to say "users would need to possess appropriate knowledge of the alternative IR components available to them (for example, retrieval algorithms, output options, query expansion facilities, inference rules, learning mechanisms, etc.), and of the implications of choices, sequences and combinations of them in terms of system behaviour and performance in relation to their needs" (Ford, 2005) (p. 89). Consequently, as indicated by the information seeking skills gap equation, the acquisition of appropriate skills comes through learning how to use information systems, and how to operate in the social space, and if necessary, by acquiring professional skills through training programs.

The symbolic equation shows that seeking information cannot always be resolved entirely through better information system design. The equation indicates that an approach that yields better results is to use social links to find relevant information, and maximise the chance of coming across new information that could not have been found only by running queries through standard computer user interfaces. Large social networks provide opportunities for serendipity and for combining expertise from adjacent disciplines that lead to new and unexpected solutions.

### *The Social Space*

A previous study suggests that social structures have a critical role in the adoption of innovation (Badilescu-Buga, 2011). However, at each stage of adoption certain structures have a predominant contribution to successful adoption (see Figure 3). The smallest structure, the community of practice, is characterised by a close-knit relationship between its members (Wenger, 2009). This community is typical of the initial stage where adopting innovators apply innovation to create new ways of practice. This social structure is critical to the spread of the innovation because its members are the first to demonstrate the applicability of the innovation and figure out how to overcome initial difficulties. The members of this community are usually highly skilled professionals that have known each other for some time and frequently meet face to face (Wenger, 2009). Despite their close-knit structure, communities of practice today rely on ubiquitous information technology for communication and sharing of information. Larger social structures also depend on the use of Internet-based networks for communication, creating relationships between individual members that do not know each other in person and linking smaller communities of practice (Hung & Nichani, 2002b); (Dron & Anderson, 2007).

The fact that these social structures operate on the back of large and sophisticated computer networks makes them simultaneously social communication gateways and generators of factual data which feeds into the Information Space. This gives the social structures in the Social Space a critical role in the adoption of innovation life cycle.

Over the past decade the Internet, mobile networks, and a large number of software applications have dropped the cost of communication to virtually zero, changing the ways

people connect to each other around the globe, adding to broadcasting and one-on-one modes of transmission online conversation as many-to- many interactions between people. This has created vast opportunities for sharing, collaboration and collective action at a scale not possible before (Shirky, 2009). Individual community members bring on average a very small contribution to the creation of content, but a significant one when aggregated. This amplified contribution makes large social structures (quasi-communities and social networks) very valuable not only for those who enjoy the benefit of accessing abundant content but also for those who contribute in a variety of social and professional roles by having opportunities to address a large audience. In a large online community with a high level of trust, members feel enticed to participate in the creation of a valuable support structure (Dron & Anderson, 2007) using their cognitive surplus for the benefit of others (Shirky, 2010).

From the point of view of information behaviour, large social structures offer support for both forms of information retrieval: serendipity and search (Ford, 2005). In the first form of information retrieval, Foster (2004) found that serendipity is widely experienced and valued as a form of information behaviour. Finding information occurs in the Social Space in a direct way, by engaging with social members with specific knowledge on the subject, or indirectly by having social members provide guidance on where to find sources of information, either within the Social Space, by referring to other people, or within the Information Space, by referring to other specific information systems. A research study on personal information management practices of teachers (Diekema & Olsen, 2011) supports the idea that finding information through social networks plays a vital role in solving work-task problems. The study found that teachers draw information from a variety of sources and surprisingly, they rarely use their school library media centres. Their online information seeking behaviour reflects a wide range of patterns influenced by a large number of variables, one of which is prominent: teachers “like the social aspects of the Internet and the ability to share resources and advice on how to use them in the classroom” (Diekema & Olsen, 2011)(p. 2). The study shows that teachers highly value their social networks as a way of finding information.

One distinction between the Information Space and the Social Space consists of the time it takes for authoring agents operating in each space to create semantic representations. In the Information Space, professional or specialised authors need time to identify, consider and process selected factual data to create semantic objects. It then takes some time, varying from immediate to days, weeks, months or even years, until other authoring agents create cognitive representations needed for filing, and for making the original semantic object searchable, discoverable. For instance, when a community of practice solves a problem after several experiments and discussions among the group members, the approach could be shared with members outside the community through social links. Alternatively, someone would document the experience by interviewing original community members and publishing the interview. Later, the published material will be made available in the Information Space in the form of an article, or a book with links, abstracts, purchase information, etc. Some semantic objects are created by machine-authors, which are software programs that generate semantic objects automatically. For instance, a software program which continuously monitors the interaction between students and educational

gaming software could generate a sophisticated report describing students' behavioural patterns during the game play.

In the Social Space, members of social structures generate semantic objects (written, verbal or visual) in a very short period of time by using a combination of factual data, semantic objects and personal knowledge. As an example, someone discussing a work-task in a Google+ hangout session may receive information created in real time by other participants. Users find information within the Social Space not only through serendipity and creative processes, but also through direct queries. For instance, one user could ask a question on the Quora website and shortly afterwards receive answers from network members who already possess the required knowledge to generate meaningful semantic objects (answers in text form) or produce references to other sources of information.

The contribution of social group members, sometimes referred to as cognitive surplus, to supporting information seeking activities could be significant (Shirky, 2010). Finding information through social structures is critical to bringing adopters to a cognitive selection state in which a clear strategy of addressing the information need is formed (Foster, 2004). Taylor found that the subject's cognitive state changes during the information seeking process, which indicates that the information retrieval system needs to be dynamic, adaptive, and provide search criteria beyond topicality (Taylor, 2012). Social structures provide a level of adaptability beyond the level offered through system design, complementing the sources of information found in information systems.

## Discussion

The analysis and the findings indicate that with the ubiquity of computing devices and the zero cost of communication thanks to the spread of the Internet, adopters of innovation increasingly rely on social networks to find information that helps them address their knowledge needs.

While social networks existed before Internet arrived, what is new is the fact that because they are enmeshed with rapid communication infrastructure it makes it possible for users to access information and be influenced by that information in ways that traditional information systems could not. Whereas CIR expanded the user space to include other social economic and institutional aspects, this study is proposing that we need to expand the information space to include social networks. Because of the technological base of social networks future search engines could combine the two spaces and offer their users the ability to search using a more traditional human-machine interface and an electronic human to human interface that helps interact with members of the social network for information searching and encountering through serendipity.

The symbolic equations are an attempt to break down knowledge behaviour into components that makes it easier to establish strategies for both innovation design and adoption of innovation. From the point of view of the innovator it is important to anticipate the level of skills of the targeted adopters in three areas: 1) Are these adopters skilled enough to use the systems that are involved in adoption?, 2) Are the adopters skilled at interacting with members of social networks and taking advantage of the knowledge that

they might be able to share?, and 3) Do the adopters possess adequate professional skills in the field where the innovation is applied?

Similarly, from the point of view of the adopters, an understanding of the effort that is required to adopt the innovation is needed to evaluate the following aspects: 1) How much do I know about the systems involved? 2) How is my social network supporting me in undertaking this adoption? and 3) Do I need additional professional training to understand the application of this particular innovation?

The questions the innovator is asking need to be reflected in the design of the innovative product to match the level of skills of the adopters in each area, while the adopters will need to evaluate the effort required to be invested for a successful adoption. The questions elicit different answers depending on what stage the adoption process is at in the adoption of innovation life cycle (Badilescu-Buga, 2011).

## Conclusion

Addressing the knowledge gap caused by the adoption of disruptive innovation is a challenge that is resolved through evaluating the information need, seeking information, and generating knowledge as required in the context of applying the innovation in practice. This paper chapter extends information seeking activities beyond the use of individual information systems including social structures in the form of social networks based on Internet infrastructure. The result of the review of research literature in the field of information retrieval and adoption of online learning design in education led to the proposal of a model of social adoption of innovation where adopters and innovators interact with sources of information that combine traditional information systems and social structures. The study also extends Brookes' (1980) equation for information science to two new symbolic equations that reflect the contribution of social structures to knowledge behaviour and the necessity of evaluation of three types of skills involved in knowledge behaviour.

This research opens a new perspective in the formulation of strategies for innovation design, spread of innovation and adoption of innovation. The suggested approach is for information system design to consider the broader context of information seeking activities, including technology-supported social structures. The research also suggests a more comprehensive approach from the perspective of the adopting individual and organisation which includes not only aspects related to access to information through information systems, but the realisation that successful adoption needs to consider the skills involved and exposure to other people's knowledge shared through social networks, all of which change in a fluid fashion as adoption goes from the innovators and early adopters stage to the early and late majority stages (Rogers, 1995).

Following this study, the next step is to use the social adoption of innovation model to design a collaborative research project that will monitor the adoption of online learning design systems in schools. The research project will collect data regarding information seeking, the use of information systems, social interactions, skill level, perceptions and adoption outcomes that will verify the validity of the model.

# Chapter 6 Social Influence in Academic Research[3]


## Abstract

Adoption of innovation in education is a complex process. Although there is a rich literature dedicated to the adoption of innovation in general, it is useful to look at the specifics of adoption of Learning Design in particular to have a better understanding of the difficulties of implementing a new methodology and identify ways in which adoption can be accelerated and be made more effective. This chapter is based on a study that analysed research literature published on LAMS (Learning Activities Management System) and its implementation around the world. This study examined issues encountered during its adoption in schools and higher education institutions and enunciated the core principles that make the adoption of educational systems and methodologies successful from a social perspective. In addition, this chapter includes a second study focused on citation analysis with social networking tools to examine how ideas have spread among authors with research publications in the field of Learning Design. The intention was to demonstrate the existence of a correlation between accelerated adoption of new ideas and strong social relationships.


## Introduction

The Larnaca Declaration (Dalziel et al., 2013) describes the field of Learning Design as follows:

The new field of Learning Design seeks to develop a descriptive framework for teaching and learning activities ("educational notation"), and to explore how this framework can assist educators to share and adopt great teaching ideas.

According to the Larnaca Declaration proposed model, Learning Design has three components: 1) Conceptual Map (a wider educational landscape related to core Learning Design concepts), 2) Learning Design Framework (a language/notational format/visualisation used for describing teaching and learning activities using different pedagogical approaches) and 3) Learning Design Practice (the application of Learning Design concepts in practice). This structure implies that the adoption of Learning Design cannot be limited to the understanding and acceptance of a theoretical concept, but needs to include a range of practical considerations in relation to the teaching cycle, learning environment, guidance, representation and sharing, tools, resources and learner responses (Dalziel et al., 2013).

Because Learning Design and its implementation in practice rely on sharing and collaboration as an essential part of the educational process, it is useful to consider the research question of how the adoption of Learning Design is enabled by social factors that exist in the form of natural individual connections, professional networks, and communities. The leadership of educational institutions could benefit from research that tries to answer this question to learn how to accelerate the adoption of new methodologies and tools and pace their investment effort to obtain enhanced outcomes more effectively.

[3] Published as a part of book chapter (Dalziel, 2015): Chapter 10 Social Adoption of Learning Design (pp. 208-223) with minor modifications.

The first study discussed in this chapter examines the social adoption of a Learning Design online tool using a model of social adoption of innovation derived from a comprehensive educational research literature that analyses various aspects of adopting an online Learning Design tool and its use in teaching and learning practice.

The online tool considered in this study is the Learning Activity Management System (LAMS). This tool implements a Learning Design framework using open source software (http://lamsinternational.com) and it has been used by many teachers around the world for about a decade or so. The framework, the product and the platform architecture are based on the fundamental belief that better teaching and learning outcomes are achieved through sharing and collaborative participation.

The second study included in this chapter presents findings resulting from a project that looked into the influence and spread of ideas in the research field of Learning Design using citation social networks analysis. Although this research is not about how new educational methodologies are adopted, it offers a social perspective on how research authors worked together on research and publications in this particular field. The reason this study is included in this chapter is to show how the model of social adoption of ideas applies to researchers working in a field in its early stages. The adoption of Learning Design by educators should have similar characteristics as innovators and early adopters as the discussion of the first study will explain in the following section. The conclusions from the two studies overlap, suggesting that adoption of innovation is not exclusively dependent on the availability of quality training and structured acquisition of knowledge through large institutional programs, but is strongly influenced by social factors, which can stimulate or inhibit adoption.

## Social Adoption of Learning Design with LAMS

An earlier research study (Badilescu-Buga, 2011) proposed that large-scale adoption is multi-dimensional and synchronous: a number of conditions have to be met in order to advance the adoption of innovation through its stages as described in the classic adoption model based on the work of Moore (2002), Rogers (2003) and Christensen et al. (2008). The research study conducted a comprehensive literature analysis consisting of 23 research papers on the adoption of LAMS by individuals and institutions around the world, its practical implementation, and related educational projects and programs.

What makes the social aspect of the adoption of Learning Design more important is the inherent nature of the field. The most important promise of Learning Design is the sharing of good teaching and learning ideas (Dalziel, 2010).

Adoption of online Learning Design tools takes place in a social context. The role of social interactions is important when new methods, concepts and tools are trialled. The complexity of new systems imposes a cognitive tax on adoption efforts. This is difficult to address because the field has not yet reached an early majority adoption stage (see Figure 5 – Multi-dimensional Adoption of Innovation) where training, instructional manuals and practices are standardised and are readily available.

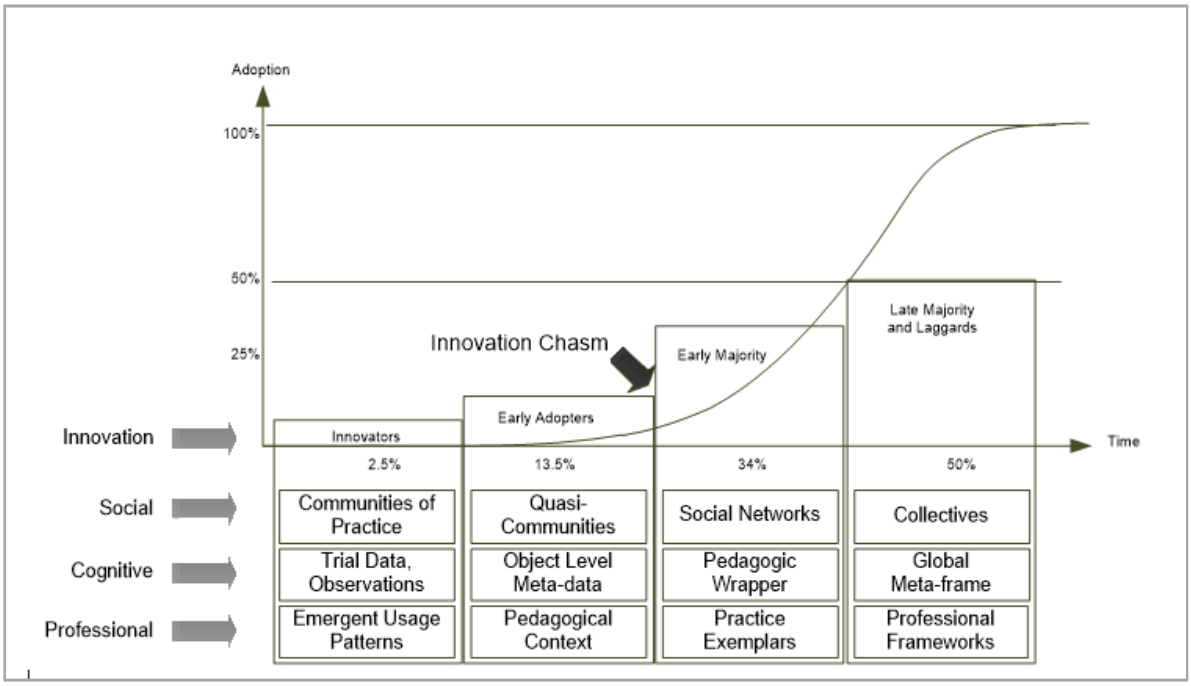


*Figure 5 Multi-dimensional Adoption of Innovation*

The study used adoption of innovation models and identified four interdependent dimensions (see Figure 5) in which adoption takes place in synchronised stages. According to this study, an innovation advances to the next level of adoption when ideas are diffused within the adopters' social structures typical to the current adoption level, the use of information has appropriate cognitive structures (information organisation, processing and conversion into knowledge), and the innovation is implemented using adequate professional standards (training, professional accreditation).

## Discussion

The adoption stages are discussed below:

### *Innovators Stage*

The earliest stage occurs in communities of practice, as defined by Wenger (2009), where the focus of its members is innovative design involving an intense process of collaboration, face-to-face interaction and tasks aimed at reaching a high-risk innovation goal. During this stage innovators try new products, services and concepts transforming current practice.

The explicit cognitive structures are not fully developed at this stage as there is little or no documentation due to the experimental characteristics of the work. The newly generated information is shared based on trust and implicit rules borne out of a long history of cooperation between members of communities of practice, face-to-face interaction and ad-hoc creative activities. Trial data and related observations are generated and presented in pedagogical terms and other minimal cognitive items are shared through mostly informal conversations among members of communities of practice. Innovators involved at this stage are highly skilled and have the ability to identify emergent usage patterns leading to

definitions of concepts, solutions for increased efficiency and distribution to broader user base.

Professional practice is established based on the knowledge and skills of members of community of practice who learn by doing throughout the innovation process. Innovators may share the acquired knowledge and experience with the broader professional community and interact with others interested in the new development.

### *Early Adopters*

Walker and Masterman (2010) found that early adopters are part of communities of practice occurring in a network of distributed communities that are loosely connected and aim to adopt new tools and processes made available by the original innovators. These are quasi-communities characterised by loosely-knit relationships, bound by an indirect explicit flow of information, with members largely unknown to each other and in general exhibiting low organisational trust (Hung & Nichani, 2002b). Online quasi-communities emerge as ad-hoc social entities on public infrastructures, which could be generic (wikis, Yahoo, Facebook) or specialised (LAMS communities, CloudWorks: http://cloudworks.ac.uk/).

According to Hung and Nichani, in a community of practice learning is demand driven, it is social, and it is identity forming (Hung & Nichani, 2002a) . These characteristics may be used to differentiate between formal school learning communities and “real-life” communities. Teachers join the quasi-communities because of their intrinsic motivation, seeking to learn and be inspired by what they find, cultivate relationships with other members based on common interests and needs, and in the process, share their own experience.

Finding information and learning through individual effort using information systems (computer based or otherwise) with instructions, manuals, and structured aid in general, is also part of the adoption process. To make the experience and findings available to others, innovators create artefacts made available as information sources through an interface that communicates messages in a linguistic form with lower semantic levels (Ingwersen, 1996). This causes a loss of meaning that is a barrier to adoption. Teachers need to invest effort in using cognitive structures based on their perception and interpretation of their current cognitive state to overcome this barrier and find the information necessary to perform their pedagogically contextualised work tasks. Thus, early adopters in quasi-communities need clear cognitive structures that help them to effectively access information that matches their needs for problem-solving purposes.

Social cognitive structures raise the level of trust in quasi-communities through an open and transparent feedback system that participants can use to rank Learning Design objects, provide commentary and make recommendations (Cohen & Prusak, 2001). Over time these cognitive structures will build implicit trust similar to organisational trust, binding together members of communities of practice (Hung & Nichani, 2002b). Creating such structures is not an easy task. The organisations that develop, maintain and support them must ensure they have adequate long-term funding

Shared Learning Designs need to be based on sound pedagogical principles (Walker & Masterman, 2010) which should be supported by the Learning Design tools. As online tools

are adopted by an increasing number of users, a professional framework needs to be put in place for two purposes: 1) to educate users about Learning Design methodology based on pedagogical principles, 2) to facilitate adoption in alignment with pedagogical goals set at institutional level. Pedagogical techniques need to be shared online and linked to Learning Design objects to enhance the sharing and re-use experience (Cameron, 2010). Where clusters of users are formed as smaller communities of practice within the larger quasi-community, leading innovators and experienced users can provide focused professional support within these clusters through face-to-face meetings. These demand-driven problem-solving educational sessions can be organised using a flexible approach such as CAMEL (Masterman et al., 2008) that offers scaffolding for the practice of Learning Design, sharing and reuse.

### *Early Majority*

A critical moment in the innovation adoption life cycle occurs when the innovation has been trialled, tested and is successfully used by early adopters with positive results. An increasing number of users are attracted by benefits resulting from the implementation of the innovation and start adopting it. This marks the beginning of the early majority stage of adoption (Moore, 2002). The gap between the two stages of adoption, which Moore calls the Innovation Chasm, represents a jump in the adoption rate from 16% to 50% with transformational impact on professional practice.

The social context in which large-scale adoption occurs in an online world undergoes some significant changes. The term quasi-community gradually becomes an inaccurate description of the user base because the participants have higher expectations from their interaction with the community in the sense that the community needs to be richer, with more opportunities for learning, and that resources needed to solve their problems should be easier to find. We use the term “social network” based on the term “network” as defined by Dron and Anderson (2007) – distributed individuals who are directly or indirectly connected, not aware of those who form the wider network, with emergent behaviour (not designed) resulting from interactions between members of the network - to describe the social nature of this type of online community, but with a professional element added to it as we refer to a community built around the use of Learning Design tools in particular and pedagogy in general.

A social network is a system that emerges from quasi-communities of successful early adopters as new members join, driven by their professional interest, need, and desire to learn from and meet new colleagues. The formation of the social network is a natural progression because it is one of the fastest platforms for sharing objects of interests, knowledge, skills and learning through the experience of others. It is assumed that by now the tools (products) have reached a higher level of maturity based on the feedback and experience accumulated at earlier stages. Social networks encourage the participation of members through reward mechanisms with multiple benefits: peer review/ranking and recognition of both formal and informal contributions, learning, and identification of professional opportunities (Dron & Anderson, 2007).

The embedded reward mechanisms encourage the expansion of sharing and reuse of Learning Designs and templates. Identity formation through social acts leads to formation of

ad-hoc groups through affiliations. These groups help users learn "about" (how do I do this task) and "to be" (who am I, who do I want to become and interact with), influencing their personal formation and professional development (Brown & Duguid, 2002). This thinking takes the social network beyond Engeström's object-centred sociality concept (Engeström, 2005) because it highlights the importance of the social element that motivates individuals to join a preferred community. Networks with identity-centred sociality have better opportunities to maintain vibrant communities where members converse about new ideas and share not only objects but experiences as well. The success of adoption through a social network depends largely on the level of trust that forms as a social capital accumulated over time (Cohen & Prusak, 2001).

Despite advances in knowledge technologies, human interaction in a social context is still needed for learning complex knowledge, especially implicit knowledge that cannot be fully described and stored explicitly in digital form (Polanyi, 1962). Consequently, this makes the role of deep diffusion in highly trusted social communities where discussions of issues and sharing of information can help address problems that elude even the most careful system design, even more important.

Large-scale adoption of Learning Design tools requires sound pedagogical principles as a foundation for sharing of Learning Designs (Ljubojevic & Laurillard, 2010). The development of the pedagogical framework needs time and involvement of participants from various educational jurisdictions to create rich general pedagogical structures that can be used as templates for localised adaptation and as support for professional development programs. Further research is needed to investigate which forms of pedagogical structures are suitable for Learning Design representations (e.g. the application of the Conversational Framework to patterns described in the LDSE project (Ljubojevic & Laurillard, 2010)).

### *Late Majority and Laggards*

Adoption at this stage is a continuation of the adoption process in the early majority stage. Depending on the size of the social network, its evolution creates historical data and behaviours that may lead gradually to the formation of Collectives, which are aggregates based on actions taken by individual members (Dron & Anderson, 2007). This could be seen as collective intelligence manifesting emergent behaviours. At this level, social interaction between members is rich and fluent. Members form strong relationships based on interests, likes, professional affiliations, locations and types of institution. It is too early to predict how a network of teachers sharing Learning Designs will look if it reaches this stage, and if it will borrow elements of design from Facebook, Google+, Quora, Twitter or other current social networks.

Deep penetration of innovation requires substantial professional and technical support (Moore, 2002). If experience of other products and services with large-scale adoption can be used as an indication, support needs to have centres of dedicated human resources who will ensure the efficient operation of the Learning Design platform within educational organisations.

### *Social Adoption of Ideas and Influence in the field of Learning Design*

Researchers working in the new field of Learning Design are themselves innovators adopting new ideas. They are influenced by the work of others, and they process a large amount of information to create highly advanced knowledge. According to the social adoption model discussed in the previous section, they would work with other members that share similar professional interests in social structures that can be described as communities of practice: local academic collaboration groups, international projects, voluntary associations, publications, working with industry in various programs, educational initiatives, etc.

Although collaboration is an important aspect of research it relies on individual effort to search for information, find facts and systematically gather data, analyse findings and generate original ideas to contribute to the creation of a larger body of knowledge. It is tempting to say that directions of research are based on methodical processes in which structured information systems are used to find sources of knowledge in an institutional context using well-defined research questions and queries.

The social adoption of innovation model suggests that the diffusion of ideas has a strong social component that complements the institutional medium, and in which sources of information, new concepts and ideas are found through social contacts with direct enquiries or through serendipity. If this is true, then theoretically if we analyse citations of research publications it is likely we will find a high level of social relationships between authors, with overlapping professional relationships over an extended period of time, even if the members of these relationships live and work at different institutions and are separated by vast geographical distances.

This study used social networks to represent author relationships based on citations. The resulting networks identify the most influential authors based on the number of citations that refer to their publications. The resulting citation networks also represents a **social map of collaborations built around personal relationships, shared projects and interests.**

The raw data was extracted from 30 publications generating over ten thousand citations (not including self-references) that link over 900 related authors. The publications were selected from a list compiled by the authors of the Larnaca Declaration, who considered them as significant contributions to the development of Learning Design. As part of this study, I designed and developed software that extracted citations from each publication to create links between authors. The resulting data has been stored in a database and used to generate lists with nodes and edges within several citation social networks.

This method of citation analysis was designed to highlight relationships between authors. The resulting networks have nodes that represent authors, not publications. The study looked into the characteristics of the relationship clusters to identify patterns that could indicate the existence of stronger social ties between the authors, either in the form of personal networks or communities of practice.

In the network diagrams below (see Figure 6, Learning Design Citations Social Network - Details), the size of each node is directly proportional to how often that particular author represented by the node is cited by others. This is a measure of influence. The edges, links

between authors, are based on citations. The more citations exist between two authors, the thicker the line representing the edge. This indicates the relationship between the pair of authors connected by the edge (see Figure 6). The selected publications cover ten years, the duration of the Learning Design timeline as a field as mentioned in the Larnaca Declaration (Dalziel et al., 2013).

After organising the network layout to highlight the authors' input, the analysis identified several patterns that suggest that social relationships between authors influence the transmission of ideas and the creation of conceptual subsets of Learning Design. The use of references in studies published over ten years also provided a view into how the field evolved over time.

The layout makes it easy to identify collaborations on writing research papers. The citation dataset was sufficiently large to visually differentiate between weak and strong links connecting pairs of authors. This study used strong links to research the work record of the identified authors during their career, and the relationship between the authors in other circumstances such as education, jobs, participation at conferences, and collaboration on books and other papers.

Figure 6 shows the overall authors' relationship network based on citations over a span of ten years.

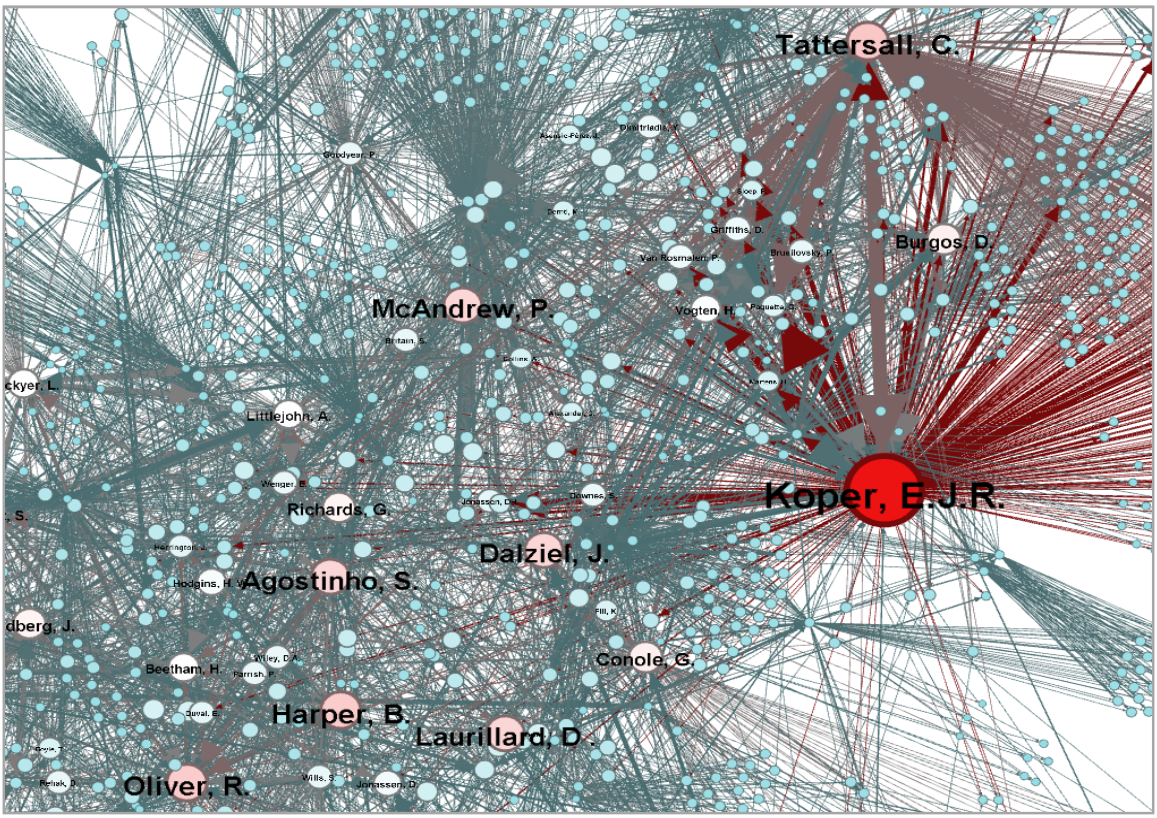


*Figure 6 Learning Design Citation Social Network - Details*

### *Dominant Influencers*

The citation networks generated for each year of publication revealed that authors who established an early lead in influence generally had increasing influence increased over time.

The citation networks showed that new authors bring original views into the field that are linked to existing research ideas. This is due not only to natural intellectual process, but also to social relationships that act as a catalyst for the transmission of ideas. The network layout has two characteristics: a fan-out type of structure that reaches to new ideas from neighbouring fields and schools of thought, and a core network of relationships between existing authors with a research history in the current field.

The distribution of influence is a long-tail distribution which is typical to social networks. Figure 7 shows how rapidly the strength of influence decreases from the top five most influential authors to those who have weak individual influence.

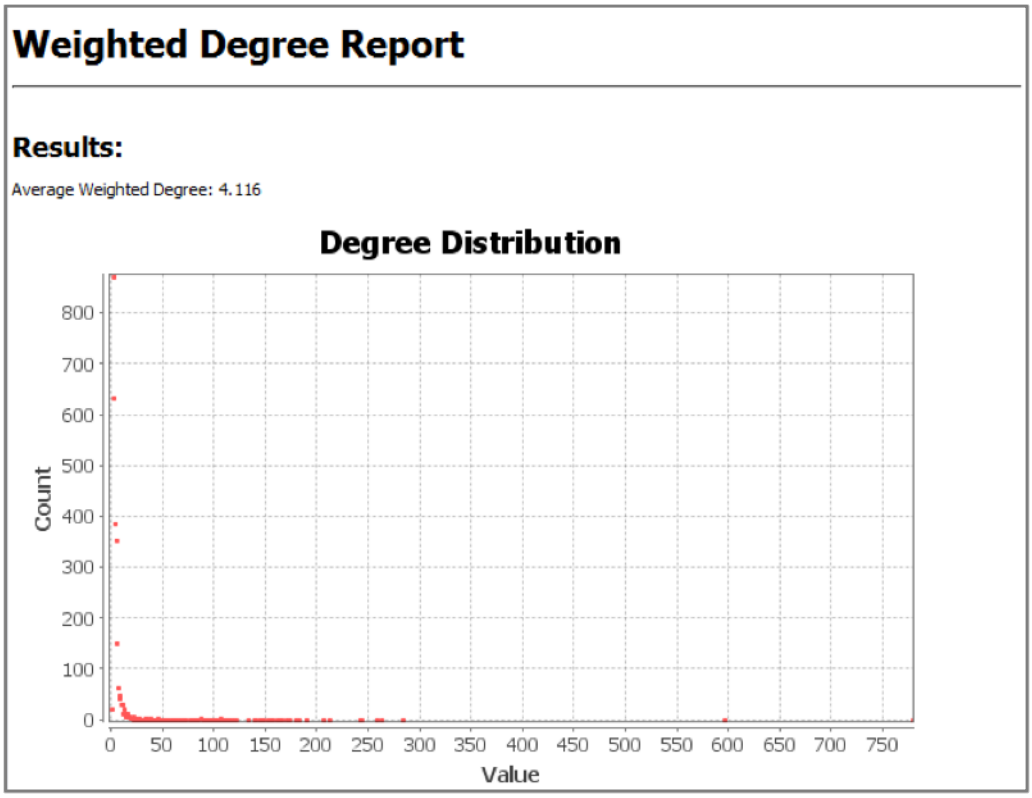


*Figure 7 Influence Distribution*

The history of the citation network over time shows that overall influence forms through strong relationships that spread ideas as a group, while group leaders' influence increases gradually over time. Learning Design had an initial strong technical background through the work of Koper and Tattersall and related research groups. As the field developed and more educational institutions became interested in the application of technology in teaching and learning, pedagogically focused researchers started to gain more influence (see Figure 7). Extending this research would be interesting as it could reveal with more clarity the influence of various schools of thought and disciplines through social connections. Learning Design draws on resources from many disciplines as shown in the map created by the HoTEL

project (Holistic Approach to Technology Enhanced Learning- http://cmapspublic3.ihmc.us/rid=1LNV3H2J9-HWSVMQ-13LH/Learning%20Theory.cmap)

### *Social adoption of ideas*

Patterns of citations that are clustered around publications where multiple authors are linked with strong edges (reflecting a large number of references from one to another) indicate stronger social relationships between authors. Nineteen clusters exhibiting this pattern were randomly selected for in-depth analysis. In all of these clusters, the research found that the associated authors had social relationships cultivated over several years. Some of the authors have worked at the same institution for a number of years as part of a research team, and although they may work and live in different countries they have collaborated over the years on multiple projects and research papers. Others have studied together or worked temporarily on the same projects.

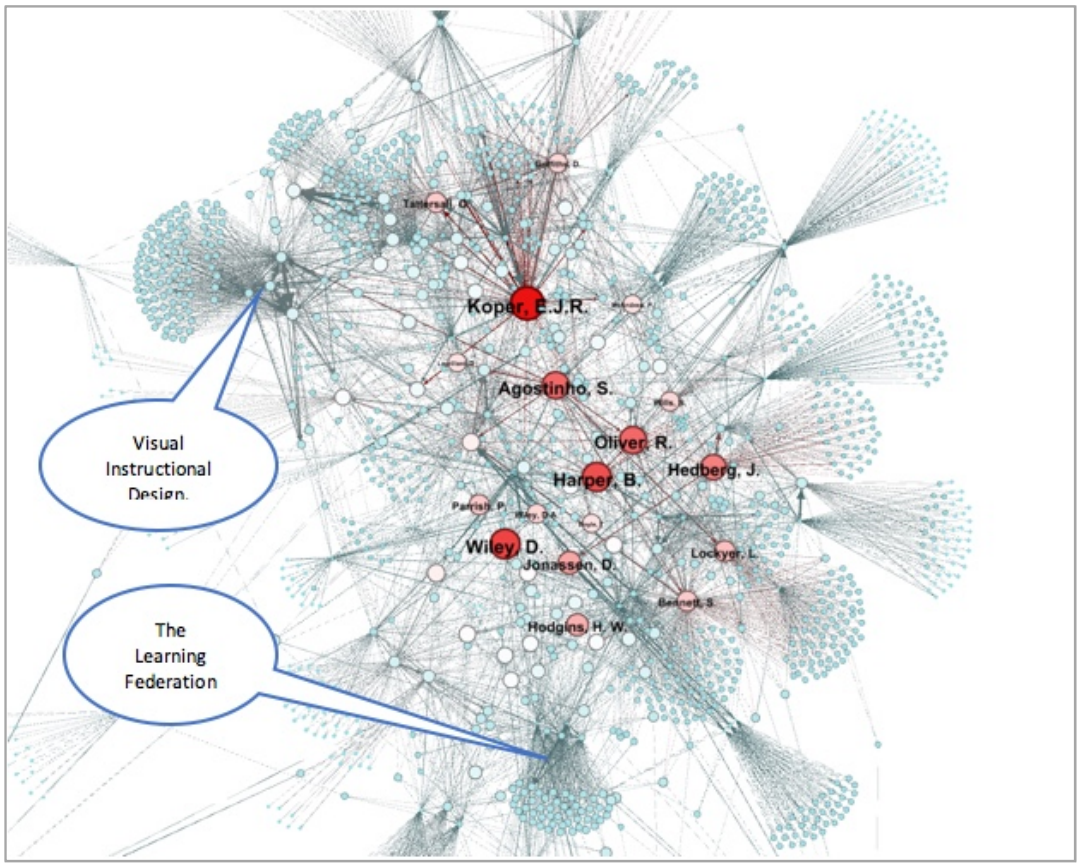


*Figure 8 Learning Design Specialised Research Areas*

Over time, collaboration clusters built around long-term relationships lead to the formation of new specialised topics within the field. For example, Figure 8 shows the focus of research interest in Visual Instructional Design and The Learning Federation Australia. The members of these clusters may not have dominant influence as individuals, but as a group they do.

The citation network analysis shows that although in some cases the physical locality matters, in most cases the concentration of research is facilitated by social connections

based on personal and professional affinities. In the case of The Learning Federation Australia the researchers are based in Western Australia, while in the case of Visual Instructional Design researchers are spread across a large geographical area from Canada to Europe.

## Conclusions

The findings of these two studies suggest that successful adoption of new methodologies and concepts is significantly helped by social structures that are appropriate for each adoption stage. The transition from the earliest stage to later stages of adoption of an idea, a methodology or a product involves different types of social structures that facilitate the transmission of influence and diffusion of innovation. The other two dimensions, cognitive and professional, are also important and they need to be considered synchronously for each stage.

There are implications that organisations attempting to adopt Learning Design methodology should consider. While the goal of adopting a new system is to have it deployed across the entire organisation, even when the adoption is supported with a strong case based on the initial assessment, the conviction of the leadership team, and examples of successful adoption elsewhere, the organisation would be wise to plan the adoption validating its merits through each stage with appropriate social, cognitive and professional structures.

The adoption of Learning Design at the Innovator stage requires the initial pilot to involve a team of highly skilled members connected by strong personal relationships, with experience as members of communities of practice collaborating on innovation projects that have resulted in the implementation of new methodologies, and who need little support to acquire in-depth knowledge in Learning Design. This team needs to evaluate the methodology hands on, collaborate, and use their knowledge in creative ways to produce new models that are applicable to their organisation.

The second stage, the Early Adopter, requires the involvement of a larger number of people. Some of them have loose connections with each other, and some of them have strong relationships. Those involved have to be comfortable with using new tools, and although they need support, they are passionate and willing to invest personal effort in taking the use of the new models to a higher level that can be shared and replicated elsewhere. The social structures that connect them are those typical of quasi-communities. This group of adopters need to have adequate support to facilitate effective social interactions. While overall the adoption project provides formal support, the social structures should be able to supplement this support by facilitating community members to help each other and share their experience and work outcomes. This is a key aspect of this adoption stage. The social structures should allow the natural emergence of patterns of interactions, promoting those who are productive and helping them build their reputation based on the quality of their creations, and their willingness and ability to share knowledge with others, even with those outside the early adopters group. The artefacts created during the first two stages, the positive view of those involved, and the clear evidence of the benefits of using the new methodology sets the ground for the next two major stages of adoption. This stage is not only about validation, but is when the interest and enthusiasm towards the adoption of the

innovation is spread across the organisation by communicating its values, sharing working models and its successes.

The Early Majority and Late Majority take the adoption of Learning Design to the rest of the organisation. The Learning Design processes at this stage are well known and well established. Training programs and dedicated support ensure the most efficient use of the methodology in a standardised fashion. This is the typical outcome of adoption in a traditional sense. However, this is not like adopting an Office software suite. Using Learning Design in teaching and learning constantly requires a fresh approach, and continuous improvement. Strong social infrastructure supporting active networks allowing sharing and communication of ideas is necessary for effective and innovative use of Learning Design.

The social adoption of innovation is a rich area for exploration. Future research is planned to examine in more detail the impact of social interactions on the adoption of innovation and how they influence the transition from awareness to habit formation at personal and institutional level.

The second study shows that long-term personal relationships have significant influence on the adoption of new ideas and directions of research. The decision to follow a particular research path is not based entirely on rational and intellectual reason. The method of citation network analysis applied in this study reveals interesting collaboration patterns based on social preferences.

Further research could expand the analysis to explore the formation of subdomains within Learning Design, the contribution of other disciplines, and the collaboration of institutions around the world from a social perspective. It is possible that citation network analysis could highlight collaboration maps that can be used for planning future research initiatives and improve the quality of research publications.

# Chapter 7 Adoption of Innovation in Higher Education


## Abstract

This study is based on data collected through interviews with thirteen participants from a university. The aim of this study is to examine the adoption of innovation through the lens of personal experience, categorise the responses using criteria defined in the theoretical model of adoption of innovation presented in Chapter 5, and discuss the findings from the perspective of the proposed model. The interview data was structured using labels matching categories defined in the theoretical model and used to produce charts that provide a quantitative view of the level of influence the categories of factors have on the adoption of innovation. Other findings that resulted from a qualitative analysis of the interview data in its original narrative form that were considered significant and are potential candidates for future studies are also presented and discussed.


## Introduction

The specific goals of this study are to test the assumptions that individuals exhibit different behaviours depending on the stage of adoption, and that those behaviours are consistently aligned with the three-dimensional model of adoption of innovation: social, cognitive and professional (Badilescu-Buga, 2011). In addition, this study is aimed at exploring additional perspectives that are often revealed during individual interviews, which are otherwise difficult to anticipate. Thus, the intention from the outset of this research project was to generate quantitative data, but also to include any qualitative observations that may have arisen during the interview analysis.

The definitions of the adoption stages, as explained to participants in the introduction to the interviews, are as follows:

**Innovators** - Adopting an innovation that was ground breaking, with a lot of research work to figure out how the adoption works. During this time, the participant had to innovate in order to apply and use the adopted innovation. This could be a new theory, a methodology, or a new system at beta development stage trialled in an organisation in innovative ways. There is little or no formal documentation, little or no formal support, and the innovation is not widely known.

**Early Adopters** - The participant adopted the innovation inspired by others, when the application of that innovation was at the beginning. The innovation is known in the market, it may even make headlines, but not many have adopted it yet. There is formal documentation and support, and it is very likely that information, shared experiences and advice can be found online.

**Late Adopters** - At the time the participant adopted the innovation, it had established history and had been used by many other people. It is likely that the adopter receives training and perhaps a certificate. The innovation may not even be considered innovation, but it was something new from the perspective of the participant. There is a large amount

of documentation, and a history of product releases with feedback from many other users who have already adopted the innovation.

The design of the interview relies on the use of categories and sub-categories linked to the theoretical model of social adoption of innovation (Chapter 5). For easier reading, the data analysis provides a definition of each term just before it is used (see below in the Analysis and Findings section).

## Interview Design

With ideas inspired by phenomenological methodology (Colaizzi, 1978), the questions were structured to allow for effective categorisation through labelling that is relevant to the research hypotheses. The frequency of labels' occurrence serves as the basis for quantitative analysis, while the content is also used for qualitative analysis to identify essential issues or ideas that emerge from the collection of answers. The interview design uses an approach similar to grounded theory (Corbin & Strauss, 1990) by creating questions that are linked to the main elements of the theoretical model previously constructed: the multi-dimensional adoption of innovation (Badilescu-Buga, 2011) and the social model for adoption of innovation based on a proposed social space and knowledge behaviour (Badilescu-Buga, 2013). According to this approach the questions focus on the process of adoption and the elements that lead to successful adoption.

The interview questionnaire is designed to challenge the following theoretical hypotheses:

- Adoption of innovation takes place in three dimensions: social, cognitive and professional.
    - The social dimension describes the influence of social factors in the adoption of new ideas, concepts or products.
    - The cognitive dimension describes the cognitive structures that assist or hinder the adoption of innovation.
    - The professional dimension describes the context in which subjects are supported to adopt innovation to reach a professional goal.
- The three dimensions have different characteristics depending on the adoption stage as defined in the adoption models developed by Rogers and Moore: innovators, early adopters, early majority and late majority. If these stage characteristics are not met synchronously, adoption is very difficult. These characteristics will be identified explicitly in the questionnaire.

The social dimension has an increasingly important role in all stages of adoption, not just in the initial phase when subjects become aware of new ideas, but also, as the adoption process progresses, for discovering, understanding, learning a new skill, and achieving personal and professional goals.

### *Design Considerations*

The targeted participants are academic researchers and educators. The interview encouraged the participants to recall personal experience of adoption of an innovation in each stage: innovators, early adopters, early and late majority. For example, a researcher may be an innovator working on a ground-breaking new theory, but the same person could be a late adopter when it comes to the adoption of a new gadget or a software system.

The questions try to ascertain the quality (how sustainable is the adoption?) of adoption by encouraging the subjects to describe how new habits are formed by identifying the three elements of a habit: cue, routine and reward.

### *Design Structure*

The questionnaire has the following components:

1. Identify the object of adoption: ideas, concepts, systems and the adoption driver (interest or work task)
2. Identify the stages of adoption: innovators, early adopters, early and late majority
3. Identify the intention of the adoption: to innovate, to enhance, to align to standard practices or for compliance reasons.
4. Identify the characteristics of each of the adoption dimensions: social, cognitive and professional
5. Evaluate the strength of adoption by habit formation
6. Identify the trigger: how did the adoption process start? Identify the supporting influences: how much did social factors matter in adoption?

The complete questionnaire is presented in Appendix A.

### *Selection Criteria*

The selection of the participants was based on the following criteria:

1. Has been part of a project aimed at evaluating, trialling and implementing a relatively new system (3-5 years old) within the organisation.
2. Has been part of, managed, or attempted to devise and implement an organisational change, such as changing the culture through a different work place arrangement, a new management structure, new collaboration system, etc.
3. Has been part of, managed or governed (as in the process of governance) as a member of an overseeing committee for the implementation of a large, widely adopted standard system (technological, administrative, performance management process, etc.).
4. Has changed a professional belief, a fundamental theoretical/conceptual principle, sometime during his/her professional career.
5. Was/has been a member or as leader, actively working on an innovation, exploring new thinking, or conceptual territory using emerging systems/tools/methodologies (including those borrowed from other disciplines).
6. Involved in projects where new technology or innovative use of technology is an important part of the work.

The criteria set was designed to capture experience around technology innovation, but it allowed for other experience as well, including the adoption of concepts or innovations that are not necessarily technological. As the questions capture all three stages of adoption, it was expected that this flexibility would elicit responses from participants who did not have a technological background, which was essential for this study.

### *Procedure*

Prior to the actual process of recruiting participants to the interview, the questions and the invitation letter were submitted to the university ethics committee for examination and approval.

A pool of candidates was created using the selection criteria. They were sent an invitation to participate to the interview, which was estimated to be fifty minutes long. Considering the time constraints, in an attempt to make the meeting minimally disruptive, the location of the interview was left at the participants' discretion, either in their office or a meeting room situated on the university campus.

The selection of the participants was deliberately planned to include a mixture of professional backgrounds that could offer different perspectives into the experience of adoption of innovation.

The thirteen candidates that responded to the invitation to participate in this interview have teaching, managerial, administrative and technical backgrounds. The group was a convenience sample from the researcher's own institution: a large (approximately 40,000 students), research intensive metropolitan university. The sample offers a broad view on a variety of experiences which is believed to represent the university as a whole well.

An important factor in deciding the sample size was to be sufficiently large to facilitate cross referencing between interviews, based on the expectation that members of the same university have intersecting experiences.

All interviews followed the same process: introduction, explanation of terms and the plan for the interview questions. The initial step also included the presentation of recording devices. Each interview session was recorded using two devices for back up purposes.

The interview audio files were named using numbers to ensure protection of the personal details of the participants. Once the interview process was completed the audio files were sent to a transcription services professional organisation to convert them into text.

## Analysis and Findings

### *Data Analysis*

The data was analysed using a coding system inspired by a grounded theory coding method (Corbin & Strauss, 1990). The descriptive codes are based on the question titles, which in turn are linked to the theoretical model of synchronised and multi-dimensional adoption of innovation (Badilescu-Buga, 2011). Axial and selective coding were created around main phenomena (such as adoption, communication, learning, decision-making, implementation, usage) and context, conditions and consequences.

Data was grouped to reflect on the following aspects: adoption triggers, social versus information systems, primary motivation for adoption, interaction types, learning sources, and success rates. The definition for each aspect is supplied under the analysis sections that follow below.

### *Types of Adoption Triggers*

A trigger is an event or a cluster of related information finding events that lead to the decision to initiate the adoption process. The event could occur spontaneously or at the end of a process driven by the participant or a third party. While one or multiple triggers lead to the participant's decision to invest time and effort to adopt an innovation, it does not mean the intended adoption will eventuate. The investment may succeed or fail, depending on a variety of factors. The trigger is only about how a person is persuaded to try the object of adoption.

Adoption triggers are categorised as follows:

**Serendipity** –This is an information encountering event. The participant finds new information unexpectedly, not being aware of the need for the new information. An example of serendipity found in one of these interviews is this: "*It was something which almost came about by accident, because a medical professor at the university hospital attended a lecture which a colleague of mine, was delivering about a particular kind of pottery that she'd worked with in Italy*" (participant #2).

**Information Seeking** – The participant makes a conscious effort to find information to satisfy a pre-defined information need. As an example: "*I was probably actively looking for. I've always been involved in conversations about how we might do the assessment online*" (participant #6).

**Knowledge Behaviour** – This is the sum of all activities in the process of evaluation of knowledge need, skills requirements and information behaviour (Badilescu-Buga, 2013). This trigger is complex and it usually occurs when impact decisions are being made. An example of a knowledge behaviour trigger: "*Yeah, also taking in as part of that the needs analysis of the users. So, we had educators as one core group, we had the students as another core group and then we had management. So, we needed to look at the analytics behind Blackboard, what could we do in Blackboard that was different to say running it with Moodle with their analytics? So, there's a bit more to the analysis than just the superficial analysis of the three products.*" (participant #4)

***Organisation Decision*** – This is a trigger that occurs as an external influence directed at the participant by the employing organisation. An example of this trigger: "*So, the university initiated a learning management system management review. They decided they were going to look at a new system and so they went out to tender and they had a look at what systems were available."* (participant #8).

**Change Agent** – This is an external trigger as well, but this time is a representative who has an interest and who plays an active influential role. The term change agent is used in the context described in the "Diffusion of Innovations" publication (Rogers, 2003). An example found in this study: "*The vendor, as I said, was evolving the product. Two years ago, they came to us and said we are implementing new features, we're updating the architecture of the system*" (participant #5).

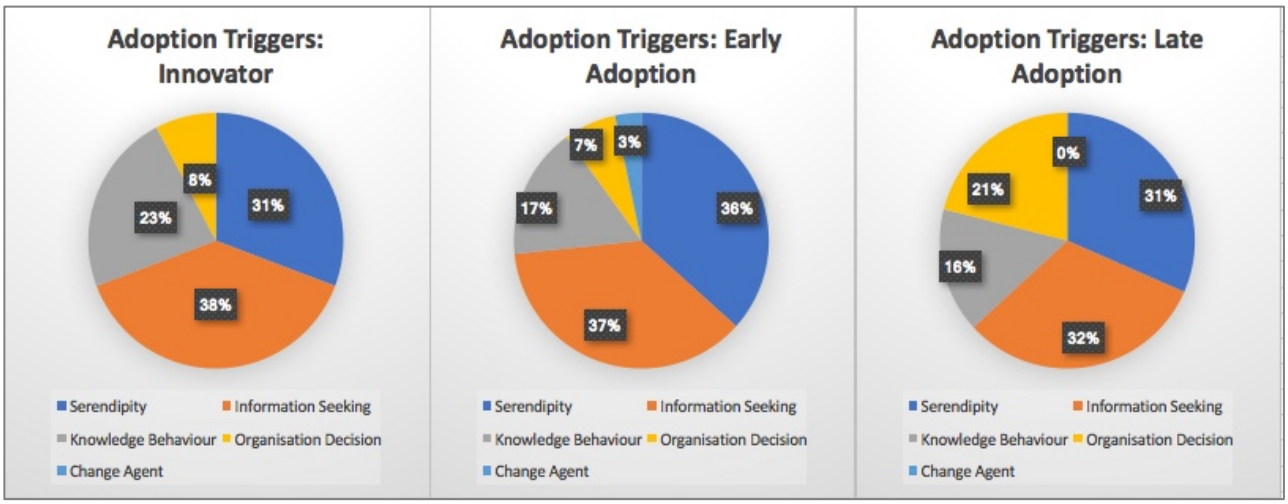


*Figure 9 Types of Adoption Triggers*

This study found that serendipity and information seeking play important roles in adoption, even in the case of the late adoption stage (see Figure 9). The Organisation Decision trigger has a higher rate of occurrence in the later adoption stage. It is interesting to see the low rate of occurrence of the Change Agents trigger. This is in contrast with the model of diffusion proposed by Rogers (2003) which attributes a much larger role in adoption of innovation to Change Agents. The findings of these interviews suggest that individuals and organisations have a substantial influence through their own access to information and understanding of innovations that are potential candidates for solutions to their specific problems and needs.

### *Social vs Information Systems*

Following on from the previous sub-section that reveals types of sources that trigger the process of adoption leading to decisions to go ahead and try to adopt innovations, we can group these sources into two categories as a way of measuring the weight of social influence. These two categories are defined as follows:

**Social** – Information seeking and, at a higher level, knowledge behaviour occurs in a social setting. Information is obtained by direct interaction with other people, regardless of the medium of communication. Thus, a social source could be a face-to-face interaction, or an email exchange with another person. Both of these sources are considered social.

**Information Systems (Info Sys)** – In this case the information or knowledge acquisition is obtained through enquiries made through non-human information systems such as computers, and physical and online libraries (printed and electronic books).

The data suggests that the social medium is more important to pick up on new ideas and find out about new products at early stages than at later stages (see Figure 10).

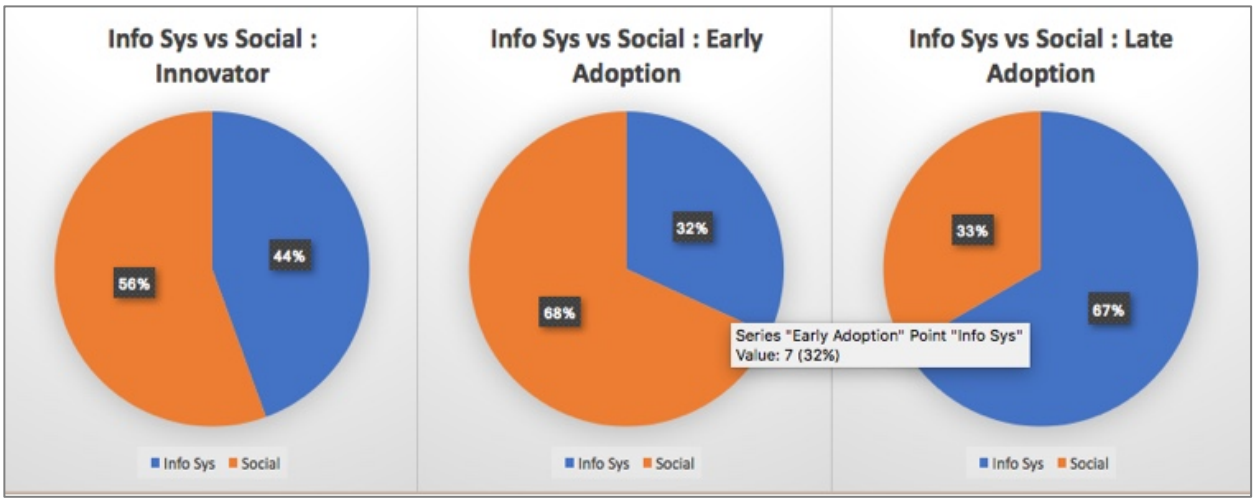


*Figure 10 Information Systems vs Social*

The Late Adoption stage indicates that the information gathered through information systems was dominant. However, if we look at the balance between social versus information systems when adoption was motivated based on personal interest (see the Primary Motivation of Adoption section below for a full list of motivation categories), the Late Adoption stage has a dominant social component (see Figure 11). The reason for this preference is correlated with motivation for adoption based on personal interest. These scenarios are related to innovations that are not initiated by the organisation and they are personal hobbies. The types of triggers of adoption are predominantly social in these circumstances.

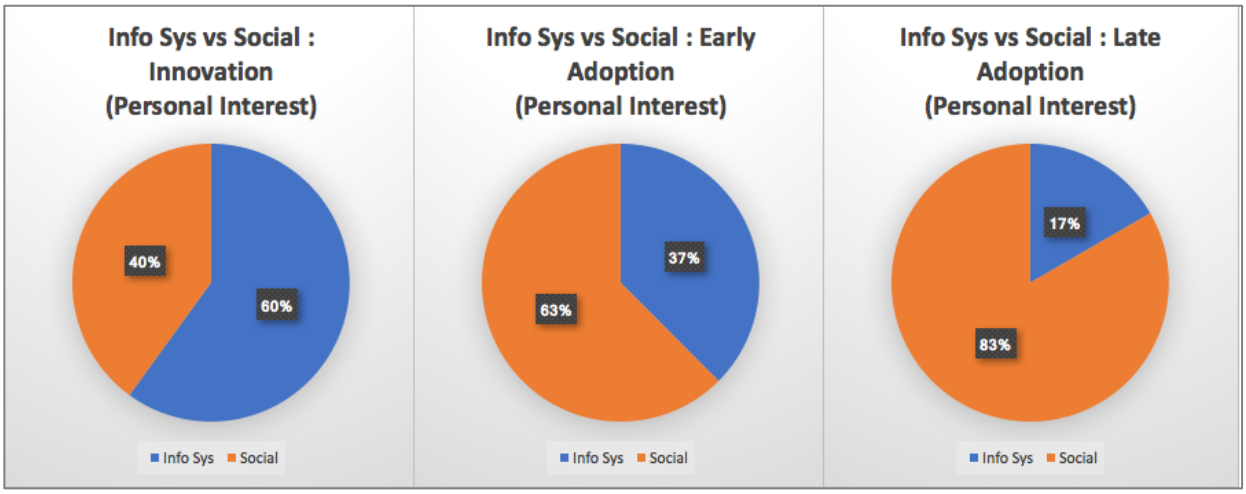


*Figure 11 Information Systems vs Social Motivated by Personal Interest*

### *Primary Motivation of Adoption*

If we look deeper into what motivates adopters when making decisions to direct their efforts of adoption of innovation, there are strong differences between the primary motivations at different stages of adoption (see Figure 12). It is striking how important personal interest is at the innovator and early adoption stages.

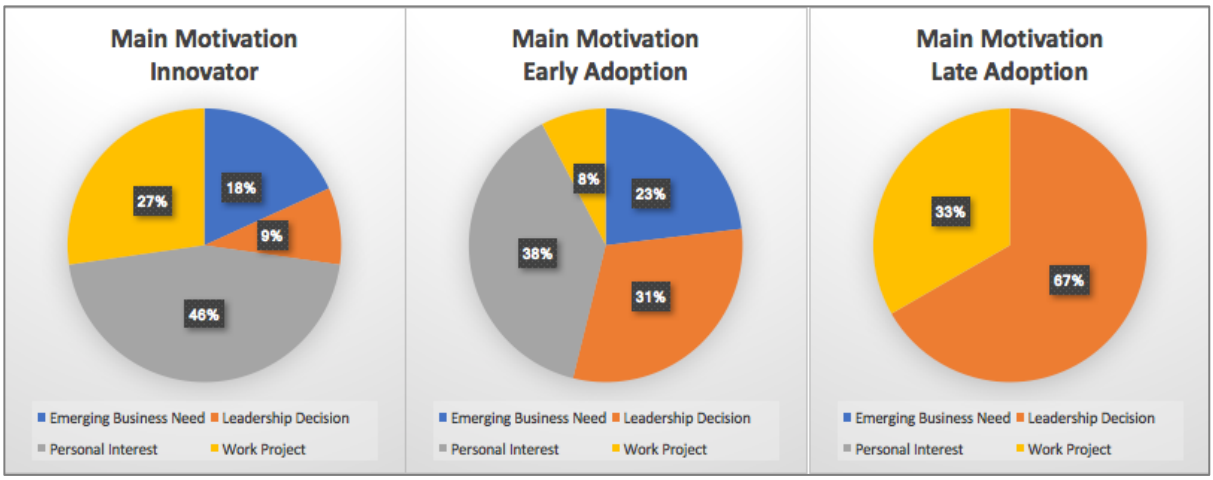


*Figure 12 Primary Motivation of Adoption*

### *Interaction Types*

During the process of adoption of innovation there are strong interactions between participants in the process. Adopters use various interaction types to communicate, obtain clarifications and additional information, improving their understanding of the new products and how they can be used to solve their problems. The interaction types are listed below:

**Face to Face** – this is a type of interaction in which the people interacting are in close physical proximity. Electronic mediums that use video communication technologies do not count as Face-To-Face interactions regardless of the quality of the video stream.

**Electronic Close Distance** – interaction through the electronic medium: email, information systems, Skype, social networks, forums, etc. Close distance means that the interaction is with people that are in close proximity, well known, and have a working or personal relationship. This interaction alternates with Face-to-Face interaction: "[team interaction] *face-to-face and email. A lot of communication comes- is driven by the student experience. When there's a problem we hear about it. That's when the communication network kicks off*" (participant #5).

**Electronic Long Distance** – similar to Electronic Close distance, but the people are far away and are very rarely involved in Face-to-Face interactions. The individuals are most likely not directly known by the adopter. This is the case when contact is made via email, a request through an online form, support forums, or social networks ("*private Facebook group […] you interact with those people although you don't personally know them*", participant #9).

**Solo, Individual** – This interaction is based on indirect exchange of ideas based on actions such as experimentation or publications written in response to other published ideas: "*online research, myself, sitting by myself coming across this concept. The engagement with other people is with the ideas that others have presented in their research.*" (participant #11). The exchange of views may work at times the same way it works in a social context. This is not an interaction in the traditional sense of communication; however, it is important to add it as an interaction when an individual adopter has a lone experience. This type of

interaction was added as a code to highlight the solitary experience of adoption which is usually accompanied by an Electronic Long Distance type of interaction.

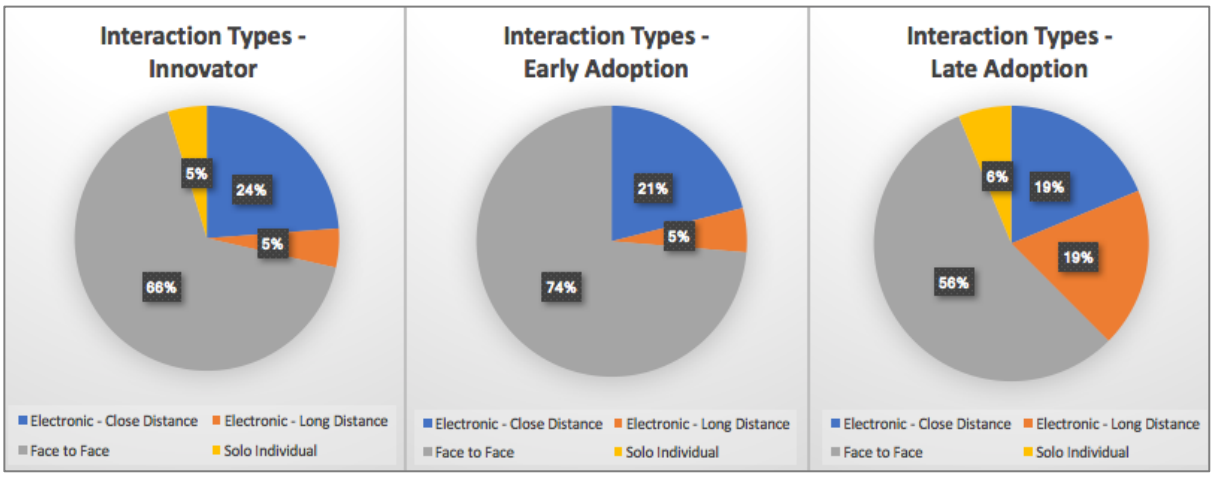


*Figure 13 Interaction Types*

The data collected in the interviews show that Face to Face and Close Distance interactions play an important role in adoption (see Figure 13). Late Adoption has a more frequent occurrence of Long Distance type of interaction.

### *Interaction Relationships*

Interactions occur in the context of social structures. The code definitions used to describe these structures are listed below:

**Family and Friends** – self-explanatory, this is a social structure that could influence adoption, even when the object of adoption is of a professional nature. The friends and family members may not necessarily have related specialised knowledge, yet they can influence the adopter.

**Community of Practice** – this social structure is based on close professional relationships that revolve around a common set of objectives. The community of practice includes, in essence those who are involved in the pursuit of achieving a common set of goals (Wenger, 2009). The members of this social structure are close colleagues that may be part of one or more organisations involved in a collaboration: "*we have a lot of discussions about the EMOTIV- this is again me and my colleagues, […] and a bunch of people who had experience doing some of the research with these […] systems. We're just talking a lot of back and forth about what are the basic needs*" (participant #10).

**Quasi-Communities** – the members of this type of online social structure are scattered around the globe and are linked by social ties based on their shared interests (Hung & Nichani, 2002b): "*…not on social networks at the time. It was more on forums. We were - we found an Australian woman who was working in a university in the UK at the time, and she had been an early adopter […] and heavily promoted it at her university. So, we had a lot of engagement with her and seeking her advice and her recommendations and what she saw as the positives*" (participant #12).

**Social Networks** – this refers to online networks in which social ties are clustered around personal relationships, but they also include professional relationships (such as Facebook, Research Gate, etc.) (Dron & Anderson, 2007).

**Collectives** – similar to social networks, but with an additional layer that acts like a filter. These are online relationships formed within large social networks, sometimes as sub-groups, in which the members form clusters of ties based on emergent behaviours that arise from common interests, likes, and interests. Examples of collectives are observed in health-related activities, elections, environmental events, education (around online courses) – see below the example mentioned in the commentary related to the chart presented in Figure 13.

**Ideas** – This is not exactly a social relationship, but an ideas relationship is nevertheless a relationship that is relevant in the adoption of innovation, because similar to social relationships, ideas created by various people are connected in the minds of individuals who find them on sharing platforms (such as books, magazines, newspapers, online publications) with a socialising effect resulting in these ideas being linked to each other: "*The engagement with other people is with the ideas that others have presented in their research.*" (participant #11). This code was added to reflect relationships established by individuals who happen to adopt an innovation through an unspoken dialogue of ideas and solitary work.

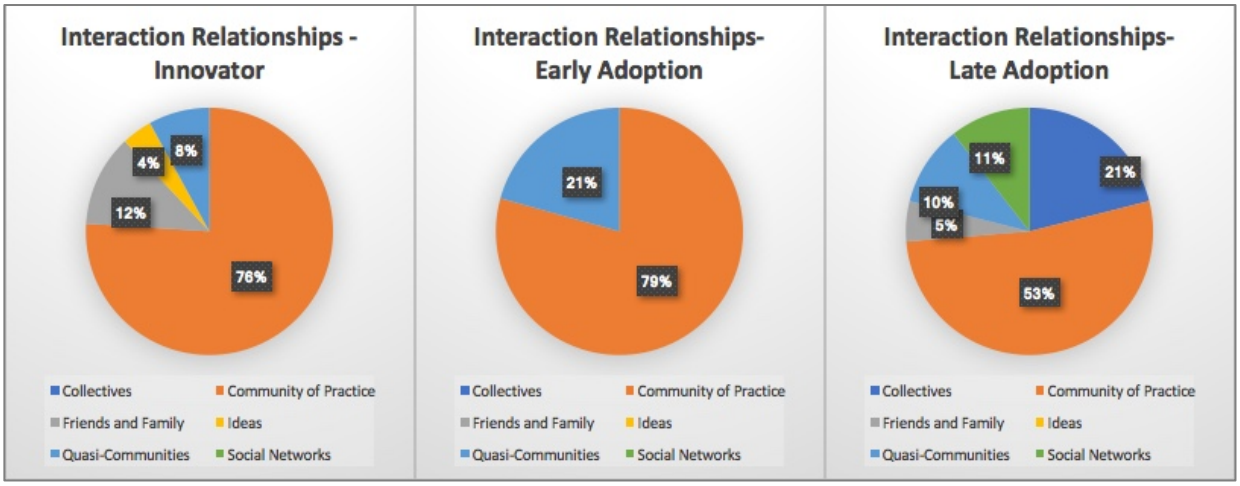


*Figure 14 Interaction Relationship Types*

The analysis of the types of social interactions that occur during the adoption process show that communities of practice play an essential role, especially in the first two stages of adoption (see Figure 14). Note the incidental role played by family and friends in the Innovator stage. This relationship may not be visible in the work project environment, but it highlights the importance of social connections.

The role of Quasi-Communities was important in all three stages, predominantly at the Early Adoption Stage. Social Networks and Collectives appear during the Late Adoption Stage. While the Social Networks type of relationship occurred for a case of adoption motivated by

personal interest as a hobby, the Collectives type of relationship appeared in both personal and organisational contexts.

A good example of a Collectives interaction relationship is the case of adoption of an online personal trainer program. The program has a dedicated private group on Facebook and while the participating members have completely different backgrounds and views, and they might not naturally connect outside this shared interest, they motivate each other: "*I thought that that might be a way forward because it works well. You look at this video and he just pops up and he talks to you- a bit of motivation about something or whatever. People comment. People talk. People motivate each other. It's really interesting how the group works. Sometimes I don't -can't be bothered, and sometimes you think oh, […] what are they talking about, but sometimes there's stuff where you want to say stuff or post a photo if I've done a park run or something like that. Yeah, sometimes you'll interact with it*" (participant #9).

### *Learning Sources*

Understanding how an innovation works is key to its adoption. In order to fully adopt an innovation sometimes users are required to update their knowledge regarding the business context within which the adoption will work. This is a requirement that is distinct from learning how the actual product operates. The cognitive processes therefore can incorporate formal and informal training on the business (operational) context, product, product documentation, business related research, product-related research, and trial and error. This classification is linked to the theoretical model of three-dimensional synchronised adoption of innovation(Badilescu-Buga, 2011). The following codes were used to classify the experience of learning about how the innovation works and applying that knowledge towards adoption and usage to meet goals:

**Trial and Error** – participant uses a trial and error process to understand the functional characteristics of the innovation and its application towards meeting the goals of adoption
**Business Context Research** – acquire information and knowledge related to the business context necessary for the full adoption of the innovation. Without the expansion of this type of knowledge it would be very difficult to apply the innovation effectively.
**Product Related Research** – acquire information and knowledge related to the actual innovation product.
**Business Context Formal Training** – participants received training regarding the business context in which the innovation can be used.
**Business Context Informal Training** – participants gain new information, knowledge upgrading their skills through informal training such as colleagues making presentations, or colleagues training colleagues through informal workshops.
**Product Formal Training** – participants receive formal training specifically related to the product. The training may provide certificates attesting the newly acquired level of skills.
**Product Informal Training** – colleagues or other known or unknown persons provide informal training which could be in the form of explaining a presentation, showing a demonstration, or showing how a particular feature works.
**Product Documentation** – the adopted product has documentation that explains in sufficient detail the parts, the functions and overall concepts necessary to understand how the product works and is supported.

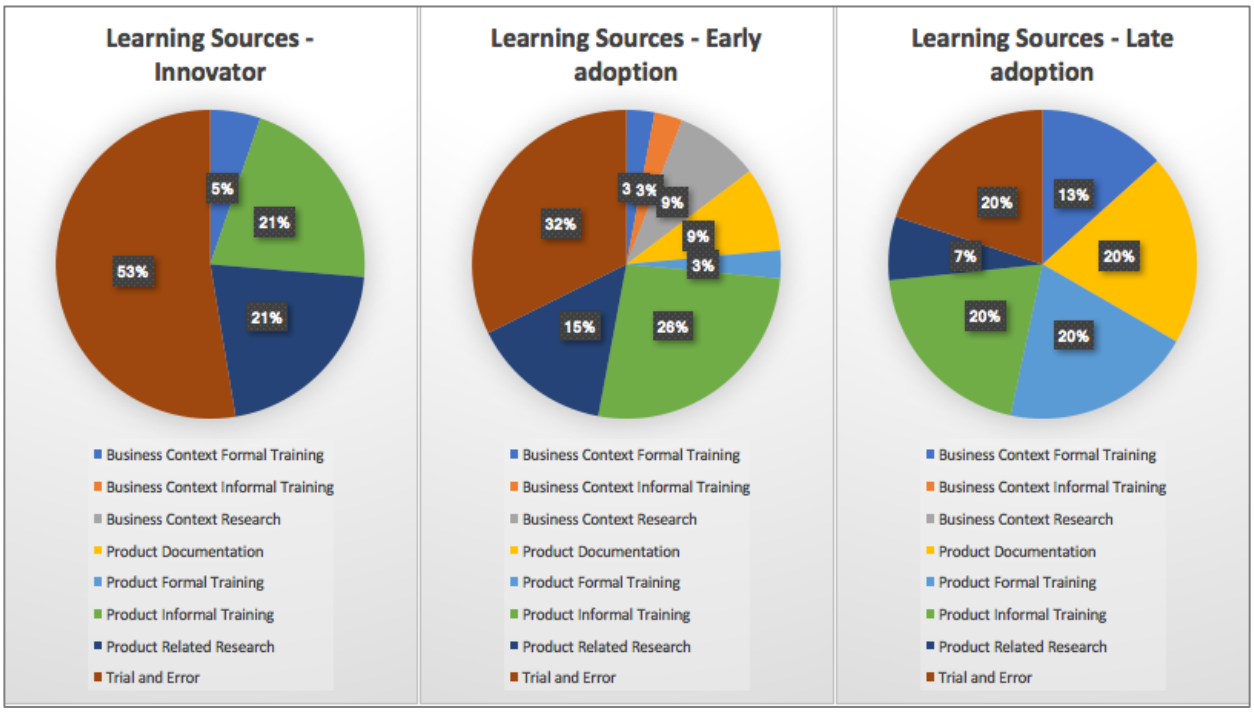


*Figure 15 Learning Sources*

The interview data clearly indicates that the Innovator and Early Adoption stages have the highest occurrence of Trial and Error as a means to understanding the innovations. Learning, understanding and applying the innovation at these stages sometimes requires improvisation that works as an interim solution (see Figure 15). An example of a pragmatic way to adopt a new product is this: "*we found an Australian woman who was working in a university in the UK at the time, and she had been an early adopter and heavily promoted it at her university. So, we had a lot of engagement with her and seeking her advice and her recommendations and what she saw as the positives. I still refer to things that she mentioned, of her findings, when I talk to people about the product today*" (participant #12).

The Product Documentation is present predominantly at the Late Adoption stage where there is information not only about product functions, but also about the broader educational context: "*... a lot of the documentation. So, their website is really good. They have a lot of information not just on how to use it but why you would use it and what- and pedagogical approaches as well*" (participant #12). Those who adopt the product at the earlier stages need to make an effort to conduct product-related research, more so than at the Late Adoption stage where there is more emphasis on formal training. Product Related Training has the highest number of mentions for the Late Adoption stage.

### *Other Findings*

The interview was designed to focus on aspects that reflect the proposed theoretical model and facilitate testing of its hypotheses. As often happens, interviews are great for identifying perspectives that escape direct observations, and this interview is no exception (Creswell, 2003).

### *Principled Beliefs*

Information seeking and knowledge behaviour, which trigger the adoption process, are motivated by need and personal interest (Badilescu-Buga, 2013). At the start of the study, the need was further divided into work project, emerging business needs, and leadership decisions, while personal interest was thought to be a matter of career and professional interest or hobby, in line with other published views (Ingwersen, 1996).

Some of the responses received during these interviews highlighted an additional type of motivation based on personal views regarding positions of power. One respondent described the experience that led to the adoption of a particular teaching style focused on learning, not just student centric, but student caring: "*The fellow who was talking to us, this was an adult learning environment in the VET sector, and we were supposed to at the end of this become specialists in learning and development. That was what our job was, training and development and learning and all of that. This was the moment, and it's so poignant I can tell you, everybody that was in the room and all of that. He said if you hand things in late you get a 10 per cent penalty for each day. […] I don't mind being penalised if I'm late, that's a consequence I know of and I need to live with, but this seems a power game. It was at that moment I thought I will never be that arrogant that I come before the benefit of the students learning, because that's what I'm here to do*" (participant #4).

Another respondent recounted a similar experience motivating the adoption of an assessment system: "I'm also very committed to addressing inequality and imbalances of power in any situation really and my feeling was that it was a misuse of our power as academics to hide from students the standards we were using to assess them. If you're assessing students you've got huge power over them because you get to decide whether they progress or not really" (participant #7).

These responses bring attention to the role of emotional beliefs in our disposition to adopt particular innovations and not others. We can group these influences under the term Principled Beliefs. In addition to individual attitudes towards positions of power, we could include in this category views on the environment, social conditions, politics, religion, and other affiliations that could have an important role.

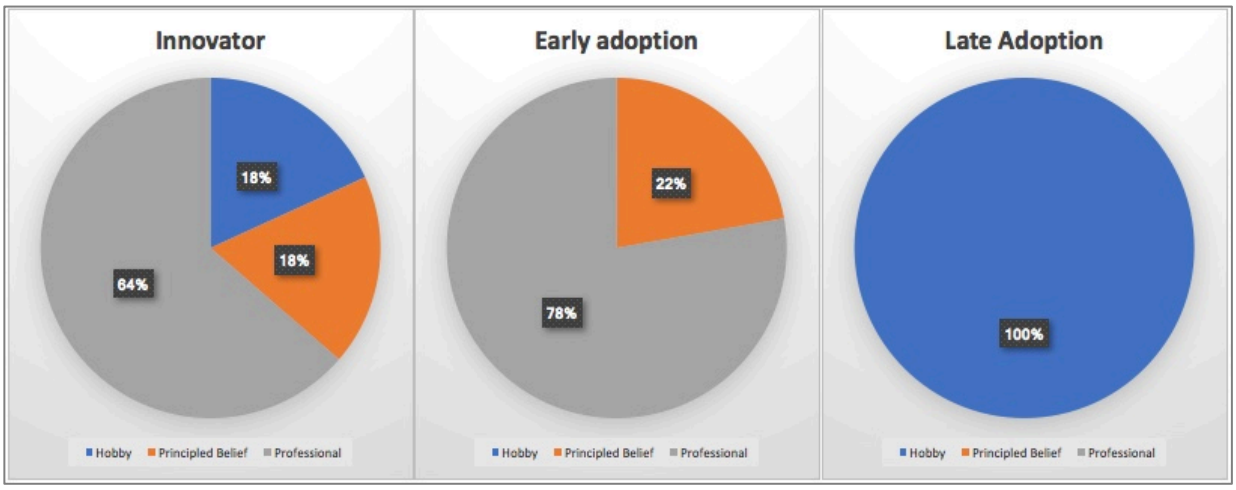


*Figure 16 Principled Beliefs*

In this interview study, the collected data shows that within the Personal Interest motivation set, Principled Beliefs had a significant presence at the first two stages of adoption, but not at the Late Adoption stage (see Figure 16).

### *Differences in Risk Aversion*

One rather striking contrast between responses of respondents with a pedagogical background versus those with a technical background was the difference in risk aversion manifested in the adoption of innovation with technology.

On one hand, the technologists are very cautious about adopting new technologies. This stance is justified by a sense of responsibility towards the user base as a whole, with the pressure of meeting expectations, and optimal use of funds. As one respondent noted: "*Part of my approach to analytics is I just sense that, if we were to do a learning management system review and go to market, within a couple of years like Canvas or Blackboard will have built in analytics that don't require us to build models, export CSVs, do data analysis and all that sort of stuff. That's my hesitation. I don't want to (1) do a shed load of work, (2) invest a shed load of resources, (3) scare the academic staff who will have to jump through all these hoops to pull out data from various plug ins. […] But I would rather do a little less work now and ensure that we have greater buy in [later] for the usage of other tools.*" (participant #6)

On the other hand, those with a non-technical background and an interest in technology have are less averse to risk and are willing to invest personal time in projects of interest. Another respondent with a technical background observed: "*A lot of the innovation actually comes in the faculties themselves. It's the academics and the learning designers- the people that support them technically- very directly. They're the ones that come up with these new ideas, or they'll go to a conference and come back with some technological tool that we don't have, or even invent stuff themselves*" (participant #5).

### *Weak Ties*

Overall, serendipity was a strong factor that triggered the process of adoption regardless of motivation or the stage of adoption. One notable aspect of this phenomenon is facilitation by individuals that are very loosely connected to the professional or social domain of which the adopter is part. This is reminiscent of the weak ties theory (Granovetter, 1973). As an example, the adoption of 3D scanning of artefacts was triggered as a result of a conversation with someone from the medical field who had an interest in Italian pottery: "*The professor identified the fact that- that's interesting, the way you analyse [pottery artefact] is precisely the same way as we analyse the human body when we put them through an MRI scan or in terms of the chemical composition of the body and what that tells us about the health of the body, et cetera*"(participant #2).

## Discussion

This study was conducted with the purpose of challenging the theoretical model of the social adoption of innovation (Badilescu-Buga, 2013) and specifically, testing the assumption that different behaviours manifest during different stages of adoption, in alignment with the three-dimensional model of adoption of innovation: social, cognitive and professional.

While most of the examples were related to adoption of innovation in an organisational context, examples of personal adoption of innovations were permitted. This was done with the purpose of capturing personal views on this process; however there are differences between the two large scenarios, especially in regards to social factors. When the difference was significant, the data was split for comparison (see Social vs Information subsection).

### *The Social Dimension*

The data analysis shows the significant role of social connections on adoption. This influence is visible not only at the beginning of the process leading to the decision to try adoption, but during the process itself. The influence of the social element is stronger for Innovator and Early Adoption stages as adopters prefer to use social connections rather than computerised information systems to find relevant information (see Figure 10 /Chapter 7). The finding supports the view proposed in the social adoption of innovation model, by which social connections are important in discovering new sources of information. The lesson for the organisation is that it will do better if it engages persons with strong network connections at the early stages of adoption.

The interview analysis reveals the strong influence of individual adopters in the selection of innovations. While organisational decisions are present at all stages, with more prevalence in the Late Adoption stage (over 21/%), serendipity and motivation based on personal interest have more influence, especially at the Innovator and Early Adoption stages. Some of these projects are successful, especially when they are supported by leadership and meet the needs of the organisation, but there is a high rate of failure in the first two stages of adoption. In contrast to Rogers' attribution of the Change Agent as a major influencer(Rogers, 2003), this interview process found only one example where a Change Agent played a definite role.

The types of social relationships involved in communication identified in this interview study are consistent with the social adoption of innovation model, not only as a general classification, but also as having specific characteristics with uneven distribution across the three stages of adoption. Thus, face-to-face communication and communities of practice are the dominant form of communication in the first two stages, while electronic communication is increasingly used in the Late Adoption stage, where organisational management processes are more formal. Quasi-community types of relationships are mentioned in the context of Early and Late Adoption stages, supporting the theoretical hypothesis. In addition, Social Networks and Collectives are present in the Late Adoption stage. During the Innovator stage, informal and personal relationships play an important role in communication, supporting the proposed theoretical model of adoption of innovation (Badilescu-Buga, 2011).

### *The Cognitive Dimension*

Activities and processes that adopters do in order to understand and learn how an innovation works, which can be applied towards fulfilling the goals of adoption, have characteristics that vary from stage to stage. As per the proposed adoption model, the Innovators stage has the highest incidence of Trial and Error as a means to understanding and learning how to apply the innovation. The prevalence of this form of learning decreases over the next two stages, with the lowest weight in the Late Adoption stage.

The Innovator stage relies on Product Related Research and informal transmission of knowledge by expert users or colleagues who have prior experience with the product, because there is little or no documentation available at this stage. At later stages, successful adoption requires Formal Product Training and Product Documentation, especially when the product is adopted at a larger scale. In one of the examples provided in the interviews, the adoption of a product in the Early Adopter stage moved into the Later Adoption stage a year or so later. Initially the product was trialled and introduced in one faculty, but later it was formally implemented throughout the entire university, backed by a policy that ensured standardised and universal adoption with a product setup that included templates and references to formal pedagogical frameworks.

### *The Professional Dimension*

There is a definite contrast, as expected, regarding formal and informal product training between stages. The Innovator stage relies on Informal product training provided by colleagues who have prior experience with the product, and little or no documentation, while the Late Adoption Stage has a heavy inclination towards formal training and the use of product documentation. This study also found the use of more formal training related the pedagogical and administrative context in which the adopted innovation is implemented.

Before providing the final conclusions, it is appropriate to note that participation was open to one university, and it had a restricted number of participants (possibly in the range of 0.5% of all staff). It is believed however, based on the participation criteria for candidate selection, that it provided a good range of responses, sufficient to build consistent material for analysis.

## Conclusion

The findings of this study indicate that social ties have significant influence on decisions to adopt innovation. Individuals make a large contribution in the discovery phase in seeking and finding additional information about innovations. This information is important in deciding whether the innovation is a good candidate for adoption, and consequently whether it is worth investing time in learning more about it and understanding its application.

The most important source of learning at the Innovator and Early Adoption stages is trial and error. A significant percentage of training is informal, especially in the first two stages. Formal training and the use of formal documentation was found to more relevant in later stages of adoption.

The study also found that perception of risk by adopters with technological and pedagogical backgrounds is asymmetrical, with technologists leaning toward the more cautious side.

# Chapter 8 Findings

## Introduction

This chapter contains an integrated analysis of all the findings resulting from the research studies, divided into two major parts: findings related to the review of literature, and findings related to studies conducted within this research project.

The first major part is a critical summary of the results of the literature review. This includes lessons learned during the review, identification of major concepts retained as parts of the scaffolding upon which the research has been built, a critique of elements of the existing literature that became part of the research objectives, and observations derived from the reviewed literature related to adoption of innovation in education systems.

The second major part discusses the findings grouped around individual studies. The analysis was structured so that it is clear how the methodologies listed in the Research Design section (Chapter 3) were utilised to collect and process data and what the key outcomes of these studies relevant to the purpose of this research project are. The findings are presented in chronological order, the same order in which the studies are described in their dedicated chapters.

## Literature Review: Inspiration and Debate

A large part of the literature review occurred in one contiguous period at the start of the research project. The other part consists of small additions following readings and reviews that occurred in an iterative, and at times serendipitous, discovery process that dotted the entire project up to its final conclusions: I read new articles, I changed my mind regarding certain assumptions, I discovered new ideas and nuances and adjusted the organisation of the material based on findings revealed by individual studies over the duration of the project. The findings consist of principles identified in the literature review and elements that have been held as reference sign posts throughout the project that became embedded in the theoretical foundation and objectives for further in-depth research. To facilitate discussion of the original contribution and potential future research directions, the adopted principles and constructive critique are presented in separate subsections as sources of inspiration and debate. (see Chapter 9, Discussion).

### *Principles Carried from Reviewed Literature*

Three key concepts have been retained from past research and publications and used to create the initial foundation for this project: 1) social connections have a strong influence in the adoption of innovation, 2) the adoption progresses in stages, as defined in the model of diffusion of innovations (Rogers, 2003), and 3) there is a critical moment (a “chasm”) in the spreading of an innovation when the adoption moves from the early adopter stage to the early majority stage (Moore, 2002).

Early sociological and anthropological studies valued the role of social connections in the transmission of ideas and adoption of innovations (see Chapter 2 Literature Review, Early Days: Adoption as Social Imitation and Sociocultural Diffusion of Innovation sections). This

idea influenced me to research the impact of the social dimension on the adoption of innovation.

The progression of adoption of innovation in stages represented as an S-curved chart is a key principle that has been retained from the diffusion of innovations theoretical model proposed by Rogers (2003). In line with this idea, I designed the research activities using the stages of adoption of innovation as a guiding framework: innovators, early adopters, early majority, late majority and laggards.

The "chasm" between the first early adopters stage and the majority adopters stage has been used as a marker that helps differentiate between disruptive innovations and improving innovations. The notion of disruption is pertinent to the market, rather than to individual adopters. Thus, we can find innovations that have been in the market for a long time and been adopted by the vast majority, and while adoption by a laggard does not cause any ripples through the industry, it may have a disruptive impact in the laggard adopter's world.

### *Adoption of Innovation Challenges in Education Systems*

In broad terms, many of the challenges identified by John Pincus in 1974 (Pincus, 1974) are still applicable today: complexity of the systems' constituencies making it difficult to satisfy all demands, being open to public scrutiny, difficulty in identifying technologies that are both dominant and suitable, and decentralised governance causing individual organisational units to face "unique configuration of clients and masters". The education sector has evolved and improved since then, but additional challenges have appeared, some difficult (competing models of education, rethinking the roles of educators), and some "wicked", complex to even define (such as balancing our connected and unconnected lives, keeping formal education relevant, scaling instructional innovations) (L. Johnson, Adams Becker, Cummins, & Estrada, 2014).

## Multidimensional Adoption Patterns in Learning Design

This study (see Chapter 4: Multidimensional Adoption Patterns in Learning Design) analysed issues encountered by researchers who studied the adoption of online Learning Design tools by educators in Australia and overseas. Using an approach inspired by the phenomenological methodology, the study analysed reported experiences related to the adoption of online Learning Design tools, identifying the most significant behavioural patterns. Further in-depth analysis of these patterns found that they could be grouped into three major categories of factors that influence the adoption of innovation. By analysing the attributes of these factors in relation to the stages of adoption of online Learning Design tools, the study concluded that factors belonging to these categories have characteristics that are synchronised with the adoption stages. Given the dynamic nature of these categories, as they change from one the adoption stage to another, the study used the term "dimension" to describe these categories. Based on these findings, the study proposed a new three-dimensional model for the adoption of innovations. The dimensions are described in more detail in the section below.

### *Dimensions*

The analysis of published papers on the subject of adoption of online Learning Design tools revealed a number of issues that were grouped into three major dimensions: social structures, cognitive structures and professional structures (see Figure 17 Patterns of Adoption Issues).

Further analysis led to the observation that these issues do not have attributes that are constant throughout the adoption process. Their characteristics change depending on the stage of adoption, which means that solving those issues requires a different approach for each stage.

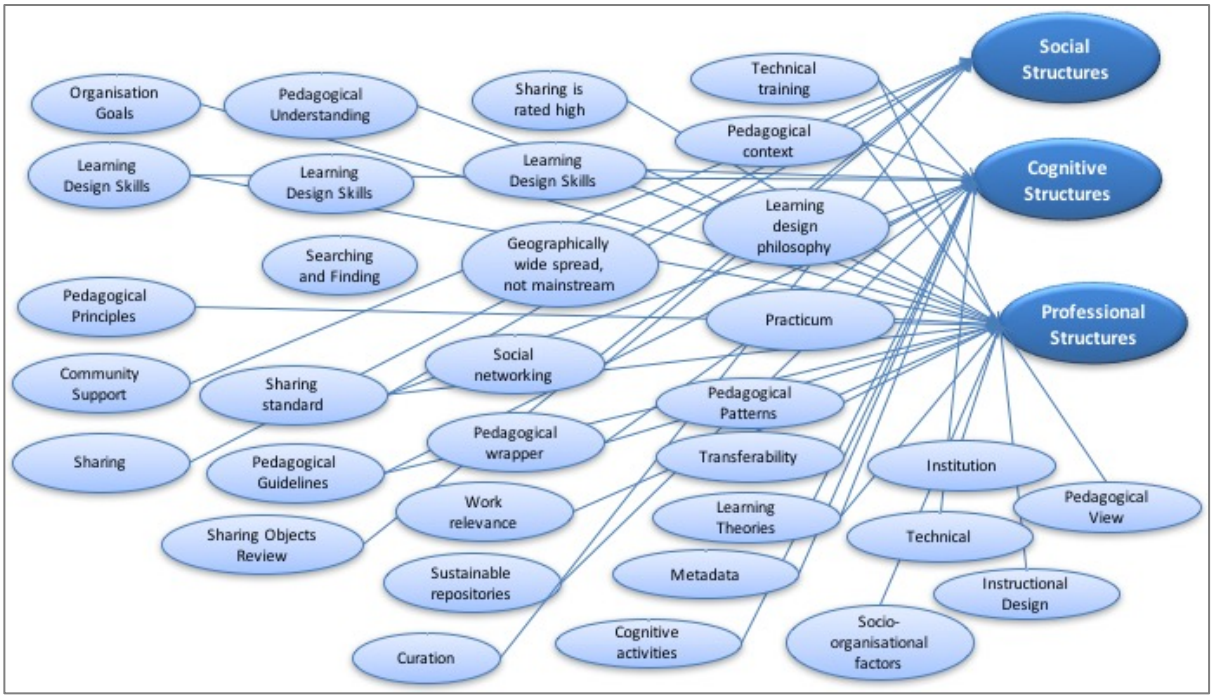


*Figure 17 Coded Patterns of Reported Adoption Issues*

A more in-depth analysis resulted in the design of a theoretical model in which these groups become dimensions with characteristics specific to individual adoption stages. These dimensions are: 1) social, 2) cognitive, and 3) professional.

The social dimension presents a social context for the adoption of innovation. Social interactions have an impact on the adoption process in the form of influence and transmission of information and knowledge. The typical structures with prevalent impact specific to each adoption stage are: communities of practice (innovators), quasi-communities (early adopters), social networks (early majority), and collectives (late majority and laggards) (see Figure 3, Chapter 4, Analysis section).

The cognitive dimension is about the collective influence of cognitive processes that are involved in the understanding of innovations, their application in combination with other products, systems and processes, their relevance to needs and interests that lead to the decision to adopt, and the consequences of adoption. This dimension is particularly well addressed by cognitive information retrieval theory (Ingwersen, 1996). The dimension is

associated with cognitive structures that are more pertinent to the main stages of adoption. For the innovators stage, trial data and observations are cognitive structures that are used very often and are sufficient to decide on adoption. Early adopters use object level meta-data, meaning the data has structures that are well defined with standard attributes such as labels, while the early majority need to be effective and have the data wrapped in a pedagogical framework for which they have professional training. The late majority and the laggards, as late adopters, will prefer to use cognitive structures that are broadly known and recognised, such as global meta-frames that are prescribed in standards that facilitate the development of compatible and interconnected applications.

The professional dimension covers the aspects of professional development that are required for adoption in a professional setting (personal development, organisational change). From an educational perspective, this is strongly related to pedagogy. The lack of pedagogical infusion into the adoption process through support for professional development is widely cited in the literature in general, and the research publications reviewed in the context of this study in particular, as one of the main reasons of failure to successfully adopt innovations by educational institutions (Zellweger, 2007); (King & Boyatt, 2015); (Boyle, 2006).

Educational adopters of innovation share a strong desire to innovate and try new things that are themselves not yet fully mature products or ideas. The professional structures associated with the innovators stage where adopters discover emergent patterns of usage are characterised by frugal or non-existent documentation and involve many trials. In later stages, other structures seem to have stronger representation: pedagogical context (early adopters), practice exemplars (early majority), and professional frameworks (late majority and laggards).

## Knowledge Behaviour and Social Adoption of Innovation Model

One of the key factors that influences the adoption of innovation is the knowledge gap that exists between the pre-adoption and post-adoption cognitive states of the adopter. Addressing this gap is essential for successful adoption of innovation and the more disruptive the innovation, the more effort is required to address the gap. This implies that if we want to improve the adoption process it is useful to have a better understanding of the adopter's perspective related to information behaviour, knowledge behaviour, skills, motivation and needs, all of which have an impact on the adoption process.

### *Individual Perspective: wants, needs*

The theory of cognitive information retrieval (Ingwersen, 1996), originating from a related field of research that studies libraries and information seeking processes, provides a different angle to the study of adoption of innovation. This theory draws knowledge and inspiration from multiple areas such as cognitive science, information and computer sciences, libraries, and human-computer interaction. The usefulness of this theory stems from the premise that information searching and finding are based on transformative mental processes. These processes are influenced by an array of intersecting needs, interests and wants situated in a broad context in which the user thinks of ideas, strategies for achieving goals, meeting job expectations, and navigating the myriad of micro and macro challenges faced by the organisation and social structures the user is part of. This theory is

useful because it offers a user's cognitive perspective, which is missing from the mainstream research on adoption of innovation, and which, as stated in the earlier section (Chapter 8, Literature Review: Inspiration and Debate), is mostly subordinated to the innovator's perspective and marketing imperative.

### *Information, Knowledge Creation, Acquisition and Sharing*

The key to adoption of innovation is access to the right information, and capability to understand the innovation and use it effectively. This involves information behaviour, knowledge behaviour and skill improvement (see Chapter 5, Information Behaviour, Key Definition sections). These processes are nonlinear, in contrast to the assumptions of linearity made by some of the older theories on diffusion of innovation. As the understanding of information needs evolves during these processes, the serendipitous nature of discoveries causes the adopter to follow a zig-zag pattern of adjustments and strategy recalibrations, rather than a linear path largely directed from the centre of a controlled environment (Ford, 2005).

Although the more recent research in the field of cognitive information retrieval recognises the importance of social networks, the findings of this study highlight their significant role in information seeking activities (especially collaboration and sharing) and their impact on information behaviour in general. The contribution of this research is to extend of the role of the social network and raise its status to the level of a major component in information retrieval, and in the broader context, the adoption of innovation model. The addition of the Social Space to the Information Space and the Cognitive Space that are part of the theory of cognitive information retrieval is significant, with major ramifications that are promising areas for future research. The Social Space is an important supplier of information that an adopter can access directly, wilfully or serendipitously and it has an impact on the behaviour manifested in the adoption process.

This research proposes a symbolic representation of general knowledge behaviour that encapsulates the main factors involved in the adoption process:

$$\Delta K = \sum (Sc + \Delta S) \rightarrow Kc + (\Delta Ii + \Delta Is)$$

This means that to cause a ΔK knowledge structural change, one needs to employ a set of current skills (Sc) together with a set of newly acquired skill upgrades (ΔS) that act on current knowledge (Kc) using new information retrieved from the information space (ΔIi) and from the social space (ΔIs).

To be effective in acquiring new information the adopter needs to possess an adequate set of information seeking skills. Thus, in addition to domain-related knowledge and skills, a productive operation in the Information Space and Social Space requires specific information seeking skills. This relationship is expressed in the symbolic equation below:

$$\Delta S = \Delta Si + \Delta Ss + \Delta Sp$$

The improvement of information seeking skill (ΔS) is made of improvements of lower level information seeking skills that are specific to the information space (ΔSi), social space (ΔSs),

and professional domain (ΔSp). The adopter will benefit from learning of new search tools, get better at forming and using social connections, and find sources of information, a new method of organising information, new professional journals and educational services. Relying on narrow and outdated information seeking skills will be a disadvantage and will result in missed opportunities to learn about other innovations, case studies, user groups, or examples of successful or unsuccessful adoption experiences. An adopter with proactive and self-improved information behaviour is in contrast to the adopter envisaged by the standard diffusion of innovations theory, to whom information is fed through the diffusion channel.

## Social Influence on Academic Researchers

### *Dominant influencers*

The study found that authors who established an early lead in influence have seen, in general, their influence increased over time. The citation network indicates that new authors bring original views into the field under the influence of their social relationships. The network layout has a fan-out type of structure built around a core network of relationships between existing authors who have a longer history in the research field, reaching to new ideas from neighbouring fields and schools of thought. The distribution of influence is a long-tail distribution which is typical to social networks.

### *Social adoption of ideas*

An in-depth investigation of network connections that form clusters (caused by a large number of references between members of the network) found that associated authors have a history of personal social relationships cultivated over years. Some authors have worked at the same institution for a number of years as part of a research team, others have studied together, and others, although they work and live in different countries, have collaborated closely over the years on multiple projects and research papers.

The citation network analysis shows that while in some cases the physical locality matters, in most cases the concentration of research is facilitated by social connections based on personal and professional affinities regardless of the geographical location. For example, in the case of The Learning Federation Australia the researchers are based in Western Australia, but in the case of Visual Instructional Design researchers with an extended collaboration history are spread across a large geographical area stretching from Canada to Europe.

## Interviews in a Higher Education Institution

This interview study was designed using the theoretical model as a guide. The findings provided answers to the original research questions, in line with expectations, but also produced some surprise findings that fall outside the intended discovery framework. The latter are summarised under the “Other Findings” sub-section further below.

### *Adoption Triggers and Information Behaviour*

Serendipity and information searching activities are important to adoption of innovation, accounting for over 60% of the factors triggering the adoption of innovation process, as

reported by the interviewees. There was only one instance in which a change agent was cited as a trigger by an interviewee. The data analysis shows that social influence is stronger in earlier stages as the interviewees discovered new ideas about innovative products through their social contacts. The use of information systems was important as well, but with greater influence in the later stages.

Motivation for adoption of innovation played an important role. When the respondents reported a strong personal interest as the key motivating factor, the structure of the influencing factors changed. Innovators and early adopters had the highest ration of personal interest as the main motivator, higher for the innovators than the early adopters. For those who were motivated by personal interest, seeking information through information systems becomes more important in the early stages, indicating that they are proactively trying to do research about the innovative products.

### *Social Interactions*

Interactions with other people involved in the adoption process are more likely to be face-to-face in the early stages. Even interactions that occur through electronic communication tend to be addressed to those who work in proximity, as a complementary channel to face-to-face communication, as one would expect given the ubiquity of software productivity tools in the workplace. Electronic communications with other people located long distance away are more prevalent in later stages of adoption.

The analysis of the types of social interactions that occur during the adoption process show that communities of practice play an essential role, especially in the first two stages of adoption. Family and friends were mentioned in the Innovator stage as part of work related interactions with direct contributions to innovating ideas. These findings support the assumption that communities of practice, closely knit personal networks, are important for innovators and early adopters. Other forms of social structures, such as digital social networks, quasi-communities and collectives, were mentioned more frequently for later stages of adoption, as proposed in the multidimensional adoption model.

### *Cognitive Strategies*

The interview data indicates clearly that the Innovator and Early Adoption stages have the highest occurrence of Trial and Error as a means to understanding an innovation. Learning, understanding and applying the innovation at these stages sometimes require improvisation that works as an interim solution. Product Documentation is present predominantly at the Late Adoption stage where there is information not only about product functions, but the broader educational context and the implementation of formal pedagogical principles.

### *Professional Development*

The respondents did not receive any formal product training for the early stages of adoption. They indicated that for these stages they did research and self-trained to learn more about the product and how to use it in innovative ways in the context of their own innovation projects. Product documentation was not used (or not available) at the innovator stage, sparsely used in the early adopter stage, and used as an important source at the late adoption stage when there was strong emphasis on formal training.

The training received during the later stage not only refers to the innovative product being adopted, but is related to the business context in which the product is planned to be implemented.

### *Multiple Attitudes Towards Innovations*

Each respondent was asked questions related to each adoption stage. The responses showed different attitudes and approaches suited for each stage of adoption. This demonstrates that the assumption of one "psychographic" profile (Moore, 2002) for each person is inaccurate. The idea that people who are late adopters of a particular high-tech product are automatically people who "don't want anything to do with technology" (Moore, 2002) is a stereotype that is not only inaccurate, it is unhelpful. Moreover, attitudes towards technology are not determined by the user's educational and professional background; they may be influenced in the way they are expressed, but not determined. Participants with humanities and social sciences backgrounds exhibited keen interest in the use of technological innovations as much as those with technical professional profile. One of the observations that came up during the interview project was how motivated the respondents were to innovate in a manner that clearly went beyond their job description. This is an aspect that will be explore more in Chapter 9, Discussion as it does not fit the traditional theory of diffusion of innovations and it is especially relevant to the education industry.

### *Other Findings*

The interviews produced a few unexpected outcomes that fall outside the initial scope of the proposed model of social adoption of innovation.

#### *Principled Beliefs*

Some of the respondents showed attitudes toward innovation that were strongly influenced by their own principled beliefs which strengthened their motivation to adopt (or not adopt) new ideas or products. The principled beliefs observed in this interview are related to the position of power and equity.

#### *Differences in Risk Aversion*

Respondents showed different degrees of risk aversion towards the adoption of new products and their implementation in an organisational context. The surprise factor in this study was that respondents with technological job responsibilities were more cautious than those who did not have a technical background. The risk aversion may be justified by their educated understanding of risk and the implications for the users they serve, their reputation and job security.

Differences in risk aversion may also be the result of a positive attitude towards experimenting something new, personal interest and curiosity (as a hobby). As a participant with a technical background observed in relation to the adoption of technological innovation, "*a lot of innovation actually comes in the faculties themselves*".

#### *Weak Ties*

The interview project also highlighted the outsized effect on adoption of innovation caused by "weak ties" (Granovetter, 1973), which are social connections involving people with links into other professional domains and who act as bridges between different networks.

Interaction with a person who is a “weak tie” in a social network, could trigger the process of adoption of an innovation which otherwise would never be considered by the prospective adopter. In one of the interviews, this is what happened in the case of the adoption of 3D scanner, which was being used in the medical field, as a tool to create a library of digital representation of archaeological artefacts in the field of education.

These findings could be a source of inspiration for further research into the adoption of innovation.

# Chapter 9 Discussion


## Abstract

This chapter shows how the research addressed the questions listed in the introductory chapter regarding major factors influencing the adoption of innovation and the use of the theoretical model by institutions as a framework for adoption of innovation. This is followed by discussion of the original contribution of the research to this field of study, and a brief discussion of the limitations of the study.

The final part exposes ideas that have emerged during this research by discussing the top three future research directions that are worth further exploration: other potential influences of social networks, the proliferation of networked autonomous systems and devices, and educational benefits derived from the teaching and learning of innovation skills. These topics have gained clarity during the last stages of the project, but were not researched due to time and resource constraints.


## Introduction

Over the course of this research project I tried to focus on the research questions and delimit the effort to areas of immediate concern. Yet, given the multidisciplinary nature of the research subject, I often felt compelled to make incursions into neighbouring areas of study and discover connections that I was completely unaware of. While my research has been steadily focused on its initial scope, I came across answers that I wasn't looking for. Consequently, I have divided the Discussion chapter into two parts: one that discusses what I planned to do and what I did, and the other about what else I discovered.

The first part contains two subsections: discussing how the research questions have been addressed and the extent of my original contribution. In the first subsection (Addressing the Research Questions) I explain the answers to the research questions point by point not just as an exercise in accountability, but as a way of reflecting on what has been achieved, the limitations of this study and, whenever possible, how this research can be used in practice. In the second subsection (Original Contribution), I provide details of what I believe to be my original contribution. I have tried to delineate my contribution as clearly as possible, and, thereby, to make it easier to challenge the findings of this research.

While I have not changed the essence of the research questions over the course of project, my understanding of what I needed to answer these questions evolved during the study, leading to me explore research areas that I did not envisage at the beginning. At the conclusion of this project I find there is an "excess" of knowledge posing interesting questions that could be the subject of follow-up studies. The second part of the chapter, Future Areas of Study, discusses these questions and potential further research.

## Addressing the Research Questions

### *What Are the Major Factors That Influence the Adoption of Innovation?*

It is important to highlight that this research focused on studying the factors that raise awareness and exert influence on decisions to pursue adoption, considering the discovery of

facts, information and acquisition of knowledge that are necessary for a successful adoption. The research has not investigated procedural aspects related to the application of innovations and their impact on adoption: cost, accessibility, availability, relevance, maintenance, and organisation change management. These are technical and management factors, internal components of the adoption process specific to the industry and the application of the innovation, which are outside the scope of this project.

The initial findings identified factors that influence the process of adoption of innovation across three dimensions: social, cognitive and professional. The influential factors within each dimension have characteristics that are specific to each stage of adoption. The social dimension is the most influential as it is important during the early phases of adoption when adopters become aware of the innovation. These factors do not affect adoption in a compartmentalised manner as they influence each other to various degrees depending on circumstances. Social factors do not act solely as a conduit to persuasion person to person, but as an important medium for sharing, seeking and finding information in a planned or serendipitous manner.

The key observation is that each stage of adoption has different corresponding social structures of predominant influence. Thus, the innovator and early adopter stage are mostly influenced by small and tightly knit social structures such as communities of practice where members possess highly relevant skills and are connected by strong personal relationships. These social characteristics are key to adopting disruptive innovations, and simultaneously innovating with these innovations. In early stages, these factors are strongly correlated to factors that belong to the cognitive dimension (see Chapter 7, Adoption in Higher Education, Interaction Relationships, Learning Sources). In this context, the adoption of innovation is more likely to succeed if the adopters are highly skilled in relevant domains, are linked through strong personal connections, are highly effective information seekers, and acquire and generate the knowledge necessary to overcome the initial knowledge gaps and solve problems that arise during the adoption (understanding the adopted innovation and innovating towards the goal that motivates their actions). The combination of social and cognitive factors is crucial to the early stages of adoption of disruptive innovations.

The third dimension is more important in the last stage of adoption, especially in an institutional setting when adopting a new system organisation-wide requires the implementation of a systematic and well prepared professional development project plan. Individuals do not always require professional development programs in order to adopt a mature innovation. In the case of individual adopters with a strong personal motivation, either professional or as a hobby, and when the innovation is user friendly, with clear instructions and abundant support available to the large public, they can adopt the innovation without professional help.

There is a relationship between the maturity of an innovation and the adopters' interests, backgrounds, their propensity to connect socially and skills that affect the adoption process. While the skill set has an importance which can be easily inferred, the other factors have a more complex and subtle relationship. The challenge posed by the initial cognitive gap depends on how mature the innovation is. For example, the adoption of the PC in 1985 posed completely different challenges compared with the adoption of a PC in 2017,

regardless of the adopter's profile. Today, a PC is almost an appliance. Not only it is easier to use, but there is abundant information and support that can help adopters learn how to use it. However, how a PC is adopted depends on the adopter, not just on how well the PC is documented or explained or how well the diffusion process is executed. As the interviews showed, a key differentiator is personal motivation. In an organisational context, the organisation can expect that a motivated person will adopt a new PC (a "new" PC means a PC that is innovatively different: a new operating system, a different user interface, new hardware accessories, etc.) autonomously, but if the new PC is to be adopted organisation-wide, differences between adopters require a higher level of support and a funded instructional project. The knowledge gap varies with the innovation and the adopter's skill set, therefore within the organisation different adopters will have different challenges, hence the utility of the planned instructional program. When the innovation is disruptive the cognitive gap can be significantly higher. Solving this issue requires the acquisition of knowledge and up-skilling. In this case, social relationships can make a big difference, as explained earlier, and they can reduce the challenge of the knowledge gap for those that initially have a lower set of necessary skills, but have better social connections and better information seeking skills that lead to faster acquisition of knowledge, and consequently to skills improvement.

### *Can Institutions Use the Theoretical Model as a Framework for Adoption of Innovation?*

The proposed model for social adoption of innovation (see Chapter 5), together with the findings of the study of the spread of influence in academic research using social network analytical tools, and the interviews on adoption of innovation in higher education could be used as an instrument to create a framework guiding the adoption of innovation in institutions. The advantage of this model is that it differentiates the adoption of innovations based on their overall stage of adoption.

For each stage, the social adoption of innovation model can be used to rate the level of readiness by examining capabilities specific to individual dimensions that influence the adoption: the type of social relationships that are prevalent in organisations and its units or departments, or across the organisation, communities of practice that can be called upon to take on more complex innovations, available skills, social connections that extend outside the organisation, the available skillset relevant to targeted innovations, infrastructure that can support sharing of ideas and collaborations, available expertise in information seeking, knowledge management, and professional development.

The education sector has one of the highest rates of employees participating in innovation (Vincent-Lancrin et al., 2014). Educational institutions can benefit from improved engagement of their employees by using a social adoption of innovation model. In contrast to the diffusion of innovations model which recommends the use of people of influence to spread ideas, this model suggests facilitating the engagement using a social network approach: it is not about disseminating information, but allowing social connections as a catalyst for sharing information and knowledge using both strong and weak links based on personal relationships. An institution could plan the involvement of communities of practice in the adoption of disruptive innovations using a framework based on the social adoption of innovation model, rather than just calling on external consulting services. Instead of using

forums, the use of social networks facilitates a more dynamic, spontaneous and motivating distribution of information, support and serendipitous experience in the case of innovations that are at a late adoption stage. This could accelerate adoption and lower the costs of addressing the knowledge gap. Additionally, the social adoption model and the underlying principles behind the symbolic equations for general knowledge behaviour and information seeking skills gap could be used for a systematic assessment of existing capabilities regarding the adoption of innovations in the organisation.

Higher education institutions could use social network analytical tools to examine targeted research fields to identify clusters of collaboration, estimate the size of the underlying network, and explore connections between clusters and the density of those connections. Chapter 6 demonstrated how social relationships influence academic research leading to the formation of schools of thought and new research directions. These findings could be used to gain a better understanding of the current state of research, or even plan the research initiatives.

The education sector is undergoing a transformation that is both positive and challenging at the same time (Cuttance, 2001); (OECD, 2010); (Vincent-Lancrin, 2014). The individual perspective is as important as the institutional perspective, because successful adoption of an innovation at the institutional level depends on individual contributions. The proposed model of social adoption of innovation suggests that individuals should be aware of the three dimensions that influence the adoption of innovation, where on the adoption curve the targeted innovation sits, and how these aspects are interlinked.

The first observation to be made is that this is not just a matter of a using a check-list, but a matter of learning and development: proactively adopting an innovation is a skill. Deciding which innovation to adopt is important, and in order to make a good decision the adopter needs to be well informed. In this context, the improvement of information seeking skills makes a substantial difference. This includes both information systems and social types of skills. The theoretical model suggests that serendipity plays a big role in expanding personal horizons, because it helps in dealing with the "I don't know what I don't know" cognitive challenge. This can be achieved through better use of information systems (search tools, applications, subscriptions, algorithms), but also through better use of social connections (within the Social Space, see Figure 4 – Innovation Space, Chapter 5). An effective personal social network has both strong and weak links. While the strong links are important in the context of close relationships and effective collaboration within a project, the weak links are important for finding information unknown to the close network. Weak links are represented by those connections on the edge of personal social circles, within the same domains, but connected to other remote networks related to adjacent disciplines, educational jurisdictions, or other functional structures. As the researched reports and interviews showed, great ideas and inspiration could be found through such links. The individual should also be aware that the adoption of innovation at early stages preferably involves collaboration within communities of practice which are more suited to dealing with uncertainty and limited instruction as they are based on trust, similar high levels of competency and language. The adoption of innovation at early stages requires a steep learning curve, high investment of time and energy with an uncertain outcome. Such adoption is more suited to innovating with innovations, rather than trying to achieve

increased productivity in well-known processes, in which case it is more suitable to adopt a mature innovation coupled with well-defined training and instructional resources.

## Original Contribution

The knowledge generated during this project is summarised by the general knowledge behaviour symbolic equation (see Chapter 5, General Knowledge Behaviour Equations):

$\Delta K = \sum (Sc + \Delta S) \rightarrow Kc + (\Delta Ii + \Delta Is)$

Through the application of existing and newly learned skills (Sc and $\Delta S$) on existing knowledge (Kc) and acquired information ($\Delta Ii + \Delta Is$) I created new knowledge ($\Delta K$). In this research project, the generation of new knowledge required learning new skills.

Some of these skills are new skills that are learned in an unplanned manner, others are existing skills that have their level of mastery improved with repeated use, while others are new skills that are acquired through planned learning. The result of the application of these skills in practice is an increase in knowledge.

### *An Individual Perspective in the Process of Adoption of Innovation*

The Chapter 8 Findings provides details regarding the adoption of innovation as an individual experience. In this discussion section I will approach this contribution from a wider perspective in an attempt to demonstrate why it is equally important to view the adoption of innovation through the eyes of the adopter.

Most of the research literature on the adoption of innovation, which stretches back over one hundred years, considers adoption as being driven either by a process of imitation or a process of diffusion. In both cases the adopter is a rather passive consumer of the new idea, even when the process requires considerable effort to be spent on understanding, evaluation, adaptation and usage. Imitation has mostly a sociocultural connotation, while diffusion of innovation is a socioeconomic concept. The diffusion methodology has been applied in practice by government and private institutions and has been recognised as a valuable tool for the spreading of innovation.

In the early industrial and pre-industrial eras, products and services had a high level of scarcity for the general public. Leading nations started to think of policies that reduced the wide-spread paucity by stimulating demand to strengthen their economies. It is not a coincidence that the theory of diffusion of innovations started with research sponsored by the government (see Chapter 2, Literature Review, Socioeconomic Diffusion of Innovation: Industrial Era**).** Spreading innovation was not only based on a commercial imperative, it was also driven by a social agenda, as a matter of national priority even (for some key innovations), as was the case in the diffusion of innovation to accelerate the adoption of more resilient and productive types of grains in agriculture, or the spread in adoption of products that improved hygiene, vaccination, and basic education. The diffusion of innovations theory and methodology has been incorporated into marketing systems which became an essential part of business practices in the following period: the marketing era (Keith, 1960) or the era of refinement and formalisation (Fullerton, 1988). The key element in the diffusion of innovations, and the adoption of innovation thinking in general, is the relationship between supply and demand. It is a top-down view of adoption of innovation

representing the suppliers of innovation, in which the methodology generally differentiates between adopters based on the adoption stage.

This project proposes a theory of social adoption of innovation which has a different focus. The contrast starts with the main concern: instead of being concerned with the issue of diffusion and absorption of innovation supply, the theory of social adoption of innovation is concerned with the issue of how the individual solves problems by adopting innovations available in the supply pool. It is not about convincing someone that a particular innovation is good, but about knowing which innovation is suitable for adoption.

The original distinction is the consideration of adoption of innovation from a cognitive perspective. Fusing the theory of cognitive information retrieval (adopted from the adjacent fields of information systems and knowledge management) with educational studies into how teachers search for information, this research studied how individuals adopt innovations to solve a problem in the context of professional need, personal motivation, hobby or a combination of those. The resulting theory indicates that overcoming the knowledge gap necessary for the adoption of disruptive innovations depends largely on the ability and effort invested by the individual. The two symbolic equations (general knowledge behaviour $\Delta K = \sum (Sc + \Delta S) \rightarrow Kc + (\Delta Ii + \Delta Is)$ and information seeking skills $\Delta S = \Delta Si + \Delta Ss + \Delta Sp$), imply that the knowledge gap is resolved through knowledge gained with the application of skills on current knowledge with input from information systems and social connections, and this is achieved through a gradual process of discovery and learning using information seeking skills specific to information systems, social relationships and professional development. This is in contrast to the diffusion of innovations, which emphasises information provided by change agents and mass media.

### *Innovation and Social Space*

A corollary of the approach to the individual perspective and how the innovation knowledge gap problem is solved, is that information seeking through social means has a significant role. The research analysis led to the conclusion that at a large scale, innovation and adoption of innovation occur simultaneously in the same space, one in which facts are generated as an accumulation of individual events (see Figure 4, Chapter 5, Innovation Space). Adopters seek information through both information systems and social connections and use it in a personal Cognitive Space to solve problems, or fulfil a goal based on personal motivation. There is a clear distinction between the two mediums. The information systems (belonging to the Information Space) have a large amount of information generated by authoring agents (writers, researchers, librarians, analysts, engineers, journalists, etc.) that can be searched with software tools. The Social Space provides information through serendipity, or purposeful personal interaction which can establish links to troves of information which would otherwise be very difficult to find with tools specific to information systems. Social connections act as providers of recommendations, curating services and technical support. The concept of Social Space, as indicated by the findings of the individual studies in this project, is an influential factor in the adoption of innovation.

The diffusion model is more effective when information is unavailable or hard to find and social connections are sparse. This scenario occurred often in the pre-industrial and

industrial periods (see Chapter 2), and in conditions with similar traits regardless of the historical context, but not in a heavily networked environment with instantaneous access to information and social connections.

This model can be expanded to include the rising social networks of intelligent and autonomous devices and agents, which form a super network that I call the Synthetic Social Network (see Future Areas of Study below). Research in this area could become a key strategic development.

### *Adopters as Innovators*

The standard view in mainstream thinking on adoption of innovation, most notably the diffusion of innovations, is that adopters have common traits corresponding to each stage of adoption. These stage-specific traits are permanent, meaning they describe an individual profile that does not change, at least for a considerable period. These traits refer in general to technical aptitudes, intelligence and educational background (see Chapter 2, Discussions, Chapter 8, Findings/Social Interactions/Multiple Attitudes Toward Innovations).

This research reached a different conclusion: not only that adopters do not fit rigid stereotypes in regards to innovation in general, but each individual adopter can have different behaviours *vis-à-vis* the adoption stage or type of innovation. Research into case studies of adoption of technology in education, and the interviews designed to capture the experience of individuals related to each adoption stage, show that individuals exhibit behavioural traits that depend on the type of innovation and professional and personal motivational factors regardless of their background. For instance, the interview study found that most of the individuals with a humanistic educational background described at least one experience as innovators and adopters of innovation in technology, most of them doing that driven by personal motivation and professional need.

This concept is aligned with (and partially explains) the trend described in the "Democratization Innovation" (Von Hippel, 2005) and Kaufmann Foundation research into entrepreneurship (Shah et al., 2012) in which users become innovators by modifying and inventing new products for themselves.

While the later stage of adoption is usually driven by pragmatic necessity (everyone uses product x, therefore it is convenient and less expensive to use it and be compatible with the rest), the early stage of the innovator is driven by the desire to solve a problem in novel ways, and to invent something new. This is innovation with innovation, a simultaneous process of adoption and innovation.

This view has significant implications on how innovations are adopted and created. This makes adopters potential creators. Knowledge behaviour analysis shows that the effort required to address the knowledge gap generates new knowledge in the process and results in improvement of the adopter's skills. Institutions that are aware of the value of this learning experience could benefit from encouraging and supporting employees who have a strong personal motivation to adopt innovation.

### *Analysing Academic Research with Social Networks Analysis Tools*

As I wanted to identify and evaluate the social relationships between academics that authored research papers, I wrote a software application that was programmed to process the reference section from research papers, extract citation relationship data and build a database of links between authors based on these relationships. The software generated over 11,000 data points which I used as input into social network analytical software, creating social networking graphs that depicted the relationships in a manner that made it possible to identify strong social patterns (see Chapter 7, Adoption of Innovation in Higher Education).

The interesting result supports the expectations in accordance with the Social Adoption of Innovation model. After rendering graphical images of the reference social networks, I conducted in-depth research using information from public sources to check if the assumptions I made regarding social connections behind the identified patterns are supported by facts. The findings were surprisingly accurate: the majority of these patterns were indeed based on strong personal relationships, some of them going back decades. Not only that, but the information found through this research helped me realise that clusters of social connections could be grouped into schools of thought.

Using the social network analysis tools and networks graphical representation algorithms I could see how the schools thought evolved in time, how the influence of authors evolves over time. The tool could potentially be used for research planning by identifying trends and communities of research ("invisible colleges", as Diana Crane called them (Crane, 1972)).

## Potential Future Areas of Study

Over the duration of the project my understanding of this field has evolved and at the end of the project it became clear that there are areas worthy of further exploration. I will discuss three of those areas in the sections below, although there are others besides these that could benefit from further research.

### *The Other Side of Social Networks*

A final review of my work brought the realisation of my own bias towards a positive view of social influence. The underlying assumption of this bias is that adopters are rational and able to discern objectively and accurately the input received from their social connections. In reality, this is very difficult to do even when the input is accurate and provided with the intention to help, because not every adopter has the required skills to overcome the innovation knowledge gap. A closer look at the Figure 4 (Chapter 5/Knowledge Behaviour and Social Adoption of Innovation) shows that seeking information in the Social Space poses an inherent challenge in assessment of the quality of the information because of the uncertainty of the authority of its source. The Social Space is a vast area which acts as a data repository, but in which social events also continuously generate data in the form of facts. Making good sense of the information received through social connections requires that people either have appropriate knowledge and skills relevant to the domain or have access to a reliable and competent source that explains the input and provides a reasonable guarantee of its quality.

The uncertainty of the source authority increases the risk that recipients of that information will reach erroneous conclusions. A more detrimental outcome is false confidence in possessing sufficient knowledge to make informed decisions although the information is of low quality and derived from insufficiently processed data. This confidence potentially has a compound negative effect as the person could be tempted to ignore or mistrust the experts (Nichols, 2017). This phenomenon has started to become more obvious recently as social media has emerged as a pervasive platform of influence and distribution of news and opinions. This effect is exacerbated when there are few or no semantic objects in the Information Space (see Figure 4, Chapter 5) that analyse, interpret and explain recent events or emerging trends that occur in the Social Space. The public experience those trends as direct participants and have instantaneous access to a broad range of opinions. Meanwhile, either experts have not yet had the time to assimilate, disseminate and produce semantic objects pertinent to those trends, or quality information is hard to get, leaving the Social Space as a seemingly unchallenged, immediate source of information. The result is the adoption of concepts and beliefs that could lead to undesirable consequences in the long run. To be clear, this is not a value judgment, but an observation that influence of social connections on adoption of innovation has its advantages and disadvantages, as it has the potential to be either an accurate source of information or a source of misinformation.

### *Synthetic Social Networks*

I define the Synthetic Social Network as an amalgamation of networks resulting from the combination of the Internet of Things and Artificial Intelligence systems.

Recent advances in Artificial Intelligence technology and the spread of the Internet of Things have created a technological ecosystem that has an increasing influence on human society. The accelerated proliferation of small devices that make up the Internet of Things has created a myriad of large and interconnected networks of things. These devices have sensorial capabilities, they can make local decisions instructing other devices to execute certain actions, or they can aggregate data to make decisions that affect broader areas. Artificial Intelligence systems can analyse data generated by the Internet of Things or the (Human) Internet, making decisions that affect devices, humans or both.

Because of their distributed autonomy and computational abilities, they are unlike any other technology innovation created in the past. Synthetic Social Network device members are connected with each other in groups similar to human social networks. An extended Social Adoption of Innovation model would incorporate a new space, the Synthetic Social Space, which is similar to the (Human) Social Space. Similar to the way the Social Space generates factual data, which is then analysed, processed and converted into information, the Synthetic Social Space generates data through billions of sensors, data which is further processed by local synthetic agents and higher level Artificial Intelligent agents. Human agents also process aggregated data, but the trend points to Artificial Intelligent systems increasingly playing the role of intermediaries because of their superior capacity to handle vast amounts of digital data. Arguably, autonomous Artificial Intelligence systems could take the initiative in data processing and use programmed intelligent algorithms (or their own algorithms, as the new generation of Artificial Intelligence systems are capable of creating) and parameters to make decisions that human operators are not even aware of.

Artificial Intelligence systems have increased their cognitive abilities at a rate that surpassed the expectations of those with expertise in the field. As an example, AlphaGo Zero which is a new version of AlphaGo Lee, a software that defeated the Go world champion Lee Sedol in 2016, was able after three days of training and self-play to outperform the chess champion program in four hours and AlphaGo Lee in eight hours (Silver et al., 2017). This progress was achieved much faster than its inventors were anticipating.

A few observations on how Synthetic Social Networks will have an impact on the way we adopt innovation:

Artificial Intelligence systems are on the edge of acquiring skills that have previously been thought to be solely mastered by humans. In January 2018, Artificial Intelligence systems reached the highest Stanford Question Answering Dataset reading comprehension score (Chong, 2018). This does not mean a machine can read and understand Shakespeare just yet, but it is clear that their capabilities of processing information will improve to the point where, as omnipresent elements embedded into the fabric of our living space, they will become networked synthetic agents that are capable of understanding at least the general meaning of what we say and what we write in real time. Equipped with the ability to process information and generate content, these synthetic agents will be able to produce semantic objects that will be harder and harder for humans to distinguish from those created by human agents.

Compared to humans, Artificial Intelligence systems have a vastly superior ability to process large amounts of digital data from multiple sources distributed around the world, all in a relatively very short period of time. This gives them an edge not only in terms of raw computational power, but also in terms of potential for learning at a scale that cannot be achieved by individual humans, an advantage that will increase over time as technology advances.

As synthetic agents become capable of interacting with humans in real time using human language, the next generation of information seeking activities will increasingly involve Artificial Intelligence systems that are connected to both Synthetic and Human Social Networks. We can infer that adoption of innovation will involve much more often the assistance of an intelligent synthetic agent (we already do this in the form of product recommendations).

The use of synthetic agents in the information seeking process will appear to solve the problem highlighted in the previous subsection (The Other Side of Social Networks) because we could assume that synthetic agents are faster, accurate and generate useful semantic objects. However, the fact that these agents become a key influential intermediary, as they are open to erroneous interpretations and decisions in the same way the humans are, could present some substantial risks which I believe are worth researching.

One risk is related to their self-learning capabilities. Artificial Systems are fast evolving and they are capable of self-learning as they are built with neuromorphic engineering technology which replicates biological adaptive systems.

This means that if Synthetic Social Networks manifest a trend that is deemed to have significant consequences, autonomous Artificial Intelligence systems could make some decisions that are reasonable from an artificial perspective, but not desirable from a human perspective. As an example of a critical autonomous decision, a driverless car could decide to kill its own passengers if it concludes that by doing otherwise the action will result in the death of a larger number of humans. Similarly, a synthetic agent may influence (diffuse) a large number of individuals to adopt a certain product or idea as a way of executing a higher order imperative that no human is aware of. This could have significant consequences if the influence is exerted over a large population base. A study of an agent-based model for diffusion of electric vehicles (Kangur et al., 2017) shows how a strategy to influence people can be planned in stages to create situational contexts in which individuals are induced ("nudged") to make targeted decisions at a later stage, when the initial method of influence is easily discernible. It is reasonable to consider the possibility that an Artificial System controlling a large array of synthetic agents could "see" the need to plan a staged adoption of innovations (such as a new behaviour, or a new class of synthetic agents) aimed at reaching an efficiency goal through a strategy of influence that is hard to detect at early stages. Examples of high impact areas in which there is a risk such strategies could be tried over a time period are behaviours related to cultural preferences, consumption of artificial foods, environment, population density, demographics, or consumption of pharmaceutical products. Alternatively, a highly innovative institution with unrestricted access to Synthetic Social Networks and Artificial Intelligence systems could use a cohort of synthetic agents to promote by stealth certain products or ideas for its own purpose and benefit.

These two challenges posed by the other side of social networks and Synthetic Social Networks highlight how important individual skills of adoption of innovation are, especially information seeking skills, and understanding of knowledge behaviour as enablers of good personal decisions. There is an uneven playing field between individuals and the multitude of human and synthetic systems designed to influence, promote and potentially deceive. As the complexity of the informational environment increases we should be concerned about how sophisticated recommendation engines that are subordinated to hidden diffusion objectives can influence our adoption of innovation processes, especially when these engines involve sophisticated synthetic agents. To address this concern, further research could look into not only the risks related to such influences, but measures that can be taken to reduce that risk. The emerging field of machine ethics, (Anderson & Anderson, 2011), which explores the subject from a philosophical and artificial intelligence perspective, looks into the idea of adding an ethical dimension to machines, but not into the influence that machines have on the propagation of ideas. Extended research could examine the application of the theory of social adoption of innovation and its emphasis on the role of the information seeking skills, knowledge behaviour and social skills.

### *Learning, Innovating and Teaching*

The Social Adoption of Innovation model (Figure 4, Chapter 5), perhaps surprisingly as it was not designed for this purpose, demonstrates one of the most difficult challenges educators are facing: teaching students knowledge relevant to the needs of society.

We could think of education as an adoption of innovation process, where the teachers present (diffuse!) novel ideas and students adopt them by learning (the ideas are novel for

students). In the context of the Innovation Space diagram, teachers are situated in the Information Space, using a large repository of semantic objects as input into the teaching process. The students are situated in the Cognitive Space assimilating knowledge provided by the teachers. As in the adoption of innovation process, the students upgrade their skills to acquire knowledge with the intention of using it later in life in helping them solve particular challenges, support their personal aspirations and passions. We could even draw a parallel between the zone of proximal development (Vygotsky, 1980)in learning and the innovation knowledge gap as similar achievement goals.

A major challenge is the adoption of knowledge that serves students well. This challenge is increasingly difficult in a knowledge society where new information is generated at such a rate that the production of semantic objects in the Information Space is falling behind. This delay has repercussions in education systems because they rely on these semantic objects to teach students skills they can use in the Social Space. In principle, this has always been the case: for society as a whole, it always takes time to process data, make sense of it, identify new patterns, adjust existing knowledge models or create new ones. The difference now is direct access to the vast Social Space through social networks that increasingly become a major source of information for the average individual. This delay and the instant access to alternative sources of information causes a misalignment between what is taught in educational institutions and what is found through personal social networks, and an erosion of the authority that these institutions have had as sources of truth and empowerment. In turn, this may cause a lack of confidence in the education system. Laurillard remarked in a paper published in 2002: “Those involved in university teaching in this digital age must cope with the fact that the knowledge industries are creating the means by which individuals can acquire the immediate skills and knowledge those industries need. As a result, many individuals are questioning the true benefit of a university education, given its cost” (Laurillard & McAndrew, 2002).

The Social Adoption of Innovation model suggests that it would be helpful to move away from the transmission teaching model, by teaching students how to innovate. Students would benefit from acquiring essential cognitive skills that are universal and this would help them make better decisions: what to adopt and how to adopt, information seeking and knowledge behaviour skills (see Chapter 5, Knowledge, Information and Skills). These skills cannot be learned by rehearsal, but through practice, and the best way to practice is to create, to innovate, in ways which help students operate in an ultra-connected world by learning how to evaluate the credibility of their information sources, validate ideas presented to them serendipitously or through “diffusion”, overcome the problem of lacking awareness, and become confident in being able to acquire new skills through self-learning. Thus “learning and teaching” becomes “learning, innovating and teaching”.

Arguably, education is the industry most suited to adopt innovation, because the education process itself is an adoption of innovation. The proposed model of social adoption predicates that the best social structure for innovating with innovation is the community of practice, something which educational institutions already have in one form or another and it would be natural to use them as communities of practice where student teams work together to innovate. Perhaps even more important than learning particular specialised knowledge, learning social skills that help someone to be an effective member of a

community of practice, how to build trust, how to exchange ideas constructively, how to learn from opposing views and adjacent domains, share knowledge and work together towards a common goal of innovation; these are some of the most valuable life long lasting skills an institution could teach.

# Chapter 10 Conclusion

Adoption of innovation has long been viewed through the eyes of marketing and with a strong pro-innovation bias. According to this view, the adoption process is fundamentally a controlled process of diffusion of information aimed at influencing customers to adopt specific innovations. The adopters have a set of common psychographic traits highly correlated with the stages of adoption, with little or no reference to their individuality, or the context of their needs, motivations and goals.

This research looked at adoption of innovation through the lens of the individual adopter, proposing a model of social adoption of innovation in which adoption is predominantly a social process, influenced by cognitive and professional factors. The research found that the adoption of innovation process is nonlinear and the psychographic stereotypes do not apply: individuals have different attitudes and behaviours depending on how the innovation matches their needs and personal motivation. The study shows that there are no prescriptive boundaries that can determine in definite terms the profile of individuals who adopt technological innovations. Moreover, this research found that individuals have an interest in innovating with innovation, especially in the first stage of adoption.

This research recognises the significant role of modern technological infrastructure in the discovery of information and the diffusion and sharing of ideas across all stages of adoption. However, the first two stages, which are fundamentally important for both innovation and adoption of innovation, are more successful in communities of practice, especially in those communities with a mix of professional backgrounds and disciplines. Communities of practice have been an influential social structure from ancient times until the present day (Wenger & Snyder, 2000).

To illustrate this as a closing argument, let's go back to a time when society experienced a similar explosion of innovation, the beginning of the Renaissance, and look at an example of adoption of innovation that shows the role of communities of practice in spreading new ideas that is strikingly similar to the role they have today in a contemporary setting.

Sometime during the first century BC, Marcus Vitruvius Pollio wrote, what is considered as probably the most important work in architectural history in the Western world, The Ten Books on Architecture, also known as *De Architectura* (Rowland & Howe, 2001). For over a thousand years this work was largely forgotten and unknown until the early 1400s when Poggio Bracciolini, an Italian humanist, discovered an eighth century copy at a monastery in Switzerland and sent it back to Florence.

After centuries of oblivion, *De Architectura* was adopted rapidly as it started to become known in the creative circles of Florence. A short time after its arrival, Brunelleschi used it as a foundation for his education to create his masterful works of art, and Leon Batista Alberti mentioned it extensively in his treatise in architecture. Brunelleschi and Alberti influenced an entire new generation of artists that learned their trade in a new crop of workshops that appeared in Florence in that period. These were communities where the craft was learned

and passed on through close collaborations and sharing of ideas between masters and pupils with a broad array of skills: architecture, painting, gold smithing, sculpting, poetry, and even medicine. One of those who learned from that influence in this vibrant artistic community, was Leonardo da Vinci who was appointed the Florence cultural ambassador to Milan. Here, communities of artists, engineers and scientists were working together on many projects in a fashion that is strikingly similar to the way skilled professionals work in creative communities in our time. For instance, Leonardo da Vinci and a couple of friends working on a solution for the design of the tiburio of the Milan's cathedral, would have had long discussions over the content of this book in their workshops (the equivalent of today's office), dinner parties, or during their trips to the University of Pavia. These discussions involved knowledge of anatomical studies, geometry of squares and circles in church architecture, transformation of shapes and "divine proportions", all inspired by concepts and ideas found in *De Architectura*. The result of these collaborations was Leonardo da Vinci's Vetruvian Man.

If we look at how the Marcus Vitruvius Pollio's innovations were adopted we see the elements of social influence and knowledge behaviour described in the social adoption of innovation model. The information was sitting in the library, but no one knew where to look for it because virtually nobody knew of that work. Some were aware of the existence of the documents archived in the Swiss monastery, but they did not know what they were good for. Serendipity brought that information to light, but it was not until it was brought to the attention of the extraordinary communities of practice that were the courts of Florence, Milan and Venice that these innovations were adopted and inspired the innovation of even greater works of art. Walter Isaacson describes the social medium of creative artistic, technological and construction works of that time: "The process of bouncing around thoughts and jointly formulating ideas was facilitated by hanging around a Renaissance court like the one in Milan. In addition to the troupes of musicians and pageant performers, those on stipend at the Sforza court included architects, engineers, mathematicians, medical researchers, and scientists of various stripes" (Isaacson, 2017).

At the time in history when the classic architectural concepts were adopted, there was no one diffusing the innovation. There is no simple imitation either, although many copied the designs (the late adopters!). It's a journey in which individuals are searching for answers, learning and sharpening their skills in their quest to create something unique. It's the individual and entrepreneurial spirit manifested within smaller communities of practice that made possible the early adoption of these innovations, the same as today.

We may be also tempted to believe that adoption of innovation is much faster in the modern times of Silicon Valley than in the past because we have much more powerful distribution networks, communication and marketing resources. This is not necessarily true. The adoption of printing technology, which many compare with internet technology in terms of its long-term socioeconomic impact, is an example of a fast adoption, comparable to the adoption of other technological innovations in our time. The first documented printing in Italy (and outside Germany) occurred in 1465 in Rome (Roberg, 1969). In 1469 printing technology arrived in Venice. In thirty years, Venice became the powerhouse of Europe with close to a hundred printing shops with over two million volumes printed off their presses by 1500 (Richardson, 1999). It is an astonishing example of adoption of

innovation driven by the demand of creative communities in Venice and other cities (Florence, Milan, Rome). The adoption of printing press technology in the last three decades of the fifteen century compares very favourably with the adoption of the IBM PC since it was first launched in 1981, although the PC innovation has been heavily marketed (diffused) on a vastly superior communication infrastructure.

The two examples mentioned above are distinct cases of innovation with adoption of innovation: one in which an old, re-discovered innovation is brought to life to create an innovative work of art, and one in which a disruptive contemporary technological innovation spreads rapidly, triggering a wave of innovations that subsequently led to fundamental changes in society. Though different, both cases of adoption of innovation share a common theme: innovations are adopted by skilled individuals who have interest and motivation to use these innovations for their creative and entrepreneurial purpose, and the adoption occurs in an interactive social environment, or in what we today call communities of practice. The political, cultural and economic institutions of the day nurtured these communities of practice that acted like crucibles of ideas that made possible the innovations with social adoption of innovation.

The proposed social adoption of innovation theory makes the case that adoption of innovation is more than just persuading someone to adopt a product or an idea. Adoption of innovation is a social process driven by the individual adopter that leads to changes in the individual's way of thinking and the ways adopted innovations are applied. This is an innovation-education philosophy that places the individual innovator and adopter of innovation at the confluence between the social and information spaces. The implication for organisations is that a more effective way to adopt innovation is to create and support communities of practice in which individuals share ideas, adopt and create innovations that could be spread for the benefit of all.

# Appendix A: Questionnaire

| 1 | Interview Details | | |
|---|---|---|---|
| Name | | Institution | |
| Profession Group | | Country | |
| Interview Details | Date Time | Location: | |
| Other Details | | | |

| 2 | Adoption examples |
|---|---|
| Give an example for each adoption stage type: innovator, early adopter, early majority and late majority (Rogers & Moore). Have you had an experience in which you played a role in each type of adoption<br>[Record discussion, take notes here] | |
| Stage | (To be classified by the interviewer for each innovation) |
| Innovator | |
| Early Adopter | |
| Early Majority | |
| Late Majority | |

| 3 | Adoption trigger |
|---|---|
| What was the trigger that initiated the adoption process? Could you recollect who or what triggered the process of adoption? The idea could have come up during your interaction with your colleagues, friends, remote contacts that you have established over digital social networks, or because of your own thinking while working on a project, researching a topic, or simply by accident while you talked to someone or reading or interacting over the internet with other users or members of the same club or forum<br>[Record discussion, take notes here] | |
| Trigger | (Classified by interviewer for each innovation) |
| | |

| 4 | What motivated the adoption |
|---|---|
| This is a simple question that tries to establish the motivation of adoption: is this because you simply like the subject, or you have a hobby, or your interest was aroused on this particular topic by pure coincidence, or is it because you need it for your work or professional purposes (further your career prospects, promotion, find a way of better dealing with complexity, etc.)<br>[Record discussion, take notes here] | |
| Motivation | (Classified by interviewer for each innovation) |
| | |

| 5 | How did you interact with other people? |
|---|---|
| This question tries to capture the type of interaction you had with other people during the adoption process. The labels used to describe the types of interactions are self- | |

| | | |
|---|---|---|
| explanatory.<br>[Record discussion, take notes here. Categories below as potential prompts] | | |
| Social Interactions | Type | Narrative |
| | | |

| | |
|---|---|
| 6 | How did you learn how the adopted object works? |
| This question is focused on the process of learning how the object of adoption works: understanding the concept, knowing how to use a program, or a system, etc.<br>[Record discussion, take notes here] | |
| Type of information | (Classified by interviewer for each innovation) |
| | |

| | |
|---|---|
| 7 | Did you receive training & certification? |
| Have you received formal training on how to use the object of adoption? Even if you did follow a course or did an in-depth study of a training manual is important to mention it here.<br>[Record discussion, take notes here] | |
| Source | Narrative |
| | |

| | |
|---|---|
| 8 | How did you incorporate the adoption into your work, life? |
| This question refers to the way we have really adopted the innovation in a sustainable way that works for a long period of time.<br>[Record discussion, take notes here] | |
| Scenario | (Classified by interviewer for each innovation) |
| | |

| | |
|---|---|
| 9 | Usage: when, how and why? |
| This question tries to understand the steps you follow in using the innovation breaking down the process of usage.<br>[Record discussion, take notes here] | |
| Sequence | (Classified by interviewer for each innovation) |
| | |

# Appendix B: Ethics Approval

## RE: HS Ethics Amendment 2  Approved (Ref No. 5201200313)

EMIL BADILESCU-BUGA <emil.badilescu-buga@students.mq.edu.au>

**Fhs Ethics** fhs.ethics@mq.edu.au Wed, Mar 22, 2017 at 1:32 PM

To: Dr Mitch Parsell <mitch.parsell@mq.edu.au>
Cc: Mr Emil BadilescuBuga <emil.badilescubuga@students.mq.edu.au>

Dear Dr Parsell,
RE: 'Social Adaption of Innovation with Technology ' (Ref: 5201200313) Thank you for your recent correspondence regarding the amendment request. The request has been reviewed and the amendments have been approved.

Please accept this email as formal notification of approval and find the attached for your records. Please do not hesitate to contact us in case of any further queries.

All the best with your research. Kind regards,

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