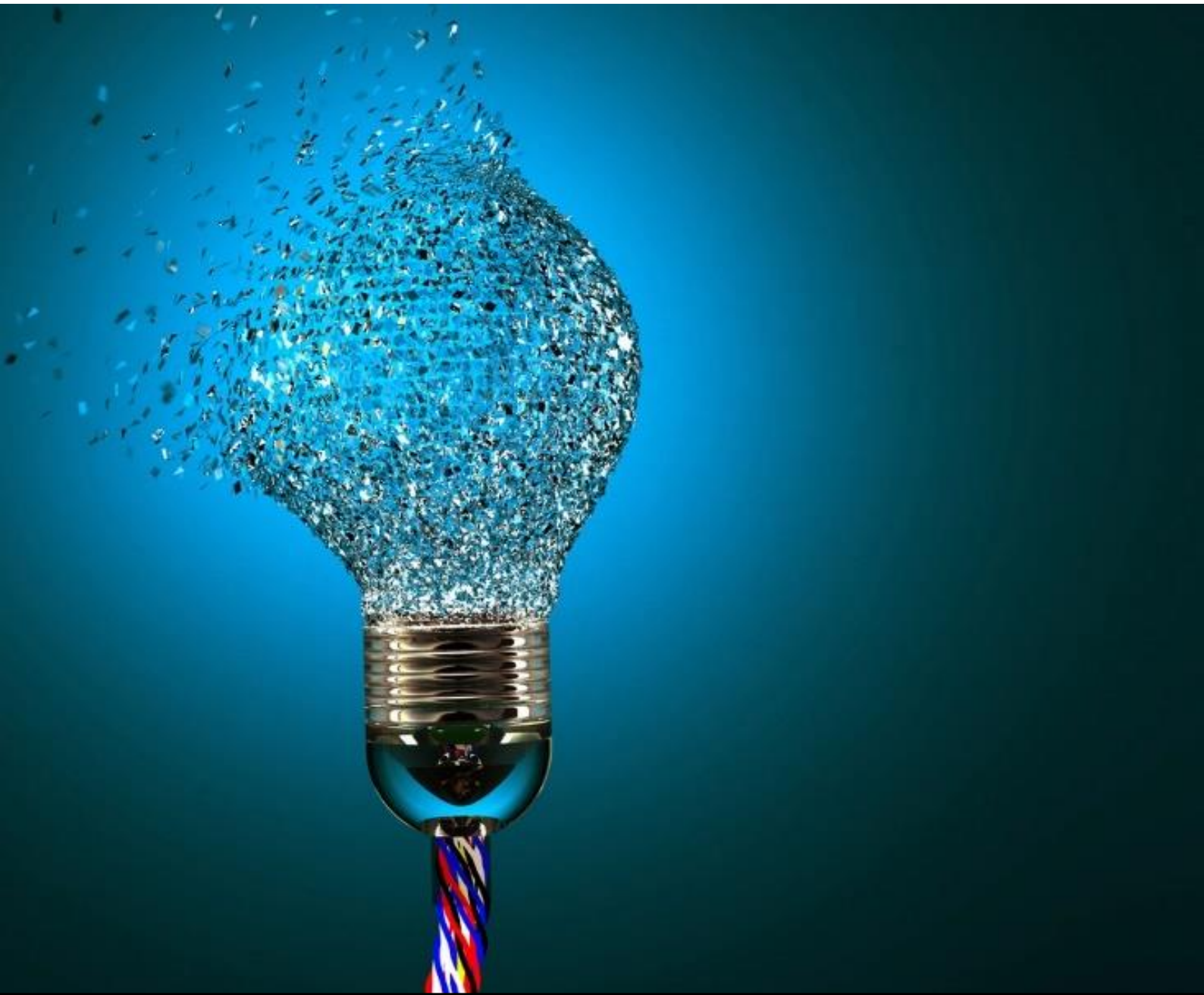# DISCOVERING THE ROLE OF INFORMATION TECHNOLOGY IN DISRUPTIVE INNOVATIONS.

Enabler, Sustainer or Barrier?

Abayomi Baiyere

Turun yliopisto
University of Turku

DISCOVERING THE ROLE OF INFORMATION TECHNOLOGY IN DISRUPTIVE INNOVATIONS

Enabler, Sustainer or Barrier?

Abayomi Baiyere

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DISCOVERING THE ROLE OF INFORMATION TECHNOLOGY IN DISRUPTIVE INNOVATIONS.

Enabler, Sustainer or Barrier?

Abayomi Baiyere

To my Moms – Oluwayemisi and Oluwatoyin

Abstract

IT Capability has traditionally been used as one of the constructs used to highlight the value of IT both to competitive advantage and firm performance. However, a school of thought is rising with the banner that IT no longer matters as a source of competitive advantage. The argument is that IT is becoming a utility like electricity and organizations need to look elsewhere for unique competitive advantage. This dissertation is therefore positioned to investigate the value (if any) of IT in today's organisations particularly in disruptive innovation scenarios.

Disruptive innovations (DI) are innovations that typically gain initial adoption at the fringe of a market but gradually attract the mainstream customers of an established firm thereby threatening the survival of such firms. Disruptive Innovations have caused leading firms to drop from their esteemed position not because of bad management or lack of technological skills but because they introduce a different set of business rules and performance measures. Therefore, DI can be a source of competitive advantage for the firm that successfully implements it and a cause for alarm for firms facing such disruptions.

By adopting a qualitative study and extensive review of literature and secondary data, the dissertation explores how IT plays a role in disruptive innovations in two streams – IT *as* DI and IT *for* DI. IT *as* DI considers - what is the significance of IT when the disruptive innovation is a digital/IT Innovation? While IT *for* DI considers - what is the essence of IT in the creation or response to disruptive innovations (regardless of the type of innovation)?

For the IT *as* DI study, the dissertation advances a theoretical proposition of Wickempowerment using the theory of empowerment and wicked problems to articulate the identified duality when a disruptive innovation is also a digital/IT innovation. Using IT capability as a theoretical lens for the IT *for* DI study, the dissertation posits that IT remains a potent source of competitive advantage in two ways. These are conceptualized as *Disrupt-ability* (ability to create disruptive innovations) and *Disruptability* (ability to be disrupted or expressed conversely as ability to respond to disruptive innovation threats). With this theoretical conceptualization, we articulate three roles of IT capabilities in disruptive innovations – IT as an enabler, IT as a sustainer and IT as a barrier.

Tiivistelmä

Yrityksen kykyä hyödyntää tietotekniikkaa (IT) on perinteisesti tutkimuksessa tarkasteltu yhtenä merkittävänä yrityksen tulokseen ja kilpailukykyyn vaikuttavana tekijänä. Toisaalta osa tutkijoista on esittänyt, että tietotekniikka ei enää ole merkittävä kilpailuedun lähde. Tämän näkemyksen mukaan tietotekniikka on sähköverkkojen tavoin osa kaikille yhteistä infrastruktuuria ja organisaatioiden tulisi hakea muita tapoja erottautua kilpailijoistaan. Tämä väitöskirja asemoituukin tutkimaan sitä, millainen arvo tietotekniikalla on yritysten markkina-asemaa voimakkaasti muuttavien disruptiivisten innovaatioiden (DI) muotoutumisessa.

Disruptiiviset innovaatiot on määritelty innovaatioiksi, jotka alkuvaiheessa kiinnostavat vain pientä osaa toimialan asiakkaista, mutta jotka vähitellen tavoittavat myös suuria asiakasryhmiä ja näin uhkaavat alan perinteisten suurten yritysten markkina-asemaa. Muutos ei siis johdu välttämättä huonosta johtamisesta tai puutteellisista teknisistä taidoista, vaan siitä, että innovaatio muuttaa alan liiketoiminnan sääntöjä ja menestystekijöitä. Yrityksen kyky tuoda tällainen uusi innovaatio markkinoille voi siis tuoda yritykselle merkittävää kilpailuetua, mutta samalla sen tulisi herättää alan muut yritykset vastaamaan uuden innovaation aiheuttamiin muutoksiin.

Käsillä oleva tutkimus hyödyntää laadullisen tutkimuksen ja systemaattisen kirjallisuuskatsauksen menetelmiä tarkastellakseen tietotekniikan roolia sekä tietotekniikkaan perustuvissa innovaatioissa erityisesti (IT *as* DI) että liiketoimintaan liittyvissä innovaatioissa yleisemmin (IT *for* DI). Ensimmäinen tutkimuskysymys (IT *as* DI) siis tarkastelee erityisesti digitaalisten innovaatioiden syntyä ja vaikutuksia. Toisen tutkimuskysymyksen kautta (IT *for* DI) huomio kohdistuu tietotekniikan rooliin liiketoiminnan innovaatioiden luomisessa ja innovaatioihin vastaamisessa (innovaation tyypistä riippumatta).

Digitaalisten innovaatioiden tarkastelussa teoreettisena viitekehyksenä hyödynnetään monitahoisten ja vaikeasti ratkaistavien ongelmien käsittelyyn ja voimaistamiseen liittyvää kirjallisuutta. Näin tarkasteltuna digitaalisissa innovaatioissa voidaan erottaa kahdensuuntaiset (positiiviset ja negatiiviset) vaikutukset niin yksilöiden, yritysten kuin yhteiskunnankin tasolla. Toisen tutkimuskysymyksen tarkastelu perustuu IT kyvykkyyksiä käsittelevään tutkimukseen. Tältä osin tutkimuksessa esitetään, että IT voi tuottaa yritykselle kilpailuetua kahdella eri tavalla: IT kyvykkyydet ovat osa yrityksen kykyä luoda uusia disruptiivisia innovaatioita (Disrupt-ability), IT kyvykkyyksien puuttuminen taas voi heikentää yrityksen kykyä vastata muiden luomiin innovaatioihin (Disruptability). Tämän teoreettisen viitekehyksen kautta IT kyvykkyyksille tunnistetaan kolme roolia disruptiivisissa innovaatioissa: IT mahdollistajana, IT ylläpitäjänä ja IT esteenä.

Acknowledgements

Having come this far, I realize I have only started to scratch the surface of knowledge. Obviously, the journey is just beginning.

This journey will not be possible without several people. So many people have contributed in helping me achieve this feat that acknowledging each and every one of you will warrant an equivalent of a dissertation document. Even if I cannot mention each of you by name, kindly note that this does not diminish my gratitude towards you. I want to use this medium to express my sincere and heartfelt gratitude to you. I will however specially call out my supervisor – Professor Hannu Salmela for his incredible support to me. There are a few people that cross our path in life and leave a positively memorable mark. For me, Hannu stands among the top of that list. You have been a remarkable influence and a pillar of support during and before this PhD journey. Thank you for the guidance, the intellectual freedom, the availability, the attention, the recommendations and the understanding. I am eternally grateful that our paths crossed.

I have come this far not by strength or skill, but by standing on the shoulders of giants. Some of these giants are the members of my review committee and I particularly want to thank each one of you. Firstly, I would like to appreciate my reviewers (Professor Kalle Lyytinen and Professor Suprateek Sarker) for their very positive and encouraging review of my dissertation. I have always held you both in high esteem and I am grateful that you accepted to be on my committee - despite your very busy schedules. I will always cherish the moment I read your reviews. Your review comments clearly encourage me and shines a ray of hope on the possibilities ahead. For these, and all you represent to me, I say a very big thank you. Another key person on my committee is my opponent - Professor Emeritus Piet Ribbers. Without your support in the critical time of need, I likely would not be able to complete this journey in 2016. You were there for me from the beginning of the journey during IMMIT and I am delighted you can once again be present as I complete another chapter in my life. You, Hannu, Paul Laifa and the IMMIT team will always remain precious to me.

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Paper 2: Baiyere A. (2014) "Disrupted Disruptions: Lessons from Potential Disruptive Innovations that barely Disrupted." *Proceedings of the 25th International Society for Professional Innovation Management Conference*, Dublin Ireland.

Paper 3: Baiyere, A., & Salmela, H. (2015). Wicked yet Empowering-When IT Innovations are also Disruptive Innovations. *Proceedings of the International Conference on Information Systems, ICIS 2015* Texas, USA.

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Paper 5: Salmela, H., Tapanainen, T., Baiyere, A., Hallanoro, M., & Galliers, R. (2015). IS Agility Research: An Assessment and Future Directions. In *Twenty-Third European Conference on Information Systems ECIS 2015*. Munster Germany.

Paper 6: Baiyere A. (2016) "Towards Discovering the role of IS/IT Capabilities in Disruptive Innovations" *under review.*

1 INTRODUCTION

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1.1 Background

Not all innovations are born equal. The impact of some innovations extend beyond their beneficial value to additionally unfold in a troubling dimension for other actors (and at times the creators too). For example, consider a company dominating its industry with - over 2/3rd of global photography market share, 10 billion US dollars in sales, largest profit share in the industry and a workforce of over 140,000 employees in its peak years. The company however, suddenly finds itself gravitating from this position of dominance to a position of bankruptcy, largely because of digital imaging (an innovation the company played a major role in pioneering) – this is the story of Kodak. Perhaps, only those familiar with the era of film photography can better appreciate the story of Kodak. Wikipedia would therefore be a more familiar example for today's generation. Encyclopædia Britannica, a veteran source of information long before the internet, had to take the bow from 244 years of printing paper copies of its encyclopaedia due to the sharp decline in its sales, which directly relates to the rise and popularity of the Wikipedia innovation.

An example that perhaps brings this concept closer to the physical location of this study is Nokia mobile phones. Hardly has an innovation caught a company off guard and affected a whole ecosystem, as the advent of the iPhone seem to have affected Nokia's mobile phone business and its many dependent companies (particularly here in Finland). At its ultimate point, Nokia had about half of the global mobile phone market, contributed about 23% in corporate tax to Finland and provided the main employment hub in Salo, Finland, among many other indicators of a dominant player in its industry. Yet, it lost almost virtually all its mobile phone market and dropped its significant position in contributing to the Finnish economy. Needless to say, many more examples of these patterns abound. These examples are classical cases that typifies a phenomenon referred to as *disruptive innovation*.

Disruptive innovations are innovations whose adoption over time results in the decline of the dominance of another innovation which ultimately results in a challenging situation for the (to be) disrupted entity/ies to respond to. Whenever disruptive innovations occur, they challenge the traditional thinking and business logic that has characterised the domain being threatened. Taking a step out of the calamitous nature of disruptive innovations would also reveal that while disruptive innovations creates a challenging situation for some, it also creates a situation where a non-existent entity or company can rise from obscurity to dominance in a business domain. These dual extreme possibilities, underscore the importance of the disruptive innovation phenomena for both practice and scholarly enquiry. Hence, the context for this study.

There has been several studies attempting to shed more light on disruptive innovations from different perspectives (Henderson 2006, Sood and Tellis 2011, Schmidt and Druehl 2008). This research is positioned to look at disruptive innovations (DI) from the information technology (IT) perspective using information systems (IS) capability lens as a pivot to understanding how IT plays a role in the occurrence of disruptive innovations, both in its creation or in responding to its threat.

Consequently, this research builds on and extends the research stream on digital innovations and the competitive advantage/value of IT in an organization. Disruptive innovation provides a timely and critical context for examining the value of IT to competitive advantage. Therefore, in conjunction with the disruptive innovation background, the purview of this study provides a contemporary examination of the essence of IT to a firm's competitiveness in today's business environment.

1.2 Motivation

Information Technology has generally been described as a platform for fostering and triggering innovations as well as a leverage for dealing with threats arising from innovations (Ravichandran and Lertwongsatien 2005, Pavlou and El Sawy 2006). Prior studies have shown how organisations have taken advantage of their IT to come up with unique innovations (Tarafdar and Gordon 2007). Similarly, examples abound in information systems literature that highlight the importance of IT in responding to turbulence or in dealing with issues in a rapid changing business environment (Pavlou and El Sawy 2006). Despite the foray of information system studies in these areas, there has been relatively little or no documented research examining specifically if and how IT plays a role in situations characterized by disruptive innovations. Hence, this research provides an attempt to investigate

how the properties of IT uncovered in prior IS research translates in creating or responding to disruptive innovations.

Furthermore, the earlier mentioned examples of Kodak, Encyclopædia Britannica and Nokia highlight how grave the impact of a disruptive innovation can be both from the organizational perspective to the societal/national viewpoint. The other side of these examples are the gainers from the disruptions. While Kodak lost its dominance, digital imaging gave rise to a plethora of smaller industries from digital cameras to multimedia businesses. Although Kodak had over 140,000 employees and was worth 28 billion US dollars at its peak, Instagram promised same value with just 13 employees before it was acquired for 1 billion US dollars (Lanier 2013). In a similar vein, Apple propelled itself from a company that was near bankruptcy to become the most valued company in the world with the launch of its flagship iPhone. Likewise, Wikipedia challenged Britannica's 244-year-old encyclopaedia business and in a space of 10 years, it completely dwarfed Encyclopædia Britannica's content base and user base. While attracting many new users, Wikipedia also significantly pulled a large base of Britannica's users. Thereby upsetting the survivability of their print business model and ultimately decimating the encyclopaedia business as a whole.

Consequently, the profound consequence of losing or gaining in a disruptive innovation scenario is so weighty that it cannot simply be ignored. While there has been an increasing call from other disciplines to conduct studies to provide better understanding about this phenomena, information systems seems to be lagging behind in appreciating the importance of the occurrence of a disruptive innovation or the significance of potential disruptions. This thesis is a step towards highlighting the importance of information systems in the study of disruptive innovation and it is presented as a foundational step towards charting a path for further scholarship on this issue.

Additionally, several examples of disruptive innovations in recent times have been information technology innovations (Nault and Vandenbosch 2000, Schmidt and Druehl 2008). This further highlights the importance of an information systems focused study on disruptive innovations. The information systems field typically prides itself as a discipline that seats at the junction of both technical research on IT, the application and business use of IT plus the social and behavioural dimensions of IT (King and Lyytinen 2004, Mckenzie 2005 Benbasat and Zmud 2003). Hence, if any field of research is better positioned to explore the significance of IT in disruptive innovations, it most likely would be information systems. It is therefore important that information systems research takes the matter earnestly, as the occurrence of a disruptive innovation tends to have both business and

social implications, which could prove definitive for both practice and academia in the future.

It is important to state that while this study is positioned to unearth the relevance of IT in disruptive innovations, this study also acknowledges that IT is by no means the only essential factor in the creation or response to disruptive innovations. However, considering the pervasive, ubiquitous, and entrenched status of IT within today's organizations, it is arguably rational if not imperative to give consideration to how IT could be of import in disruptive innovation situations. This study is therefore geared towards the IT perspective with due acknowledgement of other organizational elements that may contribute to a successful creation or response to disruptive innovations.

A logical question that may arise from this could be – in what way does/should IT play a role in disruptive innovations? These rationale and more are elaborated as research questions in the next section and subsequent sections of this thesis are structured towards providing some light on this.

1.3   Research Questions

Considering the dearth of research studying the linkage between information technology and disruptive innovation, this study is of an exploratory nature. The study is positioned to attempt to investigate the different ways IT has or can possibly be of significance (if at all) in the creation of and response to disruptive innovations. In general terms, the study strives to understand the position of IT in the occurrence of a disruptive innovation and to shed light on the relevance of these linkages. This is expressed as the study's overarching research question, which is further subdivided into two-sub research, questions (RQ 1 and RQ 2) as follow:

RQ: How could (or does) IT play a role in Disruptive Innovations (if at all)?

*RQ 1: How does IT play a role **as** a disruptive innovation?*

*RQ 2: How could IT play a role **for** the creation or response to disruptive innovations?*

Additionally, if the IS field is to embark on further studies on disruptive innovation, it is necessary and of value to have a good foundation on some of the central elements of the disruptive innovation concept. It is also important to have a general understanding of the evolution and status of the research in this area for theoretical

grounding and as a footing that further studies can build on. Based on this, a corollary goal of this research is to provide a reflective review of the current state of understanding on the disruptive innovation topic and an aggregate of key constructs that could be of value for the information systems discipline.

The unit of analysis for each research question is drawn from the level of abstraction and the phenomenon that the study is aimed at (Markus and Robey 1988). Markus and Robey (1988) highlight the usefulness of conducting studies that observe information technology and organizational change from both a macro and micro level. This is particularly the case for studies that take place in an interdisciplinary field where mixed-level phenomena are inevitable elements of the study (Rousseau 1985,1986 in Markus and Robey 1988). For RQ 1, the addresses a phenomenon that exists at the level of markets and society. Hence, the research question takes a societal perspective and the unit of analysis is the society. The proposed theoretical contribution of "wickempowerment" advanced for this research question, is articulated at this level of abstraction. For RQ 2, the study addresses a phenomenon that exists at the level of organisations. Hence, the study takes an organizational/industry perspective and the adopted unit of analysis is organizational. This is also further highlighted by the advanced theoretical constructs of "disrupt-ability" and "disruptability", which articulates the resulting answer to this research question.

The research approach adopted for addressing these questions is largely qualitative and conceptual. The qualitative aspect relies on secondary and interview data while the conceptual part was built on a synthesis of prior literature and systematic reviews. These research questions are answered with the collection of six (6) selected articles included in this dissertation as opposed to a monograph-styled dissertation. A general overview of the articles plus how they are related to each other and importantly how they collectively answer these research questions is presented in the subsequent chapters of this work[1].

1.4   Organisation of Thesis

The thesis is structured in five (5) main chapters. The chapters and the whole thesis is centred around six (6) selected research articles that together form the core contribution of this thesis. The articles as mentioned earlier also form the building blocks for answering the stated research questions.

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1 See Figure 8 for a diagrammatic representation of how each paper connects to the two main streams of enquiry in the thesis and the relationship of each paper to the research questions.

As is typical for an article based dissertation, the articles were written first each with a specific focus. Although each article attended to a specific contribution, and can be understood independently, they each nonetheless provide the underlying knowledge and fragments that are combined together to form a whole in this thesis. The thesis on the other hand is dependent on the findings of the paper. This implies that further depths and more specific details can be referenced from the included articles, when necessary. In effect, this thesis is a synopsis that ties all the six articles together.

1.4.1 Chapter outline

Firstly, the chapters are structured around the following themes – Introduction, Prior Research, Research Approach, Results and Findings and finally, Discussions and Implications. Chapter 1 introduces the research and the key construct of disruptive innovation around which the whole research is built. The chapter also gives a brief background and motivation of the study. Chapter 1 is concluded with the research questions driving the study and a brief explanation of the research outline.

Chapter 2 is centred on elaborating on the key concepts and theories from which the research derives its theoretical underpinnings. The concepts and theories are explained in terms of their suitability, historical relevance/evolution, how they have been applied in prior research and how they are applicable for the study at hand.

Chapter 3 looks both outwards and inwards. Firstly, it looks outwards by explaining the foundations, choices and justifications for the research approach employed by drawing from prior use and methodological practice in the field. Secondly, the chapter looks inwards by subsequently detailing how the research approach has been applied and explicating the adaptations in the different research articles.

Chapter 4 provides an in depth look at each of the articles. It also provides a general discussion of the research findings and how they relate to answering the research question. It summarily presents a narrative that shows the linkage between each of the selected papers and the research question they contribute to.

Chapter 5 closes the dissertation by outlining the theoretical, practical and societal implications that can be drawn from the study. A conclusion is presented with a call for further studies around a disruptive innovation and IT themed research agenda.

1.4.2 Summary of selected articles

The title of the selected articles considered for inclusion in this dissertation are presented below:

1. Review: Disruptive Innovation & Information Technology – *Charting a path.* (ACIS 2013)
2. *Disrupted Disruptions* - Lessons from Potential Disruptive Innovations that barely disrupted. (ISPIM 2014)
3. *Wicked yet Empowering* - When IT Innovations are also Disruptive Innovations. (ICIS 2015)
4. *IS Agility Research* - An Assessment and Future Directions. (ECIS 2015)
5. Towards a Unified View of *Information System (IS) Capability.* (PACIS 2014)
6. Towards discovering the *role of IT Capabilities* in Disruptive Innovations. (2016 in review)
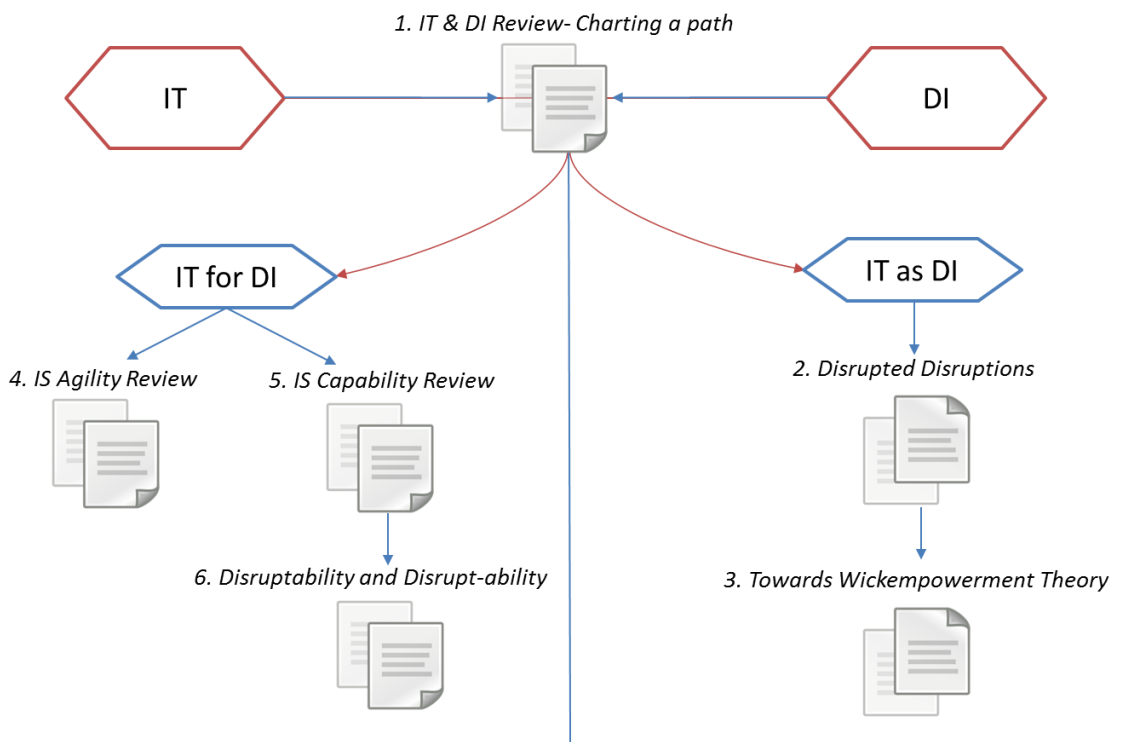
Figure 1. A representation of the connection between selected articles

Figure 1 shows how the articles are connected to each other. Basically, the research started from paper 1, which is an attempt to understand the existing knowledge on both disruptive innovation and IT plus how they have been dis-

cussed together in prior studies. From this pivotal paper, two study streams appeared in the research, which lead to the bifurcation into (a) IT as the disruptive innovation – IT as DI and (b) IT as role player for creating/responding to disruptive innovations – IT for DI.

Under the "IT as DI" stream, papers 2 and 3 examine the role of IT in situations where IT innovations are also disruptive innovations. Under the "IT for DI" stream, papers 4, 5 and 6 investigate the role of IT by using existing IS concepts/theories (IS agility and IS Capability) to specifically understand how prior knowledge from IS could help us examine how/if IT could play a role in disruptive innovations.
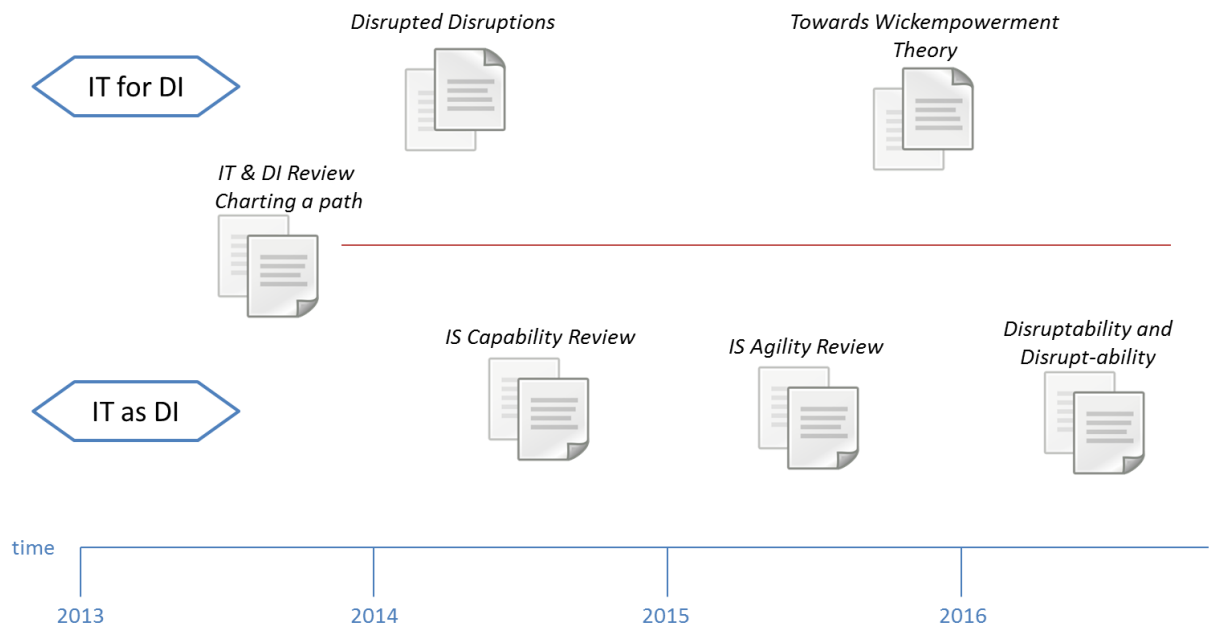
Figure 2. A timeline of the publication of selected articles

Figure 2 provides an overview of the papers with respect to the publication timing. The timeline helps to understand the chronological order in which different studies have been conducted. It highlights the use of empirical data for the IT for DI stream while the IT as DI stream developed largely via conceptual synthesis and the use of systematic reviews. The presentation of the figure also shows the progression of studies within each of the streams of enquiry. The timeline perspective helps to see how each study informed the other. It additionally gives an indication of how the theoretical insights advanced in the concluding paper of each stream (Paper 3 and Paper 6) gradually developed and were emboldened with the passage of time. Among other things, the timeline view highlights the exploratory

nature of this research and shows that more empirical studies are needed to consolidate and strengthen our knowledge in this area.

2 PRIOR RESEARCH

Everything not saved will be lost.
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Considering the interdisciplinary purview of this research, it is imperative to present the body of knowledge to which this research aims to contribute. Perhaps more importantly, it is also necessary to highlight existing knowledge from prior research that are relevant for this study. This section outlines and elaborates the key concepts and theoretical leanings from which the thesis draws its foundation.

Since the focus of the research is to explore the role of information technology in disruptive innovations, the two overarching theoretical concepts to be elaborated in this section are disruptive innovation and information technology. Considering that information technology as a theoretical construct is a rather broad concept, the theoretical lens of information systems capability has been selected to further narrow down the scope of the thesis. This is done to facilitate a minute and sharper theoretical clarity of the study. Furthermore, the study is positioned within the competitive advantage of IT and digital innovation literature. In essence, the stream of research this study is positioned to contribute to are information systems research and disruptive innovation research in general, and IS capability research in particular.

2.1 Disruptive Innovation

The phenomena captured by the theory of disruptive innovation (DI) has long existed before its conceptualization into a theory by Clayton Christensen about two decades ago (Christensen 1997). The conceptualization into a theory presented a step towards a better understanding of what takes place in these situations. By observing the disk drive industry in the early 1990's, Christensen noticed a pattern that companies with inferior innovations end up surpassing established incumbents in the industry (Christensen 1997). With this premise, he then articulated the phe-

nomenon in the theory of disruptive innovation. In its *initial* form, disruptive innovation describes innovations that when introduced to the market, are initially attractive to non-mainstream customers due to their inferiority on the parameters valued by the mainstream customers. However, the innovations improve along the trajectory valued by the mainstream customers over time and end up challenging the survivability of the incumbent by attracting the incumbent's mainstream customers.

Christensen further contrasted this class of innovations with what he termed sustaining innovations. Sustaining innovations are innovations that are not disruptive but rather are regular innovations that keeps an organization competitive in its business domain. While disruptive innovations can propel the creating organization to a status of growth and spell calamity to competitors, sustaining innovations basically keep the wheel turning. An easy example of a sustaining innovation is Apple's successive release of its iPhone line. The innovation that moved iPhone 1 to iPhone 2, 3, 4 are no longer disruptive but basically sustaining innovations. Christensen's conceptualization of the theory are captured in series of articles and books on the topic (Christensen, 1993; Christensen and Bower, 1996; Christensen and Rosenbloom, 1995; Christensen et al, 1998; Christensen and Raynor 2003; Christensen 2006, Johnson et al. 2008, Christensen 2013, Christensen et al 2015)

The theory of disruptive innovation has however been extended from its basic form, and applied in a variety of context. It has gained widespread popularity among academics as well as the mass media. This has resulted in gross misconception, misuse, and perhaps a dilution of the core essence of the theory in both scholarly and public discourse (Christensen 2015, Baiyere 2015b,). It is not uncommon to find media articles in the public press, labelling things as disruptive innovation without diligent consideration of the actual definition or evolving conceptualization of the term. This section of the thesis will attempt to present the current knowledge on disruptive innovation and clarify some of the myths and popular misconceptions as well as provide a reflective criticism of the theory.

2.1.1 *What makes an innovation disruptive?*

Many scholars have contributed to our understanding of what makes an innovation qualify to be considered a disruptive innovation (Markides 2006, Christensen 2006, Schmidt and Druehl 2008, Yu and Han 2010). Building on Christensen's initial conception of the theory and the work by Christensen and Raynor (2003) among others, Govindarajan and Kopalle (2006) highlight five characteristics of a disruptive innovation as follow:

(1) the innovation underperforms on the attributes mainstream customers value;

(2) the new features offered by the innovation are not valued by the mainstream customers;

(3) the innovation typically is simpler and cheaper and is offered at a lower price than existing products;

(4) at the time of its introduction, the innovation appeals to a low-end, price-sensitive customer segment, thus limiting the profit potential for incumbents; and

(5) over time, further developments improve the innovation's performance on the attributes mainstream customers value to a level where the innovation begins to attract more of these customers.

Similarly, King and Baatartogtokh (2015) also outline what they consider as the four core cornerstone principle of disruptive innovation as articulated by Christensen in his initial conceptualization. The four-point description of disruptive innovation as presented by King and Baatartogtokh are:

(1) that incumbents in a market are improving along a trajectory of sustaining innovation,

(2) that they overshoot customer needs,

(3) that they possess the capability to respond to disruptive threats, and

(4) that incumbents end up floundering as a result of the disruption.

In addition to these views, Yu and Han (2008) conducted a literature review on disruptive innovation and highlighted some attributes that they identified as essential for labelling an innovation as disruptive. These attributes include:

(1) be inferior on the attributes that mainstream customers value;

(2) offer new value propositions to attract a new customer segment or the more price sensitive mainstream market;

(3) be sold at a lower price; and

(4) penetrate the market from niche to mainstream.

Baiyere (2014) built on these prior characteristics and other criteria from other studies that have been ascribed to innovations considered to be disruptive to come up with a combined list of the attributes of a disruptive innovation. In the combined list, some of the earlier attributes have been modified or advanced by recent knowledge. For example, the initial condition that the innovation should start at the low-end has been extended to include both low-end and high-end disruptions. The list of the identified disruptive innovation attributes is presented in Table 1

and detailed in Baiyere (2014). Table 2 on the other hand, is a representative view of the attributes that is based on the extended definition of DI. It shows the key attributes after considering the redundant and duplicate attributes. For example: "Different performance attributes" caters for "inferior quality" and simultaneously considers superior quality, while "Appeals to market fringes" equally covers "Targets low end of market" as well as the high end of the market. Further details on these tables are provided in paper 2.

Table 1. Combined list of identified attributes of a disruptive innovation

General Disruptive Innovation attributes
Different performance attributes
Not valued by key customers
Encroaches existing markets
Appeals to market fringes
Simpler, more convenient
Serves non-consumers
Gains adoption
Target low end of market
Product innovation
Less costly offerings
Inferior quality
Existence of a disrupted?

Table 2. Consolidated attributes of a disruptive innovation

Disruptive Innovation attributes
Different performance attributes
Not valued by key customers
Encroaches existing markets
Appeals to market fringes
Serves non-consumers
Gains adoption

An essential component of the disruption theory is that it is a relative phenomenon (Christensen 2006, Baiyere 2015b). What this mean is that in order to be able to say an innovation is disruptive, it should be possible to identify what it is disruptive to. An innovation cannot be disruptive in itself. It earns the title of being a disruptive innovation when the relativity condition can be said to be satisfied. The

implication and explanation of this is further elaborated on in Baiyere and Salmela (2014) and Baiyere (2015b).

2.1.2 Evolution of the theory

One of the defining point in the evolution of the disruptive innovation theory unfolded in a 2006 special issue on the topic in the Journal of Product Innovation Management (among others such as IEEE Transactions on Engineering Management, 2002). From this issue, a modified definition was provided, categories of disruptive innovations became identifiable and some criticism were levied against the theory (Govindarajan and Kopalle 2006, Daneels 2006, Markides 2006, Tellis 2006). Govindarajan and Kopalle (2006), advanced the definition of the theory (and more recently in Govindarajan, Kopalle and Daneels, 2011) to also consider high-end innovations as opposed to Christensen's low-end view. They articulated their proposed definition as follow:

"A disruptive innovation introduces a different set of features, performance, and price attributes relative to the existing product, an unattractive combination for mainstream customers at the time of product introduction because of inferior performance on the attributes these customers value and/or a high price—although a different customer segment may value the new attributes. Subsequent developments over time, however, raise the new product's attributes to a level sufficient to satisfy mainstream customers, thus attracting more of the mainstream market."

This has been a widely adopted definition of disruptive innovation and one that has been duly acknowledged by Christensen (2006). This has been adopted as the starting definition for this study. It is however worth noting Christensen's recent Harvard Business Review article (Christensen et al 2015) which attempts to reposition the theory back to solely the low-end view. The HBR article was an attempt to curtail the misuse and misappropriation of the theory by clarifying what it is and what it is not. On a reflective note, while I stand with Christensen's drive on the need to stem the misuse of the theory, I however hesitate to share his reluctance for the theory to be extended.

2.1.3 Criticism of the disruptive innovation theory

As is to be expected of a theory that has grown in popularity over a short period, there has been criticism directed at the theory. Chief among the critical comments

about the theory is its low predictive power (Daneels 2004 and 2006, Markides 2006). The descriptive power of the theory is well acknowledged but it stops short of providing a lens for predicting if, when or how an innovation can become disruptive. Due to this it has been labelled as a theory that is only unveiled after the fact.

In response to this criticism, several studies have provided different extensions to the theory to contribute to our knowledge of how an innovation can be predicted to be disruptive. Govindarajan and Kopalle (2006) present a framework that extends our understanding of the usefulness of ex-post measures of measuring disruptiveness towards making ex-ante predictions. Similarly, Sood and Tellis (2011) developed a conceptual model that can be used for broadening the knowledge and predicting disruptive technologies. Contributing to the discussion, Schmidt and Druehl (2008) presented a conceptual framework that shows how the predictive power of the disruptive innovation concept can be unfolded. Summarily, there is now increasing efforts from studies aimed at understanding how to respond or survive disruptive innovations to studies geared towards understanding the creation/prediction of disruptive innovations.

Another criticism of the theory comes from claims that the examples given by Christensen over the years to be disruptive in his books have not all withstood the test of time (King and Baatartogtokh 2015). Very few of the examples currently satisfy all the attributes of disruptive innovation as outlined by Christensen. It is however worth noting that the theory itself has evolved from the initial conceptualization used by King and Baatartogtokh to evaluate the examples. While the study shows the difficulty in accurately labelling an innovation as disruptive ex-ante, it nonetheless does not diminish the theoretical value of the concept itself.

2.1.4 Categories of disruptive innovations

From a review of literature on disruptive innovations, two categories of disruptive innovations can be identified. These are disruptive innovation category by *market diffusion* and a category based on *innovation type* (Baiyere and Salmela 2013). These categories become apparent when reviewing different research papers on the theory (see Figure 3).

Categorizing disruptive innovation by market diffusion is reflective of the different ways a disruptive innovation can infringe on a market. The three different classification identified under this category are

- Low-End Market Disruption
- High-End Market Disruption and

- New Market Disruption

The names are indicative of the distinction between the three different classes of market disruptions. While low-end market disruption (Christensen 1997, 2006 and Christensen et al., 2015) encroaches the mainstream market by first attracting the low paying customers in the market, high-end market disruption encroaches from the other end. High-end market disruption is an extension of the low-end market disruption as postulated by Christensen. The high-end consider a situation where the innovation that ends up becoming disruptive gradually infringes on the mainstream market by starting first from the high value – high paying customers of the incumbent (Govindarajan and Kopalle 2006). The third class in this category of disruptive innovations are the new market disruption, which involves innovations that create a new market, which attracts existing customers of an incumbent (Christensen 2006).
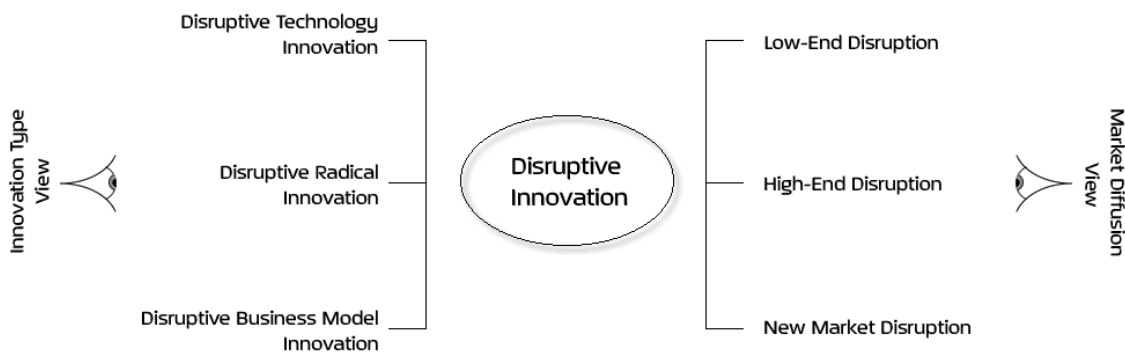
Figure 3. Categories of Disruptive Innovation

For the second category, the root type of the innovation forms the bases for classifying these disruptive innovations. The identified classes are:

- Disruptive Business Model Innovation
- Disruptive Technology Innovation and
- Disruptive Radical Innovation

This classification emphasizes the distinction in the actual type of innovation that resulted in the disruption. While disruptive business model innovations (Christensen 1997, Johnson et al 2008, Christensen and Overdorf 2000) have the core innovation that led to the disruption resident in the business model (for example, Google's adwords and Amazon), the disruptive technology innovation's core disruptive attribute lies in the technology innovation (for example, digital imaging vs film). Taking a step aside from these two is the disruptive radical innovation. These class of disruptive innovations are radical innovations that end up as disruptive innovation (for example, the telephone versus telegraph). (Markides 2006, Lyytinen and Rose 2003, Govindarajan et al 2011, Chandy and Tellis 1998). Markides

(2006) particularly outlines the properties and examples of what makes a radical innovation qualify to be a disruptive radical innovation.

This classification helps in providing clarity when dealing with disruptive innovations. The granular distinction between the different classifications of disruptive innovation makes it clear in what category a specific innovation falls and subsequently allows us to better deal with it in the appropriate light.

2.2 Information Systems (IS) Capability

Information systems capability is a theoretical construct in information systems that typifies the capacity of an organisation to deploy, harness, leverage and reconfigure its Information assets and IT resources to meet the current and emerging needs of the organisation (Wade and Hulland 2004, Pavlou and El Sawy 2006). IS capability takes its roots from the resource based view (RBV) theory and it is related to the dynamic capability and competence theories (Teece, Pisano and Schuen 1997, Prahalad and Hamel 1990, Bharadwaj 2000, Kraaijenbrink et al. 2010).

The concept of IS capability (or IT capability) entered into the information systems field as a research stream in the late 90's and early 2000's (Ross et al 1996, Powell and Dent-Micallef 1997, Peppard and Ward 2004, Mata, Fuerst and Barney 1995). It emerged in the IS scene at a time when there was a lot of questions and growing concerns about the value of IT to an organisations competitiveness, and particularly how IT could/does contribute to competitive advantage (Peppard and Ward 2004, Santhanam and Hartono 2003, Tippins and Sohi 2003, Mata, Fuerst and Barney 1995, Sambamurthy et al 2003). This was a period that was characterized by conversations about the productivity paradox of IT (Brynjolfsson 1993). It also coincide with the waning patience of organisation leadership who have been waiting for IT to return the dividends from the hefty investments poured into it (Ross et al. 1998, Peppard et al. 2004)).

With this background, prior research on IS capability have contributed extensively in broadening our knowledge on the value of IT to firm performance and competitive advantage (Santhanam and Hartono 2003, Pavlou et al. 2006, Ravichandran et al. 2005). Since the burden of proof lies directly on the information systems discipline, the theoretical conceptualization of IS capability became a valuable avenue for IS scholars to respond and showcase the significance of IS to an organisations profitability among others.

2.2.1 Evolution and criticism of the IS Capability theory

Information systems is a field that seats in a nexus of different research disciplines (Galliers 2003, King and Lyytinen 2004, 2006, Hirschheim and Klein 2003, Benbasat and Zmud 2003). Hence, it is imperative that IS researchers utilize theories and concepts from other fields. While this is arguably one of the strengths of the field, it also has the tendency to be an Achilles heel (Wade et al 2004). Although it is important to borrow concepts from outside IS, this should be done without bringing the dissensus and inconsistencies along with the borrowed theories. In the case of IS capability, this seems to be the case.

There seems to be confusion about the distinction between three related constructs under the capability umbrella – IS/IT Capability, IS/IT Resources and IS/IT Competences. Besides the issue with the distinction, there also seem to be a lack of consensus on the hierarchy or structural relationship between these constructs (See Figure 4, Figure 5 and Figure 6). A further review of the literature on RBV, competences and dynamic capability, from outside information systems shows that this issue exists not only within the IS field but also in the reference disciplines.

From a literature review on IS capability, three distinct views of IS capability seem to be prevalent in prior studies (Baiyere and Salmela 2014). These three views are

- Subset View
- Combination View and
- Equality View

The susbset view are research papers that implicitly or expressly take the position that the relationship between capability, resources and competences is that of one being a subset of the others (Peppard et al 2004, Bharadwaj 2000, Sambamurthy 2003, Ravichandran 2005). Figure 4 illustrates this in a pictorial form.
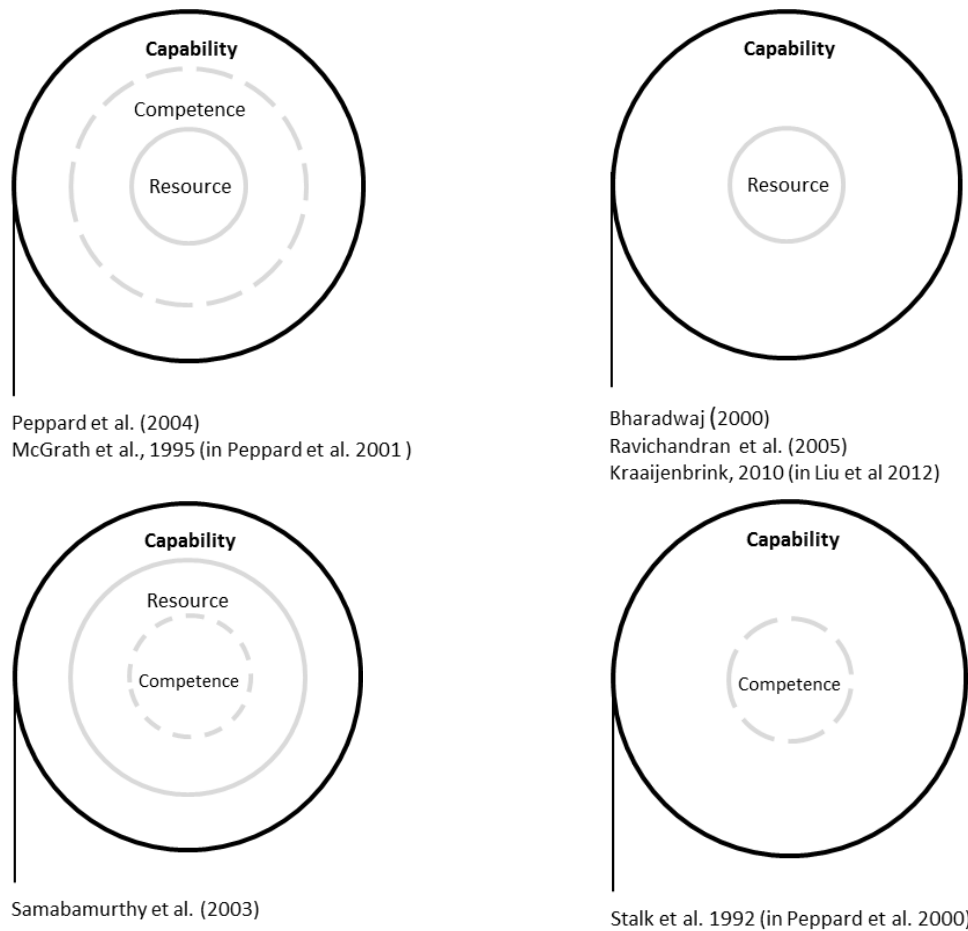
Figure 4. Definitions of Capabilities, Resources and Competences showing their relationship as subsets of each other

Similarly, another group of scholars take the position that these three constructs are related in combinatory format (Wade et al 2004, Caldeira et al. 2010). This means that one construct is made up of the combination of the others. Hence, IS capability in this view could be the combination of the IS resources and IS competence present within an organization. Figure 5 gives a representation of some selected examples.

Wade et al. (2004)
Caldeira et al.(2010)

Teece et al., 2004 (in Trafaldar, 2007)
Tippins et al. (2003)

Stoel et al. (2009)
*Capability = Special Resource

Barney 1991(in Peppard et al. 2000)
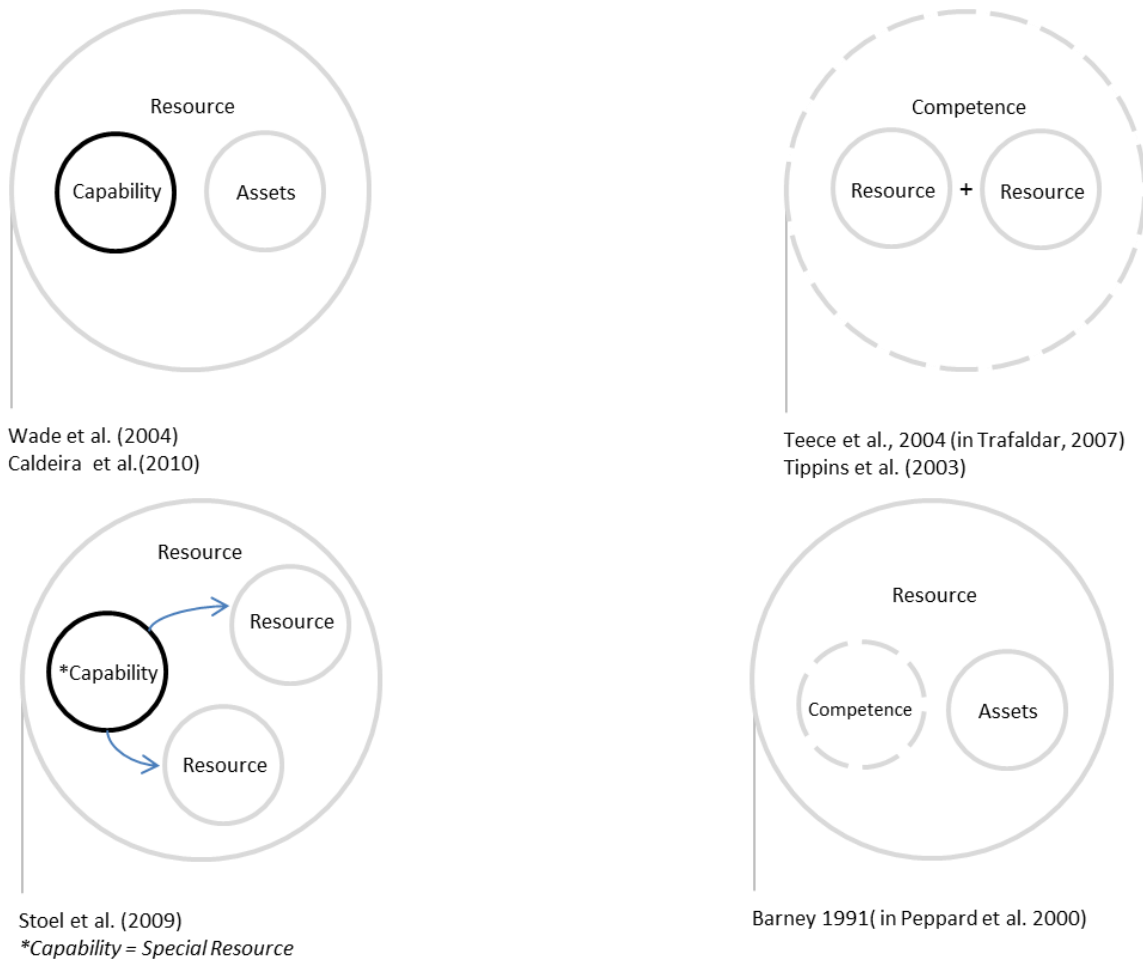
Figure 5. Definitions of Capabilities, Resources and Competences described as a combination of each other

The third view which is worth paying attention to is the equality view. This is the most prevalent view in most IS literature. In many cases, this view is implied and alluded to in scholarly research. This is a view that considers IS capability, IS resources, IS assets and IS competences to be one and same. This seeps into many IS capability writings as synonyms that can replace each other without a change in the intended meaning. This is an important view to note because; an understanding that these concepts have been used to replace each other in earlier studies will help us in collecting relevant literature to build on when planning a study in this area. Figure 6 shows some selected examples of prior literature belonging to this view.
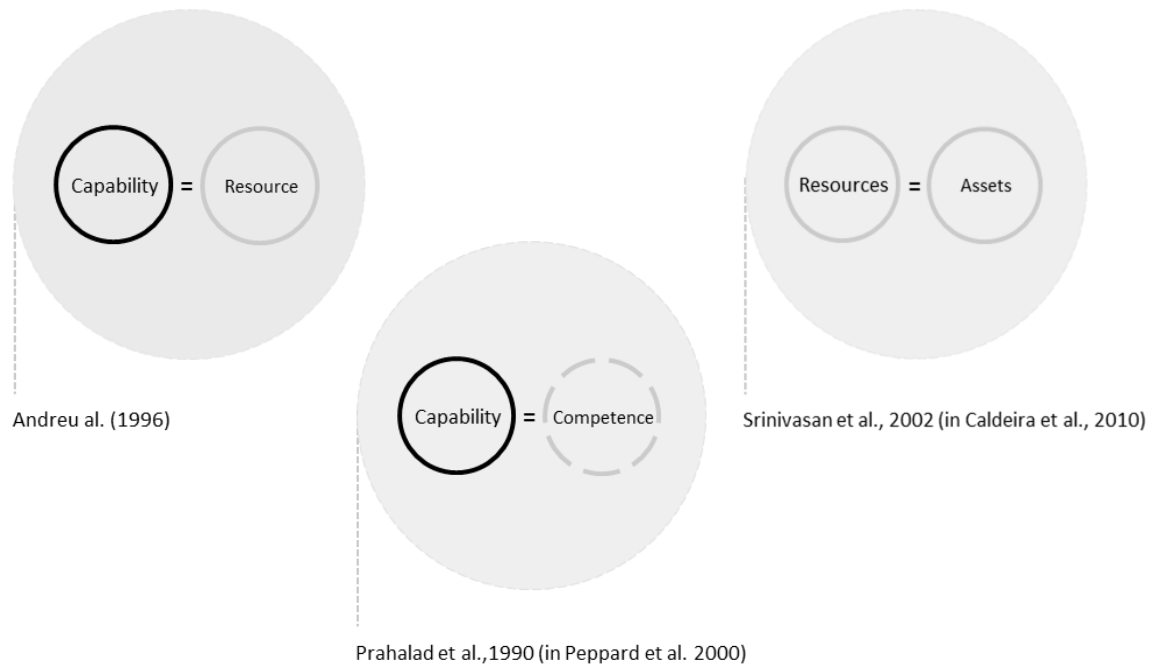
Figure 6. Definitions of Capabilities, Resources and Competences described as equal constructs

It is worth stating that, although this lack of consensus exist in prior research on IS capability, we should acknowledge this, but we do not need to continue with the current dissensus (Baiyere et al. 2014).

2.2.2 State of the IS Capability theory

Three different focus areas can be said to have emerged from the research on IS capability over the years. These three main focus areas are:
- Organisation change/Turbulence
- Competitive advantage/Firm performance
- Innovation/New product development

As mentioned earlier, research on competitive advantage and firm performance are one of the key drivers for studies on IS capability in IS (Ross et al 1996, Peppard et al 2004, Bhatt and Grover 2005, Rai et al. 2012). Hence, a vast number of IS capability research have focused on this theme. In addition to this, another research area under which IS capability research has been geared is organisation change and turbulence (Pavlou et al 2006, Pavlou and El Sawy 2010). Researchers as well as practitioners have turned to there IS capability to seek answers to how they can navigate change effectively and efficiently. At a time when IT has become ubiquitous, pervasive and closely woven into the fabric of today's organization, it

has therefore become essential for organizations to seek for avenues to reconfigure and reposition their business swiftly in order to be both proactive and responsive in a fast changing business world (Salmela et al. 2015)

The third and emerging research focus under IS capability has been its connection to innovation and the innovativeness of an organization (Ravicahndran et al. 2005, Tarafdar et al. 2007). Increasingly, organisations are turning to there IS capability for answers and opportunities that can be leveraged to create new businesses, identify business models and create new products (Pavlou et al. 2006, Ravicahndran et al. 2005, Tarafdar et al. 2007). Studies in this area have looked at how IS capability contributes to the innovation process plus how it can both enable and trigger innovations and new application areas.

2.2.3 Classifications of IS Capability

There has been different classification of IS capability into minute elements by different scholars. A tabular representation of the identified classifications are presented in Table 3.

Classification

Article[2]									
Bharadwaj	IS/IT infrastructure	IS/IT enabled intangibles	Human IS/IT skills						
Tippins and Sohi	IT objects	IT operations	IT knowledge						
Bhatt and Grover	IT infrastructure	IT business experience	Relationship infrastructure						
Fink and Neumann	IT Personnel Capabilities	IT Infrastructure Capabilities	IT-Dependent Organizational Agility						
Lu and Ramamurthy	IT infrastructure capability	IT proactive stance	IT business spanning capability						
Ross, Beath and Goodhue	Technology assets	Relationship assets	Human assets	IT processes					
Ravichandran and Lertwongsatien	IS planning sophistication	Systems development capability	IS support maturity	IS operations capability					
Bharadwaj, Sambamurthy and Zmud	IT infrastructure	External IT partnerships	Internal IT partnerships	Business process Integration	IT management	Strategic vision of IT			

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2 See appendix 3 for (L16,L8…L30) reference.

Article[3]	Classification								
Sambamurthy, Bharadwaj and Grover	Knowledge reach	Knowledge reach	Process richness	Process reach	Agility	Entrepreneurial alertness	Positional assets (L16)		
Peppard and Ward	Supply	Delivery solutions	Defining the IT capability (L30)	Defining the IS contribution	Exploitation	Strategy	Business & IS strategic thinking (L8)		
Wade and Hulland	External relationships	market responsiveness	IS-business partnership	IS planning and change management	IS infrastructure	IS technical skills	IS development	cost-effective IS operations	
Feeny and Willocks	Business system thinking	Business-IT relationship	Contract Facilitation	IS/IT Governance	Design of IT architectures	Making Technlogy work	Informed IT buying	Contract Monitoring	Vendor Development

Table 3. Classification of IS Capability by different IS scholars

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3 See appendix 3 for detailed information.

2.3   Reference Research Streams

2.3.1   *Competitive advantage of IT*

The notion that IT/IS contributes to the competitive advantage of an organization has been long discussed (Grover and Kohli 2013, Mata et al. 1995 Kettinger et al. 1994, Clemons and Row 1987, Clemons 1986, Porter and Millar 1985). An identifiable list of studies can be easily found that supports the thinking that IT does contribute value as a source of competitive advantage (Piccoli and Ives 2011). The case of American Airlines and American Hospital Supplies have been widely documented as iconic examples of IT contributing to competitive advantage among many others (Lubin and Esty 2010). These among other examples, highlight how IT has provided competitive advantage and enabled companies to quickly gain market share and market leadership.

A recurring theme among many studies exploring the competitive advantage of IT has been the resource based view and the related IT capability construct (Rai and Tang 2010, Pavlou et al. 2010 & 2006, Doherty and Terry 2009, Melville et al. 2004, Mata et al. 1995). It is in the quest to understand the ways in which IT could contribute to competitive advantage that the research stream on IT/IS Capability evolved (Ross et al. 1996). Peppard and Ward (2004) takes this connection further by advocating for IT Capability as the next wave for competitive advantage studies that goes beyond traditional strategic information systems (Galliers 1993). Hence, a section of this thesis has been focused on elaborating on the prior literatures on IT capability.

Indications from prior studies show that the issue of IT and competitive advantage has been studied from different perspectives. A dominant view has been from the business organisations viewpoint (Tavakolian 1989, Rackoff et al 1985) while Salmela and Turunen (2003) have looked at it from the perspective of public organisations. Additionally, while most studies have looked at organisation level analysis (Dehning and Stratopolous 2003), studies like Rai et al. (2010, 2012) and Johnston et al. (1988) considered an interorganisational perspective.

Furthermore, from the review of existing studies in this area, it seems that most of the prior literature are quite aged. It also appears that the IT competitive advantage discussion is gradually fading away as illustrated by the publication years of articles highlighted by Piccolo and Ives (2011). This could probably be explained by the possibility that the connection between IT and competitive advantage is gradually becoming a taken for granted view (Buhl et al 2012, Galliers

1993). If so, perhaps this view is making IS researchers complacent towards exploring this further - particularly in recent times? In response to this, Schryen (2013) makes an expository call for further studies on revisiting the contribution of Information Systems to internal and competitive business value.

In recent years, this (almost taken-for-granted) view is increasingly being questioned (Carr 2003). According to Nicholas Carr (2003) – IT does not matter. Carr argues that IT is becoming a typical commodity and is no longer a key differentiator from which organizations can distinguish themselves or look to for distinct competitive leverage. The school of thought that aligns with Carr, likens IT to electricity among other examples (Stewart 2003). They make a case for the ubiquity of electricity as a precursor for electricity becoming a necessary apparatus for carrying out the daily operations of an organisation. With the increasing pervasiveness, ubiquity and standardisation of IT offerings, they argue that IT has lost its uniqueness just like electricity – hence the uniqueness property of IT from which an organization can leverage for an exclusive competitive edge is gradually vanishing.

Since the premise for considering that IT has lost its competitive advantage is based on the current status and projections of IT, it thus makes sense to select a contemporary context in investigating the veracity of these claims. Herein lies the value of disruptive innovation as the context of this study. Disruptive innovation lends itself readily as a fitting context that is both contemporary and extreme in the demands it requires from IT (or other organizational capabilities). Very few studies can be found that have considered the role of IT in competitive advantage within a turbulent environment (Pavlou et al. 2006, Salmela et al. 2000). This is an additional premise where this current study on disruptive innovation aims to contribute.

2.3.2   Digital Innovation

Digital innovation describes IT innovations that are characterized by the utility of new combinations of digital and physical elements to produce novel outputs (Yoo, Henfridsson and Lyytinen 2010b). These innovations are usually distinguished by the associated encoding of analog data elements to digital formats (Yoo 2010). The pace of development in the creation and emergence of digital innovation seems to be accelerating (Yoo et al 2010b). With this accelerated increase comes different implications on different levels of the societal strata. Typically, digital innovations are seen as an enabler of various functionalities and activities at an increased level of performance, efficiency or value (Yoo et al .2012). Many of the conversations around digital innovations tend to highlight the novel and interesting contributions it brings from the individual, organization or societal level

(Fichman et al. 2014; Henfridsson et al. 2009). The perception of digital innovations reflects its latency to open up opportunities and enable individual or group creativity to be unleashed in ways that allows unique accomplishments that where hitherto not conceivable (Adomavicius et al. 2008). The potential value due to digitalization and the innovations emerging from it has further driven the push for the creation of more digital innovations (Yoo et al. 2010b). This further increases the chance that some of these innovations would also be disruptive innovations.

Besides digital innovation emerging solely because of novel opportunities made possible by technological advances, there are also hosts of digital innovations that are replicas or rather transformation of existing traditional innovations (Svahn et al. 2009). Both cases of digital innovations have ushered in new sets of challenges and opportunities that are worthy of attention (Yoo et al. 2010a). One of the main challenges of digital innovation can be derived from the ongoing convergence and digital materiality that accompanies these innovations (Yoo et al. 2010a). Convergence due to digital innovations are leading to the erosion of existing systems and structures (Yoo et al. 2010a, 2010b). Organizations that are seemingly well established in traditional industries are suddenly facing disruptive threats from digitalization (Baiyere and Salmela 2015). In essence, while digital innovation holds the promise of creative solutions to different issues in the society, it also seem to have the facility to embody a degree of change in long-held traditions, which is introducing uncertainties and complexities that are proving to be challenging.

In conceptualizing digital innovations, Yoo et al. (2010b) highlighted three unique characteristics of a digital innovation. These are reprogrammability, homogenization of data and self-reference. *Reprogrammability* describes the capacity of digital innovations to be amenable to perform a vast array of functions. *Homogenization of data* is the property of digital innovations that enable them to separate the content from the medium, which allows the combination of heterogeneous data to create and deliver various services - thereby leading to a dissolution of organizational and product borders. The *Self-reference* attribute of digital innovation characterizes the propensity of digital innovations to leverage on existing digital technologies thereby creating positive network externalities that further accelerates and reinforces the emergence of more digital innovations. These identified characteristics provide useful explanatory power to understanding the evolution and impact potential of emerging digital innovations.

Prior literature on digital innovation have highlighted the value and importance of digital innovation to organizations (Lee and Berente 2012; Selander et al. 2010; Svahn et al. 2009; Yoo et al. 2010b). It is however worth noting that although most literature on digital innovation reference the importance of digital innovation on a societal level, little attention has been accorded to empirically study this. Most of the prior studies have focused specifically on the organizational impact of digital innovation hence leaving a gap in our understanding of its implication on a societal

level. This paper attempts to contribute to this knowledge gap by taking a societal perspective on digital innovations. This paper is also in consonance with the call by Yoo et al. (2010b) and Majchrzak et al. (2016) for studies aimed at understanding the consequences of digital innovation (referred to as IT innovation subsequently for consistency), which as they acknowledged - could be both positive and negative.

3 RESEARCH APPROACH

Ceci ne pas une pipe.
René Magritte

With the interdisciplinary and exploratory nature of this study, it was necessary to adopt research approaches deemed appropriate to better understand the various issues that were emerging. This section details the research method and the methodological choices that were made to guide this research towards achieving the set out goals and research questions.

3.1 Research Methods Overview

The research methods adopted for this thesis draws from the IS research approach classification taxonomy advanced by Järvinen (2004). The taxonomy provides value to the study as a guide that helps map the research questions to the research methods and also to clarify the extent and limitations of the study. Figure 7 presents the research approach classification with the emphasis highlighting the boxes were this research seats.
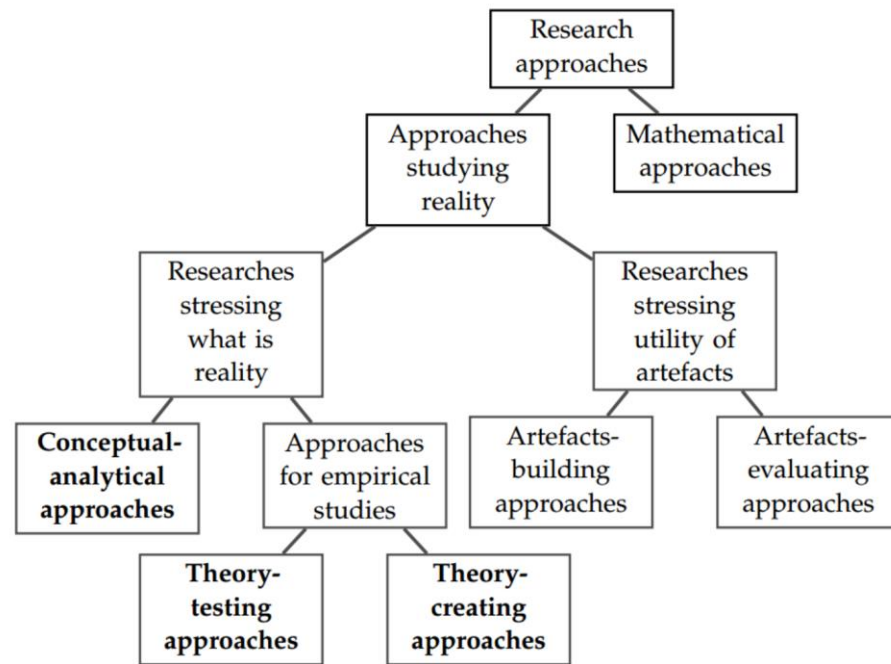
Figure 7. Research Approach Classification

In consistence with Järvinen's classification and in consonance with the research questions driving this study, this study is positioned to discover and illuminate our understanding about the reality around the relationship between IT and disruptive innovation. The research is not aimed at investigating the utility, creation or evaluation of specific artifacts. On the contrary, the research is about developing a conceptual analysis and framework of what is known/possible in the interaction between IT and an organisation's position in scenarios of disruptive innovation. Furthermore, the research aims to generate propositions that can inform future research in this area as well as test existing theories that could be of value in unravelling the role of IT in disruptive innovations. Hence, the research logically requires both conceptual and empirical approaches as indicated in Figure 7. With this background, the research approaches adopted for this study are primarily conceptual and qualitative in nature. The conceptual analysis were largely through literature reviews and supported by some qualitative exploratory studies based on interview and secondary data.

The choice to adopt conceptual and qualitative approaches are further derived from the nature of the research topic and the questions under consideration (Yin 1994, Jarvinen 2004, Myers 1997). The research topic and questions are exploratory in their positioning and additionally they are situated towards seeking answers in an under-investigated area spanning two interdisciplinary boundaries (Information Systems and Innovation Management). Adopting a qualitative research approach for the empirical analysis is also appropriate due to the contextual nature of the data required to answer the questions. According to Eisenhardt (1989), this

approach is especially appropriate in studying contemporary topics and the resultant theory is appropriate to be further tested and empirically validated. Investigating the relationship between two relatively disparate concepts such as disruptive innovation and information technology will require such a contextual collection of data. Additionally, this research is centred around a contemporary phenomenon in a real-life context. According to Yin (1994) these are sufficient conditions to select a qualitative research approach.

The epistemological foundation of the study leans more towards the critical realist paradigm rather than the positivist and interpretivist divides (Mingers 2004, Orlikowski and Baroudi 1991, Carlsson 2011). While positivists, favour the hypothetic-deductive approach grounded on objective constructs and interpretivist argue for a thorough understanding of a phenomenon through subjective meanings of perspective in a social world, this study departs from this and opts for a paradigm that bridges the divide by adopting critical realisms in line with Mingers (2004). According to Mingers, Mutch and Willcocks (2013) and Carlson (2011), critical realism does not advocate a single form of research enquiry but rather values the application of different research methods in recognition of the inherent complexity and variety of research objects. The paradigm accepts different types of objects of knowledge—physical, social, and conceptual—which have different ontological and epistemological characteristics (Mingers et al. 2013). From the tenets of critical realism, it generally steers away from the positivist approach of finding causal relationships at the level of events, to investigating them at the level of the generative mechanism. It thus supports research where the object of enquiry has real, amendable mechanisms that are configurable to produce particular outcomes and it also supports the use of social scientific method to identify the associated mechanisms (Fletcher 2016, Carlsson 2011). An example of a research technique amenable to a critical realist viewpoint among many others is hermeneutics, which has been adopted alongside thematic analysis in this study (Vandenberghe 2013, Roberge 2011).

The study aligns with the search for a deep and thorough understanding of the underlying mechanisms and importance of IT in disruptive innovation scenarios and also aims to extend the generalisation of its ensuing theories as allowed by critical realism. In consonance with Mingers 2001, research methods can be detached from research paradigms because the consideration of the research questions and objectives are the critical drivers in guiding the choice of research methods. Hence, this study has attempted to align its methodological choices closely to their appropriateness for the research questions propelling this research. The choice to use conceptual and qualitative research approaches are therefore in order to a) facilitate the synthesis of existing knowledge about IT and disruptive innovations as well as b) advance propositions towards a research agenda for IS.

3.2 Conceptual Research Approach

3.2.1 Conceptual studies

Although theoretical conceptualization is considered one of the hallmark of scientific research, relatively very few guidelines exists on how to specifically write a research based on theoretical conceptualization. While there are many actual conceptual papers published in academic journals, the scales seem to be tilted towards empirical papers when it comes to providing how-to guidelines. With some notable exceptions like (Locke and Golden-Biddle 1997, Wand, Monarchi, Parsons and Woo 1995), the field of IS and Innovation management appear to lack such guidelines.

Despite the relative scarcity of guidelines on writing scientific conceptual papers, the value of conceptual papers and theoretical conceptualization as a whole cannot be overemphasized. Conceptual papers tend to be the pacesetters in leading a research trend or charting a path for a new area of inquiry (Wade and Hulland 2004, Adler and Kwon 2002, Swanson and Ramiller 2004, Bharadwaj, Sambamurthy and Zmud 1999, Fattahi and Afshar 2006). Similarly, conceptual studies can be considered as a useful and non-trivial guiding lens particularly in an uncharted space (for example: Orlikowski 2010, Henderson and Venkatraman 1993, Yoo, Henfridsson and Lyyytinen 2010b, Porter 1979). They tend to be especially appropriate for studies were very little has been done and hence stand as a lightning rod to identify possibilities for further studies and to propose research agendas (for example: Alavi and Leidner 2001). We therefore can draw lessons from the vast examples of conceptual papers written to have a better understanding of how and when to write a conceptual papers. Although there are different flavours of conceptual papers both in style, structure and purpose, there are nonetheless similarities and valuable learnings that can be drawn from such studies.

Some key points can be outlined from the prior examples of seminal conceptual papers both in IS and other research fields. One of such is the relative independence of the theoretical contribution on empirical data. Many conceptual studies therefore rely on the power of thinking, imagination, rationalization and wealth of insights in generating knowledge. In addition, while the focus is not from generating knowledge from empirical data, conceptual papers are usually firmly grounded in prior research. Hence, it is not uncommon for a conceptual paper to be based on a synthesis or review of literature on a particular topic (Wade and Hulland 2004). In essence, conceptual studies are poised to challenge, advance, reorient or extend our current knowledge on a specific theme. It additionally finds value as a useful approach in opening up further research in areas that are emerging or underdeveloped.

Since very little has been done to understand how and if IT does play a role in disruptive innovations, it can only be hypothesized based on prior knowledge of IS research that IT may be of importance in these situations. Unlike Paper 1 – 5 that utilized empirical material in varying degrees, Paper 6 included in this study is mostly conceptual. Paper 6 is built on conceptual arguments that relied on prior literature and acquired understanding of the status of both IT - specifically IT capability - and disruptive innovations, to advance the concept of *disrupt-ability* and *disruptability* as theoretical concepts of how IT capability can play a role in the occurrence of disruptive innovation.

Taking on two disparate research streams that have not been previously studied requires a conceptual analysis of the current situation and propositions for future studies. This thesis is therefore positioned to present a conceptual synthesis of what is known about each research domain and their interrelationship. Based on this synthesis and in consonance with the research questions, the conceptual research approach aims to propose a grounding for future research linking IT and disruptive innovation. To achieve the synthesis of prior knowledge in these areas, the study firstly adopts a series of systematic reviews to understand each domain separately and subsequently to understand the joint interaction of both domains. According to (Rivard 2014, Webster and Watson 2000) literature reviews are useful approaches to arriving at a conceptual clarity of the state of a research area and in advancing propositions for further scholarship (Rowe 2014, Orlikowski and Scott 2008).

3.2.2 Systematic literature review

This study has extensively applied systematic literature reviews as a means of generating knowledge and providing answers to the research questions. This is identifiable from the fact that half of the papers included in the study are based on literature reviews (Papers 1, 4 and 5). Literature review helps us to get a good overview of the status of research in a specific research area. They are useful in synthesizing and describing the past (Webster et al 2000, Tranfield et al 2003). However, their power can be further unleashed when extended with the power of theoretical conceptualizations to propel the synthesis into useful conceptual knowledge that did not exist in the prior studies (Markus and Sanders 2007, Rivard 2014). Taking such leaps that are grounded in prior research into the foray of theorization is what makes literature reviews a potent tool in conceptual research.

The reviews conducted in this study are largely based on Webster and Watsons's (2000) approach of going forward and going backwards. While Webster

and Watson's approach are useful in identifying research via a snowballing approach, other researchers have also provided some useful approaches that can be used in conducting a literature review (Boell and Cecez-Kecmanovic 2014, Wolfswinkel et al. 2013, Okoli and Schabram 2010, Vom Brocke et al. 2009). Although, systematic literature review has its strengths, it is not free from criticism (Boell and Cecez-Kecmanovic 2014, 2015). Some scholars have advocated for reviews that places more emphasis on the dialogical interaction between the literature and the researcher, iterative reflection and questioning; critical assessment and imagination; argument development and interpretation which are activities aimed more at intellectual development over the replicability focus of systematic reviews (Boell et al 2014, MacLure, 2005, Boell et al 2015, Hart, 1998).

The principles of clustering techniques were borrowed as the preferred method of analysis used in making sense and synthesizing the gathered literature. Clustering is typically considered helpful in making classifications and this use of clustering is widely employed in academic research (Punj and Stewart 1983). The technique is a relevant approach for studies that are attempting to achieve the identification of discrete categories or taxonomies (Punj and Stewart 1983, Parsons and Wand 2008, Kaufman and Rousseeuw 2009). Considering the vast volume of literature encountered in most review studies, clustering helps to sort the core essence of the reviewed articles into fitting groups bases on suitable classification criteria that emerges through the articles. For the three review papers presented in this study (Paper 1, 4 and 5), the literatures were grouped and classified into categories that shed light into the current state of knowledge, the direction of research in the studied areas and the limitation plus gaps that are yet to be explored. For paper 1, the emerging categories that were discovered in the papers provided the footing that enabled the advancement of a conceptual positioning of each of the papers.

The reviews helped to shed light on different aspects of the journey towards answering the research questions. The first review was aimed at an extensive and systematic search for prior research on disruptive innovations that have considered IT as a core construct in their arguments. The review was followed by a reflective review of disruptive innovation, its definitions, related concepts and classifications among others. The second and third reviews were systematic literature reviews aimed at understanding the state of knowledge of two IS concepts that have the potential to be valuable in highlighting the likely contributions of IT and IS research in disruptive innovations. These two concepts are IS agility and IS capability. Both concepts were drawn from an acquired understanding of the constructs identified in disruptive innovations that may provide insight into the potential value of IT in disruptive innovation occurrence. These three review papers are presented in more details in subsequent chapters.

3.3 Qualitative Research Approach

The qualitative nature of the study stems from the use of interviews and secondary data as data source for empirical evidence. The adopted approach aligns with qualitative field study in contrast to case studies (Sarker et al. 2013, Benbasat et al. 1987). This section details the data collection and data analysis adopted for the study.

3.3.1 Interviews

Interviews have been used as instruments for primary data collection during the course of this study. Interviews were considered suitable due to their value and applicability when attempting to unearth closer detail about an area where little is known and in order to get an in-depth understanding of a topic of interest. (Myers and Newman 2007, Gillham 2005). The interviews were conducted as semi-structured interview (see appendix 1 for interview questions). Semi-structured interviews are appropriate as they allow for the interview to have a predetermined guiding theme, and yet allow the flexibility to recalibrate the interview questions as the process unfolds, with the aim of extracting valuable insights that contributes to the knowledge sought (Rubin and Rubin 2013, Gillham 2005).

Firstly, the interviews were aimed as a means to better understand how disruptive innovations are perceived particularly for practitioners' within the IT industry. Secondly, the interviews were also geared towards understanding the evolution of disruptive innovations from their perspective and how IT plays a role within this context. For this purpose, two sets of interviews were conducted. The first set was built on an earlier study positioned as exploratory interviews to understand the what, how and why (Yin 1994) innovations can be disruptive, while the second set was to understand it more closely within the IT context in a business domain. Whereas the first set of interviews focused on understanding disruptive innovations within an industry and its business environment, the second set of interviews were positioned to collect the view of informed IT professionals who then form a basis for expert interviews/opinions on the topic starting out first as pilot interviews. Each interview took about 45 to 75 minutes and were recorded.

The sampling of participants recruited for the study follows the principles of the snowballing sampling technique (Myers and Newman 2007). This approach involves on leveraging the current participant to identify the next participant until saturation is reached. Participants were mostly innovation/research managers or IT managers who are deemed to have the expertise to assess the wave of innovations that they consider to be disruptive or with the potential to be disruptive. The first

set of interview involved thirteen (13) innovation professionals or managers with research related responsibilities. One of main essence of the interview was to draw from their expertise in their domain to illuminate how an innovation is disruptive or can be disruptive to them and to position innovations as either disruptive or having potential to be disruptive from a test scenario.

The second set of interviews involved six (6) IT professionals with some degree of innovation or research/product development in their job profile (See appendix 2). These were conducted with the goal of providing further enlightenment on the role of IT in general and IS/IT capability in particular in the creation or response to disruptive innovations. Paper 2 details the use of this approach in the study that aims to uncover the conceptualization of disruptive innovation by extracting and focusing on specific examples of (potential) disruptive innovations.

3.3.2   Archival/Secondary data

To provide better insights in understanding the research topic, which deals with a contemporary issue as well as with two disparate fields of research, coupled with the fact that disruptive innovations has gained a lot of attention in both business and professional media, it was necessary to look beyond academic literatures and primary interview data. Archival data is an increasingly viable resource due to the growing amount of research material becoming available and accessible (Silverman 2006, 2010). Basically, the proliferation of data ranging from periodicals to blogs to corporate annual reports to review websites has broadened the scope and applicability of systematic, archival research (Fischer and Parmentier 2010). Archival data are also increasingly being seen as primary source of insight that complements the growing critiques of the weakness of interview data as a primary resource in qualitative research (Arnould and Wallendorf 1994).

Secondary analysis of archival data has thus been contended to be appropriate in testing existing theories or in generating new knowledge, new hypothesis, or new propositions as is expected of this study plus it additionally allows for a wider use of data from rare or inaccessible recipients (Rouse and Daellenbach 2002, Hinds, Vogel and Clarke-Steffen 1997). Archival data as a source of insight for academic research is particularly becoming more important with the advances in technology and today's digital channels of disseminating, collecting and analyzing data.

While indicating the strengths and value of using archival data for scientific research, the study also acknowledges the shortcomings of this approach. Some have questioned if secondary data is tenable for qualitative studies due to its subjective nature. It is however not isolated in this as other forms of enquiry (both

qualitative and quantitative) at some point are contingent on the researcher's ability to form insights and meanings based on interpretation and contextualization of their data. Furthermore, recent critique and inherent challenges of qualitative interviews have raised our thinking about the possibility and suitability of archival data among others as plausible complements to better address some research designs (Alvesson 2003). Arnould and Wallendorf (1994) demonstrated the discrepancies in what people say in interviews and what they actually do which presents a compelling case why it is not sufficient to always rely primarily on interviews for complete insights into certain research issues.

For this study, papers 2 and 3 (Baiyere 2014, Baiyere and Salmela 2015) utilize archival data as part of the data used in acquiring answers to the research questions. These data were sourced primarily from publicly available media data from different online repositories which aligns with the unit of study in each paper. The main source of data used were media articles, blog articles, corporate websites/reports, government websites/reports. In each publication were archival data was used, they were valuable secondary sources of data that enabled the assessment and confirmation of prior information gathered either via the interviews or via the literature reviews. For instance, in understanding the notion of potential disruption, the secondary data provided useful data that helped in positioning the relative disruptive status of selected case innovations (Baiyere 2014).

3.3.3 Case selection

The thesis adopts the principles of purposive sampling for the selection of cases included in the study (Coyne 1997). Purposive sampling is a non-probability sampling procedure, where the selection of cases is based on the characteristics of a population and the underlying objective of the study (Teddlie & Yu 2007, Devers and Frankel 2000). Particularly the deviant purposive sampling approach has been used in the study, which aligns with the critical realist paradigm taken by this dissertation (O'Donnel, Kramar & Dyball 2013). The deviant purposive sampling (or extreme purposive sampling) is a useful approach for sampling when the study at hand requires an analysis of outliers that diverge from the norm with regards to the phenomenon of interest (Ritchie, Lewis & Elam 2003). Two of the papers (papers 2 and 3) included in the thesis are based on analysis of selected cases using this technique. This section describes the sampling and inclusion choice for deciding on the cases used in the thesis.

Firstly, the choice of case selection was guided by both a prior literature review (paper 3) and a pilot interview (paper 2). The design of these studies involves the analysis of archival and historical data on the selected cases. Hence, the initial

identification phase involved the documentation of possible cases meeting predefined criteria. This phase established the background for selecting the actual cases that meets the criteria and formed the basis for the sampling process of selecting from the list of satisfying cases for further analysis. In consistence with the principles of purposive sampling, the final cases were selected based on the acquired knowledge about the cases and the purpose of the study paper, plus the availability and access to data on each case (Okoli et al 2010).

3.3.4   Data analysis

   The analysis of the qualitative data were mostly carried out using thematic analysis for the interviews and hermeneutics as the adopted sense-making techniques for the collected secondary data. The details of the analysis of the data are presented in more details in the respective publications (Paper 2 and 3). Thematic analysis proved useful as an analysis approach for the interviews as it helped identify the underlying ideas, patterns, assumptions and significance of IT in disruptive innovations (Aronso 1995). Using the coding techniques of thematic analysis the data was analysed for meanings highlighting how IT plays a role in disruptive innovations (Boyatzis 1998, Bensch 2012). These were subsequently put in emergent themes of potential disruptive innovations and disrupted disruptive innovations which formed the basis of the theoretical positioning of paper 2 (Baiyere 2014). For the paper, thematic analysis enabled the isolation of the data analysis to focus on specific interview questions and research areas without losing sight of the overall direction based on the particular theoretical goal of the paper (Boyatzis 1998).
   For the secondary data, hermeneutics was adopted. Hermeneutics is a technique that is particularly helpful in helping to make sense and meaning of textual data. The hermeneutic cycle provides a process that enables the extraction of meaning from the text as a whole in relation to the interpretation of its parts in a dialectic (Myers 1997, 2004). According to Gadamer 1976 (in Myers 1997), the movement of understanding is continuously from the whole to the parts and back from the parts to the whole in a circular fashion. Consequently, the hermeneutic process adopted in this study involved the analysis of the collected textual data (see papers 2 and 3) as a whole by iterating from the construction of meaning from the specific data points (for example media articles or corporate document) and back to the understanding of the whole data set and vice versa. For example, this adopted hermeneutic cycle approach enabled the use of the theory of empowerment and wicked problems to make sense of the societal implications of the role of IT innovations that are disruptive. This was done by taking each case and iterating through the data points to make sense of how the case demonstrates empowerment or wickedness. Then cycling back from the knowledge emerging from the cases as a whole to further analyse and probe the data points for clarification and deeper insight to the phenomenom.

4 RESULTS AND FINDINGS

"No Signal found" (…but for perspiration and imagination.)
Sony projector message

This section of the thesis presents and discusses the key findings of the dissertation by providing a vivid yet pithy description of the articles in which they were published. The presentation of each of the articles will summarily highlight the aim of the paper, the research approach adopted, the key findings and the contributions of the article to the thesis and research questions. A general overview of the connection between the papers and the research question (RQ) that they contribute to is presented in Figure 8.
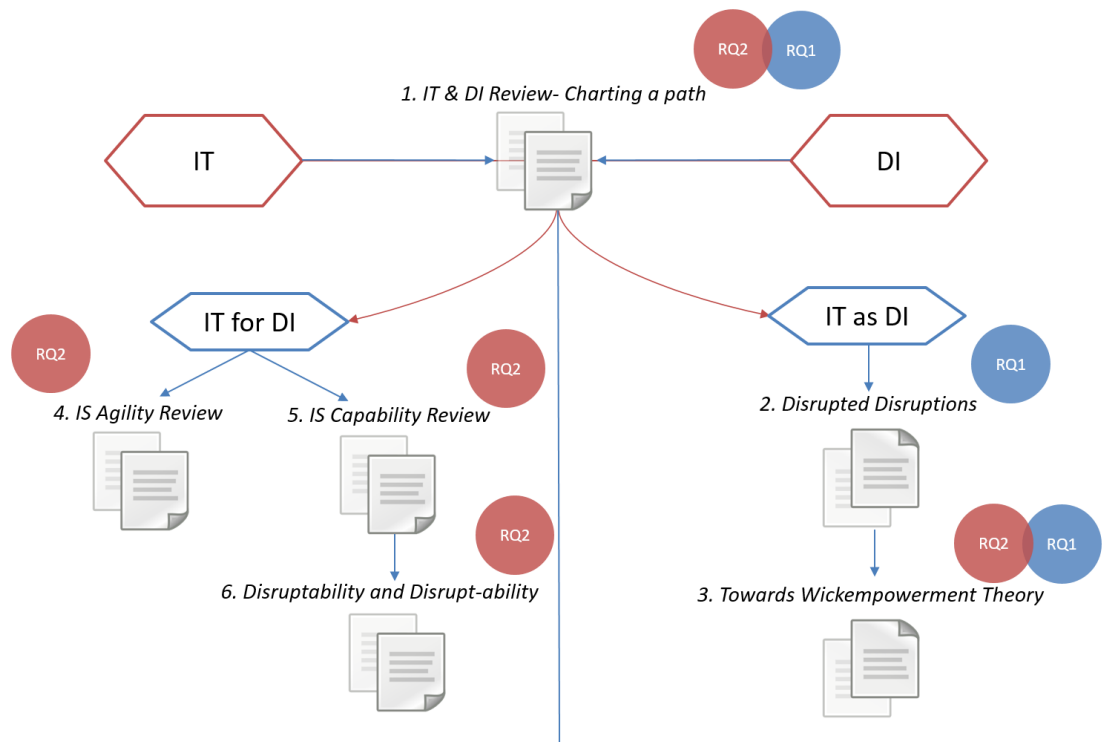
Figure 8. Selected articles and their contribution to the research questions

4.1 Publication 1: *IT & DI Review – Charting a Path*

The first article in this paper-based dissertation is the article titled "*Review: Disruptive Innovation & Information Technology – Charting a path.*" by Baiyere and

Salmela 2013, published in Australasian conference of information Systems (ACIS 2013). The aim of the paper is to examine prior literature as is customary of studies of this nature, with the express objective of finding the link between IT and disruptive innovations. It was intended to help identify the different perspective from which prior research has studied the interrelationship between IT and disruptive innovations (see Figure 9).

Figure 9. Pictorial representation of Paper 1 linking IT and DI

The paper is therefore a literature review study that sets the tone and stage for the subsequent publications and layout of the research that followed. A systematic review process following the guidelines of Webster and Watson (2002) was adopted to identify the appropriate literature dealing with IT and DI. A narrative literature review of disruptive innovation was also carried out in a similar fashion with Boell et al's (2014) recommendation.

With the notable exception of Lyytinen and Rose 2003, Lyytinen et al. 2010 and Nault and Vandenbosch (2000), very little studies have considered the role of IT in disruptive innovations. This paper therefore helped provide a background on what is known about the topic being investigated. The paper also helped refine the two research questions. Two streams of investigation evolved from the paper (see Figure 10), which helped focus the study. The two streams are: the *role of IT in disruptive innovations* a) when IT is the disruptive innovation [IT as DI] and b) when IT is not the innovation but IT is used in the creation and/or response to the disruptive innovation [IT for DI]. Two key findings from the paper were that, firstly, it can be observed that very little research has been done on topics relating both IT and DI. Secondly, there seem to be two perspectives with which IT has been positioned in DI related studies. The two perspectives effectively led to the two streams that informed the structure of the thesis. This findings therefore contributed to providing the foundation for answering research question one.
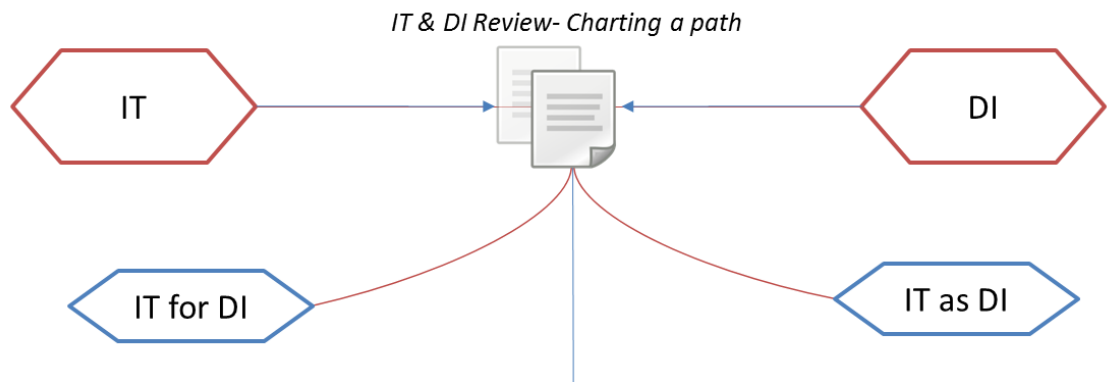
Figure 10. The emergent streams of connection between IT and disruptive innovation

Towards contributing to research question two, the paper proceeded to present a reflective review focused on disruptive innovation. This was done with the goal of highlighting the key knowledge about disruptive innovation so as to inform IS scholars about the state of prior research about disruptive innovations. This phase of the paper attempts to clarify the differences, classify the types and extend the definition of disruptive innovation for the IS field. Figure 11 shows the classification of disruptive innovation that was presented in the paper. The highlights (Market Diffusion and Innovation Type) indicate the developed categorisation under which the different type of disruptive innovation identified in the review were positioned. The different type of innovations are explained in more details in the paper.
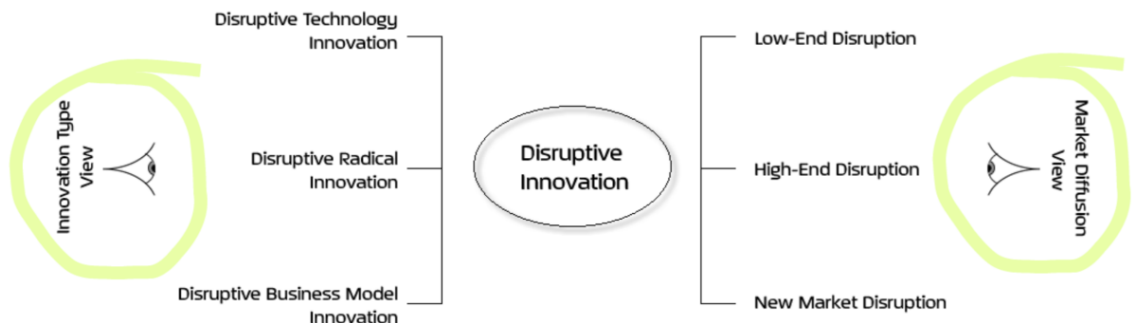
Figure 11. The identified categories of disruptive innovations

Additionally, one of the contributions of the paper is the identification of some inconsistencies in the way the disruptive innovation theory has been defined and the emergent utility of the theory in actual research that the general disruptive innovation definition does not account for. This observation led to the extension of the definition of the theory to accommodate for these anomalies that were not considered in the initial and subsequent articulation of the theory. These discrepancies were primarily:

(a) the fact that the theory has been advanced to cater for both low-end and high-end market unlike its first articulation which recognised only low-end market disruptions;

(b) the observation that the theory was expressed with technology (and later products) as the element that disrupts, however with the disruptive business model, the disruption does not have to be a product; and

(c) the assumption that disruption is benchmarked based on (inferior) performance to an existing product does not hold for radical disruptive innovation where the innovation is new to the world and has no established benchmark but yet disrupts a market by coming in from a tangent via a completely new market.

With this observation, an improved version of the definition was proposed without altering the core of the definition. The contribution of this to the thesis is that it attempts to provide future research with an encompassing definition that has taken into accounts the current state of knowledge about the theory. Thus further contributing to our knowledge of disruptive innovaitons. As an extension to the accepted definition of Christensen 1997 and Govindarajan et al 2011, the proposed definition is presented as follow:

*"A disruptive innovation introduces a different set of **attributes** relative to a **market** which are unattractive for mainstream customers on inception due to **variance** in attributes valued by this market - although a different market segment may value the new attributes. Subsequent developments over time, however, raise the innovation's attributes to a level sufficient to satisfy mainstream customers, thus attracting more of the mainstream market."*

Where:

Market = (products, business models, goods, services... and/or technologies).

Variance = (inferior, superior, complexity…) and

Attributes = (features, performance, price, operations, business rules... and/or processes)

4.2 Publication 2: *Disrupted Disruptions*

The second article is titled "*Disrupted Disruptions - Lessons from Potential Disruptive Innovations that barely disrupted.*" by Baiyere 2014, published in the conference of International Society of Professional Innovation Management (ISPIM 2014). The aim of the paper is to examine case examples of disruptive innovation in mostly the IT industry. In accordance with the paper mapping of Figure 8, this paper is positioned in the "IT as DI" stream. Therefore, the paper looks at what is

the role of IT when it is the disruptive innovation. The IT case examples used in the study are: GoogleDocs, NintendoWii, Minicomputers and Mobile devices.

With respect to the contribution of the paper to the aforementioned research questions, the paper sets out to contribute an answer specifically to research question one. So in essence, some of its core contribution lies in the provision of knowledge about disruptive innovations that could guide further studies looking at the interaction between IT and DI. To achieve this, the paper is based on empirical data gathered via interview instruments and collection of relevant archival data. The research approach employed in the paper is qualitative by design. It was conducted as an extensive exploratory study involving multiple sources of data in order to allow for triangulation as well as to provide a thorough and critical perspective of the topic.

In consistence with the critical realist paradigm, the paper took a rather critical and counterintuitive stand to produce one of its key findings. This counterintuitive exposition of disruptive innovation occurred by reversing the notion of disruptive innovation and trying to understand why certain innovations labelled as disruptive failed to attain that status. This led to the paper coining the terms *Disrupted Disruptions* and *Potential Disruptive Innovations.* The premise of the paper's finding is that, when an innovation is created, even if it ticks all the checklist of the attributes of a disruptive innovation, it is at best – a potential disruptive innovation until there is an identifiable entity that it has disrupted. The earlier set of interviews had identified some innovations as disruptive but a few years later; these innovations seem to have lost the momentum towards being considered disruptive. With this observation, further digging into the case examples with secondary data, revealed that there can be three possible states to a disruptive innovation. This is illustrated in Figure 12.
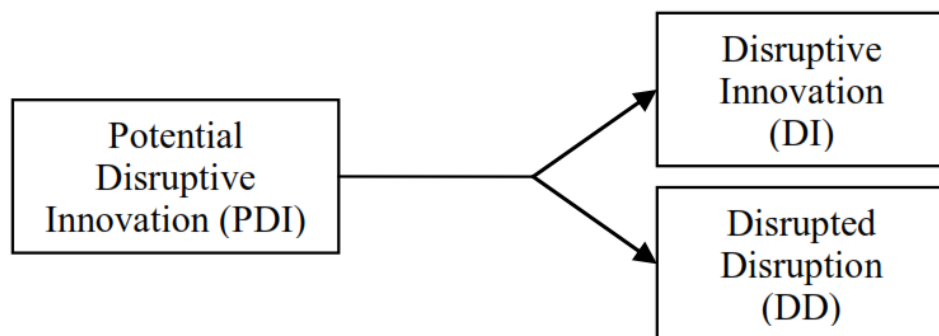
Figure 12. The evolution possibilities of a disruptive innovation

From Figure 12, it can be said that an innovation that starts out with the potential to be disruptive may either end up becoming a true disruptive innovation or end up as a disrupted disruption (meaning failed to become disruptive). As outlined in

the prior research section of the paper, qualifying to be considered disruptive, requires that another entity can be identified that is being disrupted – due to the relativity element of the theory.

Table 4. Attributes for distinguishing between a potential, disrupted, and disruptive innovations

	PDI_{t1}	DD_{t2}	DI_{t2}
Innovation attributes			
Different performance attributes	Necessary	*Not Necessary	*Necessary
Not valued by key customers	Necessary	*Not Necessary	*Necessary
Encroaches existing markets	Necessary	*Not Necessary	*Necessary
Appeals to market fringes	Necessary	*Not Necessary	*Necessary
Simpler, more convenient	Necessary	*Not Necessary	*Necessary
Serves non-consumers	Necessary	*Not Necessary	*Necessary
Gains adoption	Necessary	*Not Necessary	*Necessary
Target low end of market	Not Necessary	Not Necessary	*Necessary
Product innovation	Not Necessary	Not Necessary	*Necessary
Less costly offerings	Not Necessary	Not Necessary	*Necessary
Inferior quality	Not Necessary	Not Necessary	*Necessary
Existence of a disrupted?	Not Necessary	No	Yes
Condition	contains two or more *necessary* attributes	lost the advantage of its key PDI attributes	significantly impacted the responders position

Key:

1. *Necessary*: Should possess the attribute but not compulsorily

2. *Necessary*: May still possess the attribute or it may have evolved

3. *Not Necessary*: Should have lost the attribute relative to responder but not compulsorily

4. *t1 and t2* indicate time at an initial time 1 and a later time 2

Central to understanding the concept of potential disruption and disrupted disruption is the attributes that makes an innovation fall into any of the three categories (see

Table 4). The paper further attempts to contribute to the disruptive innovation discussion by identifying and aggregating the different attributes that makes an innovation disruptive. Based on the attributes identified in prior literature the paper itemized these attributes into a checklist of necessary properties an innovation should have in order to be disruptive. This list was then extended to identify what attributes need to be present (or absent) for an innovation to be considered a potential disruptive innovation, a disrupted disruption or a disruptive innovation as shown in

Table 4 (Baiyere 2014). This is expected to contribute to advancing DI knowledge that can be considered for conducting disruptive innovation studies in information systems. From

Table 4, attributes considered *Necessary* imply that the attribute is a necessary but not sufficient condition for considering if the innovation is a DI, a PDI or a DD. This implies that the attribute is one of the needed properties but if the attribute is missing while others are present, then the innovation may still qualify for a position in its category. The *Necessary* condition is stronger at the early stages (hence time = t_1). The *Not Necessary* property is the opposite of the *Necessary,* which means that the attribute's present is not required for the innovation to qualify for its category.

In contrast, the * before the properties is representative of the change in the property from time t_1 to time t_2. Essetially, the * is a function of the change in the property of the attribute at time t_2. Attributes considered **Not necessary* are attributes that are not essential for determining the positioning of the innovation. This is particularly the case in DD situations where the attribute is considered lost (hence time = t_2). Lastly, attributes considered **Necessary* are attributes that may be present at t_1 but that may have evolved at time t_2. For example an innovation that initially started out as low performance product targeting the low end of the market may have evolved into a high performance product targeting mainstream customers. A more detailed explanation of the table is presented in Baiyere (2014).

Another key output of the research is the four propositions advanced which are positioned to contribute further understanding to the advanced concepts of potential disruptive innovations and disrupted disruptions. These propositions are tagged DIVE and are expressed as follow:

*Proposition **D** (**Direct competition**): If the initial offering of a Potential Disruptive Innovations is not 'directly competing' for the mainstream customers, the chances of ultimately becoming disruptive is higher. (*For example, Google Docs versus Microsoft Word)

*Proposition **I** (**Ignore**): If a potential disruptive innovation is acknowledged 'early and not ignored', the likelihood of it significantly disrupting the market position of the responder can be limited.* (For example, Kodak films versus digital imaging.)

*Proposition **V** (**Velocity of adoption**): The 'velocity of adoption' of a potential disruptive innovation is one of the parameters that can significantly determine if it will eventually develop to be disruptive.* (For example, Wikipedia versus Britannica)

*Proposition **E** (Entrants): New 'entrants' to a market/industry are more likely to disrupt than incumbents.* (For example, Nokia phones versus Apple's Iphone)

These propositions are drawn from prior literature and they are presented to contribute to helping us shape our understanding about disruptive innovations and as a step towards operationalizing the PDI and DD constructs. A means of applying these proposition is presented under the practical implications section of this dissertation.

4.3 Publication 3: *Towards Wickempowerment theory*

Publication three (3) is titled: *"Wicked yet Empowering - When IT Innovations are also Disruptive Innovations."* by Baiyere and Salmela 2015 published in the proceedings of the International Conference of Information Systems (ICIS 2015). The aim of this paper is to explore the significance when disruptive innovations are also IT innovations. This paper also falls under the "IT as DI" stream (see Figure 8).

The research approach adopted for the study is also qualitative and it is one of the papers that reflects the critical realism underpinning the thesis. Archival data examining four selected instances of IT innovations that are also disruptive innovations, was employed for the study. Building on paper two, this paper also briefly analysed potential disruptive IT case examples. These are virtual currency (e.g Bitcoin), 3D printing, ride sharing (e.g Uber), video streaming (e.g Netflix). Data for both the full disruptive innovation cases and the potential cases were collected from available repositories online. These included, media articles, blog articles, government and corporate reports among others. A pictorial representation of the data collection process is presented in the paper (see Baiyere et al. 2015). The paper also applied the theories of wicked problem and empowerment as theoretical lens for guiding the analysis of the data.

The paper contributes to answering research question 1. The contribution of the paper to the research questions comes in the form of a vivid presentation of the role of IT in disruptive innovations when the innovation in focus is also an IT innovation. The paper does this by highlighting the impact of such occurrence particularly from a societal perspective that considers, individuals, organization and the society as a whole. The societal implication of this thesis are unbundled from this paper.
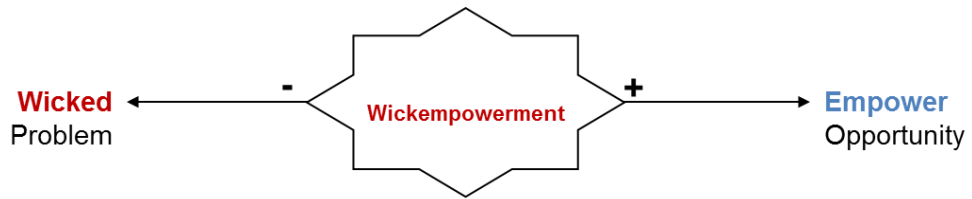
Figure 13. The Wickempower Spectrum

One of the key contribution of this paper is the presentation of the *wickempowerment* proposition as a step towards the possible generation of a theoretical conceptualization. The conceptualization of the impact of IT innovations that are disruptive innovations unfolds from the discovery that innovations satisfying this criteria tend to exhibit a duality of varying degrees and effect on different actors or units within the society. These innovations (called DITI – Disruptive Information Technology Innovations) have the tendency to create empowerment value to some actors while at same time it can unfold itself as a challenging problem characterized by complexity, divergence and uncertainty (See Figure 13). These duality stems from the capacity and typical tendency of IT innovations to be empowering and emancipating in nature while on the other hand disruptive innovation are typically characterized by calamities and challenges. This study helped provide a holistic view of the role of IT in DI specifically in the cases where IT is also the DI. These dual manifestations of the occurrence of a DITI can be represented as a spectrum along a negative to positive continuum as shown in Figure 13.
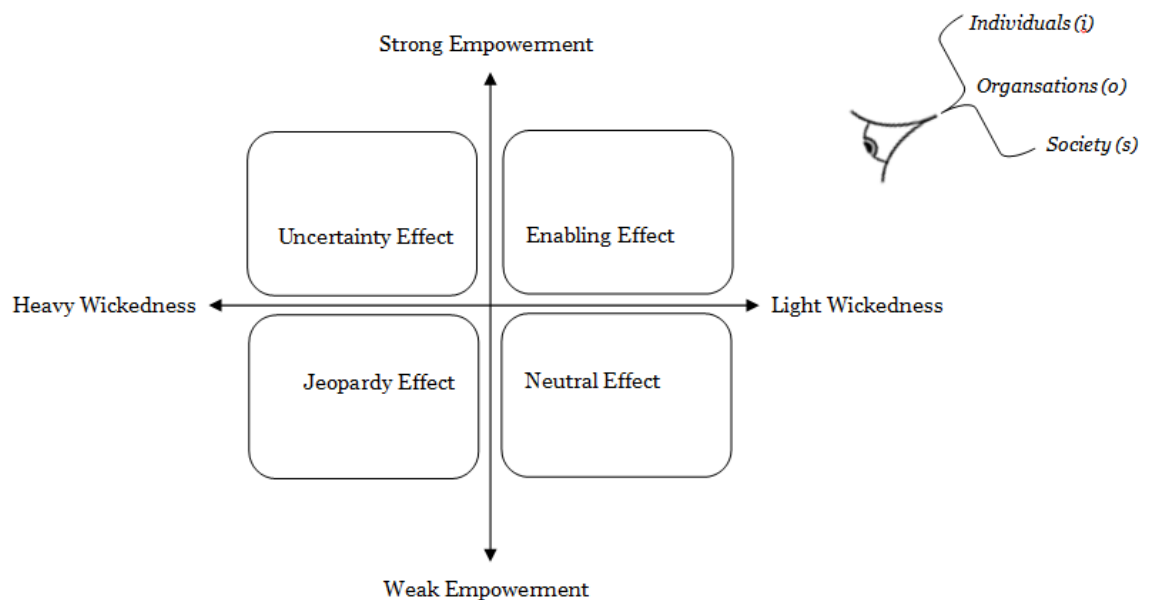
Figure 14. A framework of the possible manifestations of the Wicked and Empowering nature of Disruptive IT Innovation

Besides identifying that disruptive IT innovations can manifest themselves in the duality of wickedness and empowerment as discussed, the paper goes forward

to develop a conceptual framework that can be used as a sense-making device to help position the relative status of such innovations to either individuals, organizations or a community. This framework is presented in Figure 14. The essence of the framework is to help any of the actors position an emerging innovation with disruptive potential in one of the quadrants. Based on the quadrant location where an innovation fits, an individual, organisation or society can assess the relative impact of the potential disruptive innovation.

For instance, an innovation evaluated to be characterized by *strong empowerment* and *light wickedness* would fall into the *Enabling Effect* quadrant. This effectively implies such an innovation should be embraced and fostered. On the other hand, if the innovation is adjudged to be characterized by *weak empowerment* and *heavy wickedness* relative to an actor, it would fall into the *Jeopardy Effect* quadrant. This implies that the innovation is likely to usher in more challenges than benefit to the actor in question. In this quadrant a suggested approach is to attack cum defend against the innovation. Same analysis goes for the *Uncertainty Effect* and the *Neutral Effect*. The framework is presented to help make sense of how an emerging innovation with disruptive potentials can be adjudged on a scale based on the degree of empowerment and challenges that it affords. This is explained in more details in chapter 5 but Baiyere (2015) elaborates on the framework in more details and provides an example using 3D printing as a plausible test scenario.

4.4   Publication 4 & 5: *IS Capability and IS Agility Review*

Articles four (4) and five (5) are presented together in this section. Although the findings in both papers are different, the studies were positioned to achieve a similar aim and produce similar contributions to answering the research questions. Hence, it is considered fitting and practical to present their contributions together.

Article 4 is titled *"IS Agility Research - An Assessment and Future Directions."* by Salmela, Tapanainen, Baiyere, Hallonoro and Galliers 2015 published in the proceedings of the European conference of Information Systems (ECIS 2015). Article 5 is titled *"Towards a Unified View of Information System (IS) Capability."* by Baiyere and Salmela 2014 published in the proceedings of the Pacific Asia Conference of Information Systems (PACIS 2014).

The aim of these papers is to search and identify a theoretical lens from information systems that affords the thesis both the theoretical affinity and practical applicability towards properly understanding and articulating the role of IT for creating/responding to disruptive innovations. Although as discovered from article 1, prior research on disruptive innovation have done little in understanding how IT plays a role in disruptive innovation. Nonetheless disruptive innovation literatures

have made reference to information technology in their discussions. So while there are little targeted studies in this regards, the role and importance of IT has been implied, hypothesized and expressed throughout disruptive innovation literature (Christensen and Raynor 2003, Schmidt et al 2008, Henderson 2006, Christensen and Overdorf 2000, Naults and Vandebosch 2000).

Similarly, some of the theories used in studying disruptive innovations have equivalents in the information systems domain. For example, studies have looked at disruptive innovations from the business model perspective, others have studied it from the resource based and dynamic capabilities view, while some have considered agility as their perspective (Johnson and Christensen 2008, Pattinson and Woodside 2009, Kostof et al. 2004). This shows that there are already viewpoints used in disruptive innovation studies that have a solid base within information systems too. From a review of the nuances and details of disruptive innovation research, plus the creation and response dimensions from which it can be studied, IS capability and IS agility where selected as established research streams in IS that may inform us about the role of IT in disruptive innovations. Thus the motivation for conducting a review of IS capability and IS agility stems from the search for a theoretical lens within IS that can be used to further explore in finer details how IT plays a role either in the creation or response to a disruptive innovation.

These two papers fall under the "IT for DI" stream as indicated in Figure 8. Unlike papers two (2) and three (3) which focused on the role of IT when IT is also the disruptive innovation, papers four (4) and five (5) attempted to provide the foundation for studying how IT could play a role towards creating or responding to disruptive innovation, regardless of whether the innovation is an IT innovation or not. Consequently, the systematic literature review was adopted as the appropriate research approach for both papers. With this premise, these two papers provided a review of IS capability and IS agility with the aim of identifying how the knowledge in the IS domain could help us towards highlighting how they may contribute to situations and studies of disruptive innovations.

Based on this, the two papers collectively contribute to the foundational knowledge required for answering research question one. Although IS capability was eventually chosen as the theoretical lens to focus on in this exploratory study, this does not exclude other viewpoints and theoretical lens from being used to study disruptive innovation. To however indicate that other possible IS theories have been also considered, the IS agility review paper has been included among the selected publications. Besides this, the IS agility paper also demonstrates potential applicability of prior IS research in that area, which could effectively contribute to the disruptive innovation discussion in IS. The eventual choice to adopt the IS capability lens for further exploration in this thesis is particularly because of its suitability in considering both the present abilities as well as being indicative

of the future. This thus makes it fitting to looking at both the creation and response to disruptive innovation.

The key findings from the IS agility review that could contribute to further studies, is the identified classification and typology of IS agility research into modules that can be applied for consideration in both practice and academic research. Four research streams that were identified are

- IT Infrastructure
- IS development
- IS personnel skills and competences
- IS organization design.

Mapping the understanding derived from this IS agility paper with the discussion found in disruptive innovation literatures, shows that the different streams of IS agility research can tell us about -

a) *IT infrastructure:* how to leverage IT infrastructure flexibility in responding quickly to evolving changes and that would support continuous redesign of business and related processes, as is common in a disruptive situation.

b) *IS development:* how to proactively/reactively embrace and create change plus learning while doing so in relation with the demands of the business environment

c) *IS personnel skills and competences:* the importance of maintaining change-agent competencies and mindfulness to respond to surprises among IT professionals.

d) *IS organization design:* how to have a change/disruption-ready IS organisation.

Similarly, the key contributions of article five (5) on IS capability also contributed more or less similar knowledge as the IS agility paper. The core distinction however that differentiates them, lies in the management aspects of IS capability addressed in the literature review while the IS agility review was stronger in highlighting the operational aspects. Additionally, the IS capability has traditionally been more closely associated with the IT competitive advantage research stream than IS agility. Furthermore, the propensity for IS capabilities to look at the responding dimensions as well as the creation dimension was also addressed in the review, hence the IS capability paper provided more background and theoretical resources to proceed with the study. In a similar manner as the IS agility paper, the IS capability paper also advanced four classifications of IS capability. These are:

- IS **M**anagement Capability
- IS **I**nfrastructure Capability

- IS **N**etworking/Sourcing Capability
- IS-Business **D**evelopment Capability

These classifications form the pseudonym MIND Capabilities. These classifications are grounded in prior research. Basically, the paper identified several classifications of IS capability that have been advanced in prior literature. From these classifications, it emerged that most of the prior classifications can be grouped into distinct categories with varying degree of overlaps. The paper therefore contributed MIND as the conceptual output of the synthesis of prior literature on IS capability. The MIND capability construct is presented below as documented in Baiyere and Salmela (2014):

IS Infrastructure Capability: This relates to the technological foundation which determines the extent to which an organization can exploit the benefits of most of its IS investments. Based on the definition of Broadbent, Weill and O'Brien (1996, 1999) The IS infrastructure capability of an organization includes not only its physical and tangible assets but also extends to its human resources and their inherent knowledge. The ability of an organization to exchange knowledge/information, align processes and remain competitive is associated with this component.

Business and IS Development Capability: This component describes the operational IS capabilities for strategic positioning. It has a lot to do with the ability of the organization to orchestrate and govern other IS related systems in relation to the business needs. This is the element of how well the IS activities of the organization fits or aligns with the business objectives. Significant tacit and intangible elements of Information System are embedded under this component.

IS Management Capability: While the Business and IS development capability of an organization addresses the operational capacity of the business, the IS management Capability is indicative of the planning and foresight capacity of the organization. This component determines the capability of the firm to effectively manage and deploy the IS knowledge, IS skills, IS competences, IS personnel and relationships plus partnership within its domain as dictated by the dynamic nature of a business landscape. Summarily, it encompasses the capacity for an organization to assess its IS status and to spot business opportunity from IS to enhance its competitive and performance advantage.

Networking Capability: Today, most organizations operations are intertwined and directly dependent on the relationships with its external environment. The defining capability here is the ability of an organization to acquire value from its business environment. This relates to the degree of agile response an organization can attain via the information and resources that it can harness from outside the fore-walls of its business. It also defines its ability to understand the appropriate outsourcing model that suits its core business operation. The capability of an organization to know how to respond to emerging threats or changes that tests the

agility of the organization is captured by the effectiveness with which it can effectively align its internal IS resources with the wealth of resources in its network.

4.5   Publication 6: *Disrupt-Ability and Disruptability*

The title of paper six (6) included in the thesis is *"Towards discovering the role of IS/IT capabilities in Disruptive Innovations"* which is a manuscript under review. The aim of this paper is to provide a consolidated view for the "IT for DI" stream and hence contribute to answering research question two. The paper is positioned to highlight the possible roles of IT capability. It further attempts to unpack how the knowledge about IT capabilities provides us insights to the potential role of IT for or in situations of disruptive innovations. The paper is presented as a conceptual study that is grounded in accumulated knowledge from prior research about both IT capabilities and disruptive innovations.

The key outputs of this paper includes an articulation of a dual perspective of IT capability that aligns well with the double-edged nature of disruptive innovations. These are: *disrupt-ability* (the ability to disrupt or to create disruptive innovation) and *disruptability* (the ability to be disrupted - or conversely the ability to respond to disruption). This duality conceptualization of IT capabilities comes from the different ways it has been used both as a construct that captures the capacity to act in a current situation plus as a construct that allows the projection of the capacity to act in a future situation. A key distinction between ability and capability is that while ability refers to a proven capacity to perform certain actions, capability identifies with same definition as ability with the addition that capability also refers to a future capacity to do or perform actions that have hitherto not been performed. In other words, ability reflects the present while capability reflects the present + the future (Julita 2016, capability 2016, ability 2016).

With this background, the paper relied on the presentation of IT capability in prior research as a) a springboard that triggers and enables the creation of innovations and b) as a leverage when dealing with threats coming from emerging innovations. Hence, the paper conceptualizes the application of IT capability in disruptive innovations as disrupt-ability and disruptability. With this conceptualization of IT capability within the context of disruptive innovation, the study provides a framing that can be applied when assessing the position of specific IT capabilities in relation to disruptive innovations. The advanced conceptualization helps to ask the right questions of an organisation's IT capability. Depending on if the focus is towards developing an innovation that is disruptive or if the focus is on assessing the preparedness of the IT capability to respond to a disruptive threat, the applicable lens and question can be used to determine its disrupt-ability or disruptability.

Disrupt-ability as defined in the paper is the latency of an organisation's IT capability to enable it to create a potential disruptive innovation. Since, the capacity to come up with innovations in general has been shown to relate to the makeup of the IT capabilities that defines an organization, disrupt-ability is the forward-looking and proactive dimension of IT capabilities.

Disruptability on the other hand refers to the potential of an organisation's IT capability to falter when confronted by disruptive threat. On a converse note, it can also be considered as the capacity for the IT capability to respond to such threats. It is therefore the reactive component of IT capability. It thus can be considered as the function of the extent to which the IT capability can support the response strategy of an organization in the face of a disruptive innovation threat.

Furthermore, the paper also expressly provided a framework which advances how the disruptability and disrupt-ability dimensions of IT capability unfolds in demonstrating the role of IT capabilities in disruptive innovations. This is illustrated in Figure 15.
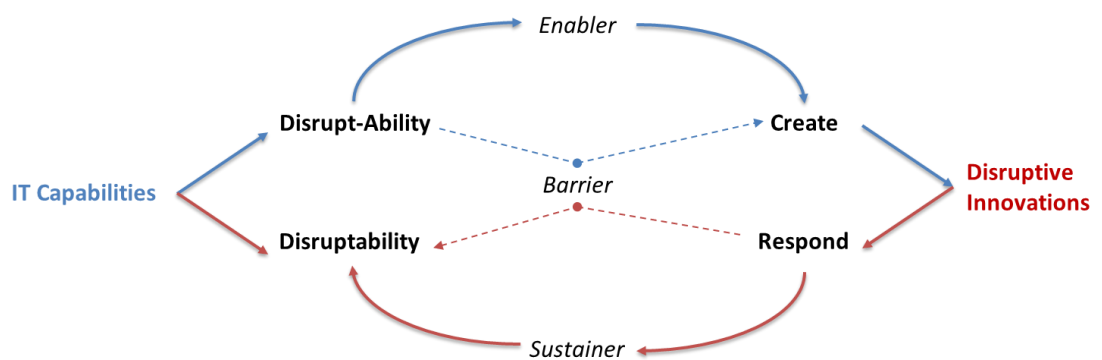
Figure 15. Roles of IT Capability in Disruptive Innovations

From Figure 15, it can be seen that the duality of IT capability dimensions in disruptive innovations can unfold in three roles. These roles are

- IT capability as *an enabler*,
- IT capability as *a sustainer* and
- IT capability as *a barrier.*

These three roles are presented as documented in the paper below:

IT Capability as Enabler: IT capability can unfold to an organization as an *enabler* if it allows the organization to leverage on it in order to create a disruptive innovation. This relates to the disrupt-ability perspective of IT capabilities. A typical example is the case of Apple who leveraged on all its accumulated IT capabilities along with other capabilities to leapfrog from the creation of the macintosh to the creation of the iPod which fed into the creation of the iPhone and subsequently the iPad.

IT Capability as Sustainer: This dimension reflects the role of IT capability as a *sustainer* where it represents one of the required cornerstones for responding, mitigating, and/or surviving the threat of a disruptive innovations. Unlike the enabler dimension, this relates to the disruptability perspective of IT capabilities. An example of a case of an organisations IT capability acting as a sustainer to a threat of a disruptive innovation is the response of Microsoft Office in responding to the disruptive threat of Googledocs. Despite Googledocs generally being acclaimed to have all the attributes of a disruptive innovation relative to MS Office when it was released, Microsoft was able to leverage on its IT capabilities to respond to Google's emerging threat.

IT Capability as a Barrier: This is a dimension that reveals the negatives that can be associated with the role of IT capability in responding to a disruptive innovation threat or in the creation of a disruptive innovation. Consequently, it is a dimension that is present in both disrupt-ability and disruptability perspectives of IT capability (see Figure 15). This typifies a situation where an organization is unable to leverage its IT capabilities to provide an adequate response to a DI threat or to create a DI. In many cases just as the IT capability can be a leverage in surviving it could also be the clog in the wheel that hampers an effective response. This is atypical of cases where the IT capability succumbs to the trap of system embeddedness and rigidity. On a similar vein, IT capability could also lead to stifling of the creation of disruptive innovations if not mindfully positioned.

5 DISCUSSION AND IMPLICATIONS

Eureka!
Archimedes

This chapter concludes the thesis by outlining the contributions of the research to both information systems and innovation management as allowed by interdisciplinary research. The chapter also highlights the answers to the research questions and presents the implications of the study to practice as well as society. As every research is due to have some limitation, the paper also highlights the limitations of the study. Finally, the thesis ends with calls and recommendations for future research in this area.

5.1 Theoretical Contributions

The papers selected for this dissertation have attempted to advance knowledge in minute details in some specific area of enquiry related to the overarching research question. In order to integrate the findings from the papers into a coherent framing, this section will detail the key contributions that form the building blocks for the eventual answers to the research question. Although an integrated view of the key findings gives an indication of the connections between the studies, it is worth noting that each paper provided a fragment of the answer to the research questions on their own. Therefore, in this section, the fragments or building blocks for subsequently deriving a consolidated view of the key findings will be presented in tandem with how they provided answers to the research questions.

The driving questions for this thesis are:

RQ: How could (or does) IT play a role in Disruptive Innovations (if at all)?

*RQ 1: How does IT play a role **as** a disruptive innovation?*

*RQ 2: How could IT play a role **for** the creation or response to disruptive innovations.*

Six articles were embarked on to provide answers and clarity to the questions and to additionally contribute to our knowledge of DI that can be utilised to further DI research in IS. The overarching question for the thesis aims to uncover the role of IT in disruptive innovations (if any). This was then divided into sub-questions

for a more granular enquiry. Hence, to understand the role of IT in disruptive innovations, it was necessary to understand the different dimensions in which IT can be present in a DI situation. To this end, the research question was splitted into the aforementioned sub questions. While the firs sub question (RQ 1) focused on the role of IT in disruptive innovations when IT is the innovation, the second question (RQ 2) focused on the role of IT in the process of creating or responding to a disruptive innovation (regardless of if the innovation is an IT innovation or not).

5.1.1 Research question one and related theoretical contributions

The first situation captured by RQ1 is expressed in a shortened form as "IT as DI". This question responds to calls for IS research to embark on studies that provides us with a nuanced understanding of the nature of digital/IT innovations, particularly their capacity to be an enabling as well as a constraining generative innovation (Yoo 2013). Prior research on digital/IT innovations provides a thorough view on the organizational perspective and the digitality components that characterise such innovations (Lyytinen et al. 2016, Yoo et al 2010, Lyytinen and Rose 2003, Nylen and Holmstrom 2015). This study however, takes its position of enquiry from a societal viewpoint and also contributes to growing calls to examine the societal impacts of IT innovations (Majchrzak et al. 2016). While prior research have presented us with new knowledge on key aspects of IT innovation, no identifiable study has considered the situation where such innovations also embody the properties of a disruptive innovation.

Therefore, to answer this question, the thesis draws from cases of disruptive innovations predominantly within the IT industry to make a macro-level abstraction of the role of IT as DI. Firstly, a theoretical proposition for understanding the situation that unfolds when an IT innovation is also a disruptive innovation has been advanced. The resulting theorization from the foregoing studies about what happens in situations when a DI is also an IT innovation is what has been conceptualized as – *wickempowerment.* Wickempowerment can be considered as the *concurrently opposing manifestation of a disruptive IT innovation's impact on different actors*.

Building on the theories of Empowerment and Wicked problems, the thesis posits that IT plays a role as DI (i.e when the DI is an IT/digital innovation) by introducing an element of empowerment into the defining attributes of the DI for different actors. Hence, the advanced concept of wickempowerment reveals to us the dynamics that IT introduces into the impact of a disruptive innovation on a societal level and its role as a moderator between the challenges and benefits associated with such innovations. With this proposition, we can conceptualize the role of IT

as a moderating factor in the degree of negativity/catastrophe associated to a disruptive innovation by different actors in a societal context. Therefore, it can be expected that an emerging IT innovation with a potential to be disruptive will carry a degree of wickempowerment. In summary, the role of IT in IT as DI situations can be characterized by the duality of impacts that it presents to different actors. This theoretical proposition is presented with the aim that it contributes to our understanding of the dynamics that IT introduces into a disruptive innovation when IT is the core component of the innovation.

Secondly, drawing from examples of disruptive innovation in the IT industry, the thesis further advances the theoretical concept of *Potential Disruptive Innovations* and *Disrupted Disruptions.* The basis for these concepts comes from the "relative" nature of disruptive innovations as clearly implied in the definition of the theory. The DI theory makes it clear that for an innovation to be labelled a disruptive innovation, there needs to be some other organisation/innovation/product etc. that has been disrupted. With this premise, the thesis takes a departure from the notion of "disruptive by design". The thesis claims that even if an innovation ticks all the attributes of a DI but has not disrupted anything, it is at best a "potential disruptive innovation". As a corollary, an innovation may evolve from being a potential disruptive innovation to becoming a "disrupted disruption". This is the case when such an innovation loses its potential to be disruptive.

Further to this, *a list of attributes* that makes an innovation, disruptive (DI), disrupted (DD) and potentially disruptive (PDI) were defined. These insights emerge from studying IT innovations that are also considered disruptive. Therefore, considering the interdisciplinary nature of the study, answering RQ1 has also contributed to knowledge that interconnects information systems and the innovation management domain. This is especially due to the fact that this will be one of the early multidisciplinary studies looking at the relationship and essence of IT in disruptive innovation scenarios.

The relationship between potential disruptive innovation and wickempowerment takes the society as its unit of analysis. Figure 16 shows how the information systems contributions are related to the innovation management contributions of the thesis. The Figure 16 a & b give a skeletal illustration of the relationship between PDI, DD, DI (adapted from Figure 12) and wickempowerment in the presence of IT or digital innovation properties.
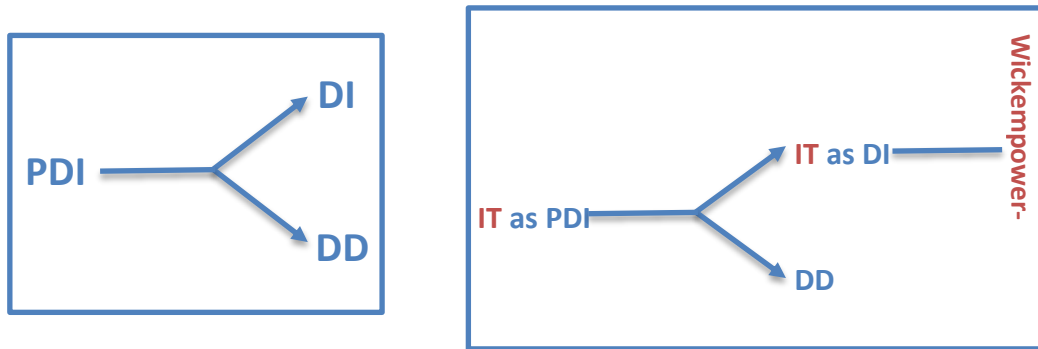
Figure 16a & b. Illustration showing wickempowerment emerging from an IT as PDI

Figure 16b utilizes the two contributions of RQ1 to demonstrates how a potential disruptive innovation that is also an IT innovation (IT as PDI) can evolve into either a disrupted disruption or a full disruptive innovation. Building on the wickempowerment propositions, the figure also illustrates that an IT innovation that ends up becoming a disruptive innovation would embody the properties of wickempowerment.

5.1.2 *Research question two and related theoretical contributions*

The second situation represented by RQ2, considers the role of IT when the dimension of IT in DI under study is the essence of IT for - the creation or response to DI – shortened as "IT for DI". Prior research on IS capabilities and competitive use of IT provides a thorough view on an organisations capacity to leverage its IT to remain competitive and relevant in its business domain (Rai and Tang 2010, Pavloue et al. 2010, Rai et al. 2006, Bhatt et al. 2005). However, there is a need to explicate the value and uniqueness of the contribution of IT in providing competitive advantage in contemporary times (Carr 2003), to this end RQ2 is positioned to provide an examination to the assertion of IT losing its contribution to competitive advantage. Additionally, with the apparent aging of research studies in this area, calls have been made to re-examine the voice of Information Systems scholarship in advancing our understanding of the importance of IT in competitive advantage (Schryen 2013). Furthermore, while prior research have given us some foundation on this topic, rarely has the topic been explored from the perspective of the role of IT in a context of turbulence such as disruptive innovation, hence the value of this current study.

Therefore, to answer question RQ2, the thesis draws from the concept of IT/IS capability as a theoretical lens. Firstly, with this lens, IT capability stands as a proxy for IT in the RQ and as a viable linkage to IT competitive advantage. Hence,

the thesis established that IT, via IT capability, plays a role in the creation and response to DI in two dimensions – *disrupt-ability* and *disruptability.* These two dimensions unfold in three possible roles – IT capability as an enabler of DI (disrupt-ability), IT capability as a sustainer against DI threats (disruptability) and IT capability (or disability in this case) as a barrier to the creation or response to DI (disrupt-ability and disruptability).

The theoretical constructs of disrupt-ability and disruptability were advanced as two key dimensions through which an organisation's IT capability can be weighed with respect to its propensity to enable the creation of a disruptive innovation and/or its propensity to succumb under the pressure of a disruptive innovation threat. With this constructs, the thesis aims to advance our thinking about IT capabilities as a potent component that can enable and trigger the creation of disruptive innovation as well as inform us about the potential vulnerability of an organisation's IT capability to sustain against disruption. In balancing this enabler and sustainer role of IT capabilities, the construct also allows us to examine the possibilities of IT capabilities to stand as a barrier to the effective creation or response to disruptive innovations.

The essence of this finding comes in the understanding that the effectiveness of an organisation's IT capability to deal with a DI situation is captured by the status of their disrupt-ability (for creation purpose) and their disruptability (for response to threats) relative to the DI. This is presented as a contribution to the IS capability literature as well as to the competitive advantage literature. Leveraging on organisational capabilities to be a gainer in a disruptive innovation situation or in surviving the threat of disruption has been identified as a source of competitive value and competitive advantage. Similarly, leveraging on IT capabilities to achieve this can logically be related to the competitive advantage accruable from IT. Additionally, an operationalized measure of disrupt-ability and disruptability for assessing an organizations readiness, would be a valuable practical contribution for organisations.

Secondly, the conceptualization of the different classification of IT capability to *MIND* (IT Management, Infrastructure, Networking/Sourcing and Development capabilities), is presented as a contribution to studies in the IT capability research stream. MIND is an integrated framework that takes into account the different classifications that exists from prior literature and synthesizes them into four measurable categories. The framework is positioned as a step towards providing a unifying view of IT capability that could inform the development of future research that helps us evaluate and assess the status of an organization's IT capability. MIND also lends itself as a theoretical framework that can be operationalized for further examination of the specific mechanism of an organisations IT capability's disrupt-ability as well as disruptability.

The contributions from the IS perspective and the innovation perspective affords us the opportunity to have a consolidated view of how the IT Capabilities (IT Cap) concept of Disrupt-Ability (Dis-A) and Disruptability (Disa) relates to the concept of potential disruptive innovation (PDI) and disrupted disruption (DD) – see Figure 17a. The figure shows a simplified version of the unfolding of IT capability dimensions in a disruptive innovation scenario - adapted from Figure 15. (IT Cap = IT Capabilities, Dis-A = Disrupt-Ability and Disa = Disruptability). Since the PDI emerges as a function of creation, this implies that the Disrupt-Ability function of IT Capability would contribute to the creation of a PDI (See Figure 17b). Similarly, after the PDI has been created, because of the relativity nature of DI, for the PDI to become a true DI, it needs to have disrupted an identifiable organisation/actor. This organisation/actor would be the responder.
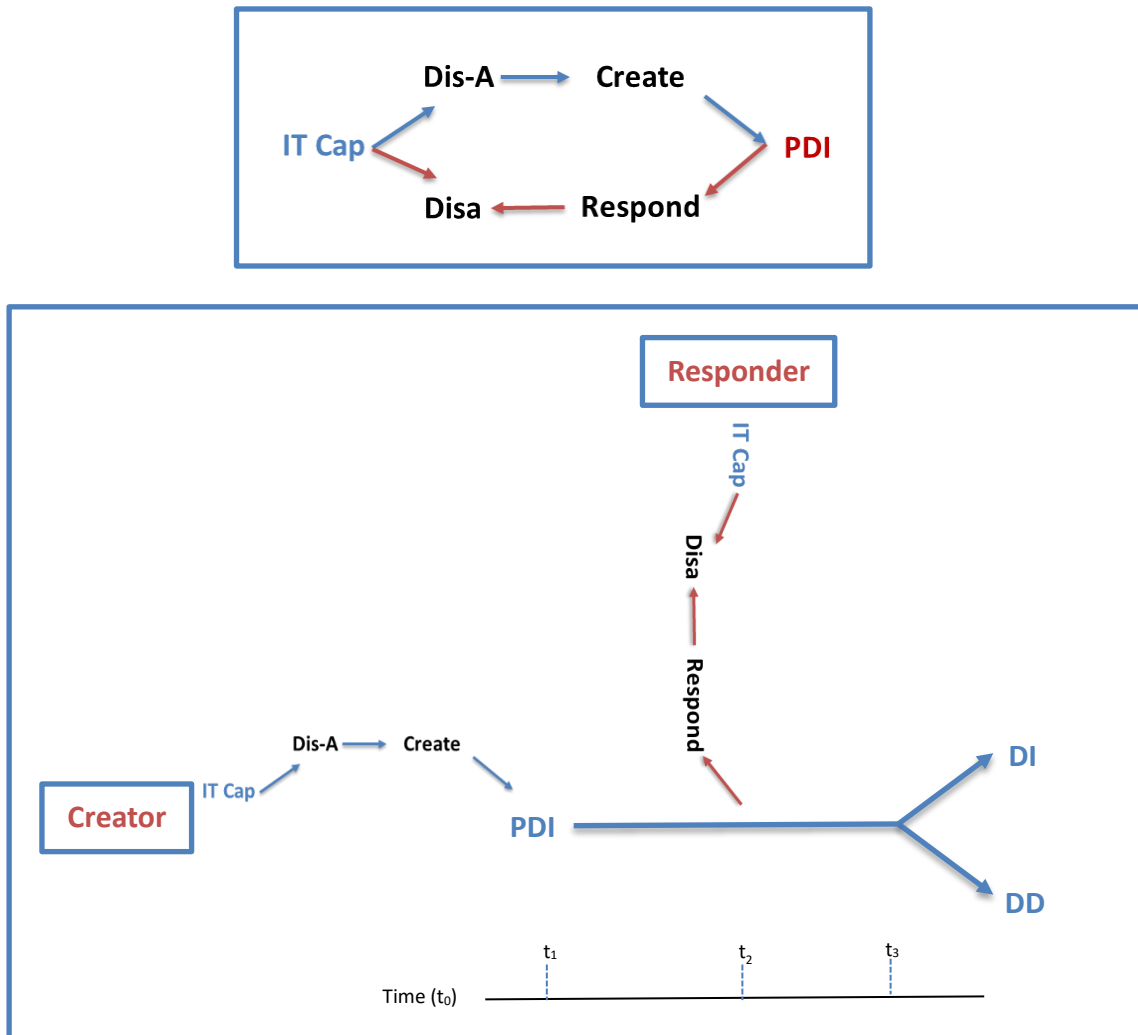
Figure 17a & b. Connecting IT Capability to the Potential Disruptive Innovation Model

The role of the responder is to prevent the PDI from becoming a DI at the responder's expense. Hence, the responder would need to access the disruptability

of its IT capability and adjust accordingly. While the PDI is pushing against the responder, the responder is pushing back with its IT capability. The tussle between the responder and the PDI will be one of the major factors that will determine if the PDI would survive long enough to become a DI or if it will eventually go the path of a DD.

The whole process from the properties of the IT capability that enables the creation of the PDI (time $t_0 - t_1$) to the struggle between the responder and the PDI (time t_2) to the final emergence of the PDI as either a DI or DD (time t_3) can be presented as a function of time (See Figure 17b). It has been acknowledged earlier in the thesis that IT capability is not necessarily the only capability or avenue that enables the creation or that sustains against the threat of a disruptive innovation. The section on practical implications takes this further and presents some other findings beside IT capabilities that can influence the eventual outcome of a PDI.

5.1.3 Contributions to innovation management

With the interdisciplinary nature of the study, the thesis provides some contributions besides information systems that extend to the innovation management field as well. These are also presented with the aim that they can inform future research in information systems about the status and foundational elements of the disruptive innovation literature.

Firstly, the thesis identified an anomaly in the current definition of disruptive innovation. Based on a review of prior literature and recent advances made on the topic, the thesis attempts to address this anomaly and proposed a modified definition that takes this anomalies into due account.

Secondly, a classification of disruptive innovation was also made. This classification was grounded in a review of prior studies and it identified that DI's can be grouped based on the type of innovation (Business Model, Technology or Radical) or based on the market disruption (Low end, New Market and High end disruptions). This is expected to be of use for future research, particularly for IS. As we borrow theories and concepts from other disciplines, this is a step towards avoiding the error of comparing apples to oranges in our analysis of DI.

Thirdly, the thesis advanced four theoretical propositions summarised as DIVE which are expressed in view of identified conditions and the corresponding propensity for a potential disruptive innovation to either emerge as a disruptive innovation or as a disrupted disruption. The propositions taken together, presents a lens through which organisations facing the threat of an emerging disruptive innovation can weigh the innovation relative to their organisations positioning.

5.2 Practical Implications

The practical implication of the study builds on the DIVE propositions to develop a model that organizations can use to navigate the threats of a disruptive innovations. At same time, the model also provides suggestions for navigation for organisations that have created a potential disruptive innovation (see Figure 18).
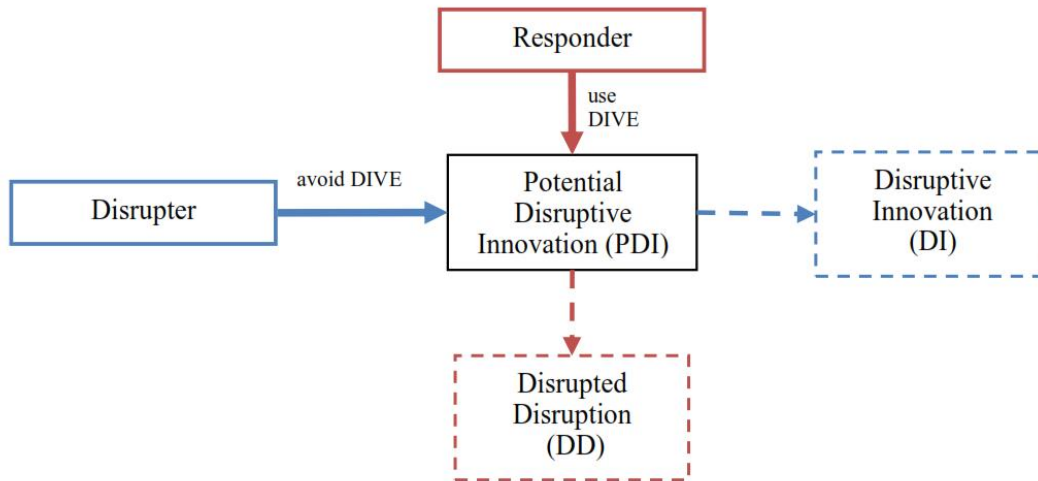
Figure 18. The DIVE model

The model is built on the foundational premise that an innovation may be disruptive by design but for it to transit from a PDI to a DI it has to pass through the response actions of the Responder. Therefore as illustrated in the model, for a Disrupter to avoid its innovation from being pushed into the DD zone, the Disrupter needs to consciously try to avoid the trap of each DIVE component/proposition (Baiyere 2014).

Conversely, by applying the same DIVE principles but in the opposite direction, the model can also be used to present the Responder some set of underlying actions to guide it to better make decisions that can potentially push the PDI to the DD zone.

5.3 Societal Implications

With the increasing call to consider the societal impact of IT in IS research (Majchrzak and Markus 2012, Majchrzak et al. 2016, Markus and Mintzer 2014, Mingers and Walsham 2010), the thesis draws from the findings of paper three (towards wickempowerment theory) to highlight the societal implications of the study. It has been discussed earlier that when an IT Innovation is also a disruptive innovation (DITI), the innovation unfolds its impact as both a wicked problem for

some and an empowerment opportunity for others. Figure 19 shows the different effects that this can have depending on the quadrant the innovation is relative to an actor. The figure also shows the corresponding suggested actions for each quadrant, illustrated by the arrows.
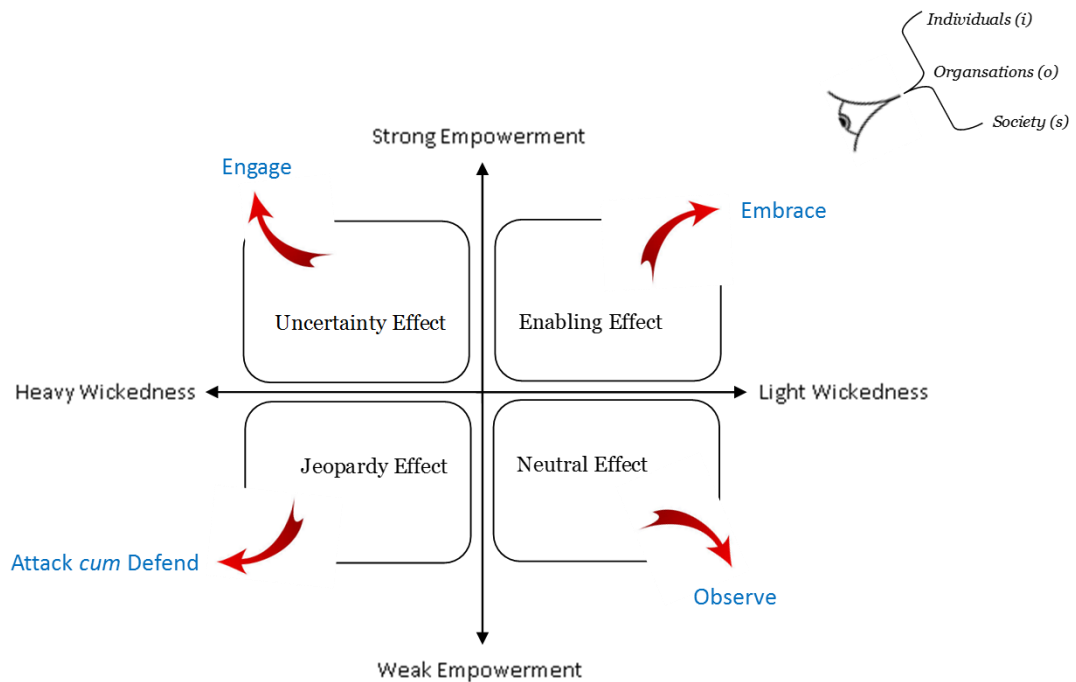
Figure 19. The societal implication of Disruptive IT Innovations

From Figure 19, depending on how strong or weak the degree of Empowerment versus how light or heavy the Wicked dimension of an innovation is, it can be positioned in a quadrant to evaluate its potential impact for specific actors. For innovations that present strong empowerment opportunities and light Wickedness, the actor in that quadrant can be said to have an impact that generates an *Enabling Effect* which is a state of being in an Empowered position. A practical suggestion for this quadrant is to "Embrace" the innovation. For DITI innovations that pose a heavy degree of wickedness with little or no opportunity for empowerment to certain actors, they will be putting such actor in a precarious situation hence the *Jeopardy effect* which is illustrative of a catastrophic/disruptive quadrant. The recommendation for this quadrant is to proactively "attack" and/or setup a "defense" against the innovation.

Innovations that offer little threat in terms of the degree of wickedness and little or no empowering benefits can be zoned to have an impact of a *neutral effect* where the sum of the impact more or less keeps the actor in its status quo as it does not introduce much change, if any. In this quadrant a course of action could be to continuously "observe" the innovation over time. On the opposite axis however, an innovation that presents a heavy degree of wickedness as well as a strong degree of empowerment can be classified as a high risk-high reward quadrant which puts the actor in an *Uncertainty effect* quadrant. This is a quadrant where observing is

not enough and attacking or defending may result in lowing the positive empowerment that it brings. Hence, the recommendation is to "engage" with the innovation by mitigating the disruption while accentuating the benefits.

It should be noted that the position of an innovation is relative and dependent on each specific actor. Same innovation can be positioned in different quadrants depending on who is doing the evaluation as represented by the eye in Figure 19 (See Baiyere and Salmela 2015 and Baiyere 2015a).

5.4   Research Limitations

The thesis is not without limitations. Firstly, the thesis relies much on conceptual synthesis of prior literatures for generating its theoretical insights. Typically, conceptual studies are considered to be liable to the bias of the researcher. An attempt to prevent accentuating this has been to develop most of the conceptual thinking in collaboration with other researchers and co-authors.

Secondly, exploratory studies are fraught with the limitation that they often present one approach from one journey, however previous scholarships have shown us that there can be numerous other ways to arrive at same destination. Hence, this work is open to be tested, falsified, extended, criticized, and adapted by further scholarly enquiries using different conceptual and empirical approaches.

Thirdly, navigating a research terrain that has little or no prior studies presents the challenge of breadth versus depth. This study has opted for an exploratory breadth which limits the depth in certain areas. Scoping the research this way, comes with the sacrifice that while many grounds is covered, it comes at the expense of achieving greater depth. The implication of this is some of the original frameworks and concepts developed remain largely open for further critical analysis. Despite the depth shortcoming, the choice for breadth provides an opportunity for multiple research directions and sets a stage for future scholarships.

6 CONCLUSION AND CALLS FOR FUTURE STUDIES

This is the final destination of this train.
Boston Train Announcement

Emerging Innovations in IT have left some industries dazed mostly because the industries hardly considered the innovation to be a threat to their business. However such innovations have enabled unseeming competitors to emerge and challenge whole industries. One of the central dilemma of DI for the executives of established incumbents is: how not to lose opportunities due to *hesitation* and simultaneously how to avoid being the fool who *rushes* in. (Pattinson and Woodside 2009). This study has investigated the role of IT in disruptive innovations. The study posits that IT can play a role both as a DI itself or in the process of creating or responding to a DI. As a DI, IT plays an important role in defining how the DI unveils its impact on different actors. In a societal context, the role of IT in IT as DI situations holds importance for those affected by it. While it can catapult some actors to a status of glory, it can be devastating for other actors. In this scenario, IT as DI can be considered a double-edged sword. This occurrence has been conceptualized as *wickempowerment.*

Furthermore, the study explored the role of IT in the creation or response to DI – a strand that is termed IT for DI. In this aspect of the study, the key finding of the thesis outlines two key dimensions through which IT capability can reflect its role in a DI situation. These are conceptualized as *disrupt-ability and disrutpability.* These two dimensions can then be traced to identify how IT capability is an enabler, a sustainer and even a barrier in DI scenarios.

Additionally, the thesis contributes to the discussion about the essence of IT capabilities in the context of the competitive value of IT. It may be argued that Apple leveraged its IT capabilities and knowledge to come up with the iTunes which galvanized into the so called app economy that is said to be worth billions of dollars. The app store concept that evolved from this is also credited with being one of the key movers for the Apple's most profitable creation - the iPhone. Without the generative value and ecosystem enabled by the iTunes app store, the iPhone would arguably have just been another phone. With this position, Apple emerged not only as the most valuable mobile phone manufacturer but it emerged as the world's most valuable company. This is an example that demonstrates that a com-

pany can attain competitive advantage by successfully leveraging its IT capabilities. It therefore may be too early to dismiss the value of looking to an organisations IT arsenal for competitive advantage.

Consequently, this thesis posits that IT should not be considered as an afterthought in an organisations strategy formation. Rather, IT should be considered as a potential driver and trigger for attaining competitive advantage. The potential for IT to change the way a business competes, should not be underestimated. It should be however noted that IT in itself is not what makes the difference but how IT is deployed in consonance with other organisational assets - hence the importance of IT capability. Organisations need to unleash the unique potentials of their IT capability in an innovative manner that inimitably distinguishes them from other companies. These could be as a component of the product, the edge in the prodcut development, or the advantage in the business process among others.

Although, this study has attempted to look at the inter-relationship between IT and DI, there are still different angles for further studies in this area. For example, what are the unique properties of a disruptive IT innovation or digital disruption? Also the harder problems of why specific innovations might become disruptive and others not (leveraging the knowledge from PDI and DD) remains largely open. In relation to IT, are the conditions the same or different for a class of IT innovations? *This thesis makes a call for the analysis of unique features of digital material and their potentially disruptive nature (such as changing the speed, cost, scale, value source or value effects of firm's operations), their mechanisms of disruption and the distinction between digital disruption and other types of disruption.* Considering the dearth of studies looking at these areas among many others, it may be considered a greenfield of enquiry and a blue ocean research avenue. There are different perspectives and theoretical lenses that can be used for studies in this area. The models and frameworks presented in this study are open to be tested, extended, criticised, built on and empirically validated by future scholarship.

Furthermore, there exist alternative theories that this work could leverage or to which it could contribute. For instance, innovation theory (including theories of innovation generation, diffusion and their relationships), theories of entrepreneurship (moving from discovery to invention and opportunity capture) or micro-level theories such as theories of cognition (creativity and mental models) or institutionalization (inertia, resistance), or theories that deal with innovation effects and related change (e.g. stakeholder theory). While these are valid perspectives that can valuable enrich the insights and contribution of this thesis, a conscious choice had to be made to focus on the selected theoretical backgrounds used in this study. It is however worth noting and acknowledging these other theories and stream of

research as opportunities for other theoretical lenses that can be adopted for future studies on this topic.

Additionally, the wickempowerment theory advanced in this thesis presents a foundation for studies that have theoretical value as well as broad societal and organizational implications. Currently the quadrants of the wickempowerment framework show us how a stakeholder can position itself in one of the quadrants relative to an emerging innovation and thereby identify the potential effect. However, the effects and their implications need to be developed further, particularly in terms of actionable tactics. It would also be a valuable contribution to know how one can move from one quadrant to the other. For instance, if a stakeholder finds itself facing the prospect of *neutral effect*, how can attempt to transition to the *enabling effect* quadrant?

Besides, the shortcomings of this research that can be plugged by future studies there are also other areas of enquiries from which this phenomena can be explored. For example, In IT/IS research, a number of studies have been carried out to understand the interaction of technology innovation and the market. An example of one such study includes the technology acceptance model (Venkatesh, Morris, Davis and Davis 2003; Venkatesh 2000) which extends to the acceptance of technological innovations. How can we draw from the wealth of knowledge gathered in the IS circle to inform organisation on how to deal with DIs? The DIVE model provided in this dissertation could be a starting point for this. The DIVE model is thus presented to be further justified empirically and to be extended with stronger theoretical reasoning.

For the disrupted firm, adjusting to disruptive business model could require making existing competencies and functional processes redundant while simultaneously rendering long acquired operational knowledge obsolete (Christensen and Raynor 2003; Henderson 2006). These are changes (or cannibalization) that are challenging for organizations (Govindarajan et al. 2011; Chandy and Tellis 1998) which managers rationally tend to be reluctant to undertake – hence the dilemma. From an IT researcher perspective, how can an organization keep its IT capabilities disruptability measure low while keeping its disrupt-ability high?

The consequences of facing the threat of a DI are significant if not catastrophic for some organisations. This thesis has extended the disruptive innovation discussion from solely the company view to include a societal perspective. How can we utilise our knowledge of the wickempowerment construct to avoid the pains while accruing the gains of disruption? This thesis has attempted to provide foundational answers to some of the fundamental questions about IT and DI, and also extend our knowledge on some of the associated issues, I however submit that there are still a lot of open questions begging for answers. Within these questions, *I see opportunities.*

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APPENDIX

Appendix 1: Interview Form
Appendix 2: Interviewee Distribution
Appendix 3: Comprehensive List of Reviewed IT Capabilities Papers
Appendix 4: Research Contribution Summary

Appendix 1: Interview Form

Interview Form

Discovering the role of Information System in Disruptive Innovations:
an Enabler, a Sustainer or a Barrier

Within this research we are investigating the role of Information Systems in Disruptive Innovation scenarios. Specifically, we are exploring this concept in the context of IS capability. We subsequently aim at inferring the conditions and factors under which an organisations' IS can be – *an enabler, a sustainer or even a barrier* to its ability to create or respond to disruptive innovations. In order to accomplish this goal we are interviewing Innovation/R&D managers and IT managers of selected companies.

With this interview we would like to learn about your company's perspective and your professional opinion on these concepts. Particularly the use and process flow of information related activities in your activities. We are also interested in your thoughts and insights on past and evolving trends in this area.

It is not expected that you will reveal any confidential information such that it harms your business. Despite this, the interview material is treated as confidential. Your valuable inputs will be used to test the research hypothesis and will form the backdrop to deliver an academic dissertation & subsequent journal publications.

The result of the work is expected to provide important insight and feedback particularly for the companies involved.

Sincerely,

Abayomi Baiyere   Prof. Hannu Salmela
PhD. Researcher   *Academic Supervisor*

(Enclosed: Tentative Interview Questions)

[4]SECTION 1:   GENERAL BACKGROUND

Please tell us about your connection to IT and/or Innovation
- Please give a quick background on how your experience is connected to 1 innovation or 2. Info tech
- How would you describe the structure of your IT & Innovation Department? (and the relationship)
- Do you take part in making recommendations or decision about innovations/IT within your organization?
- What will make you consider something to be an innovation?

SECTION 2:   ROLE OF IT FROM INNOVATION PERSPECTIVE

IT as information tool

- How would you describe the role of information in Innovation?
- What would you say are the primary information channels used in XYZ innovation departments?
- How would you rate these drivers for your IT strategy: 1) New IT Innovations 2) Market pressure 3) Internal pressure

IT as decision support
- What role does IT play in decision making process about innovations?
- How does IT help in deciding to follow an innovation idea?

IT as innovation advantage

- Have you had to make changes to your IT setup due to the recent market situation?
- How would you position your organisation in terms of its adoption of new tech? (Cloud, BYOD, WFH, BigData, Mobile, Social Media ...)
- What order prevails mostly in XYZ, IT suggests a new tech or the business discovers a new tech and passes it to the IT?
- What are the training challenges for this new adoptions for both IT and business staff?
- How do you maintain stability/ (harness the advantages) based on this changes?

IT as environment scanning tool and business intelligence
- How do you leverage your IT to acquire intelligence from the market?
- In what ways do you use IT to signal what is going on in the environment? (e.g acquisitions, disruptive startups, changing trends…)

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[4] It should be noted that the interview questions have not been fully explored in the selected articles for the dissertation, particularly from the dominant IT capability perspective reflected in the questions. They nonetheless provided valuable insight for the development of the IT as DI perspective of the thesis

IT as an enabler

- In what ways would you say your IT enhances the creativity of your innovations?
- How would you deal with a new tech that despite its advantages means a lot of changes to your existing system? Or even risking the stability of your existing IT structure? (e.g Cloud Computing)
- What takes priority in your IT decisions – system stability or exploitation of new tech?
- Considering the nature of your organisation what process will such a revolutionizing new tech idea go through before approval?
- What role does IT play in making market forecasts? How reliable are these forecasts?
- How do you think IT plays or could play a role in eventual market adoption?
- Generally, how would you describe the value provided by IT to your organisations innovation process and final products?
- What do you understand by the concept of disruptive innovations?
- Do you see your organization coming up with a disruptive innovation? What contribution do you see your IT playing in this? (Enabler + Barrier possibilities)

IT as a responder

- If there is a need to quickly change the focus of XYZ's business which requires process change and changes in IT setup, how would you evaluate the possibility that your IT system maybe a barrier to such swift changes?
- Would you consider your IT systems to be simple, easy to use? How about the configuration, setup and customization?
- What standard procedures do you follow before making changes to existing systems? Or are business requests carried out as they come?
- Would you evaluate the impact of a business request on the enterprise systems before approving such changes? (How thorough is this?)
- Are there exceptions due to the urgency of a request? (under what circumstances? please give an example)
- Which is a more common approach to resolving business requests – buy or build in house?
- How do you deal with technologies that make some expertise redundant? (e.g Business Intelligence software taking the place of data/market analyst?)
- How do you operate mostly – Business makes strategy and pass needs to IT or IT team is part of the business strategy meeting? (How about Innovation Strategy)
- How are requests handled? Carry out business requests as is or give expert opinion on better alternatives?
- In what situations would you consider a request to be a misfit or a case where providing the request is not considered appropriate by IT?

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- If you need to respond to a DI how swiftly do you think it will be for your current IT to facilitate required changes?
- Would it be right to assume you also follow trends and what is happening around your industry? How then do you think XYZ would identify if there is a potential disruptive threat?
- How would your IT/IS help in detecting, evaluating, learning, monitoring potential DIs? (Enabler + Barrier possibilities: e.g Blind Analytics) *Remind about definition of IT/IS*
- Were IT professionals/managers able to participate and contribute in identifying and evaluating potential DI threats – how?
- Did you modify your information systems to be able to better monitor DI and it's impact on markets? Why – why not?
- How did your existing IT systems support you in designing a response to an identified DI threat?

SECTION 3:   IS CAPABILITY
IS Infrastructure Capability
- How do you measure return in IT investment (or contribution of an IT project on research output)
- How are IT staffs involved in business/research operations? (training, brainstorming, designing biz processes)
- How does IT help to preserve tacit knowledge in the org?
- How does IT help in acquiring new knowledge and skills?

IS Management Capability
- How are your best IT practices preserved?
- How do you use IT in deciding on acquisitions/Spinoffs?
- Which influences your IT strategy most:
  a) taking advantage of new IT innovations OR b) business strategy

  [Example: IT sees that Cloud allows cost savings and increases organisation agility, while Business strategy is to maintain stability - if not broken don't fix it, right? Which of these two important yet opposing strategies would IT likely pursue?]

- Give a scenario of how IT helped your organisation in adapting to an organisational change. (e.g introduction of new tech, the financial crisis, business process change, organisation reshuffle, layoffs…)

Business and IS Development Capability
- To what extent does your branch's IT setup reflect the global organisation?
- What process methodologies guide your operations (ITIL, 6 Sigma, Lean ...
  scrum, (Prince2) and/or others?
- How is knowledge management carried out? (storing it, accessing it and its effectiveness)

IS Networking Capability
- In what ways is IT used in collaborating with external partners?
- How easily can you access IT resources outside your organization?
- How does your organisation leverage on outsourcing for its IT operations?
- How does IT support any other form of outsourcing going on in the organisation?
- How do you use IT in building communities/markets/ecosystems around your products? When do you involve IT mostly – product ideation or product diffusion (give examples please)

IT in DI Insights
- With your knowledge and experience how would you recommend organisations structure their IT to 1) Leverage disruptions? 2) Respond to disruptions
- Please evaluate the general IS capabilities of your organization + their overall significance:
    - IS management cap.
    - IS development cap.
    - IS networking cap.
    - IS infrastructure cap.

SECTION 4   ROLE OF IT FROM BUSINESS PERSPECTIVE
- If you were to change your business model today, in what ways can your IT infrastructure be leveraged?
- If there is a sudden need to cut cost how readily would the business be to cut from its IT department?
- If there occurs a need to quickly change the business process of the organisation that would require a completely new IT setup, how easy and comfortable will this be? (In light of replacing existing IT competencies, introducing unfamiliar systems, cutting through bureaucracy ….)
- As a follow up would you anticipate personnel opposition? Technology misfit? (e.g legacy systems, protocol mismatch and ..)

SECTION 5   TRENDS AND DI SCENARIO

Please give your opinion on a test scenario.

Appendix 2: Interviewee Distribution

Interviewee Distribution by profession

Table 5: Distribution of interviewees by profession

	Interviewee Category	Number of Interviewees
1	Innovation/Research Managers	13
2	IT Managers	6
	Total	19

Interviewee Distribution by business sector

Table 6: Distribution of interviewees by business sector

Industry	Number of respondents
IT Sector	
Computers	2
Processors	1
Telecommunications	1
Mobile Devices	1
ERP	1
IT Consultancy & Services	6
Non IT sectors	
Oil & Gas	1
Automobile service	1
Innovation, Designs & Products	3
Banking and Finance	2
Total	**19**

Additional Interviews

Six (6) additional interviews not included in the published paper were conducted for the dissertation. This brings the total number of interviews conducted for the whole study to twenty five (25).

Appendix 3: Comprehensive List of Reviewed IT Capabilities Papers

Table 7: Comprehensive List of Reviewed Literatures

Code	Author	Article	Journal	Year	Research focus
L1	Andreu and Ciborra	Organisational learning and core capabilities development: the role of IT	Journal of Strategic Information Systems	1996	The RBVF framework is summarized, including the concepts of capabilities and core capabilities and the organizational processes that lead to them. Next, an organizational learning model is presented: an interpretation of capability development that emphasizes situated learning and knowledge accumulation. The model is then used to show how IT can contribute to core capability formation in a firm.
L2	Bharadwaj	A Resource-Based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation	MIS Quarterly	2000	This paper develops the concept of IT as an organizational capability and empirically examines the association between IT capability and firm performance.
L3	Bharadwaj, Sambamurthy and Zmud	IT Capabilities: Theoretical Perspectives and Empirical Operationalization	International conference on Information Systems	1999	Drawing from theoretical perspectives and a systematic multi-stage research framework based on Delphi panels and focus groups, they conceptualize an enterprise-wide IT capability as a second order factor model.
L4	Bhatt and Grover	Types of Information Technology Capabilities and Their Role in Competitive Advantage: An Empirical Study	Journal of Management Information Systems	2005	Specifically, it is argued that by demarcating specific types of capabilities, they contribute to better understanding of the sources of IT-based competitive advantage. Conceptually, they distinguished between value, competitive, and dynamic capabilities as three distinct types of capabilities.
L5	Caldeira & Ward	Understanding the successful adoption and use of IS/IT in SMEs: an explanation from Portuguese manufacturing industries	Info Systems J (2002)	2002	to identify factors enabling or inhibiting the adoption and use of information systems and technology (IS/IT) in Portuguese manufacturing small and medium-sized enterprises (SMEs) and understand how these factors interrelate in determining relative success in the adoption and use of IS/IT.
L6	Caldeira and Dhillon	Are we really competent? Assessing organizational ability in delivering IT benefits	Business Process Management Journal	2010	to present organizational competencies for gaining information technology (IT) benefits within organizations.
L7	Clark, Cavanaugh, Brown and Sambamurthy	Building Change-Readiness Capabilities in the IS Organization: Insights from the Bell Atlantic Experience	MIS Quarterly,	1997	This paper examines two important questions: What are the design elements of a change-ready IS organization? How can transformations to such designs be effectively managed?

Code	Author	Article	Journal	Year	Research focus
L8	Cragg, Caldeira and Ward	Organizational information systems competences in small and medium-sized enterprises	Information & Management	2011	using RBT and evidence from empirical studies the paper evolve a framework of IS competences in small and medium-sized enterprises (SMEs). The framework creates a comprehensive set of IS competences that can be used inboth SME practice and research.
L9	Doherty and Terry	The role of IS capabilities in delivering sustainable improvements to competitive positioning	Journal of Strategic Information Systems	2009	this paper explores how the effective deployment of IS capabilities might deliver sustainable improvements to an organization's competitive positioning.In so doing, this research makes a significant departure from the enterprise-level orientation of prior studies, by focusing upon the role of IS capabilities in leveraging sustainable improvements to competitive positioning from individual IS initiatives
L10	Feeny and Willocks	Core IS capabilities for exploiting information technology	Sloan Management Review	1998	Core IS Capabilities for Exploiting Information Technology
L11	Feeny, Willocks and Olson	Implementing Core IS Capabilities - Feeny–Willcocks IT Governance and Management Framework Revisited	European Management Journal	2006	This paper revisits the framework of Feeny and Willcocks (1998), examining the challenges and learning points from its implementation in three Organizations from 2000 to 2005.
L12	Fink and Neumann	Gaining Agility through IT Personnel Capabilities: The Mediating Role of IT Infrastructure Capabilities	Journal of the association for Information systems	2007	This study advances understanding of the interrelationships between two major subsets of IT capabilities, and their relationships with the agility afforded by IT.
L13	Gu and Jong	The Effects of IS Resources, Capabilities, and Qualities on Organizational Performance: An Integrated Approach	Information & Management	2010	The current study reviews the effects of these theories in terms of IS resources, capabilities and qualities, and further proposes an integrated approach for examining organizational performance.
L14	Johnston and Carrico	Developing Capabilities to Use Information Strategically	MIS Quarterly	1998	Findings indicate that competitive advantage depends on the interaction between industry conditions and internal capability to identify and exploit opportunities. Internal capabilities and conditions and the processes that created these capabilities are defined and described
L15	Khani, Nor, Hakimpoor, Bahrami and Salavati	IS/IT Capability And Strategic Information System Planning (Sisp) Success	International Journal of Managing Information Technology	2011	This paper provides a model for IT capability and strategic information system planning success, by considering environmental and organizational factors that may influence this relationship in a contingency model. A review of existing IT capability and SISP literature is given to identify the opportunities in building successful SISP.
L16	Li, Chen and Huang	A framework for investigating the impact of IT capability and organisational capability on firm performance in the late industrialising context	Int. J. Technology Management,	2006	proposes an integrated framework that provides the latecomer firms with a roadmap to build up their capabilities and improve their performance. The purpose is to advancean understanding of the relationship among IT capability, organisational capability, and firm performance.

Code	Author	Article	Journal	Year	Research focus
L17	Liang, You and Liu	A resource-based perspective on information technology and firm performance: a meta analysis	Industrial Management & Data Systems	2010	to aggregate previous research that adopts the resource-based view (RBV) to examine whether information technology (IT) and organizational resources have significant effect on firm performance.
L18	Lin B.	Information technology capability and value creation: Evidence from the US banking industry	Technology in Society	2007	This paper investigates whether the firm Information technology (IT) capability of a firm can create economic value and competitive advantage. In contrast to past research, which generally assumed that IT investment leads to IT capability that in turn leads to competitive advantage, this study examines IT capability directly.
L19	Liu, Ke, Wei, and Hua	The impact of IT capabilities on firm performance: The mediating roles of absorptive capacity and supply chain agility	Decision Support Systems	2012	this article proposes a model to examine how IT capabilities (i.e., flexible IT infrastructure and IT assimilation) affect firm performance through absorptive capacity and supply chain agility in the supply chain context.
L20	Lu and Ramamurthy	Understanding the link Between Information Technology Capability And Organizational Agility: An Empirical Examination	MIS Quarterly	2011	propose and theorize this frequently observed but understudied IT–agility contradiction by which IT may enable or impede agility. They develop the premise that organizations need to develop superior firm-wide IT capability to successfully manage their IT resources to realize agility.
L21	McLaren, Head, Yuan and Chan	A Multilevel Model For Measuring Fit Between A Firm's Competitive Strategies And Information Systems Capabilities	MIS Quarterly	2011	addresses the need for a more fine-grained approach for assessing the specific areas of misfit between a firm's competitive strategies and IS capabilities
L22	Melville, Kraemer and Gurbaxani	Review: Information Technology and Organizational Performance: An Integrative Model of IT Business Value	MIS Quarterly	2004	A principal finding is that IT is valuable, but the extent and dimensions are dependent upon internal and external factors, including complementary organizational resources of the firm and its trading partners, as well as the competitive and macro environment.
L23	Merali , Papadopoulos and Tanvee	Information systems strategy: Past, present, future?	Journal of Strategic Information Systems	2012	The future and identity of SIS.
L24	Mithas, Ramasubbu and Sambamurthy	How Information Management Capability Influences Firm Performance	MIS Quarterly	2011	This study develops a conceptual model linking IT-enabled information management capability with three important organizational capabilities (customer management capability, process management capability, and performance management capability).

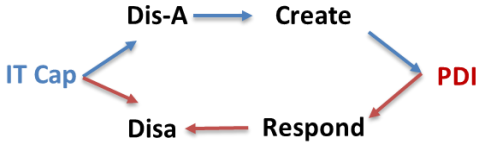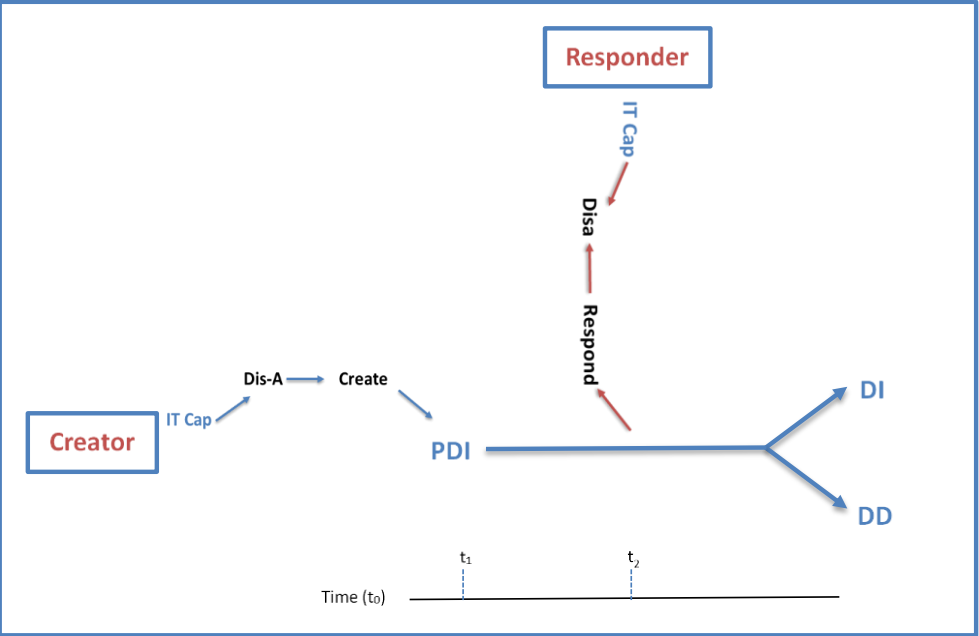| Code	Author	Article	Journal	Year	Research focus
L25	Nevo and Wade	The Formation And Value Of IT-Enabled Resources: Antecedents And Consequences Of Synergistic Relationships	MIS Quarterly	2010	This paper synthesizes systems theory and the resource-based view of the firm to build a unified conceptual model linking IT assets with firm-level benefits.
L26	Overby, Bharadwaj and Sambamurthy	Enterprise agility and the enabling role of information technology	European Journal of Information Systems	2006	define and deconstruct enterprise agility, delineate enterprise agility from similar concepts in the business research literature, explore the underlying capabilities that support enterprise agility, explicate the enabling role of information technology (IT) and digital options, and propose a method for measuring enterprise agility.
L27	Paul Cragg	Identifying key Information Systems competencies in small firms	Total Quality Management & Business Excellence	2008	Rather than examine all types of organisational capability, this paper focuses on Information Systems (IS) competencies, which can be viewed as a pre-requisite for building some organisational capabilities.
L28	Pavlou and El Sawy	From IT Leveraging Competence to Competitive Advantage in Turbulent Environments: The Case of New Product Development	Information Systems Research	2006	this study focuses on the business process level of analysis and introduces the construct of IT leveraging competence—the ability to effectively use IT functionalities. IT leveraging competence is shown to indirectly influence competitive advantage in NPD through two key mediating links: functional competencies (the ability to effectively execute operational NPD processes) and dynamic capabilities (the ability to reconfigure functional competencies to address turbulent environments). Environmental turbulence is also shown to moderate the process by which IT leveraging competence influences competitive advantage in NPD.
L29	Pavlou and El Sawy	The "Third Hand": IT-Enabled Competitive Advantage in Turbulence Through Improvisational Capabilities	Information Systems Research	2010	the paper develops the notion of improvisational capabilities and articulates the key differences between the two "reconfiguration"—improvisational and dynamic—capabilities. Second, the paper compares the relative effects of improvisational and dynamic capabilities in the context of new product development in different levels of environmental turbulence. Third, the paper shows how IT-leveraging capability in new product development is decomposed into its three digital IT systems.
L30	Peppard and Ward	Beyond strategic information systems: towards an IS capability	Journal of Strategic Information Systems	2004	Drawing on resource-based theory, this paper proposes a perspective on the management of IT in organizations that specifically considers how organizations can continuously derive and leverage value through IT. The analysis moves beyond a focus on identifying 'strategic systems' and develops the concept of an IS capability, suggesting that it heralds the arrival of a new era.
L31	Peppard, Lambert and Edwards	Whose job is it anyway?: organizational information competencies for value creation	Information Systems Journal	2000	This paper examines the problem of value creation from IS investments from an organizational as opposed to an IS functional perspective. The paper argues that the effective deployment and exploitation of information should be viewed as a 'strategic asset'. To leverage value from IS, the paper proposes that organizations must recognize and develop information competencies and that the elements of these competencies are distributed throughout the organization and not solely resident in the IS function.

Code	Author	Article	Journal	Year	Research focus
L32	Ravichandran and Lertwongsatien	Effect of Information Systems Resources and Capabilities on Firm Performance: A Resource-Based Perspective	Journal of Management Information Systems	2005	draw on the resource-based theory to examine how information systems (IS) resources and capabilities affect firm performance. A basic premise is that a firm's performance can be explained by how effective the firm is in using information technology (IT) to support and enhance its core competencies.
L33	Rivard, Raymond and Verreault	Resource-based view and competitive strategy: An integrated model of the contribution of information technology to firm performance	Journal of Strategic Information Systems	2006	The contribution of IT to business performance has been studied from two main perspectives: a 'strategy as positioning perspective,' which underlines a market power imperative, and a resource based view perspective, which conceptualizes the enterprise as a 'bundle of unique resources.' The objective of the present study is to improve our understanding of the contribution of IT to firm performance in building upon the complementarity between the two perspectives.
L34	Ross, Beath and Goodhue	Developing long-term competitiveness through information technology assets	Sloan Management Review	1996	Reporting on a two-year study of IT management practices, the authors note that some firms do appear to generate competitive advantage from their IT, but the advantage results from their IT capabilities, not from their IT applications. Specifically, a firm delivers value from IT by building and leveraging three assets: highly competent IT human resources, a reusable technology infrastructure, and a strong IT-business partner relationship.
L35	Sambamurthy and Zmud	Research Commentary: The Organizing Logic for an Enterprise's IT Activities in the Digital Era—A Prognosis of Practice and a Call for Research	Information Systems Research	2000	This essay seeks to direct research attention toward the following question: How should firms organize their IT activities in order to manage the imperatives of the business and technological environments in the digital economy?
L36	Sambamurthy, Bharadwaj and Grover	Shaping Agility Through Digital Options: Reconceptualizing The Role Of Information Technology In Contemporary Firms	MIS Quarterly	2003	The purpose of this paper is to broaden understanding about the strategic role of IT by examining the nomological network of influences through which IT impacts firm performance. By drawing upon recent thinking in the strategy, entrepreneurship, and IT management literatures, this paper uses a multitheoretic lens to argue that information technology investments and capabilities influence firm performance through three significant organizational capabilities
L37	Sánchez	The Effect Of Information Technology Management Capability On Firm Competitiveness	European and Mediterranean Conference on Information Systems	2006	analyse kinds of relation for the information technology management capability. The results of the analysis show two principal conclusions: the development of this capability depends on both several human resources and organizational capabilities, and the level of this capability moderates the impact of information technology availability on distinct results measures.
L38	Santhanam and Hartono	Issues In Linking Information Technology Capability To Firm Performance	MIS Quarterly	2003	results indicate that firms with superior IT capability indeed exhibit superior current and sustained firm performance when compared to average industry performance, even after adjusting for effects of prior firm performance.

Code	Author	Article	Journal	Year	Research focus
L39	Stoel and Muhanna	IT capabilities and firm performance: A contingency analysis of the role of industry and IT capability type	Information & Management	2009	Drawing on a resource-based view, they advanced a contingency perspective and proposed that IT capabilities' impact on firm resources was contingent on the ''fit'' between the type of IT capability/resource a firm possesses and the demands of the industry in which it competes.
L40	Tallon P.	Inside the Adaptive Enterprise: An Information Technology Capabilities Perspective on Business Process Agility	Information Technology and Management	2007	This paper posits that managerial IT capabilities based on IT-business partnerships, strategic planning, and ex-post IT project analysis lead to the development of technical IT capabilities associated with a flexible IT infrastructure which in turn drives agility or a firm's ability to react to change in its products and markets.
L41	Tarafdar and Gordon	Understanding the influence of information systems competencies on process innovation: A resource-based view	Journal of Strategic Information Systems	2007	The resource based view of firms is used to explore how information system (IS) competencies affect process innovation in an organization.
L42	Tippins and Sohi	IT Competency And Firm Performance: Is Organizational Learning A Missing Link?	Strategic Management Journal	2003	This study proposes that organization learning plays a significant role in determining the outcomes of IT. Drawing from resource theory and IT literature, the authors develop the concept of IT competency.
L43	Wade and Hulland	REVIEW: The Resource-Based View And Information Systems Research: Review, Extension, And Suggestions For Future Research	MIS Quarterly,	2004	The purpose of this paper is to explore and critically evaluate use of the resource-based view of the firm (RBV) by IS researchers. The paper provides a brief review of resource-based theory and then suggests extensions to make the RBV more useful for empirical IS research.
L44	Yin and Yang	The Construction Of Firm's It Capability And Its Impact On It Assimilation: An Empirical Investigation In China	Service Science,	2011	The paper's research purpose is to discuss the key firm-specific IT capability and its impact on the business value of IT. the paper builds research model based on Resource-Based View, this model describes how the partnership between business and IT management partially mediates the effects of IT infrastructure capability and managerial IT skills on the organization-level of IT assimilation (as proxy for business value of IT).
L45	Zhang M, Sarker S, Sarker S	Unpacking the effect of IT capability on the performance of export-focused SMEs: a report from China	Information Systems Journal	2008	To determine whether higher IT capability of export-focused small and medium sized enterprises (SMEs) in China lead to their higher performance and explore the nature of the effect of the different IT capability dimensions on such performance.

Appendix 4: Research Contribution Summary

Table 8: A summarized view of the key findings towards the research questions

Research Question & Papers	Literature Stream	Role of IT in DI
RQ1: Paper 1, Paper 2 and Paper 3	• Digital Innovation • Disruptive Innovation Related research areas • Societal Impact of IT	<u>IT as DI</u> *Wickempowerment* – When IT innovations are also Dis

RQ2: Paper 1, Paper 4, Paper 5 and Paper 6	• IT Capability • Competitive advantage of IT • Disruptive Innovations Related research areas • Dynamic Capabilities	IT for DI *Disrupt-ability* (Enabler, Barrier) – towards DI creation *Disruptability* (Sustainer, Barrier) – towards DI response

Table 9: A summarized view of other information systems contributions

Literature Stream	Information Systems Contribution
• Digital Innovation Related research areas • Societal Impact of IT • Strategic IT planning	Societal implication of disruptive IT innovations

• IT Capability • Competitive advantage of IT Related research areas • IT Agility • Dynamic Capabilities	Roles of IT Capability in disruptive innovations
• IT Capability Related research areas • Resource based view • IT Strategy	Classifications of IT/IS Capability • IS **M**anagement Capability • IS **I**nfrastructure Capability • IS **N**etworking/Sourcing Capability • IS-Business **D**evelopment Capability

Table 10: A summarized view of contributions to innovation management

Summary	Knowledge Contribution to Disruptive Innovation
Extending the definition of disruptive innovation	*"A disruptive innovation introduces a different set of **attributes** relative to a **market** which are unattractive for mainstream customers on inception due to **variance** in attributes valued by this market - although a different market segment may value the new attributes. Subsequent developments over time, however, raise the innovation's attributes to a level sufficient to satisfy mainstream customers, thus attracting more of the mainstream market."* Where: *Market* = (products, business models, goods, services... and/or technologies). *Variance* = (inferior, superior, complexity…) and *Attributes* = (features, performance, price, operations, business rules... and/or processes)
Classifications of disruptive innovation	
A process conceptualization of disruptive innovation	

Attributes of a potential, disrupted and disruptive innovation.				
	Innovation attributes	PDI_{t1}	DD_{t2}	DI_{t2}
	Different performance attributes	Necessary	*Not Necessary	*Necessary
	Not valued by key customers	Necessary	*Not Necessary	*Necessary
	Encroaches existing markets	Necessary	*Not Necessary	*Necessary
	Appeals to market fringes	Necessary	*Not Necessary	*Necessary
	Simpler, more convenient	Necessary	*Not Necessary	*Necessary
	Serves non-consumers	Necessary	*Not Necessary	*Necessary

Theoretical propositions of disruptive innovation	DIVE propositions
	*Proposition **D (Direct competition)**: If the initial offering of a Potential Disruptive Innovations is not 'directly competing' for the mainstream customers, the chances of ultimately becoming disruptive is higher. (*For example, Google Docs versus Microsoft Word)
	*Proposition **I (Ignore)**: If a potential disruptive innovation is acknowledged 'early and not ignored', the likelihood of it significantly disrupting the market position of the responder can be limited.* (For example, Kodak films versus digital imaging.)
	*Proposition **V (Velocity of adoption)**: The 'velocity of adoption' of a potential disruptive innovation is one of the parameters that can significantly determine if it will eventually develop to be disruptive.* (For example, Wikipedia versus Britannica)
	*Proposition **E (Entrants)**: New 'entrants' to a market/industry are more likely to disrupt than incumbents.* (For example, Nokia phones versus Apple's Iphone)

DIVE Model as a sensemaking tool for avoiding or advancing disruptive Innovation	

SELECTED PUBLICATIONS

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Paper 1: Review: Disruptive Innovation & Information Technology - Charting a Path

Baiyere, A., & Salmela, H. (2013). Review: Disruptive Innovation & Information Technology- Charting a Path. *Proceedings of the 24th Australasian Conference on Information Systems (ACIS 2013)*. In Deng, H. and Standing, C. (eds) December 4-6, Melbourne, Australia, 1-11.

Review: Disruptive Innovation & Information Technology –Charting a path

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Abstract

While it has been established that the Information technology (IT) capability of an organization contributes to its ability to innovate and respond to threats, very little has been done in understanding the significance, if any, of the role of IT in disruptive innovation (DI) scenarios. This paper systematically reviews prior research on the concept of DI in relation to IT. Importantly, this paper lays out a research agenda for the exploration of IT and IS research on the subject of DI. Topical questions are raised and calls are made for further studies to position the relevance of IT/IS to the maturing discussion of disruptive innovation. Concurrently, a general review of the evolution of the theory of disruptive innovation and its current status is also presented. A framework classifying disruptive innovation based on typology and definitions is demonstrated in tandem with ensuing questions on the role of information technology.

Keywords:

Disruptive Innovation, Information Technology, Literature Review, Research agenda

INTRODUCTION

An era is emerging where organizations are not just thinking about innovating in order to sustain a business but are also consciously thinking about how to disrupt others with their innovations. It is increasingly becoming an apparent threat that has led to the quote – "Disrupt or be Disrupted". At a time like this, it is worth asking if the existing traditional organization designs are well structured to combat ambidextrous challenges of this nature. Similarly, it has long been established that information systems are central to the core of an organisations' design. Volonino, Robinson and Watson (1992) put it in this way *"The need for innovation, flexibility, and adaptability has fostered significant changes in information system requirements, particularly those that are hosted on information technology (IT) infrastructures. Attempts to respond to these competitive needs in dynamic and at times disruptive environments by applying IT is driving dramatic changes in how organizations are designed to conduct business".* In this emerging era the value of information to a business enterprise cannot be over emphasized. Although, Information has been and will continue to be a valuable resource that can be a defining differentiator between the success of firms (Johnston and Vitale 1988), hardly as there been a time in history when we have had as much information processing abilities like today (Power 1983). Information Technology (IT) and Information Systems (IS) have thus been central to the ability of firms to harness the latent advantages of the information available within and outside their networks (Bakos 1991 and Johnston and Vitale 1988). The value and utility of the information at an organization's disposal, plays a significant role in the quality of knowledge and decision making abilities of such an organization (Thomas and McDaniel 1990 and Power 1983). The pursuit of Disruptive Innovations (DI), either to create or respond to an emerging one, are (among other things) largely knowledge and decision based activities. The decisions made by firms in regard to disruptive innovations are known to have usually either made or broken them. The impact of disruptive innovations can be so extreme that a virtually non-existent firm can rise to dominance while a leading incumbent can basically cease to exist or largely diminish in importance. These extreme outcomes underscore the need to understand the role played by information technology and information systems in the occurrence of disruptive innovation.

Consider a company that has attained a significant maturity in its industry both in market position and profitability, which suddenly find itself on a decline spin and gradually losing its esteemed position in all these attributes. This is a typical illustration of a company contending with the threat of disruptive innovation. Basically, disruptive innovation introduces a different set of rules to the traditional act of doing business in a domain. In the face of disruptive innovation, the functional knowledge and operational process skills gathered by a company over several years could see itself gradually facing a rising risk of irrelevance and obsolescence (Johnson, Christensen and Kagermann, 2008). These accumulated knowledge and process frameworks are logically related to the *business processing structure* and *the information processing capacity* possessed by such an organization. Among other things, an organization's business process and its information processing ability are likewise entrenched in the IS capability that defines the organization (Chesborough, 2010; Pavlou and El Sawy 2006). This therefore suggests that the IS/IT of an organization plays a significant role in disruptive innovation scenario, either in its creation or in strategically responding to its threat.

Generally, disruptive innovation can be considered as innovations regarded by incumbent companies as unsuitable for their mainstream customers but which gradually matures to threaten the esteemed position of such companies. They usually begin with simplistic applications at the fringe of a market but gradually surge 'up market' and then develop with a potential to eventually displace established market leaders (Christensen, 1997). This has led to the displacement of leading incumbents by new entrants and fledging entrepreneurs. Typical examples include the disruption of mainframe companies (UNISYS) by minicomputers and subsequent disruption of minicomputer companies by desktop companies (IBM), Xerox photocopiers by Canon copiers, wired telephone companies by mobile phones (Nokia). Recent examples of innovations with similar tendencies include: the iPad (Apple) disrupting the PC, smart phones disrupting GPS (TomTom) and Skype/VoIP disrupting the telecom industry (T-Mobile) among many others.

What role does IT play in *enabling* the creation of disruptive innovations? Perhaps a question of more significance to an organization dealing with the threat of disruptive innovation would be - What role does IT play as a *sustainer* in the face of disruptive innovation threats? To add a rather balancing perspective to these questions, it would be relevant to also seek to understand the answer to the question – How can IT stand as a *barrier* in responding to or creating disruptive innovations? These are few of the important questions that remain unanswered. Without targeted studies seeking to bring light to this presently grey area of research, they would continue to be unknown. This paper is therefore aimed at highlighting the dearth of research studying the significance of IT in DI scenarios. Furthermore, the paper is also geared at evoking attention to themes and questions that are open to be researched. A point to additionally note is that while these questions pose important issues to reflect on in the IT/IS domain, IT alone may not be the only determining factor in each case. This however does not diminish the value of understanding the significance of the role of IT in this phenomenon.While it might be hypothesized, that the IS/IT capability of an organization could be an enabler or a sustainer specifically in cases of disruptive innovation; it is open to be empirically proven. This has led to the need to carry out this review as an essential forerunner and agenda for future research on this hypothesis.

The paper is structured in two main parts. The first part presents a systematic literature review and a comprehensive analysis of the existing literature which have specifically related IT to disruptive innovation. The second part is a general literature review on the concept of disruptive innovation which is interlaced with topical questions on information technology revealing open areas of research within the DI context. Although, there has been copious studies on DI, the diversity and misconceptions associated with DI literature, may stand as a source of ambiguity and hindrance for future research (Yu and Hang 2010). This has informed the need to carry out a general review of present knowledge on DI as a pilot study for future DI research in the IT/IS domain.

In addition, by analyzing the evolution of the disruptive innovation discussion, we present a categorization of disruptive innovation by – a) innovation type and b) market diffusion. By innovation type, disruptive innovation is subdivided into three distinct classifications: *Disruptive Technology Innovation, Disruptive Business Model and Disruptive Radical Products.* By market diffusion, identified types of disruptive innovations are: *Low-end Disruption, High-end Disruption and New Market Disruption.* The paper further presents the implications of having consistency in the DI concepts for the IT/IS research domain and for subsequent DI research in general.

DISRUPTIVE INNOVATION AND INFORMATION TECHNOLOGY/SYSTEM – FINDING THE LINK

This section presents a systematic review of existing literature on IS/IT. Generally, the goal of this review is to discover and present what has been done on DI specifically in relation to the IS/IT field. The review

is steered towards highlighting the varying perspectives with which research relating this concept has been approached over the years. Subsequently, the goal is to identify similarities, differences and possible areas open to further research investigation (Okoli and Schabram 2010).

Methodology

The methodology adopted for this paper follows an adaptation of the guidelines outlined for conducting a systematic literature review provided by Webster and Watson (2002) Okoli and Schabram (2010) and Tranfield, Denyer and Smart (2003). For the review, Web of Knowledge journal database was initially used.

The first search criterion was to identify existing prior literature that demonstrates some degree of relationship between IT and DI. This was the central inclusion or exclusion factor on which the eventually selected papers were evaluated. The search term "Disruptive Innovation and Information Technology" returned 61 articles. From the 61 articles returned, 23 were selected from the inclination of their title to the aforementioned selection criteria. After a further drilling down with the aid of the abstracts of these articles, 14 articles were finally identified as more relevantly fitting the IT – DI criteria. Having such a few number of articles returned, it was decided to add another search term in order to hopefully find more relevant literature. Therefore the knowledge that the abbreviation of information Technology as IT is widely adopted and used by many articles, the search term "Disruptive Innovation and IT" was employed for the second search iteration. A total of 217 articles were returned from this search.

Considering the relatively low number of research articles found from this search process and also considering the fact that the essence of this review is really to understand what knowledge has been documented in prior research about the relationship between IT and DI, it was decided to repeat this process in three other journal databases. This was done with the presumption that there could be some relevant articles unearthed via this process. For this process the Science Direct (Elsevier) journal database, Science Direct (Scopus) journal database and EBSCO Host journal database were employed. However, repeating the search process for these three did not significantly increase the number of articles meeting the inclusion criteria to be included in the review.

The essential pivot term for the article search was disruption. For an article to be considered it has to have a clear association with the concept of disruptive innovation. When this has been satisfied then the article was then further tested for a relationship with an aspect of IT and DI. It is worth stating that getting prior research that has clearly studied IT and DI was not a very straightforward activity as IT is a very broad domain and it is associated with a vast number of constructs. Therefore articles were included on the IT criteria based on if the study represents one aspect, artefact or construct of the Information Technology field. With the large option of key IT terms, the determination of the relevance of an article required first checking the title for keywords, then reading the abstract of papers with any inclination towards the IT-DI criteria.

With the shortage of prior research explicitly studying the relationship between IT and DI, it became necessary to expand the scope of the literatures to be reviewed. Hence the criteria were broadened by totally eliminating the IT restriction and then filtering the returned list with information technology. However, at the end of these search iterations in the journal databases, the total number of articles which were selected was 17.

Lastly, from a quick glance at the articles collected so far, it was obvious that the Management Information System Quarterly (MISQ) and Information System Journals (ISJ) have more articles represented in the selected articles. For the purpose of thoroughness and with the hope of increasing the number of articles, it was decided to search solely through some of the top IS journals - MISQ, ISJ and the Information System Research (ISR) journal archives for exactly same search terms. By repeating the process highlighted below, no additional article was found to be added to the already selected articles. *Hence, it became apparent that there has indeed been very little research done to relate or study the role of IT in cases of disruptive innovations.*

It is worth noting that there are a number of disruptive innovation articles that have mentioned IT in some form, however the aim of this review is specifically to review disruptive innovation articles where the core focus has been IT or IT has been centrally considered in the discussion.

Review Analysis

The articles collected for the review are presented in table 1. The table highlights the journals in which the articles have been published, the year and the context with which IT was viewed relative to the concept of

disruption in each article. Although the sparse number of articles available for this review limits the scope of analysis that can be done, it however makes it apparent that there is room for more research in this area. Despite the fact that not much extensive analysis can be done, the review does achieve the goal of revealing the lack of research in this area and this is an open call for researchers.

Table 1: List of articles discussing disruptive Innovation in relation to an aspect of IT

Year	Author	Article	Journal	Relationship to IT
2013	Downes,L	The role of ICT in supporting disruptive innovation- a multi-site qualitative study of nurse practitioners in emergency departments	Harvard Business Review	Role of IT in DI
2013	Sultan N	Knowledge management in the age of cloud computing and Web 2.0: Experiencing the power of disruptive innovations	International Journal of Information Management	IT as the DI
2012	Mohan, K., Ramesh, B., Cao, L., & Sarkar, S.	Managing Disruptive and Sustaining Innovations in Green IT	IT Professional	IT as the DI
2012	Sultan, N and van de Bunt-Kokhuis, S	Organisational culture and cloud computing: coping with a disruptive innovation	Technology Analysis & Strategic Management	IT as the DI
2011	Christophe M. Elie-Dit-Cosaque and Detmar, Straub	Opening the black box of system usage: user adaptation to disruptive IT	European Journal of Information Systems	Use of disruptive IT
2011	Menon, Siddhartha	Linking generativity and disruptive innovation to conceptualize ICTs	Internet Research	linking DI to IT Innovations
2011	Carlo, J. L., Lyytinen, K., & Rose, G. M.	Internet computing as a disruptive information technology innovation: the role of strong order effects	Information Systems Journal	IT as the DI
2010	Westbrook, J and Braithwaite, J	Will information and communication technology disrupt the health system and deliver on its promise?	Medical Journal of Australia	How IT can disrupt health system (IT as the DI)
2009	Latzer, M	Information and communication technology innovations: radical and disruptive?	New Media Society	IT as the DI
2009	Garrison, G	An assessment of organizational size and sense and response capability on the early adoption of disruptive technology	Computers In Human Behavior	IT as a DI sensor
2009	Lucas CH. and Goh M	Disruptive technology: How Kodak missed the digital photography revolution	Journal of Strategic Information Systems	IT as the DI
2009	Nagle, T and Golden, W	An Examination of the Disruptive Innovation Paradox: The Application of the Innovators Dilemma to SME's	Information Systems - Creativity And Innovation In Small And Medium-Sized Enterprises	effect of IT as the DI
2008	Brydon, M and Vining A.R	Adoption, improvement, and disruption: Predicting the impact of open source applications in enterprise software markets	Journal Of Database Management	potential of Open Source IT to be disruptive
2006	Sherif, K., Zmud, RW and Browne, G	Managing peer-to-peer conflicts in disruptive information technology innovations: The case of software reuse	MIS Quarterly	IT as the innovation
2003	Lyytinen, K and Rose GM.	Disruptive information system innovation: the case of internet computing	Information Systems Journal	How DI affects use of IT (and IT as DI)
2003	Lyytinen, K and Rose GM.	The disruptive nature of information technology innovations: The case of Internet computing in systems development organizations	MIS Quarterly	IT as the DI
2000	Nault, BR and Vandenbosch, MB	Research report: Disruptive technologies - Explaining entry in next generation information technology markets	Information Systems Research	IT as the DI

Journal Distribution and Year of Publication Analysis: It is worth noting that over half of the articles identified come from the IS discipline while the others are from very different fields. In context of individual journals, MISQ and Information System Journal takes a representative proportion as they are the only two journals to have more than one article in the review. The analysis of the year of publication shows that most of the research studying some form of relationship between IT and DI are quite recent. While the research on DI has been around since Christensen introduced it in 1997, the majority of the IT-DI research have been largely published in the last decade which is indicative that the research stream is still at its early days.

Relationship to IT: While it is important to realise how IT has been disruptive it is equally important perhaps even moreso to study the role that IT plays in scenarios of disruptive innovation. As can be seen in table 1, most of the research so far have focused mostly on how IT is or can be the disruptive innovation. It is of particular interest for IT and IS researchers to understand the importance of this phenomenon to their discipline especially as it concerns a topic which is laying a trend that is of high impact to organisations and even entire industries across the globe.

Charting a path for future research

Evidently very little research has been done in the IS domain to understand the role of IT/IS in the occurrence of DI. There are however notable exceptions like Lyytinen et al. (2003) and Nault and Vandenbosch (2000), who among others advanced knowledge of this phenomenon for the IS research community. Having identified the status of research on these concepts, the remaining of this paper is aimed at reviewing current knowledge from the disruptive innovation literature. This is expected to serve as a reference platform from which future IS/IT research relating to disruptive innovation can leverage. It will be of value for instance to answer the question: How does IT contribute to the *disruptability* of an organisation. Where disruptability is the ability of an organization to identify and create a disruption and/or its ability to identify and react to an oncoming disruption.

Without reinventing the wheel, this disruptive innovation review aims at consolidating the different school of thoughts on DI and presenting a pointer to substance that are relevant and peculiar to the IS/IT research scholars. Key items that could be of importance going forward in building research in this stream can include - definitions of key constructs, a clear taxonomy and a granular classification. These among others are the goals of the next section of this paper.

DISRUPTIVE INNOVATION OR DISRUPTIVE TECHNOLOGIES?

In the beginning, it was disruptive technologies (Christensen 1997). Then it became disruptive innovations (Christensen and Raynor 2003). Yet it appears many researchers either did not notice the change or could not grasp the difference. The terms have therefore been often interchanged as one and same. Firstly, why was the terminology changed? Secondly, what then are the significant differences between both? How do we proceed in using this terminology in a consistent fashion without falling into the confusion and commonly repeated errors of past research?

It is important and necessary to make this distinction clear, because the IS research discipline by its structure and definition, is a field that is closely related to several other research fields (Wade and Hulland 2004), hence it is inherently valuable and necessary to utilize theories and concepts outside the IT/IS domain. While this is a useful step in IS research, it is however of importance to avoid transferring external theories blindly, in order not bring along the disensus associated with such theories into the IS domain (Wade and Hulland 2004). Therefore, to examine this change in terminology in the Disruptive Innovation concept, we would look at its evolution through the explanation of Christensen - the founding researcher of both terminologies. Christensen (2006) explains:

"... I decided that labeling the phenomenon as disruptive technology was inaccurate. The technology did not [always] make incumbent response difficult. The disruptive innovation in business models made it vexing, and I have subsequently sought to use the term disruptive innovation."

In essence, Christensen observed an anomaly that the initial construct of disruptive technology could not properly account for. That observation was an opening to improve the theory such that the anomaly can be addressed. Hence the ensuing changes from 'technology' to 'innovation'. This among many other improvements to the theory was only more clearly articulated after his initial popular book - Innovators Dilemma which chronicled the disruptive technology theory. The central element of Christensen's theory is the disruptiveness. However framing it as disruptive technology limited the theory and with more insight into the concept, it became clear that the disruption is not necessarily only as a result of advancement

in technology, it could be as a result of an innovation in business model *but not limited to these two*. It therefore was logical to use an encompassing term that captures these possibilities therefore the change from disruptive technology to disruptive innovation.

However, this improvement or expansion in terminology does not necessarily rule out the use of the term disruptive technology, it on the other hand shows the limitation of using that terminology comparatively to disruptive innovation. The widespread acceptance of the innovators dilemma also resulted in many subsequent studies referring to the disruptive technology definition, while in principle they were referring to the disruptive innovation construct. Although this has been the case in early studies, this does not have to be the case moving forward, particularly in the evolving DI research in the IS field.

Additionally, from the root meaning of the words technology and innovation, one can infer that Disruptive Technology would be fundamentally different from Disruptive Innovation. From a technological standpoint, not every technological invention makes the shift to becoming an innovation. For the purpose of clarity in making DI research, it is evident that in many cases, no single company can lay claim to a particular technology (For example – the internet which has been a platform for many disruptions). On the other hand the company that brings a technology (or its application) to the market can easily lay claim to that brand as its innovation. For example, VOIP technologies kept advancing from different research communities but Skype popularized and marketed a creative application of it. Similarly, smartphones or mobile phones in general evolved gradually with input from different firms and research institutes. However, while Nokia was the trail blazer in the initial mobile phone landscape, it was Apple that initially creatively designed, marketed and promoted the smartphone to strike the chord that widely diffused the smartphones to a larger market population. So in essence when researchers are structuring there research design, it is worth noting the distinction between the technology and the firm that boosted the technology to the status of a disruptive innovation. Therefore the question to be asked would be: Is this research interested in the technology (DT) that is causing the disruption or in the firm that has made it into a disruptive innovation (DI)?

CLASSIFYING DISRUPTIVE INNOVATION BY INNOVATION TYPE

To carry out progressive IT related research on the topic of disruptive innovations, it is of import to understand the different types of this phenomenon that have been identified by prior research. This is particularly so, due to the different and unique type of challenges that each DI type poses and the rather diverse implication of each DI to organizations and researchers alike (Markides 2006). Lumping all the different DI types into one category potentially implies that we would lose the fine granularity that can be achieved, compared to when DI research is conducted with the lens of each of the unique DI types.

The three classes of disruptive innovation that can be deduced from prior literature are: Disruptive Technology Innovation [DTI] (Christensen 2006, 1997; Markides 2006), Disruptive Business Model [DBM] (Christensen 2006; Markides 2006) and Disruptive Radical Innovation [DRI] (Govindarajan and Kopalle 2006; Markides 2006). The underlying similarity between all three DI classes above is that they are (or become) disruptive relative to an existing organization. However, the mechanism with which they disrupt is significantly different in each case. If we look at disruption as the central theme of the theory of disruptive innovation, it can be logically deduced that these are indeed subcategories or finer divisions of the disruptive innovation construct.

We would examine these three classes of DI with a generally accepted modification to the definition of disruptive innovation as presented by Govindarajan and Kopalle (2006) (and more recently Govindarajan, Kopalle and Danneels 2011) which states:

*"A disruptive innovation introduces a different set of features, performance, and price attributes relative to the **existing product**, an unattractive combination for mainstream customers at the time of product introduction because of **inferior** performance on the attributes these customers value and/or a **high price**—although a different customer segment may value the new attributes. Subsequent developments over time, however, raise the new product's attributes to a level sufficient to satisfy mainstream customers, thus attracting more of the mainstream market."* (Emphasis ours).

Disruptive Technology Innovations [DTI]: These are the disruptive innovations whose disruptive tendencies stem from the advancement in the technological component of the innovation (Christensen 1997; Markides 2006). A classical and well referred to example is the disruption of the disk drive used by Christensen (1997) in his seminal thesis. While the disk drive featured advancement or changes in technology, the business model employed in taking it to the market from one disk drive generation to another was not significantly different. The innovation involved was also neither radical nor new to the world. Another

typical DTI example can be found in the disruption of film cameras by digital cameras and also the disruption of mainframe computers by the minicomputer and the subsequent disruption of minicomputers by PC and the looming disruption of laptops by tablet PCs + smartphones.

In recent years the rapid flux of innovations in IT has become an urgent force to be reckoned with in the discussion of disruptive innovations. Frequently, the introduction of a new information technology innovation comes along with a potential to be disruptive (Lyytinen and Rose 2003). For example, with the introduction of the internet, we witness the emergence of Amazon and Google; with the introduction of VOIP, we witness the emergence of Skype; with the introduction of smartphones we witness the emergence of GPS navigation apps among many other examples. *What lessons can we learn from the past of IT innovations that can be projected to understand the disruptive potentials of future innovations?*

Disruptive Business Models [DBM]: In contrast to the DTI, the core of the disruptive business model concept is *not* the technology but the manner the business model has been employed (Crockett McGee and Payne 2013 and Markides 2006). In most cases, the business model innovation is at a tangent with the traditional or existing models and gradually results in the eventual disruption on an industry or incumbent organization. For example, Amazon did not invent the art of bookselling neither did Amazon invent e-commerce. What Amazon did was to change its approach of generating revenue while selling books. Another typical example of the DBM is Google's subtle disruption of the advertising landscape. Google provided valuable services for free while generating revenue by making it possible for businesses (large and small) to do targeted national and even international advertising, without hiring costly ad agencies or direct marketing firms.

For the disrupted firm, adjusting to disruptive business model could require making existing competencies and functional processes redundant while simultaneously rendering long acquired operational knowledge obsolete (Christensen and Raynor 2003; Henderson 2006). These are changes (or cannibalization) that are challenging for organizations (Govindarajan et al. 2011; Chandy and Tellis 1998) which managers rationally tend to be reluctant to undertake – hence the dilemma. From an IT researcher perspective, it would be interesting to understand how the fast pace of change in IT innovations can stimulate the emergence of DBM. More so, for managers the question of practical value would be: *How can advancement in the IT frontier be exploited in creating disruptive business models?*

Disruptive Radical Innovations [DRI]: According to Markides (2006), these are innovations that are new-to-the-world that grow in significance to a point that ultimately disrupt an existing product or technology. These category of innovation products are distinctively novel and dissimilar relative to existing products or technologies. They are mostly not *demand driven* and they usually tend to have a slow adoption rate (for one or more of several reasons – complexity, cost, and performance among others) but they become disruptive If/when they become mainstream and considerably attract customers away from an existing market (Rogers 2003; Markides 2006). For example, the telephone was a radical innovation which grew to be disruptive to the telegraph industry. The process of disruption in this case usually involves late entrants coming into the picture to disrupt the original radical innovator (or early stage innovators of the product) in a manner similar to the other disruptive innovation categories. These entrants basically grow the market from a niche to a mass market. For example, Xerox pioneered the creation of the photocopying machine, however it found itself facing disruption from Canon and other new entrants who ended up diffusing the innovation to the mass market.

It is important to mention that not all radical innovations are disruptive innovation. For example while Teflon or the film camera can be considered as radical innovations, they arguably cannot be said to have disrupted any industry, hence they do not qualify as disruptive radical innovations.

There has been a debate on what can be classified as a [disruptive] radical innovation (Christensen 2006; Markides 2006 and Govindarajan and Kopalle (2006). Govindarajan and Kopalle (2006) take a stimulating stance on radicalness of an innovation. They position radicalness of an innovation as a *measure* and not a *binary* value of either radical or not radical. They referred to certain innovations as high on radicalness or less radical in nature. With this point of view in conjunction with the new-to-the-world definition of Markides (2006) we can therefore express the concept of the radicalness of an innovation based on how new-to-the-world-ish an innovation is. Most innovations are generally advancement of what exists before. The degree to which the advancement is new or unexpected would then determine the radicalness of such an innovation. A truly radical innovation would be a truly first by several measures. Like Christensen (2006) stated, there was indeed a first wheel, a first photograph, a first boat e.t.c Whenever an innovation cannot be expressed relatively to an earlier existing product or technology, it then suffices to claim it indeed is new to the world.

Combined View: The Three Classes of Disruptive Innovation

It is worth noting that although these DI classes exhibit certain unique differences, there can in fact be combinations of two or all of them present in a particular disruptive scenario. A technological disruptive innovation is usually also a product innovation and by extension it could also be a disruptive radical product innovation. [Example: The calculator disrupting the slide rule was both a DTI and a DRI]. Similarly a DI scenario could also be the combination of both a disruptive technology innovation and a disruptive business model innovation. [Example: Google's search algorithm in combination with its adwords and freemium business model]. Another possibility is the combination of a disruptive radical innovation and a disruptive business model. [Example: Amazon was the first to create an online bookstore as a platform to offer books in a business model fundamentally different from the traditional book stores].

If we reconsider the definition of Govindarajan and Kopalle (2006) in light of the above discussion, we would realize that all classes of DI can readily fit into this definition. However, one can also identify certain areas in need of improvement in this definition. Firstly, the focus in the definition has mostly been about products but as demonstrated with the DBM class of DIs, *the disruption does not necessarily have to be as a result of a **product** innovation.* Secondly, as illustrated in the case of DRI, most radical innovations are usually not demand motivated but mostly supply driven hence *there does not always have to be an already **existing** product/market for the innovation.* Thirdly, from the examples given of the three DI classes (DTI, DBM and DRI), it becomes apparent that *the disruption is not essentially dependent on whether the offering is of **inferior** performance and/or **high price**.*

To address this anomaly that is not addressed by the earlier definition (Christensen 2006), and in line with calls for an encompassing definition (Danneels 2004; Markides 2006; Schimdt et al 2008) an extension to the definition of Govindarajan and Kopalle (2006) is necessary. This can be stated to capture these identified points without altering the core as follow: *A disruptive innovation introduces a different set of **attributes** relative to a **market** which are unattractive for mainstream customers on inception due to **variance** in attributes valued by this market - although a different market segment may value the new attributes. Subsequent developments over time, however, raise the innovation's attributes to a level sufficient to satisfy mainstream customers, thus attracting more of the mainstream market.*

$$\left\{ \begin{array}{l} \text{Where: Market}\ \ = \text{(products, business models, goods, services... and/or technologies).} \\ \text{Variance} = \text{(inferior, superior, complexity...) and} \\ \text{Attributes} = \text{(features, performance, price, operations, business rules... and/or processes)} \end{array} \right\}$$

To conclude this section, after reviewing the three classes of DI by definition, one can easily recognize the existence of a stream of IT/IS research on each of the supporting root class (i.e Business models and Innovation). It is indeed a recognized fact that IT and IS research have contributed to the knowledge on business models (Bharadwaj, El Sawy, Pavlou and Venkatraman 2013; Keen and Williams 2013 and Onetti and Capobianco 2005) Similarly IT and IS research have contributed to the (technological and radical) innovation capacity of organizations (Swanson and Ramiller (2004); Fichman 2001; Carlo, Lyytinen, and Rose 2012; Xue, Ray, and Sambamurthy 2012 and Westerman and Curley 2008). *How then can we extend these accumulated understanding of IT/IS in these areas to specifically embolden our knowledge of disruptive innovations?*

CLASSIFYING DISRUPTIVE INNOVATION BY MARKET DIFFUSION

Disruptive Innovation can also be classified based on the difference in the approach and characteristics of adoption and diffusion to the market. Christensen and Raynor (2003) identified that disruption is characterized by two fundamentally different market phenomena which they named – low-end disruptions and new-market disruptions. Subsequently, other researchers notably of which are (Govindarajan and Kopalle 2006 and Schmidt and Druehl 2008) realized that the concept of disruption could also diffuse from the high end of the market. Hence, they expanded this classification to include what they term high-end disruption or high end encroachment (Schmidt and Druehl 2008 and Sood and Tellis 2011). It was based on this expansion that Govindarajan and Kopalle (2006) presented the updated definition of the disruptive innovation construct highlighted earlier in this article. This definition has, in similitude to the initial definition of Christensen, been accepted and adopted by many scholars on this topic (Christensen 2006; Yu and Hang 2010; Govindarajan, Kopalle and Danneels 2011 and Katsamakas and Georgantzas 2010).

Low-End Disruption (LeD): These are the type of disruptions that encroach on an existing market from the base of the market. The customers at this point in the market are not considered the most valuable customers by the business. This is the foundational illustration of disruptive innovation as presented by Christensen (1997).

High-End Disruption (HeD): As would be expected from the name, this category is the opposite of the LeD. The innovation that disrupts this market are usually not necessarily cheaper or simpler in comparison with the LeD. They could be of higher performance and price and yet attract the high paying customers of a market until it gains enough momentum to gradually cause a disruption to an existing market.

New Market Disruption (NmD): This is a unique type of disruption that initially occurs by creating a new market. However, like the other type of market disruptions it also gradually becomes attractive to customers of an existing market. It could gain market share from an existing market from any part of the market – LeD or HeD.

In IT/IS research, a number of researches have been carried out to understand the interaction of technology innovation and the market. An example of one such study includes the technology acceptance model (Venkatesh, Morris, Davis and Davis 2003; Venkatesh 2000) which extends to the acceptance of technological innovations. *Can the wealth of knowledge gathered in the IS circle be of value in dealing with DIs? Since NmDs are about markets which do not presently exist, what insight does IT/IS give us in analyzing such markets? Or should we conclude that markets that don't exist cannot be analysed? What then can the role of Big Data be here?*

Emerging Innovations in IT has left some industries dazed mostly because the industries hardly considered the innovation to be a threat to their business. However such innovations have enabled unseeming competitors to emerge and challenge whole industries. One of the central dilemma of DI for the executives of established incumbents is: how not to lose opportunities due to *hesitation* and simultaneously how to avoid being the fool who *rushes* in. (Pattinson and Woodside 2009). *Can IS provide tools/decision-making frameworks to ease this burden on the decision makers?* For example: the emergence of internet search engines was not an obvious threat for the advertising industry; the initially low quality VOIP innovation was not a competitive worry for the telecommunication industry and the introduction of the internet had a different enough focus not to be considered a threat by the newspaper industry. Such situations open up stimulating questions for the research community. Firstly, what insights can researchers extract from emerging trends in IT like SoMoClo (Social Media, Mobile and Cloud Computing), Big Data, 3D printing among others in predicting ex ante what industries are vulnerable to disruptive threats? Or conversely, how can we provide non-IT savvy managers with knowledge that suggests what industry may be disrupted or threatened by an emerging IT innovation?

CONCLUSION

This paper demonstrated by way of a systematic literature review the lack of research studying the particular role of IT in the occurrence of disruptive innovation. The paper highlights that while the importance of disruptive innovation as a phenomena with high organizational impact cannot be over emphasized, the IS and IT discipline are yet to explore the significance of IT and IS in such situations. Furthermore, the paper through a general review of literatures emboldened the current knowledge of the definition and classification of disruptive innovation. The concept of disruptive innovation was classified based on discussion in prior literature into DI by innovation type (disruptive business model DBM, disruptive technology innovation DTI and disruptive radical innovation) and DI by market diffusion (low-end disruption, high-end disruption and new market disruption). Viewing the classifications with the lens of existing DI definition revealed gaps that could not be properly accounted for by the present definition. Hence, a consolidated definition which accounts for the missing pieces based on the prior definition was advanced. The values of having a precise and specific definition for DI going forward are that we can more clearly study it and recognize its benefits and its limits. Furthermore, the paper poses thematic questions all through the discussion to stimulate and exhibit areas open for research in this stream.

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Paper 2: Disrupted Disruptions: Lessons from Potential Disruptive Innovations that barely disrupted

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Disrupted Disruptions: Lessons from Potential Disruptive Innovations that barely disrupted[i]

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Abstract: Some potentially disruptive innovations (DI) will either not survive long enough or will not sustain their momentum sufficiently to eventually become disruptive. What value can we then extract from these occurrences to better understand how to sustain a potential DI? Conversely how does this phenomenon contribute to our knowledge of dealing with threats of disruptive innovation? This paper advances the concept of disrupted disruptions and reveals the surrounding elements and traits that can make an innovation with a disruptive promise to loose such potential. It also gives us understanding of how an innovation may lose such capacity due to the characteristics of the innovation itself or the responding actions of the industry/company being disrupted. The paper further present four propositions based on which a model - DIVE was then developed to conceptualize the characteristics and response attributes that characterize disrupted disruptions.

Keywords: Disruptive Innovation; Disrupted Disruptions; DIVE Model; Adoption Velocity; Information Technology; Change.

1 Introduction

Often times an innovation is introduced with attributes that seemingly qualifies such an innovation to be labelled a potential disruptive innovations. However over time, rather than developing to a fully disruptive innovation, many of such innovations tend to lose the disruptive potency with which they were associated at the onset. While some do not live long enough before they are themselves disrupted, others on the other hand, could not persistently maintain that disruptive potential to the degree necessary to become truly disruptive.

Many innovations are often quickly labelled as disruptive particularly when there are traits matching the definition of disruptive innovation postulated by Christensen (1997). For example, Google Docs was acclaimed as a potential disruptor for the dominant Microsoft office (Hang et.al. 2011) but it is yet to live up to the status. Minicomputers also potentially disrupted the mainframe, but not long enough to withstand the disruption of the personal computer which prior to its emergence was literally non-existent.

Typically, when disruptive innovation occurs, they usually hold extreme consequences for the organisations involved. The significance of this extremeness is typified by the fact that a leading company can face the threat of irrelevance if not complete obsolescence while disruptive innovations can equally propel a non-existing company to the status of a major player (Christensen & Overdorf 2000). The challenge for organisations, particularly leading companies in their industry is how to identify and respond appropriately to innovation threats of a disruptive nature. It has therefore become important for organisations to be strategically aware and alert to avert disruptive innovations that can potentially upset their projected sustenance (Crockett, McGee and Payne 2013).

Logical questions to then consider includes: what makes an innovation disruptive and how can we assess the potential of an innovation to be disruptive? (Danneels 2004) Perhaps a question of more practical relevance to managers would be – how can a potentially disruptive innovation threat be prevented from resulting in a catastrophe?

a)   Current Understanding

There has been a number of established and documented academic research on the concept of disruptive innovation (Govindarajan & Kopalle 2006; Danneels 2004 and Christensen 2000). Very few studies have however focused on examining the lessons that could be learnt from innovations that were considered as

potentially disruptive on several measures which eventually end up not being disruptive or where themselves disrupted. Several issues are still open to be investigated to deepen our understanding of the disruptive innovation phenomenon and the dynamics of an innovation maturing from being potentially disruptive to becoming actually disruptive (Danneels 2004). With this research, the aim is to build on the disruptive innovation discuss to extend knowledge in this area specifically following the calls by Danneels (2004) and Markides (2006).

Research Questions

The aim of this research is to investigate why potentially disruptive innovations which have been analysed to be disruptive relative to an industry/product fail to achieve that status despite the initial promise on several measures. In attaining these objectives, some of the underlying questions examined include:

What are the key attributes and theoretical background that characterizes disrupted disruptions and potential disruptive innovations?

What lessons can we extract from these occurrences that other managers facing threats of disruptive innovation can find valuable?

2 Methodology

This paper is a result of a two-step research process. The general research design is closely modelled after the approach adopted by Yu and Hang (2011). The first process involves a review of prior research via an academic literature review plus available media and archival data. The second process involved two sets of qualitative interviews which are detailed in this section.

Starting with the interviews, expert interviews were conducted to acquire insights from practitioners involved on the innovation examples that were finally included in our analysis. These interviews were useful in understanding the why's, how's and what if's (Yin 1994) that surrounds the notion for a particular innovation to have been deemed potentially disruptive as viewed from their foresight/hindsight. These qualitative technique of interviews most suitably fits this need due to the nature of answers required which depended on the intrinsic knowledge of the participants of the interviews (Eisenhardt 1989).

Nineteen (19) interviews were conducted over a period of three (3) years. The first interviews were conducted in 2011 involving thirteen (13) managers with Innovation responsibilities or research related responsibilities in ten (10) leading multinationals across different industries. This provided foresight answers to a test scenario of what innovations were considered likely to move from being potential DIs to actual DIs from the list. The next sets of interviews were conducted in 2013 with six (6) executive level managers with innovations and IT as their domain of expertise. These second set of interviews were now aimed at assessing their expert opinions from hindsight on the potentially disruptive innovations from the list that could be considered to have truly transcended to the status of an actual DI or if they have fallen short of that label – hence becoming disrupted disruptions. The insights and knowledge gathered from the interviews thus provided the basis for answering the second research question.

In initiating the study, a systematic literature review[5] was first carried out to identify innovations that have been labelled as disruptive from prior academic research. The methodology adopted for this process follows an adaptation of the guidelines outlined for conducting a literature review provided by Okoli & Schabram (2010) and Webster & Watson (2002). This study employed an analysis of articles returned from two academic journal databases - Science Direct (Elsevier) journal database and EBSCO Host journal database.

This involved searching the databases with the keyword 'disruptive innovation' and subsequently collecting articles that specifically were referring to disruptive innovation in the context of one or more particular innovation examples rather than general disruptive innovation discussions. This pre-selection mostly

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[5]Due to space limitations, further details and tables from the literature review are available on request.

involved the title and the abstract of the returned articles. From the selected articles, a list was made highlighting different examples of innovations that have been labeled as either a DI or a potential DI. This list provided the starting point for this study. The review also provided the academic framework under which any pre-identified innovation in prior literature has and/or can be considered as a disruptive innovation and by extension – a disrupted disruption. The literature review additionally provided a source for collecting a list of innovations that have been considered disruptive or potentially disruptive from the perspective of academic research.

In addition, the decision to proceed further to examine archival data is due to the nature of the research questions and topic under consideration. The archival data were valuable secondary sources of data to assess and confirm the relative disruptive status of innovations that have been earlier predicted to be of a disruptive potential. This process was more targeted as further secondary information was sought for most of the innovations that were unfamiliar in the compiled list. This helped to make an initial screening of the collected examples and to confirm the present status of the DI examples and to better assess if the example is indeed a DI, a potential DI or a case of a failed DI. An extensive collection of data spanning different industries and product history were gathered to facilitate the analysis from which the proposed disrupted disruption framework advanced for this paper has been deduced.

Lastly, to test the broad acceptability of the disrupted DI examples and gather further data on other possible cases of disrupted disruptions, a workshop with 36 participants was organized on the concept of disruptive innovation, disrupted disruption and potential DI. The participants were then requested to make a list of examples (with reasons) that they consider to be clear cases of disrupted disruptions and potential disruptive innovations. This phase of the research served as a triangulation measure to confirm and further analyze our preliminary findings and to tune the lessons learnt for practical relevance to practitioners as well as the academic society (Eisenhardt 1989).

In summary, this paper builds on an extensive body of academic literature, historical articles, industry publications, archival data and interviews on the topic of disruptive innovations especially the evolution of potentially disruptive innovations.

3 Results and Discussions

b)   *Conceptualising Disrupted Disruptions and Potential Disruptive Innovations*

Due to the nature of disruptive innovations, they generally cannot be truly labelled as such ex ante (Christensen 2006, Markides 2006, Daneels 2004). Also, according to Christensen (2006) and Govindarajan Koppalle (2006), DI is a relative phenomenon, which therefore implies that it is not sufficient for an innovation to only have the attributes of a DI to actually qualify as a DI. For an innovation to thoroughly qualify as a DI there needs to be what it has been disruptive relative too. For example, for each disk drive disruption there was a generation of disk drives being disrupted (Schmidt and Druehl 2008 and Christensen 1997); for the disruption of the PC computers, there was a mainframe computer disrupted. In other words before an innovation has a clearly identifiable organisation/product that it has disrupted, it can only at best be considered a *potential disruptive innovation (PDI).* Therefore, when an innovation with tendencies and attributes of a disruptive innovation is introduced, it is logical to pronounce such an innovation as a potential disruptive innovation until what it is disruptive relative to is clearly adjudged as disrupted.

The concept of PDI becomes relevant if we consider the different cases of acclaimed DIs that really never disrupted. These PDIs that eventually fall short of being termed DIs are what we effectively refer to as *disrupted disruptions (DD).* This then leads to a logical consideration of the possible paths of a PDI as illustrated in figure 1.
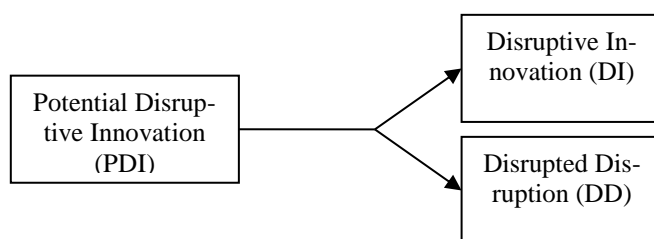
Figure 1 The possible evolution path of a potential disruptive Innovation.

The key distinction between a DI and a DD is dependent on if what the PDI was poised to disrupt is eventually disrupted. This is due to the fact that the relativity of the DI construct implies that the subsequent disruption process is not completely dependent on the Innovation or the creator of the innovation alone but it is also dependent on the actions and response implemented by the responding/threatened organisation. This therefore implies that while an innovation might be disruptive by design, its eventual path from the PDI position to either DI or DD can be influenced by the actions of the organisation to which it is potentially disruptive too.

The implication of this path view to the emergence of a DI highlights the point that organisations threatened by a PDI can in many case play a role in determining if the innovation would eventually become disruptive. This view is opposed to the thinking that an innovation is necessarily and sufficiently disruptive only by design. The identified distinction between the three concepts as identified and condensed from different papers form the conducted literature review is presented as a *disruption differentiating framework* in table 1.

Table 1 Framework for distinguishing between Potential Disruptive Innovation, Disrupted Disruptions and Disruptive Innovations

	PDI_{t1}	DD_{t2}	DI_{t2}
Innovation attributes			
Different performance attributes	Necessary	*Not Necessary	*Necessary
Not valued by key customers	Necessary	*Not Necessary	*Necessary
Encroaches existing markets	Necessary	*Not Necessary	*Necessary
Appeals to market fringes	Necessary	*Not Necessary	*Necessary
Simpler, more convenient	Necessary	*Not Necessary	*Necessary
Serves non-consumers	Necessary	*Not Necessary	*Necessary
Gains adoption	Necessary	*Not Necessary	*Necessary
Target low end of market	Not Necessary	Not Necessary	*Necessary
Product innovation	Not Necessary	Not Necessary	*Necessary
Less costly offerings	Not Necessary	Not Necessary	*Necessary
Inferior quality	Not Necessary	Not Necessary	*Necessary
Existence of a disrupted?	Not Necessary	No	Yes
Condition	contains some *necessary* attributes	lost the advantage of its key PDI attributes	significantly impacted the responders position

Key:

1. *Necessary*: Should possess the attribute but not compulsorily

2. *Necessary: May still possess the attribute or it may have evolved

3. *Not Necessary*: Should have lost the attribute relative to responder but not compulsorily

4. *t1 and t2* indicate time at an initial time 1 and a later time 2

Table 1 shows a classification of the differences of an innovations attribute that distinguishes its status as a PDI, DD or DI. The table shows that while the presence of one or more attributes maybe a necessary requirement for being a PDI the absence of an attribute does not nullify its qualification provided the innovation possesses at least more than one of the attributes. For example, 3D printing does not presently score in terms of the attribute 'Gains adoption' but it can be said to be a PDI since it qualifies on other attributes (Grynol 2013). Additionally, 3D printing can also not already be considered a DI or DD because it is an emerging innovation in its infancy that has not significantly impacted the manufacturing industry it is poised to disrupt neither has it lost its potency in the PDI attributes that currently defines it.

The attributes were collected from different papers during the literature review, it was however discovered that while there are many attributes associated with a disruptive innovation in prior literature, most

where different variations of the initial attributes of a DI as postulated by Christensen (1997, 2000) and further extended by Govindarajan and Kopalle (2006), Adner (2002) and Schmidt and Druehl (2008). Hence the attributes included in table 1 is representative of the dominantly occurring themes that has been used to characterize DI. Additionally, positioning the attributes into the different cells of PDI, DD and DI required taking a guide from Yu et.al. (2008) review of DI and a recent definition of DI advanced by Baiyere and Salmela (2013) which attempts to address some identified anomalies in earlier definitions:

> "A disruptive innovation introduces a different set of **attributes** relative to a **market** which are unattractive for mainstream customers on inception due to **variance** in attributes valued by this market - although a different market segment may value the new attributes. Subsequent developments over time, however, raise the innovation's attributes to a level sufficient to satisfy mainstream customers, thus attracting more of the mainstream market.
>
> Where: *Market* = (products, business models, goods... and/or technologies).
>
> *Variance* = (inferior, superior, complexity…) and
>
> *Attributes* = (features, performance, price,... and/or processes)"

Going from the definition of DI above, the attributes labelled as 'Not Necessary' in the PDI column can be readily understood. For instance, a PDI or DI does not necessarily have to be a product innovation but could also be a business model innovation. Furthermore the disruption is not essentially dependent on if the innovation is of lesser cost or is aimed at the low-end of the market neither is it dependent on if it is of inferior or superior quality as described by Baiyere et.al (2013).

To further clarify the concepts of DD and PDI, cases that were dominantly recurring from the interview would be presented in the next section. These cases are a) mobile devices innovation as a pivot for a set of PDIs and b) some example cases of typical DDs.

c)   Case I: Mobile-Device-Driven Innovations as a Potential Disruptive Innovation

Some Innovations centred around the advances in the mobile device domain have been considered to be a case of PDI by both prior literature and interview respondents. Taking the increasing adoption of mobile devices as a pivot, many innovations surrounding or emanating from the mobile space have positioned themselves as PDI to leading incumbents across several industries (See figure 2).
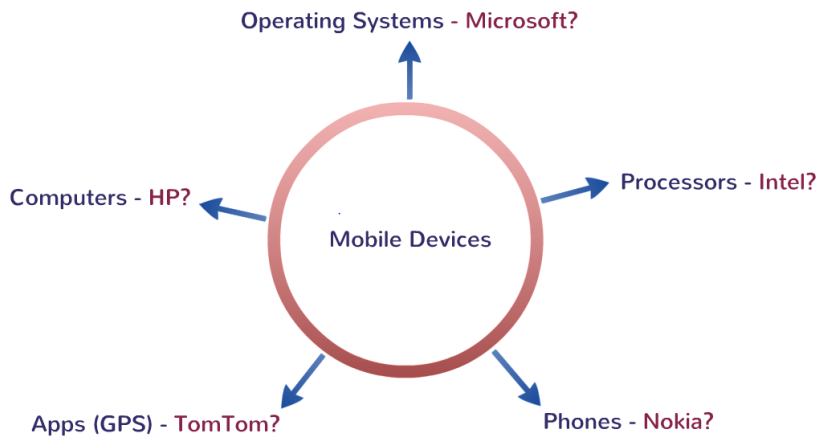
Figure 2: Mobile-driven innovations as a case of potential disruptive innovation

Figure 2 presents some of the perspectives with which the mobile space innovations have been identified to have disruptive potentials. The central factor considered to be driving this potential is the rate at which mobile devices are gaining adoption. Interestingly the industries identified as facing the threat from these trends are not directly operating in the mobile device industry. *This confirms the points out that disruptions can and do arise from industries or sectors that are tangential to the actual focus of the organisation facing such disruptions.*

In this case, while Nokia could be considered a direct responder to the emergence of smartphones, HP would be responding to the growing trend of users substituting their choice of buying computers with mobile devices like smartphones and tablets (see figure 3). Consequently, since computers are tightly associated with processors and operating systems, a decline in the computer industry in terms of manufacturing and sales potentially impacts dominant companies in this sector like Microsoft and Intel. TomTom on the other hand is facing the threat in the space as mobile apps like Google maps gains increasing adoption as an alternative route navigation system.

Figure 3 presents charts that highlight the trend of events that position some of these companies in a responding situation to the PDI nature of the mobile space innovations. The charts (culled from Business Insider (2013, 2010) using public available data sourced from Asymco, IDC and Morgan Stanley research), shows the increasing pace of growth of mobile devices relative to the personal computers – PC. While figure 3a shows the relative growth of mobiles, figure 3b shows the stunted and declining growth of the PC market. These trends are of importance when viewed with respect to the dominant status of the companies facing this potential disruption. For instance, Microsoft's windows operating system accounts for 90% of all computing platforms in 2009 but presently accounts for 24% while Google's Android is continuously increasing its share in this space (Blodget 2013). Similarly, Intel is a clear leader in the microprocessor business, however, since Intel's business is closely tied to the PC industry, this dominant status is potentially being challenged by relatively new entrants like ARM (Andrew 2005, and Mallinson 2008). Table 2 shows how these mobile-driven Innovations fit into the PDI component of the disruption differentiating framework of table 1.
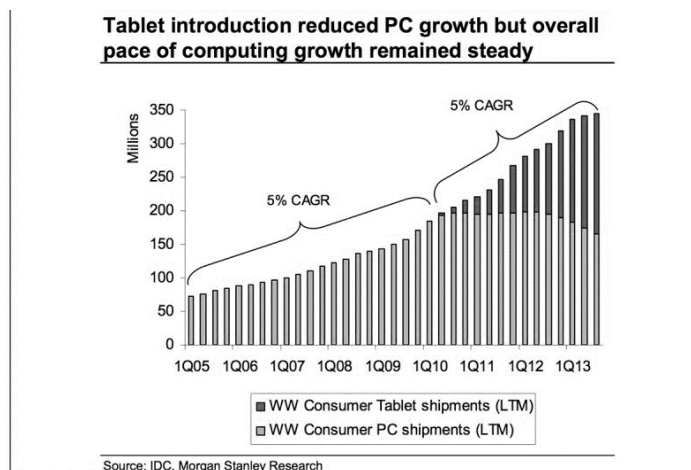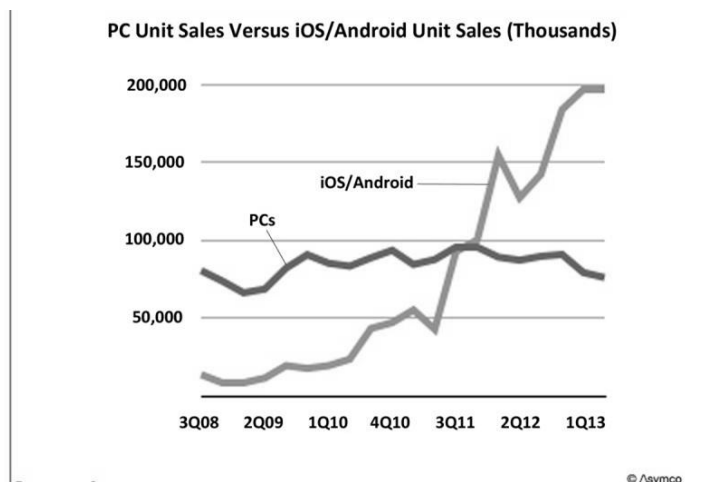
Figure 3: a) The outpacing growth of mobile devices relative to PCs b) The substitution trend of PCs by tablets

From Table 2 it can be observed that the innovations meet at least two of the criteria and not necessarily all as indicated by the conditions for labelling an innovation as a PDI in table 1. It should be noted however that the categorization is not a binary of true/false but based on the degree of fit (or level of fulfilment - Hüsig et.al. 2005) with which each individual attributes can be associated with each innovation. The process of determining the appropriate check for each case is based on the insights of the interview respondents and further information sourced from the literature and historical data. The tick symbol ☑ is indicative that the attribute can - to a good extent be associated with the innovation while the ☒ symbol indicates a low or null association. The ☐ symbol symbolises neutrality where the status is neither true nor exactly false.

Table 2 Positioning the mobile space innovations as potential disruptive innovations.

Potential Disruptive Innovation ➜	Android / iOS	iPhone / Galaxy	ARM Processors	Tablets / Smartphones	Google Maps
Potentially disruptive to ➜	Windows (Microsoft?)	Feature phones (Nokia?)	PC processors (Intel?)	PCs (HP/Dell?)	GPS Navigation (TomTom?)
Innovation attributes					
Different performance attributes	☑	☑	☑	☑	☑
Not valued by key customers	☑	☒[6]	☑	☐[7]	☑
Encroaches existing markets	☑	☑	☒[8]	☑	☑
Appeals to market fringes	☑	☑	☑	☑	☒[9]
Simpler, more convenient	☐[10]	☑	☑	☑	☒[12]
Serves non-consumers	☑	☒[11]	☑	☑	☑
Gains adoption	☑	☑	☑	☑	☒[13]

Although these innovations may currently be regarded as PDIs, if they will eventually become a DI or end up as a DD is a function of time. However, their eventual path as demonstrated in figure 1 is very much dependent on their adoption and sustaining characteristics as well as the responding actions of the incumbents. The possibility and implications of these innovations ending up as a DD is captured by the DIVE model presented later in this paper.

d)   Case II: Examining some examples of Disrupted Disruptions

Google Docs is a classic example of an innovation that at inception, very well aligned with the defining characteristics of a PDI. It scored highly in almost all metrics of a disruptive innovation as initially advanced by Christensen (1997, 2000). Although Google Docs can be said to be an innovation that was disruptive by design (Keller and Husig 2009), it however has lost the disruptive potential that characterizes its early days. To determine if it indeed has moved from being a PDI to a DD, the attributes that makes it a

---

6 - Directly valued by high paying customers

7 - Valued as a supplement rather than a substitute

8 - Creates new market

9 - Appeals directly to same customers

10 - Not necessarily simpler/ more convenient but rather different.

11 - Serves existing consumers

12 - Not necessarily simpler however ccumbersome to mount

13 - Adoption currently in the infancy stage

PDI relative to Microsoft Office would be evaluated with the disruption differentiating framework of table 2. From the table it can be readily deduced that it satisfies most of the criteria of a PDI with the possible exception of "Serves new customers" and Gain adoption". According to the framework, the condition to be considered a DD is that it should have lost most of the key attributes that made it a PDI. For instance the attribute "Different performance attributes" is no longer valid as Microsoft has also launched an identical product with some performance attributes as initially possessed by Google Docs.

A logical question to ask would then be – why/how did it end up as a DD? The answer lies in the response of the responding organisation – Microsoft and its adoption rate. Microsoft being a *direct competitor* with Google on other grounds easily noticed the innovation, recognised the potential and *promptly responded without ignoring* it (Mohan et.al. 2012). Secondly, Microsoft also had enough time to adequately respond to it due to the customer lock-in and inertia that limited the *speed of adoption* of Google Docs (Hang et.al. 2011).

Nintendo Wii is an example of an innovation that seems poised to be disruptive to Xbox360 and Sony's PlayStation3 (Yu et.al. 2011). In similar fashion as Google Docs, the Wii held the promise of another case of a DI (Kohlbacher 2007). An evaluation with the framework also confirms its PDI position as well as its current DD status. Comparably with the Google Docs case, Wii was aimed at disrupting incumbents with which its parent company – Nintendo already *directly competes*. Due to this awareness, *ignoring* the advances of Wii would not be a logical response. Therefore Wii's key advantage of creating a new market was *spotted early* and due to the *slowing rate of adoption,* Microsoft also had space to advance its Kinect technology to rival the performance attribute of the Wii.

Another example of a typical DD is the **Tata Nano** which also scores very well on the PDI scales but never advanced to becoming a DI. Interestingly, its PDI attributes that were most pronounced by analysts and scholars where all the PDI attributes that have been considered "Not Necessary" in the framework in table 1 (Ray et.al 2011). It was an example that draws a parallel with how the Japanese cars grew to be of a disruptive nature to the automobile industry in the US and Europe (Hart and Christensen 2002).

However despite its well fitted characteristics as a PDI (Wells 2010), Tata Nano *never gained adoption fast* enough to evolve to a significant threat to either the automobile industry or the two wheelers industry (Birtchnell 2011). In addition, being an *incumbent* in the automobile industry attracted attention such that *competitors* like Renault declared their intention to introduce a car which would be even cheaper than the Nano (Anthony 2009). These factors have therefore eroded its key advantage of "Serving non consumers" with "Less costly offerings".

A unique example of a DD case is the **Minicomputer**. What distinguishes this from the other DD cases is that it extends the PDI disruption path presented in figure 1. This is because it is a case where a PDI became a DI before becoming a DD itself (see figure 4). This occurrence is in line with Christensen's (1997) observation that a disruptive entrant usually matures or later slacks to a point that it then becomes an incumbent that is also ripe for disruption by another disruptor. He equally demonstrated this with the different generations of disk drives that disrupted the preceding generation. It can also be hypothesized that there is another path where a PDI that becomes a DD can similarly also revive its potential to finally become a DI, however this study's present data (literature review, archival data + interviews) does not provide evidence of this. This therefore leaves this path of enquiry open to be empirically verified.
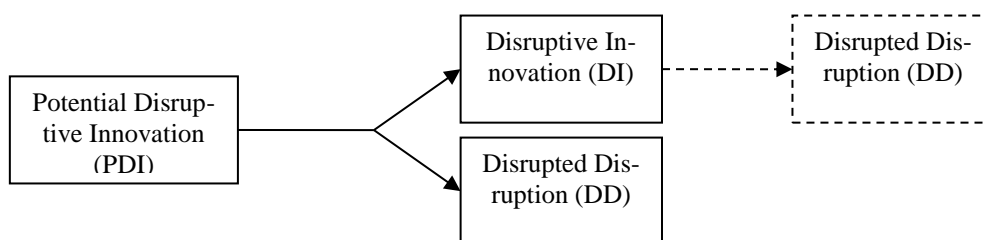
Figure 4 The extended evolution path of a potential disruptive Innovation

The Minicomputer case can be referred to as the *stepping stone to the core disruption.* According to Markides (2006), it is often not the initial creator of the innovation (particularly disruptive radical innovations) that necessarily moves the innovation to its disruptive potential. In this case the minicomputers eventually disrupted the mainframe computer market but they were subsequently disrupted by the now dominant personal computers. In contrast to the other examples, this is an example where the companies who created the innovation at its PDI phase were mostly *entrants* and the PC companies subsequently that disrupted it were equally entrants (Denning 2012). Also, this is a case where most of the incumbents in both instances *ignored* the PDI only to realise they were *too late* (Bower et.al 1996, Christensen, Bohmer and Kenagy 2000), with the exception of IBM that successfully navigated through the disruption waves (Christensen et.al 2000b). Additionally, all the disrupting entrant companies in this chain of events were not already in *direct competition* with the incumbents. Lastly, the *pace of adoption* of the innovation was fast enough that late responding companies were indeed too late.

4 Theoretical and Practical Implications

e)   *Disrupted Disruption Propositions*

Following the analysis of the different examples of DDs presented above, we can summarily highlight some key characteristics that are peculiar to DDs. In this section the defining characteristics of DD that have been identified are specifically expatiated upon to formulate four set of propositions (represented by DIVE) that attempt to better conceptualize the notion of disrupted disruptions. These propositions open up research agendas that are open to be empirically developed by future research.

Firstly, innovations that create entirely new markets or encroach on an existing market from the fringes can effectively grow to a significant level before the responding organisation (responder) gears itself to respond. However, innovations that begin by directly attacking the core customers of the responder would very likely be promptly resisted before its disruptive potential is unleashed. For instance, PCs were not targeted at the core customers of the minicomputers or the mainframes at inception. Due to this the PC market could grow without any targeted response until the PCs gradually started attracting the main customers of the minicomputers. Generally, PDIs tends to be more lethal when they emerge from unsuspecting or unlikely contenders.

> Proposition **D** (Direct competition): *If the initial offering of a Potential Disruptive Innovations is not 'directly competing' for the mainstream customers, the chances of ultimately becoming disruptive is higher.*

Secondly, when a PDI is spotted early enough and importantly, if it is not ignored, the responding organisation gains a valuable start to launch a counter response. However, often times most PDIs are actually spotted early yet they are ignored at the onset. The challenge here is closely related to Proposition D because when the disrupter is an unsuspecting/unlikely contender, it understandably gets lesser attention compared to a direct competitor. Baiyere et.al (2013) provides a CLIF framework which highlights why most PDIs are ignored. These include a) Customers feedback as a blinding veil. b) Leadership orientation based on short term goals c) Innovators emotional attachment to their existing innovation. d) Financial projections as a DI evaluation lens. From the DD examples above it can be seen that one of the core reasons why they failed to become disruptive is related to the fact that they were not ignored by the responding organisation Generally, one major factor that supports many PDI to advance enough to unleash their disruptive potential is because they were not considered worthy of the attention and resources of the incumbent company. History has therefore shown that ignoring PDIs could come at a big cost.

> Proposition **I** (Ignore): *If a potential disruptive innovation is acknowledged 'early and not ignored', the likelihood of it significantly disrupting the market position of the responder can be limited.*

Thirdly, an important component in the success of a PDI is the adoption. While adoption is perhaps a constant in all cases of eventual disruptive innovations, the speed with which the innovation is adopted is relevant in determining the possibility of an effective response. Following the arguments of Proposition I, it can be logically deduced that spotting a PDI 'early' is relative to the rate at which the PDI is being adopted. In essence, being 'early' or 'late' is a function of how far the PDI has been adopted. For example,

when Xerox realised it had to respond to the threat of the lesser performing copiers from Canon, the Japanese copiers had gained wide spread adoption and the damage was already done. However, Google Docs' rate of adoption was slow enough for Microsoft to come up with an effective response.

*Proposition **V** (Velocity of adoption): The 'velocity of adoption' of a potential disruptive innovation is one of the parameters that can significantly determine if it will eventually develop to be disruptive.*

Lastly, most examples show that when an innovation that is poised to be disruptive occurs in a domain where the innovation creator (disruptor) is already competing with the responding organisation, the likelihood of the innovation ending up as disrupted rather than disruptive increases. This can primarily be because competitors naturally are aware of - and pay attention to – any new innovation from each other which makes it difficult to create an innovation that will be ignored by the competitors (Baiyere 2011). This can be also explained with a converse argument. For example, it was easier for Google to be disruptive to the traditional advertising industry since that sector was not its primary business focus. Similarly, Apple could easily attack Nokia's dominance without an immediate response since it was considered a novice entrant into Nokia's terrain of vast expertise, if however the iPhone was introduced by Motorola, it plausibly would have received more attention. Therefore new entrants introducing a PDI to an industry have an advantage of stealth over the incumbents.

*Proposition **E** (Entrants): New 'entrants' to a market/industry are more likely to disrupt than incumbents.*

f) The DIVE Model

The four propositions characterizing DDs are useful inputs in modelling the interaction between the innovation and the responding/disrupting organizations which we refer to as the DIVE model (see figure 5). Each component of the DIVE model is representative of 4 set of evaluations that are needed in better understanding the potential of the innovation. These are the Customer, Market, Industry and Self evaluations.
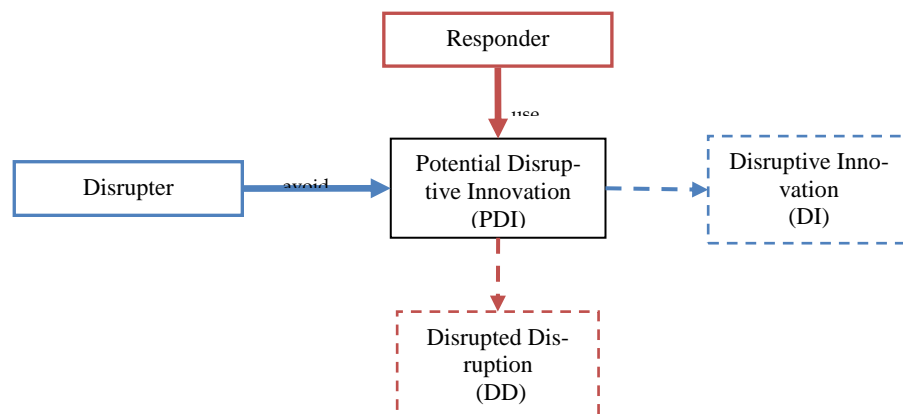
Figure 5 The DIVE Model

The model is built on the foundational premise that an innovation may be disruptive by design but for it to transit from a PDI to a DI it has to pass through the response actions of the Responder. Therefore as illustrated in the model, for a Disrupter to avoid its innovation from being pushed into the DD zone, the Disrupter needs to consciously try to avoid the trap of each DIVE component. This implies that the innovation needs to be positioned to satisfy questions such as –

g) *How can 'direct competition' for the mainstream customers be initially avoided?[Customer Evaluation]*

h) *Can the responder(s) consider it as an innovation to 'ignore'? [Industry Evaluation]*

    i)   *How do we gain a high 'velocity of adoption'? [Market Evaluation] and*

    j)   *Are we positioned as 'entrants/incumbents'? [Self-Evaluation]*

By applying same DIVE principles but by applying it conversely the model can also be used to present the Responder some set of underlying questions to guide it to better make decisions that can potentially push the PDI to the DD zone. The questions that should be satisfied in order to better position and have the possibility to prevent the PDI from blossoming to a DI include:

    a)   *Which segment of our customers is the innovation 'directly targeting'? Or is the innovation presenting our customers with a substitute?[Customer Evaluation]*

    b)   *What are the risks of 'ignoring'? [Self-Evaluation]*

    c)   *How 'fast is it gaining adoption'? [Market Evaluation] and*

    d)   *Is the potential disrupter an 'entrant/incumbent'? [Industry Evaluation]*

In summary, the model provides a simple yet practical tool for the evaluation of an innovation both from the disrupters' perspective as well as the responders' perspective. Basically innovations can be easily positioned as a PDI, DD or DI using the disruption differentiating framework (Table 1). If the output of the framework is a PDI, the DIVE model can then subsequently be used to analyse the PDI and better determine the most suitable course of action relative to either the Disrupter or the Responder position. The model is advanced to help conceptualize the attributes and response approaches that can characterize disrupted disruptions. It is however opened to be further empirically advanced. It is currently presented to illuminate some of the findings of this research and to contribute to current understanding of the disruptive innovation phenomenon.

5 Conclusions

This study indicates that the concept of disrupted disruptions can provide us valuable insights into how innovations with potential to be disruptive relative to an incumbent can lose its potency and become just another innovation. On the other hand the study also conversely provides some approaches that can be followed to mitigate an emerging disruptive innovation by an incumbent company facing the threat of imminent disruption. Additionally, the disruption differentiating framework provides a platform and reference point for future research to elicit as a worksheet for determining whether an innovation qualifies to be considered a PDI, DD or DI.

The practical implication and contribution of this paper is unfolded in two dimensions with one focus on the disrupters while the second focus is from the perspective of responders. For organisations creating or aiming at creating innovations that can be labelled disruptive, the paper provides the DIVE model with which they can evaluate their innovations potential. For the responding organizations, the model also gives the decision makers some indices to position the looming disruption and better guide their decisions towards thwarting the innovation from attaining its disruptive potential.

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Paper 3: Wicked yet Empowering-When IT Innovations are also Disruptive Innovations.

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Wicked yet Empowering - When IT Innovations are also Disruptive Innovations.
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Abstract

What happens when an IT innovation is also a disruptive innovation? This study explores this question by examining sample cases of advances in IT that have also been categorized as disruptive innovations. The study leads to a conceptual thesis that such occurrences result in a contrasting duality dimension of wicked challenges and empowerment opportunities for different actors. We advance a model for positioning an IT innovation with disruptive tendencies in an impact quadrant to access its relative position to different actors. We observe that in an era characterized by continuous rapid advancement in IT, the tendency for the emergence of disruptive IT innovations increases. We therefore conclude by highlighting trends in this direction and advance future research agenda that should open up an opportunity for IS research that could be both theoretically insightful as well as practically relevant.

Keywords: Disruptive Innovations/Technologies, IT Innovations, Wicked Problems, Empowerment, Sustainability and Societal Impacts of IS, Economics and Value of IS, Value Creation

Introduction

Typically, Information Technology (IT) Innovations tend to empower those using it in different ways and from different perspectives. In many cases, the opportunities opened up by an IT innovation can be very different for different groups and individuals. This is not to say that IT always ushers in an innovation that is entirely glorious and pleasant to all involved. IT innovations are however often perceived and received for the benefits accruable due to the opportunities they bring. Although recently, there has been a call for more focus on the consequence of advances in IT as well as the opportunities they afford (Markus and Mentzer 2014; Majchrzak and Markus 2012).

On a very similar footing, Disruptive Innovations have a general connotation of calamity and challenging circumstances particularly by those facing its threat (Christensen 1997, 2006). This however is not completely the case, depending from what perspective the disruptive innovation is viewed and by who (Baiyere 2015). While disruptive innovations have caused many leading organisations to falter and in many cases become obsolete or even extinct, there exists another side to the phenomenon, which happens not to be much recognized nor mentioned in scholarly research that nonetheless provides benefits to certain actors.

Generally, it can be said that the predominant view is that IT innovations by their nature are sources of *empowerment* for different actors at different levels (Yoo et al. 2010, Brynjolfsson and Saunders 2010) while disruptive innovations by their nature create *wicked problems* for actors challenged by them (Danneels 2004). Empowerment in this context refers to the affordance given to an actor to achieve, perform and realize goals that were hitherto not readily possible (Page and Czuba 1999). Wicked problems on the other hand describe situations that are characterized by

significant degree of complexity, uncertainty and divergence that makes an easy solution difficult, if at all possible (Churchman 1967).

In a situation where an Innovation is both an IT innovation as well as a disruptive innovation, a question that will logically surface would be - which of the typical attributes of the innovations prevail and in what ways does these affect the different actors concerned? This paper examines what happens when an IT innovation is also a disruptive innovation - an occurrence that we call Disruptive IT Innovation (or - DITI henceforth).

With today's IT innovation space highly characterized by a fast-paced change and technological advances, the emergence of disruptive IT innovations is ever on the increase. This becomes particularly relevant in this era where there is increasing interest in exploring Blue Ocean IS research opportunities. This paper consequently presents a set of future research agenda that can serve as a step towards scholarly inquiry in this direction.

Research Motivation

A recent literature review reveals that despite the importance of the concept of disruptive innovation and the prevalence of examples from the IT domain, IS research has sparsely extended its inquiry into the occurrence or relationship between IT and disruptive innovations (Baiyere and Salmela 2013, Nault 2006, Lyttinen et al 2003). Although a copious amount of research exist in other disciplines on disruptive innovations (Christensen 1997, 2006 Danneels 2004, Govindarajan and Kopalle 2011, Tellis 2006), the general perception seems to align towards how an innovation comes along and an incumbent struggles to deal with it. While in the IS research stream the perception of IT tends to have a more positive tone as to the value that IT brings to different groups or individuals (Hitt and Brynjolfsson 1996). This rather contrasting and opposite perception exist despite the fact that most examples of disruptive innovation have been IT innovations. It is therefore of interest to have a joint analysis of the interplay between IT and DI in other to highlight the importance of IT in disruptive innovation scenarios.

Consequently, the apparent disparity in perspectives led to this enquiry to understand the implication of IT innovations that are also disruptive innovations and to examine how such innovations impact different actors. Based on this the driving research question for this study is simply expressed as follow:

How does/can disruptive IT innovations affect different actors and what are the associated implications of such occurrences?

Theoretical Framework

Due to the interdisciplinary nature of the studies, it would be of value to examine the different constructs form reference disciplines that are employed in this research with relation to an IT context. According to Wade and Hulland (2004) it is valuable for IS as a discipline to borrow from reference disciplines, we should however avoid doing so blindly without due consideration for the IS context. Furthermore, it is also of key importance to highlight what has been done in this area by prior studies both in the IS and other disciplines. We would therefore be exploring what is known about disruptive innovations, wicked problems and the concept of empowerment (Baiyere 2015) with emphasis on the aspects most relevant to the study at hand.

Disruptive Innovation (DI)

A disruptive innovation has generally been defined in the context of organisations as an innovation that whenever it occurs, introduces a new set of business rules to the market that causes an incumbent organisation to struggle and in many cases to lose whatever esteemed position it may have in that business environment (Christensen 1997; Kostof, Boylan and Simons 2004). Responding to a disruptive innovation can be likened to changing the wheel on a car in motion. This is because responding to the change could entail rendering existing competencies and long earned operational knowledge obsolete (Christensen and Raynor 2003; Henderson 2006). These changes or cannibalizations are usually challenging for organisations, and managers (for very rational reasons) tend to be reluctant to undertake them – therein lies the dilemma (Govindarajan, Kopalle and Daneels 2011; Chandy and Tellis 1998).

Disruptive innovations have resulted in the displacement of leading companies by unseemly new entrants or at times by innovations that are very much within their capacity to create (Christensen et al 2003). For example, UNISYS was disrupted in the mainframe era by minicomputers and

subsequently by desktop computers, Kodak got disrupted with the advent of digital imaging which they interestingly were among the notable pioneers, Xerox despite being the inventor of the copying machines got displaced as market leader by Canon and other less-performing copying machines at that time. Disruptive innovations challenges incumbents with complex (and at times conflicting) choices and introduce a divergent performance measures from what the incumbent companies are traditionally used to.

It should be noted that disruptive innovations are distinct and very different from radical innovations and discontinuous innovations (Baiyere et al. 2013). While radical innovations are often "wow" innovations that are in most cases new to the world, disruptive innovations can be very basic and simple (Christensen 2006). For example, the motor car was a radical innovation for its time while desktop computers - although inferior in many ways - disrupted the high-performance mainframe computers. Discontinuous innovations on the other hand are innovations that change the trajectory of an innovation (Lynn, Morone and Paulson 1996). For example, the concept of phones has always been - it needs to be on a table and be connected by a wire. The advent of the cellular mobile phones changed the trajectory of phones from a desk device to a handheld device. Similarly, televisions are traditionally made with cathode ray tubes but gradually moved from the hunch-backed sets to a flat screen concept. In essence, discontinuous innovations change existing standards and introduce a new standard that ensuing innovations follow but do not necessarily cause a disruption (Tidd et al. 2009).

Disruptive Information Technology Innovation (DITI)

Despite the dearth of research exploring both IT and DI (Baiyere 2013, Nault et al 2000 and Sherif et al. 2006), a notable exception is the study by Lyytinen and Rose (2002) where they described the concept of disruptive information technology with respect to a developmental context. They presented disruptive information technology as an innovation that has an impact on the development process and the eventual outcomes. These are also construed to reflect innovations that require a radical shift that calls for significant change or modification to the architecture of work processes (Sherif, Zmud and Browne 2006). In essence, the focus of DITI in this context is localized as the purview was from and for the organisation's IT. In this study, we extend the definition of DITI as - IT innovations that are also disruptive innovations in the sense that they are disruptive not only within an organisation but also have impact beyond organisations to individuals and/or the society.

The distinction between a regular IT innovation and a DITI lies essentially in the disruptive attributes of the innovation. Following the delineation between disruptive innovation and other innovations made by Christensen (2006) and Govindarajan & Kopalle (2006), the disruptiveness of an innovation lies not so much in the technological advancement but in its impact on the market position of existing innovations and its consequent displacement of an incumbent. By extension, an IT innovation is only a DITI in this context, if it is also a disruptive innovation. Since disruptive innovation is a relative construct by definition (Christensen 2006, Baiyere 2014), this means that for an IT innovation to be labelled a DITI there should clearly be an existing innovation, market or organisation that has been disrupted by it. As typical, with disruptive innovations, the impacts of such disruption could extend beyond the organisation to individuals and the society (Baiyere 2015). If an IT innovation exhibits the attributes of a disruptive innovation but cannot be said to have clearly disrupted anything, it is at best a potential DITI (Baiyere 2014). For example, the mouse as an input device innovation can be considered a regular IT innovation despite its pervasive success; while the digital camera can be considered a DITI as it is an IT innovation that became disruptive to Kodak and lastly, Bitcoin can currently be considered a potential disruptive IT innovation.

Wicked Problems

This is the term used to describe complex matters that are difficult to resolve due to inadequate, conflicting and varying requirements that are often very hard to recognize (Churchman 1967). In general, wicked problems usually give confusing information and produce conflicting interests within different stakeholders. These are characterized by challenging situations without a single clear-cut solution (Rittel and Weber 1973), and they are unique to each particular context (churchman 1967).

Solutions to such problems are not necessarily measured by true or false but rather good or bad (Rittel and Weber 1973). It is also worth mentioning that the construct of "wicked" does not typify

evil in the dictionary sense but rather it is used to conceptualize the associated complexity, uncertainty and divergence of the problem (Conklin, E. J., and Conklin, J. (2006). Additionally, due to the uncertain nature and the complex interdependencies of wicked problems, they are usually very challenging to completely solve. This is because the process of solving one aspect could trigger or open up other hidden problems (Ferlie, E, Fitzgerald, L, McGivern, G, Dopson, S and Bennett, C, 2013).

Whyte and Thompson (2012) sum it up by distinguishing it from traditional problems as follow: Unlike problems with clear cut understanding and little disparity about its formulation, wicked problems are characterized by uncertainties and ambiguity in their foundational assumptions and the possible solution options used in their articulation (Ferlie et al. 2013; Conklin et al 2006). These attributes are closely related to the challenging dimension of disruptive innovation for actors threatened by it. (Dufor 2013).

Empowerment

The term Empowerment has been widely used in different fields of research and the meaning has taken various forms in different disciplines. In this study we have adopted Page and Czuba's (1999) definition which relates to management and hence offers closer application to the IS context. They described empowerment as a social process that allows individuals/groups/organisations to have control over certain key aspects of their existence (i.e their lives and activities) and it affords the opportunity to achieve things that were hitherto not possible. It is a concept that fosters the notion of power (that is the capacity to implement or make happen) in people, for utility in their own actions, their environment and in their society, by taking action on issues that are of importance to them (Page and Czuba 1999).

Furthermore, empowerment can be seen from either an individual perspective or a group or societal perspective. For individual's, it is a construct describing the process where individuals are enabled to have the ability to facilitate the achievement of their goals (Mechanic 1991 in Zimmerman 2000). From the goals angle, empowerment describes having control over the determinants of one's quality of life. From the process angle, empowerment describes the ability to take control over activity (-ies), by having the capacity to determine both the goals of the process and the means to put it to use (Tengland 2008, Rappaport 1985).

Lastly, from the societal/organisation perspective, Empowerment is a mutual process that aids people without an equal share of some valued capability to have better access to and control over those capabilities (Zimmerman 2000; Rappaport 1987; Cornell, 1989).

Study Design

The design of this study involves the analysis of archival and historical data on DITI. This involves making use of publicly available data to correlate and make sense of how each disruptive information technology has impacted different actors. Firstly, a review of prior innovations that have been labelled disruptive innovation in earlier academic research was conducted. The review of prior studies was done to identify examples of DITI. Webster and Watson's (2000) approach to conducting a review was adopted to make the process systematic. However, the focus of the study is not to position it as a literature review but to use the review as a background for selecting the actual cases to be studied. The review phase was an important step as it helped to make the eventual list of the innovations to be studied. Secondly, in order to sharpen the focus of the study and get sufficient depth, it was necessary to make a sub-selection of the DITI examples for further analysis. The basic criterion for narrowing the list to the final six examined in this study was the availability and access to archival data on each case. A necessary follow up inclusion criterion was to see if the available data covered the individuals, organisations and/or the society for each identified case (Okoli et al 2010).

After the review, the data about each of the selected cases from the DITI list were collected. The data were all secondary data, sourced primarily from publicly available media data from different online repositories that discussed one or more of the cases. Key sources for the organisation perspective were company documents and reports. Further organisation based data were collected from the public media including, The Economist, Harvard Business Review Blog Network and TechCrunch. For individual perspectives, general news media content were gathered and utilized to understand how each specific DITI has been reported to be impacting individuals. For the societal perspective, government archives, and reports were extracted from government websites and publications. In many cases, the sources provided information that supports the impact on

more than one actor. Each impact identified from a source was corroborated with content from another source to be considered valid. Essentially, these secondary data were sought to get a deeper understanding of each of the innovations and their impact on the defined set of actors. Figure 1 gives a diagrammatic overview of the flow of the data collection process in three steps with the number of DITI examples and articles collected in each phase highlighted accordingly.
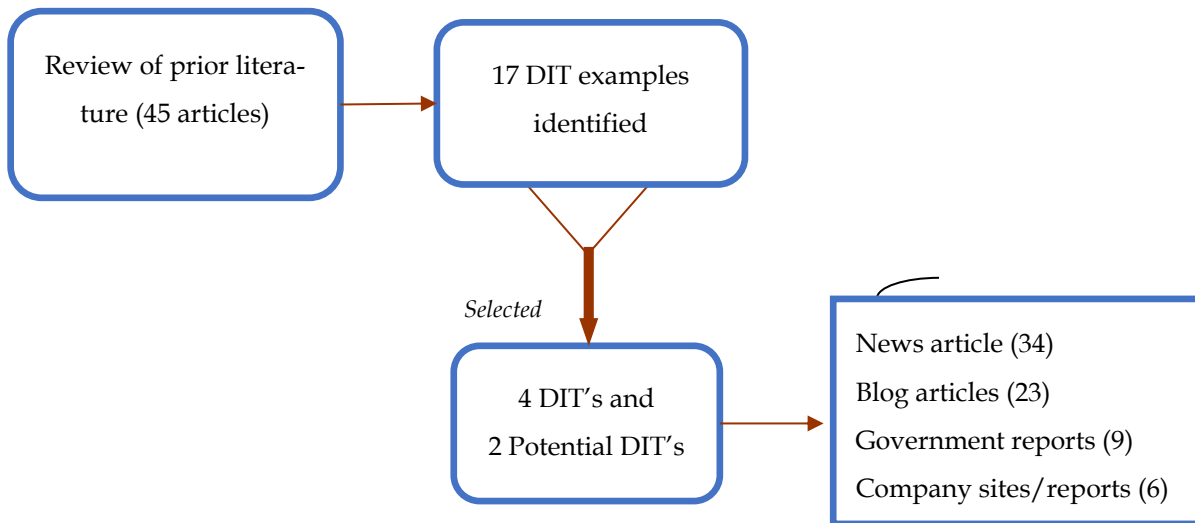
Figure 1: Data collection approach

The actors to be used as the unit of analysis is consistent with earlier delineation of actors in prior research (Meyer and Jepperson 2000, Baiyere 2015). To determine the appropriate actors for this study, we examined the different types of actors in prior research. Following the steps of Meyer and Jepperson (2000) and Harpaz (2002) we chose the – individual, organisation and society frame as the lens for analyzing every case that was selected. For each case, we examined the impact of the DITI on each of the actors. This enabled the collection of insights about the many and varied implications of the occurrence of a DITI ranging from the micro perspective of individuals/users to organisation and to the macro dimensions of the society.

Results

Case Examples

Each of the selected case examples have been analysed to extract the different ways they are empowering or wicked relative to the three predefined actors. For each case, we approach the analysis from two perspectives. From the wicked problem dimension and then subsequently from the empowerment dimension. The driving question for the analysis of each data source was *"How has this particular case exhibited wicked problems/empowerment opportunities?"* This is followed by a question of *"To which of the actors is each instance of a wicked problem/empowerment opportunity aimed?"* A summarized attribute distribution of this finding is briefly discussed in subsequent sections and an actor-based synthesis is subsequently presented in a tabular format.

Internet

Wicked Dimension: The internet has been considered a disruptive innovation by many scholars from various disciplines and different perspectives (Lyytinen et al. 2002). The internet is one DITI that has been a platform for many other DITIs. It is a form of "super" DITI or rather a "mother" DITI as many other examples of recent DITIs have leveraged the presence of the internet to be disruptive. This same argument is also why it has been the source of most of the wicked problems that many other emerging DITIs bring. The advent of the internet has led to troubling times for many industries including brick and mortar stores (due to amazon), traditional advertising industry (via google adwords) and music producers among many others.

Empowerment Dimension: While being a source of headache for some, it has been a tremendous source of empowerment for many. The singular trait of it being a platform for other DITI's is a key empowerment contribution that the internet brings. Globalization and its benefits have

being reinforced by the internet. It has made many things more affordable and accessible. Social connections and business connections have been made easier. Many businesses have been introduced that rely on basically the internet and many nations can attribute a significant portion of their GDP to internet based business.

Smartphone

Wicked Dimension: To understand the degree of the duality of the wicked and empower dimensions of IT and disruptive innovation in the case of the smartphone, one needs to only view it from its degree of pervasiveness in todays' society. A step back in time will reveal that in not so long ago, there were businesses thriving on creating, distributing and selling radios, alarm clocks, calculators, cameras, GPS, cassette players, compass, pocket dictionaries video recorders, atlas maps and … however, today **all** these devices can be replaced by a single device – the smartphone.

Empowerment Dimension: While it is indeed a source of trouble for those concerned, there is no doubt that on a relative view, the smartphone has been of immense value to different actors in different ways. Walking along the street with the entire aforementioned devices will be very difficult if not bordering close to impossible but with the smartphone you have them all in one hand. There is an economic and social rationale in this empowerment scenario.

On an organisational level, while the smartphone has contributed to the demise of many fledging businesses and product lines it has also created many other businesses that today we talk of the "app economy". On a society level, an illustrative example is Nokia which once significantly contributed economically to Finland which is now seeing a decline in this significant position.

Digital Imaging

Wicked Dimension: This innovation led to the demise of film photography and many other companies in that industry. This happened despite the fact that they were companies among the global business leaders at some point. Kodak has been attributed with the title of being one of the pioneers of digital imaging (Lucas and Goh 2009). Despite this, Kodak fell a victim of disruptive innovation by not taking advantage of it, albeit with supposedly *good* management reasons. Digital imaging was a direct conflict to the revenue model and business model of Kodak. Besides, at the nascent stage of the innovation, the digital images could not compare in quality to the output of the then film images. Additionally, they were cumbersome to generate and required a rather clunky device. When Kodak was at its peak, it employed over 140,000 people while recently Instagram employs 13 and promises the same value proposition (Jaron Lazier 2013).

Empowerment Dimension: If we however consider a point in time during the Kodak age where after capturing an amazing moment with your Kodak camera, you desire to share that image with friends or relatives living in a faraway location (for example another country). The process that will be required to achieve that noble desire would be beset with tedious and time-consuming efforts, not to mention the cost. It is easy to imagine how many such virtuous aspirations went unfulfilled at that time but would only take a few clicks today.

Telephone

Wicked Dimension: The telegraph was very dominant before the advent of the telephone. Telegraph was so dominant that Western Union – the leading company at that time - could not imagine why anyone would ever want to use a "ringing monster" when they can send a telegraph. Western Union was so certain of its business that in the settlement of their lawsuit against Bell System, they assigned all telephone rights to Bell and requested that Bell must never compete in the profitable telegraphy business (Sterling, Bernt and Weiss 2006). This case demonstrates how complexity derives from the uncertainty and divergence of dealing with nascent disruptive innovations.

Empowerment Dimension: While telegraph is history today, the telephone has gained dominance as a major means of communication empowering and connecting people and organisations all over the globe. Real time conversation is now possible regardless of distance. In addition, the telephone introduced a richer medium of communication compared to wired messages.

Other cases identified in the study includes - Cloud Computing (Krikos 2011) and Social Media platforms among many others, which exhibit similar characteristics with the aforementioned cases and further demonstrate the dual nature of DITIs.

Potential Future Cases

The historic cases presented above, give a representation of how DITI's have been both wicked and empowering for IT innovations acknowledged as disruptive innovations. We extend the analysis to examine recent cases of IT innovations with a tendency and potential to become disruptive innovations. These cases cannot however be labelled disruptive yet. This is because due to the relative nature of DI, for any innovation to be called disruptive, it should have caused an identifiable disruption to another innovation or organization (Christensen 2006, Govindarajan et al. 2011). Therefore, these potential future cases are potential DITIs, which have the necessary attributes of a disruptive innovation, but are yet to meet the sufficiency criterion of relative disruption. We now explore the dimensions of wickedness and empowerment that each case holds.

3D Printing

3D printing is an example of an innovation that is at its early stage. If it does become disruptive, the industry it appears to be pitched against is the manufacturing industry. The implication of such a disruption can hold significant consequences for individuals and organisations working in that sector. The effect may be felt in the society as it has the potential to reshuffle the wealth of nations (particularly with manufacturing outsourcing) which might affect the global economics (Christensen and Hart 2001). While this might seem like a catastrophic picture, on the other hand 3D printing also promises users an amazing opportunity to unleash their creativity and customize materials to meet their specific needs. Small and medium enterprises (SMEs) would potentially have a key resource to compete on a completely different scale than they presently can. Among other things, 3D printing also has the tendency to hold some legal and standardization conundrum.

Virtual Currency (Bitcoin)

Virtual currencies like Bitcoin are also budding IT enabled innovations with potential to become disruptive to the financial world, as we know them today. Financial institutions have long been considered as key players in business transaction and exchange. Virtual currency innovations are however not only attempting to change the rules of the game but also the playground – which is characteristic of disruptive innovations. At its core, examples like Bitcoin present a technology that enables new payment/ transaction system to be developed. In a similar way that the internet allows permissionless communication, it also aims to allow permissionless monetization. While this is an issue that institutions like banks need worry about, it is a big opportunity for the developing world to have a voice in shaping global finance. Since banks are one of the key institutions that determine the economic health of a country, an innovation that affects this sector will most likely touch a nerve that extends to the societal perspective.

Others (VoIP - Skype, Video Streaming- Netflix, RideSharing - Uber)

There are other recent trends in this category with strong potential to be disruptive which we analyzed for their empowerment and wickedness dimensions for individuals, organisations and the society. Voice over Internet Protocol (VoIP) like Skype for instance, while challenging the revenue model of traditional telecommunication companies has opened up a possibility to have both audio and video conversation over the internet for basically free. The traditional logic for the revenue model of telecoms is to charge more for longer distances due to connection costs among other reasons. This logic is however currently being challenged.

Similarly, Video Streaming services like Netflix while riding on the provisions of the internet are rendering movie rental businesses bankrupt. At the same time, they are offering users the capability to browse through thousands of options without leaving the comfort of their home or having to worry about paying late fees.

Ridesharing services such as Uber is another innovation that leverages advances in GPS and smartphone technology to challenge the traditional approach for getting a taxi ride. This is shaking up the taxi business and redefining the concept of getting a taxi ride. This has posed both regulatory and legal challenges as the possibilities of the advances in technology has made this possible but the business rules and taxi regulations are yet to completely understand how to respond or adjust to this. This is moreso because despite the challenge being posed to the taxi industry, the service is creating a notable record of employment and generating visible satisfaction

to the populace. The dilemma for policy makers in this situation is how to respond to an employment creating opportunity that at the same time is making the huge long-term license fees paid by registered taxi drivers become redundant.

Cases	Individuals	Organisations	Society
Internet	**W:** Loss of jobs; Privacy and surveillance issues.	Bankruptcy of several brick and mortar businesses (e.g bookstore chains.).	Regulatory challenges as geographical borders blurred; Ease of social unrest mobilization.
	E: Creation of new job types: Increased access to information and goods.	New businesses such as Amazon, Google e.t.c are possible.	Increased Globalization.
Smartphone	**W:** Loss of income and economic migration (e.g whole unit of Salo city closed.	Nokia's decline from 49% to 3% market share.	National GDP reduction (Nokia's 23% tax contribution to Finland dissipated).
	E: Possibility to do more with one device; Entrepreneurial opportunities with the "App Economy".	Apple emerged from bankruptcy to be the most valuable company in the world.	Increased contribution of gainers to national income (e.g Samsung and Apple).
Digital Imaging	**W:** Unexpected Pension woes as retirement dreams evaporated (e.g aftermath of Kodak's bankruptcy).	Kodak's decline from a peak of 2/3 of global market and 10 billion $ sales to bankruptcy.	Population decline (e.g Kodak's bankruptcy impact on the city of Rochester).
	E: Empowered to easily share moments, Basic photography not exclusive to experts.	Digital camera companies thrived.	Space photography advanced.
Telephone	**W:** Disrupted supply chain of telegraph hence loss of income for people involved.	Western Union's Telegraph could not keep its dominance nor outlive the telephone.	Infrastructures are rendered obsolete and investments become sunk costs.
	E: Expanded our communication possibilities; Real-time conversation.	Paved way for many companies in telecommunications today.	Reduced geographical barrier between communities.
	W: Potential Loss of manufacturing workers; possibility	Possibly lead to struggling times for	Nations flourishing by receiving out-

3D Printing	to reproduce regulated products.	the manufacturing industry.	sourced manufacturing jobs may face challenging times.
	E: Provides potential empowerment to unleash individual creativities in new ways.	Various Entrepreneurial opportunities and possibilities can be enabled.	Manufacturing may be possible locally without the need to outsource jobs.
(Virtual Currency) Bitcoin	**W:** Technically challenging to be comprehended by the public, leaving power to the knowledgeable few.	Potentially disruptive to banks and financial institutions as we know them today.	Possible reshuffling of the positioning of the wealth of nations; No single national regulatory power.
	E: Currency freedom and no geographical boundary limitations.	An alternative means of transactional tender and transfer of value.	Potential opportunity for developing countries to have a voice in global finance.

Key:
Wicked Problem (**W**)
Empowerment Opportunity (**E**)

Table 1. Illustrative examples of the Wickedness and Empowerment of some DITIs on Individuals, Organisations and the Society.

Discussion

Empowering and Wicked Attributes of DITI

From the analysis of our selected case examples, we have identified attributes of a DITI that are empowering and those that are wicked. To better understand these emerging themes we have adopted the classification by Dufour and Steane (2006) which has been used to classify disruptive innovations complexity in the health sector. The classifications are Social, Political, Technical, Network and Change Complexity. On applying Dufour and Steane's (2006) classifications as a lens to understanding the emerging themes in the data, we discovered other wickedness and empowerment dimensions such as Economic and Legal wickedness plus Economic and Knowledge empowerments. By extending the classification by Dufour and Steane (2006) to reflect the DITI perspective, we conceptualise these attributes as "SPELT" and "SKENT" for wicked problems and empowerment opportunities respectively. We present these as theoretical attributes that can be useful in understanding some of the possible dimensions of a DITIs impact.

The five key attributes (SPELT) of the wicked problem dimension can be classified as follow:

- Social Wickedness (S)
- Political Wickedness (P)
- Economic Wickedness (E)
- Legal Wickedness (L)
- Technical Wickedness (T)

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Social Wickedness refers to the social related problems that are associated with a DITI from the perspective of any of the three actors. For example, the advent of the internet has helped facilitate unprecedented uprisings as witnessed during the Arab spring and the move by many countries to ban and censor the use of the internet. Similarly, Uber has led to riots as witnessed in Paris and other parts of the world. (Internet, Ridesharing).

Political Wickedness deals with DITI situations that confront policy makers with tough decision-making choices. This attributes aligns more towards society perspective. For example, 3D printing has already been used to print guns. Cases like this challenges the political notions of gun laws particularly when they can just be easily designed in one country and printed in another. In addition, the issue of regulating a virtual currency such as Bitcoin, which is not pegged to a single country, raises unusual challenges. These are issues that require political will across several countries but the digital nature of DITI and its capacity to ignore country borders introduces an additional layer of complexity. (Cloud Computing, 3D Printing).

Economic Wickedness can be used to describe wicked problems that present economic challenges and possibly decline. This is a traditional measure for determining the impact of a disruptive innovation for organisations but it does hold true for both individuals and the society. For example, job loss for individuals and tax income reduction for communities. (Digital Imaging, Smartphone).

Technical Wickedness this is a component of a wicked problem in DITI that presents any of the three actors with a challenge in the technical requirements required to solve the problem. (Virtual Currency, 3D Printing).

Legal Wickedness refers to DITI issues that generate unexpected loopholes in existing legislation and present concerning encounters about the right rules and regulations that best address a DITI legal requirement. A classic example of a potential DITI that has caused legal dilemma is Uber. (Ridesharing, Virtual Currency).

For the empowerment attributes, we have classified these into five main attributes (SKENT) :

- Social Empowerment (S)
- Knowledge Empowerment (K)
- Economic Empowerment (E)
- Network Empowerment (N)
- Technical Empowerment (T)

Social Empowerment is the attribute of a DITI that enables and liberates social interaction/engagement in ways that would not have been easy or feasible. This can be of value to the three actors in varying degrees. For example, a rural farmer in a remote part of a developing country can now easily be connected to the world via a smartphone. (Telephone, Digital Imaging).

Knowledge Empowerment occurs when the DITI expands the possibility to seek and acquire knowledge from different sources. Education and research activities of individuals and organisations have typically benefited from being empowered by this attribute. The internet has helped many to expand their knowledge horizon beyond what they would have been able to achieve in their local location. (Internet, Video Streaming).

Economic Empowerment can be said to occur when the DITI gives any of the actors an opportunity to improve their economic status. This is one of the hallmarks of most DITIs because there is usually a form of creative destruction in which; while one actor is economically empowered another might have an economic downturn, due to the same DITI. For example, Nokia vs Apple (Ridesharing, Internet).

Network Empowerment describes the attribute of a DITI that gives the actors the ability to extend their reach beyond their immediate environment and harness value from their networks. The emerging shared economy innovations such as airbnb and Uber are representative examples of this as well as social media platforms enabled by the internet (Internet, VoIP).

Technical Empowerment is one of the attributes were certain technical abilities are bestowed to actors who would have otherwise not been capable of such without significant cost and effort. (Smartphone, 3D Printing).

Empower Vs Wicked Model of DITI

To put the findings into relevant practical and theoretical application, we propose a model of DITI Empowerment Vs Wickedness (See Figure 2). The model examines the different quadrants in which an actor can position a potential disruptive information technology innovation relative to itself. We advance
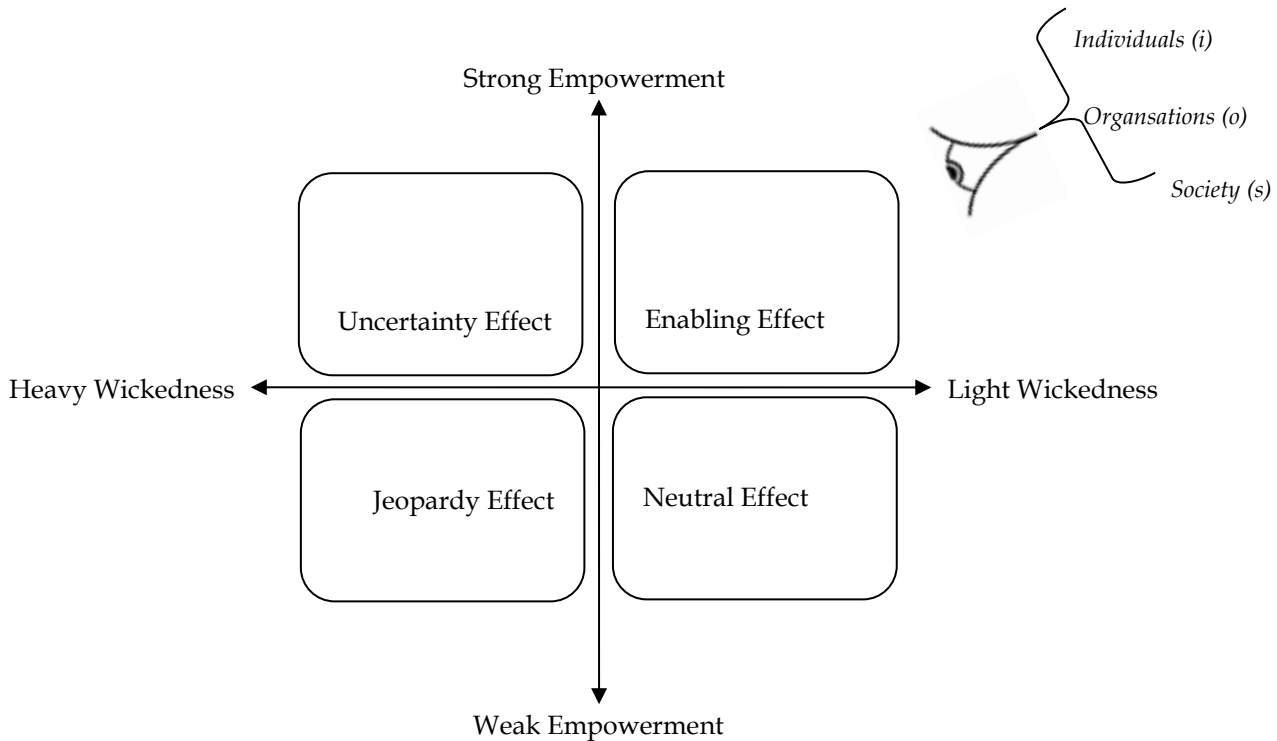
Figure 2: Model of DITI Empowerment Vs Wickedness

the model as a sense making tool that can enable researcher to situate an IT innovation regardless of its disruptive inclination to assess how it relates to the different actors. For a particular DITI, the resulting quadrant would vary depending on which of the actors view is in consideration.

The model presents a framework for assessing the possible position of an emerging innovation even before it becomes disruptive. Depending on how strong or weak the degree of Empowerment versus how light or heavy the Wicked dimension of an innovation is, it can be positioned in a quadrant to evaluate its potential impact for specific actors. For innovations that present strong empowerment opportunities and light Wickedness, the actor in that quadrant can be said to have an impact that generates an *Enabling Effect* which is a state of being in an Empowered position. For DITI innovations that pose a heavy degree of wickedness with little or no opportunity for empowerment to certain actors, they will be putting such actor in a precarious situation hence the *Jeopardy effect* which is illustrative of a catastrophic/disruptive quadrant.

Innovations that offer little threat in terms of the degree of wickedness and little or no empowering benefits can be zoned to have an impact of a *neutral effect* where the sum of the impact more or less keeps the actor in its status quo as it does not introduce much change, if any. On the opposite axis however, an innovation that presents a heavy degree of wickedness as well as a strong degree of empowerment can be classified as a high risk-high reward quadrant which puts the actor in an *Uncertainty effect* quadrant.

It should be noted that the position of an innovation is relative and dependent on each specific actor. Same innovation can be positioned in different quadrants depending on who is doing the evaluation (as represented by the eye in Figure 1. With an evaluation of the potential risk and benefit that an innovation brings, the model allows us to make an assessment of what can be done to either mitigate the risk or increase the benefit. It gives a sense making tool that actors can use to prepare themselves for the consequences of an emerging IT innovation.

From the foregoing analysis and discussion, a concise expression of the combination of IT innovations and Disruptive Innovations can be stated as follow: *The impact of a disruptive information technology innovation to any actor is a sum function of the degree of empowerment and the degree of wickedness presented by that innovation to the actor.*

This can be operationalized in a mathematical expression as follow:

$$DIT_{impact} = \big[E(i,o,s)\big] + \big[-W(i,o,s)\big]$$

Where DIT_{impact} = Disruptive Innovation Impact

E = Empowerment

$-W$ = Wickedness

Giving the wickedness section of the equation a negative weight $\big[-W(i,o,s)\big]$ implies that a resulting positive value for *DITI* would imply an empowering DITI while a negative resultant value would imply a wicked DITI for the actor involved. The relativeness of the impact of a DITI to particular actors should be noted as it would be different for the same innovation. With the mathematical model, the DITI construct is put in an operationalized and applicable form. We present this as a contribution to be built upon, critiqued, improved and extended by further enquiry by the research community.

Conclusion: Towards a Societal-focused IS Research Agenda

It is worth pondering the economic, social and management aspects of Disruptive IT innovations. DITI by its natural structure, introduces a phenomenon that brings to question our understanding of the value additions of IT innovations vis-à-vis its negative consequences. This paper demonstrates that IT innovations can hold a double edged nature depending from which actor's perspective it is observed.

In todays' continuously digitalized world, such line of research brings to surface issues like why IT innovations may increase satisfaction and happiness for individuals without any increase in national GDP. Similarly, DITI can create enormous wealth for a few with little or no significant contribution to the larger populace. The study also shows that organisations are not left untouched in the DITI discourse. DITI's create new growths in the industries where they occur despite the fact that they lead to the decimation of other incumbent organisations. DITI's do this by enabling less skilled and less wealthy individuals to achieve things that previously could only be done by specialists or the affluent. They essentially make products and services affordable, at a higher performance level than ever before. It thus can be said that DITI's is a core microeconomic driver of macroeconomic growth with impactful implications for the society as a whole.

In conclusion, it is noteworthy to consider pondering the consequence of IT innovations that are also disruptive innovations especially in the context of societal impact of IS research. This line of scholarly enquiry is a green field of research for the IS domain that offers various uncontested, unique and novel research opportunities. We also present this as an opportunity to chart a path in response to recent calls for research that carries both theoretical and practical application (Rosemann and Vessey 2008). Additionally, the multifaceted nature of DITIs makes it amenable to different research approach ranging from design science to behavioral science research.

Acknowledgements

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Paper 4: Towards a Unified view of Information Systems (IS) Capability

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TOWARDS A UNIFIED VIEW OF INFORMATION SYSTEM (IS) CAPABILITY

Abstract

Since the introduction of the concept of IS capability to IS research, it has been extensively used to explain various IS related studies - for instance: competitive advantage, firm performance, and agility among several others. This extensive use of the concept has resulted in several interpretations and diverse classifications. These discrepancies in combination with the extensive use of the concept put its fundamental logic at the danger of losing its meaning. Using a systematic literature review, this paper highlights the similarities, differences and fragmented knowledge groups and consequently provides a possibility to move towards a unified view of IS capability. To consolidate the fragmented classifications, the paper advances a four ellipse model from prior classification to vividly conceptualize the IS capability construct and hence provide an integrated platform for future research.

Keywords: IS Capabilities, Ellipse Model, Literature Review, Information Systems/Technology Capability Classification.

1 INTRODUCTION

The concept of IS capability was first introduced to IS research in the mid 1990's (Ross, Beath and Goodhue, 1996; Andreu and Ciborra, 1996). Since then, it has been used by many authors in research about Competitive Advantage (Bhatt and Grover, 2005; Doherty and Terry, 2009), Organisational Change (Clark, Cavanaugh, Brown and Sambamurthy, 1997), Agility (Fink and Neumann, 2007; Lu and Ramamurthy, 2011), Firm Performance (Bharadwaj, 2000; Li, Cheng and Huang, 2006) and Innovation (Pavlou and El Sawy, 2006; Tarafdar and Gordon, 2007) to mention a few. These wide utility of the concept has led to varying and diverse interpretations of the concept.

As a background, the capability concept has largely been drawn from organization science and strategic management research. Therefore IS capability largely borrows its foundational principles from these research fields. IS capability generally refers to the ability for an organizations to - redesign processes - facilitate information management and - fulfill knowledge sharing needs among many other benefits (Ramirez, Melville and Lawler, 2010; Mithas, Ramasubbu and Sambamurthy 2011). Apart from the resources of an organization, the capabilities of today's organizations additionally come from the attributes of their IT resources (Hoopes & Madsen 2008), and this can be particularly useful for firms operating in rapidly changing environments (Wade & Hulland 2004). Therefore, even if the IT resources/capabilities do not lead the organization to a position of superior competitive advantage, they are nonetheless very important to attaining a sustained competitiveness in stable/unstable environments. This is particularly the case if the IT resource/capability can help the organization to develop, add, integrate, and release other key resources over time (Wade et al. 2004).

This paper uses a systematic literature review to collect research that has built upon the concept of IS capability. This review is aimed at throwing light on what has been done previously on IT/IS capability specifically in the IS domain. The paper is geared towards providing the different perspectives and lenses with which research on this concept has been approached over the years. This is done with the objective of *identifying similarities, disparity, research focus, research calls, maturity areas, and areas open to further research* (Okoli and Schabram, 2010).

The review of the use of IS capability led to identification of some similarities but there were also differences. Some typical examples of the disparate interpretations accorded to this concept includes: differences in terminologies, fragmentation in classifications and unconsolidated definitions. These discrepancies plus the extensive use of the concept puts its foundational essence at the peril of losing its significance. Hence, this paper is a step towards a unified view of IS capability. Perhaps most importantly, this paper advances the ellipse model to consolidate current knowledge on this topic.

The paper is structured in three related divisions. Firstly, we take an historical look at the origins and the use of the concept in IS research as part of the introduction. Secondly, the study design and ensuing results are presented as section 2 and 3. Lastly, we discuss the results and analysis which leads to the theoretical and practical contribution of the research in sections 4 and 5.

1.1 Origins of the concept of IS Capability

The capability concept generally stems from the management research discipline. It is a concept that is built on and closely related to the resource based view. From the IS perspective, there are generally three related school of thoughts to the capability concept. These are – Resource based view, Dynamic Capability and Core Competence views. Even in the management field, disparity

and area of dissensus can be identified (Leiblein, 2001). To have a good understanding of how this concept developed and diffused into the IS domain, we will give a brief discussion of these three concepts.

The *resource-based view* (RBV) has evolved over the years into arguably one of the most referenced theories in the field of management (Kraaijenbrink, 2010) The theory looks at the source of a firms sustained competitive advantage as emanating and dependent on the internal resources of a firm. This view is a different dimension to Porter (1985) view of a firm's competitiveness being dependent on its operating environment. The core essence of the theory is that a firms competitive stand is as a result of its acquisition and management of valuable, rare, inimitable, and non-substitutable resources. (Barney, 1991). *Dynamic capability theory* stems from the RBV with an added proposition that an organization needs to be able to integrate and reconfigure its resources in other to attain a sustainable competitive advantage in a rapidly changing environment – hence the "dynamic" component (Helfat and Peteraf, 2003; Teece, Pisano, and Shuen, 1997). In addition, *core competence* has also been advocated to refer to distinctive abilities of an organization relative to other organisations which is also related to the asset endowment of the organization. (Prahalad and Hamel, 1990; Teece et al. 1997)

While IS research field may have borrowed these important concepts from management, we have also carried along the disparity associated with the terminologies. This is because even in the management domain, there is yet to be a standing consensus on the difference between this constructs. In IS research, it remains necessary, in fact essential to borrow from other disciplines, however as Wade et al (2004) points out, it may be beneficial to pause and evaluate the use and application of a borrowed theory in an IS context before adapting it to an IS-based research. Having highlighted the root of the IS Capability – IS Resource – IS Competence construct, we would suggest that as this research stream approaches maturity and for the sake of consistency, it is important that a clear taxonomy and clarification of the definitions of these related constructs be advanced for the IS domain.

1.2 Use of IS Capability concept in prior IS research

As was typical of the IS literatures of the mid 1990's, which corresponds to the strategic Information systems (SIS) era, managements were more interested in how to extract competitive advantage from their IT/IS investment (Peppard and Ward, 2004). Consequently, during the early days of IS capability which corresponds to that era, research was mostly focused on this same theme and providing answers to the competitive value contribution of IT to the enterprise (Feeny and Willcocks, 1998; Ross et.al., 1996).

Subsequently, IS capability research evolved to include other research focus. This ranged from research about the contribution of IT to firm performance, agility, and outsourcing among many others (Feeny, Willcocks and Olson, 2006). However, this view tend to present the static potentials of the IS capability construct. In an environment that is characterized by not just constant change but rapid change and turbulence, this opens up possibilities to consider the dynamic component of IS capability IS and IT Researchers and practitioners are thus left with some questions: what is the role of IT, or perhaps more importantly, what value does IS capability provide to an organization in a disruptive scenario?

2 STUDY DESIGN

In conducting the systematic review of literature on IS capability, the approach suggested by Webster and Watson (2002) has been mostly adopted. The selection process of the papers to be analyzed began with the identification of the required keywords to be used in the search process. Foremost in the keywords list were the terms: IS capability, IT capability including their plural forms and full expressions (i.e IS - Information System and IT - Information Technology). For, the initial phase of the search process, Science Direct (SciVerse, Scopus) journal database was

employed with "IS Capability" as the keyword. However, very few relevant results were identified from this search. From the relevant results, articles that were published in top journals excluding conference papers were further identified.

An additional drilling down of the remaining subset of returned articles was carried out to identify the earliest of the articles from the selected articles. In this case the paper was the well cited paper by Peppard and Ward (2004). After this, the remaining articles were sorted in that order – from earliest to latest. Following the guideline for a structured approach to sourcing material for a literature review proposed by Webster et. al (2002), the next steps involved *going backward* and subsequently *going forward*. Going backward, involved a review of the references provided in each of these top articles. Going forward, required using the citation list provided by the SciVerse database for each of these articles to identify which articles citing each of these papers, qualifies to be considered in these literature review.

The process of checking references and citations highlighted above quickly showed how sparingly the keyword IS and IT capability (and their full forms) have been used in the titles of IS articles. This then required a pause in the search process to read through the abstract of most of the articles found by this stage. However, it is worth mentioning that additional articles included in this review only became obvious as relevant, after they were referenced while fully reading other IS capability articles. In reading through the articles, it became apparent that there has been different terminologies used in describing the IS capability concept in prior literature. This is a clear indication of the fragmentation in the naming convention used by IS researchers in referring to this concept.

In effect, no single search terminology would yield all the relevant articles on the topic of IS capability. This therefore informed the need to go back and broaden the keywords used in the search. The possible keywords list expanded continuously, such that after reading a few articles another possible '*synonym*' for IS capability would surface. This process continued until likely new keywords stopped emerging. The new list of keywords includes: IS/IT Resource, IS/IT Competence, IS/IT Assets.

With the plethora of keyword possibilities, the determination of the relevance of an article required first checking the title for keywords, and then reading through the abstract of selected returned papers with any inclination towards the concept of IS capability. It was also discovered that by reading the earlier sourced articles, other articles referenced in between the text and based on the actual context, provided more clue to the papers that are likely to have discussions relevant to IS capability. In this regard, Webster et al. (2002) approach of going forward and going backward proved very useful for this review. In locating a potentially relevant paper that was identified based on how it has been cited in another article, Science Direct was not always returning these specific articles. Therefore Google scholar which searches through multiple databases, was employed to locate such papers. After selecting a potential paper to be considered, the content of the abstract in most cases was sufficient to decide on the relevance of the article. In addition, some articles were found that have conducted certain degree of literature review on these concept. Utilizing both approaches provided further list of relevant articles that were considered for this work. In total a count of 45 IS capability related articles[14] were included in this review.

Summarily, the disparity in terminology used made the sourcing of relevant articles by the sole use of selected keywords ineffective. However, the combined approach eventually adopted made

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[14] Due to space limitations, a comprehensive detail of reviewed articles are available on request

it possible to identify a wider range of articles than would have been normally identified using the traditional keyword approach.

3   RESULTS AND ANALYSIS

3.1   Publication Distribution (By Journal and Research Period)

A scan of the collected literatures indicated a tilt towards some particular journals. This prompted further analysis to understand what journals have been showing attention to this research stream. This analysis also lends itself readily to describing the time span through which IS capability has been researched and presented since its introduction into IS literature (see Table 11).

From the journal analysis of the reviewed articles, it becomes apparent that almost 40% of the IS capability articles are published in two journals – MIS Quarterly and Journal of Strategic Information Systems. While MIS Quarterly takes a significant representative portion of the published articles, twenty two (22) other journals actually published IS capability articles. However, most of the journals categorized as 'others' published just one article included in this review.

Journal	Quantity (Articles)	Distribution (%)	Cumulative
MIS Quarterly	11	24,44	24,44
Journal of Strategic Information Systems	6	13,33	37,78
Information Systems Journal	3	6,67	44,44
Information Systems Research	3	6,67	51,11
Information & Management	3	6,67	57,78
Journal of Management Information Systems	2	4,44	62,22
Sloan Management Review	2	4,44	66,67
Others	15	33,33	100,00
TOTAL	45	100,00	

Table 11.   Journal distribution of IS Capability articles

If we consider the spread of the articles in a time period from the date of publishing of the earliest paper 1996 to the most recent article found 2012 (Ross, Beath & Goodhue 1996 and Liu, Ke, Wei, & Huang 2012), we would observe a significant increase in the number of publications addressing this issue. The numbers of publications in the last 8 years (2005-2012 with 29 publications) have almost doubled the publications found for the first 9 years (1996-2004 with 16 publications) of research on this concept. The core emphasis and principal foundations for the IS capability research began in the early 2000s hence the research stream can still be considered relatively new. This suggests that there exist possibilities for more research in this area.

3.2   What can be learnt from the 'What' and 'How' of Prior Research?

While this review aligns with earlier reviews on this topic, it is necessary to note that the objective of this review is not to make a tautological replay of past reviews but to highlight the similarities and differences in prior research towards advancing a unified view of the concept of IS capability. We investigate prior literature to see the areas of *consensus vs dissensus* and areas that are *matured vs emerging*. Thus, the selected literatures will, among other analysis, be reviewed specifically for relationships to three main parameters: Organizational Change / Turbulence, Competitive advantage / Firm performance and Innovation. The three axis from which this review will be focused can be modelled on the classification of IS capabilities described by Bhatt (2005). These are Value Capability, Dynamic Capability and Competitive Capability. Bhatt's classification lends itself readily to these highlighted attributes of disruptive innovation. A mapping of the review parameters and the classifications can be directly represented as*: Innovation* – Value Capability; *Change/Turbulence* – Dynamic Capability and *Competitive Advantage* – Competitive Capability.

Reviewing existing literature shows where IS research on IS/IT capabilities has been focused in the past and how this has progressed in recent years. The chart in Figure 20a shows the distribution of prior IS capability research on these three dimensions. For this analysis, the reviewed papers were grouped into two periods: 1996-2004 and 2005-2012. Although 1996-2004 covers 9 years, it can be seen as a grouping of 8 years each since no article was found from 2001 to be included in this review. From Figure 20a, among other deductions, two things become immediately obvious. Firstly, there has always been interest in studying the issue of IS contribution to firm performance and a firms competitive advantage. Secondly there is relatively little research focused on the relationship between innovation and IS capability *[Emerging]*. The interest in studying a firms competitiveness has significantly grown over the years and IS capability researchers have considerable researched these dimension of IS capability (McLaren, Head, Yuan and Chan, 2011). It is worth mentioning that IS capability evolved at a time when there was increasing question about the value or significant contribution of IS/IT to an organization. In overview, IS capability has contributed significantly in understanding how information technology remains a valuable component of any modern day firm (Santhanam and Hartono 2003).

While there has been predominant focus on using IS capability to advocate the value of IT to a firms competitiveness [*Consensus*], the second obvious fact from the figure is that there has been relatively few research on the role of IS capability in the innovativeness of an organization. As evidenced in the chart, the move from the 1990s to the 2000s shows no significant increase in the number of studies relating IS capability to innovation. With notable exceptions like (Li et al. 2006; Bharadwaj et al., 1999; Pavlou et al. 2006; Lu and Ramamurthy 2011) that have advanced knowledge in this area. This indicates that there is room for more studies in this dimension. It has been posited that *sustainable* competitive advantage of an organization is directly related to its innovativeness (Tarafdar et al. 2007; Li et al 2006; Sambamurthy, Bharadwaj and Grover, 2003). Hence further research positioning the significance of IT in this area would be a valuable contribution to the body of knowledge.
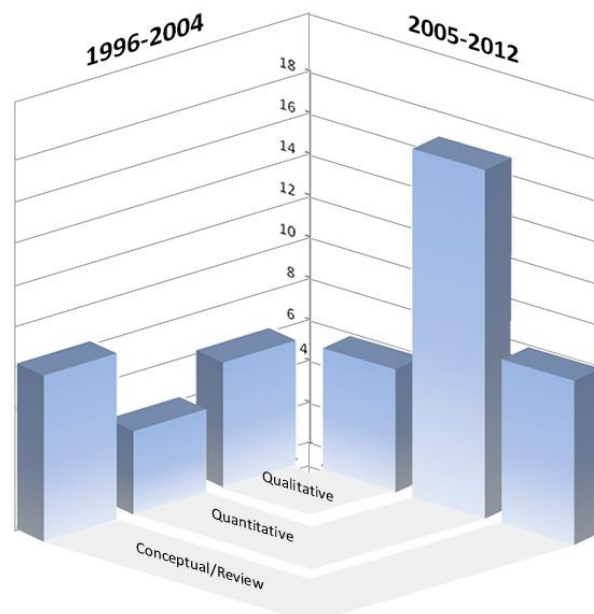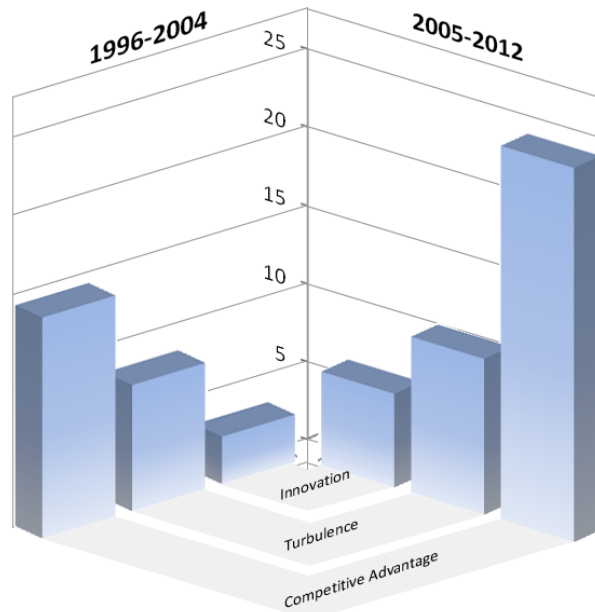
Figure 20.   *(a) Emerging trend of IS capability research on Innovation, Turbulence and Competitive Advantage. (b) Trend of article distribution by adopted methodology*

The third component in Figure 20a – Organization Change/Turbulence appears to have had considerable medium research focus relative to Competitive advantage and Innovation. On the other hand, a close look at the increase in turbulence studies between the two periods shows a little change. A comparative analysis shows that not significantly much more study have been carried out relating IS capability to organization change, agility or turbulent environments.

The chart in Figure 20b presents the different research methods adopted over the two time period being studied. As is expected of a new and evolving research area, there were more conceptual papers in the early period of the IS capability research. However moving forward to the recent period of 2005-2012, the jump in the number of research adopting the quantitative approach is significantly high. While quantitative research accounted for the lesser of the three adopted methodologies between 1996-2004, it dwarfed both the qualitative research and conceptual papers in the 2005-2012 period. This confirms the disposition of IS researchers to utilize the quantitative research approach. Another striking observation is the flat nature of the change in the number of publications using the qualitative approach over the two periods.

4   DISCUSSION

4.1   Terminology fragmentation from the lens of prior research

There is presently an avalanche of constructs and definitions which although are all generally describing the same or similar IS capability phenomena, have been presented under different terminologies. Firstly, previous literature reviews conducted on topics related to the IS capability have identified this variations. To make these variations vivid, the distributions of constructs used in the reviewed articles are presented in Figure 2. The import of this figure is to show that contrary to expectations, terms like IS/IT resource are not predominantly used as the core construct in IS research. The figure demonstrates that the term IT capability is attaining dominance as it appears to be mostly used as the central construct in reviewed articles, followed closely by IS capability. Although these terms have been used interchangeably in most of the articles, there is usually a central term used in each paper. It is this main construct used in the literature that has been outlined to highlight the disparity in this area. (The axis labeled as 'Others' are the constructs that have been used as the central construct only once in the articles reviewed.
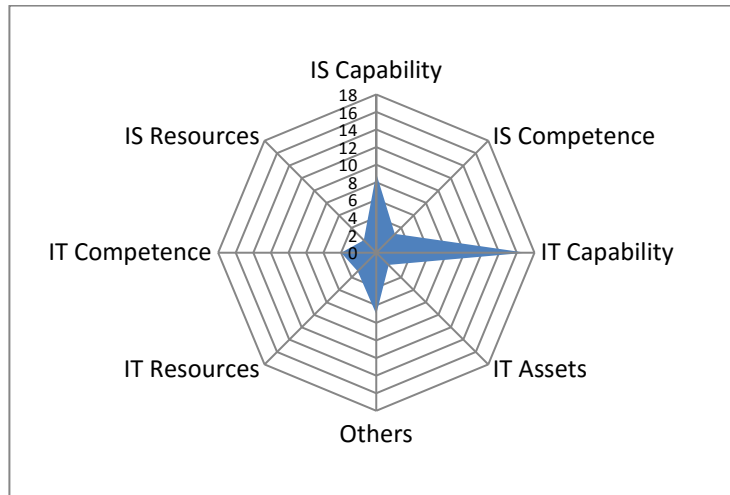
Figure 21.   IS related constructs used in prior literature

These plethora of constructs thus suggests that - as this research stream approaches maturity and for the sake of consistency, it is important that a clear taxonomy and clarification of the definitions of these related constructs be advanced for the IS domain. It is therefore wise to take a step back to understand the foundation of the term IS capability as used by IS researchers.

4.2   Reviewing IS Capability Definitions

Based on the articles reviewed we attempt to highlight the different school of thoughts that exists in the IS field concerning the definition of these terms. Several of the papers reviewed highlighted the disparity in the definitions of the terms – IS/IT Capability, IS/IT resources, IS/IT Competence among other related constructs (Cragg, Caldeira and Ward, 2011; Caldeira and Dhillon, 2010; Wade and Hulland 2004). These three terms have particularly been used interchangeably in IS literature. There have been attempts to distinguish between these constructs (Sambamurthy et al., 2003). To highlight the existing construct definitions we have grouped them into three categories: The *Subset View, The Combination View* and *the The Equality View*.

The Susbset View: Concerning which of the three constructs is a subset of the other, draws a close analogy to the classic dilemma of the *chick or the egg, which comes first?* Some authors present IS capability as a subset of IS resources while others argue for the reverse. Similar positions are also being held by different researchers concerning IS competencies and IS capabilities. These are views that describe the core of the constructs as the raw material or building block from which the higher order construct is made. Hence, according to Peppard et al. (2004) perspective, resources are the fundamental unit of this relationship. They presented *resources* as the information, systems and technology possessed by a firm and extensible to include the knowledge and skills of personnels. While *Competence* is presented in terms of resources as the ability to deploy organization *resources* in order to achieve a specific objective. *Capability* is then in turn presented in terms of competencies as the strategic application of *competences* in order to achieve given organizational goals. Similar reasoning as demonstrated from Peppard et al. view is also applied in the definitions ascribed to this construct by some authors (Bharadwaj, 2000; Ravichandran and Lertwongsatienl, 2005 and Samabamurthy et al., 2003)

The Combination View: Authors maintaining this view present very close logic with the subset view. However this constructs are expressly used to describe the combination of two or more

constructs rather than aiming at expressing one construct as a direct function of the other as presented by the subset view. In the combination perspective these constructs are considered as compositions of two or more constructs. For example, In describing *resources*, Wade and Hulland (2004) referred to it as the combination of the *assets* and *capabilities* that are available and relevant in the response and detection of market opportunities and threats. Some other examples include Caldeira et al.(2010), Stoel & Muhanna (2009) and Tippins & Sohi (2003) among others.

The Equality View: In this perspective, the constructs are directly referred to interchangeably and explicitly defined as same. With this view, a resource can be equal and same with capability. In other words some constructs are considered as synonyms of each other. It is interesting to note that while many authors have not explicitly defined constructs as equal, it has mostly been subtly implied in the literatures. This would explain the frequent interchange in the use of this constructs. It is based on the premise of the equality view that most IS capability research need to get context from. This is because for a thorough understanding of what has been done, it is necessary to apply the equality view otherwise relevant research describing same or related phenomena would be missed. With this view, researchers of IS capability, IS resources and IS competence would have an underlying assumption that these terms have been interchanged. While this might be necessary when studying what has been done in the past, it does not have to be so going forward. Andreu and Ciborra (1996) in defining *Capabilities*, completely assigned all the attributes associated with *resources* in prior literature to describe the capability construct. They described capability to be of strategic potential when it is valuable, rare, imperfectly imitable and with no strategically equivalent substitutes. When compared with the definition of resources by many other researchers (Barney, 1991; Conner, 1991; Leiblein, 2011) these two constructs could be perfectly interchanged according to this view. Similar perspective is shared by a school of thought that considers competence and capability to be one and same (Prahalad and Hamel, 1990)

Having evaluated the different perspectives with which these constructs have been defined [*Dissensus*], it is important however to understand that one definition is not necessarily wrong relative to the others. According to Caldeira and Dhillon (2010), these differences could be be explained as a result of the differences in the objectives and contexts under which the research was carried out. For instance, Caldeira and Ward (2003) as focused on SMEs while Peppard et al (2004) was based on analysis of large companies. Caldeira et al. also posits that this could be also due to the differences in the level of abstraction and level of details used in the definition of the terms. He showed this by using the contrast in the case study approach used by Dhillon (2008) which was at a higher level of abstraction compared to the multiple case studies they employed in their research.

4.3   Status Map of current IS capability research

IS capability has evolved to be a research stream that underscores the valuable contribution of information systems both for practical application in business organizations and for knowledge advancement in IS research. As a research area, IS capability in relation to competitive advantage has gained *maturity* to a substantial degree relative to other emerging IS research fields. However, there still exists some areas in need of improvement in the IS capability research. Using an adaptation of Deetz (1996) framework as depicted in

Figure *22*, we present a status map to give an overview of the current state of the IS capability research stream.

The figure makes it obvious at a glance to see conclusions of this review. Areas where there needs to be more attention (*Dissensus* and *Emerging* axis) and the areas that have received significant attention (*Matured* and *Consensus*). The *Dissensus* and *Matured* quadrant is indicative of an area where there is identified difficult to reconcile discrepancies. This was not identified in this review at this present stage of the IS capability discuss, hence it is left open. It however becomes immediately clear from the status map that IS capability literatures have significantly indicated the value of IS capability in detailing its benefits to firm performance and competitive advantage over the years.
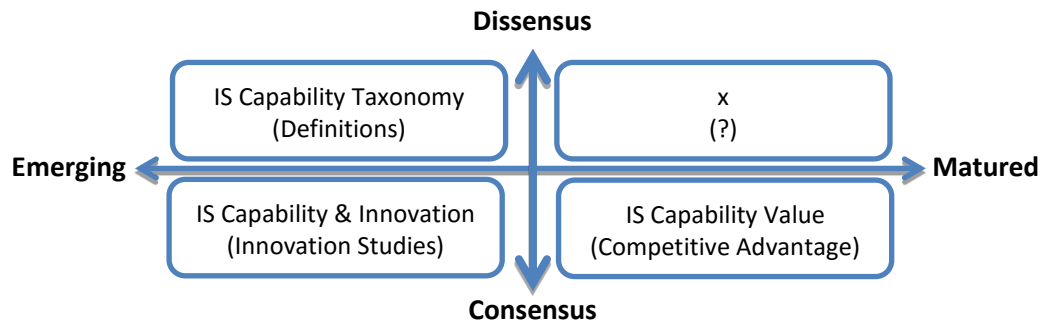
Figure 22.   *A status map summarizing the present status of IS capability research*

On the other hand it also reveals the apparent lack of consensus in the definition of IS capability and its related constructs. Also as mentioned earlier, the research stream on Innovation studies (and organizational change or environmental turbulence) is still emerging and this is an open call for more studies in this area.

5   CONTRIBUTIONS

5.1   Contributions for research: The 4 Ellipse Model

IS Capability and its related constructs have been classified into different categories in prior research. A careful identification of these classifications reveals similarities which can all be regrouped to formulate a broader taxonomy. These are grouped into four major IS components – IS Infrastructure, Business and IS development, Networking and IS Management Capability (see Table 12). This categorization provides a concise and yet encompassing view of the constituent elements defining an organizations' IS capability. With this background, we advance the four ellipse model to capture the essence of this categorization for future evaluation of IS capability in practice and in research.

Existing classifications of IS capability related constructs have been developed from different perspectives. Starting from Ross et al. (1996) who made a grouping of IT resources into human assets, technology assets and relationship assets plus IT processes. Bharadwaj (2000) made a modification to this classification to IT infrastructure, human IT resources and IT enabled-intangibles. However, Li et al. (2006) observed the missing process dimension in this classification. On a similar pedestal, Feeny and Willcocks (1998) using the IS capability terminology proposed a classification of nine IS capabilities. Using a construct where Feeny et al's capability construct equates to competence in similitude, Peppard et al. (2004) made a classification of six macro capabilities that are composed of 26 competences. Peppard's classification was later modified by Cragg et al. (2011) from an SME perspective. In total, fourteen (14) articles were identified with different classifications and these are composed of a total of 60 individual elements.

In developing a conceptual synthesis, it is essential to build on existing research and theories in relevant domains. Following the steps of Nevo and Wade (2010) who identified the parallel between systems theory and the resource base view, we posit that a systemic view of IS capability provides a broader base to describing an organizational IS Capability. In systems theory, organizations are viewed as the assembly of interrelating subsystems which can be delineated by the activities they carry out and the objectives towards which they are aimed (Courtney 2001; Daft

1992). In a similar way, RBV also views an organization as a collection of resources which culminates into the defining capabilities of the organization (Nevo et al., 2010; Tippins et al., 2003; Amit and Schoemaker, 1993; Ravichandran et al., 2005). From an organizations perspective, several subsystems are put in place to

Article	IS Infrastructure Capability	Business & IS Development Capability	Networking Capability	Management capability
Bharadwaj (2000)	IS/IT infrastructure, Human IS/IT skills	IS/IT enabled intangibles		
Tippins and Sohi (2003)	IT operations, IT knowledge, IT objects			
Bhatt and Grover (2005)	IT infrastructure	IT business experience; Relationship experience		
Fink and Neumann (2007)	IT Infrastructure Capabilities; IT Personnel Capabilities	IT-Dependent Organizational Agility		
Lu and Ramamurthy (2011)	IT infrastructure capability	IT proactive stance; IT business spanning capability		
Ross, Beath and Goodhue (1996)	Technology assets; IT processes, Human assets	Relationship assets		
Ravichandran and Lertwongsatien (2005)	IS operations capability; IS support maturity	Systems development capability		IS planning sophistication
Bharadwaj, Sambamurthy and Zmud (1999)	IT infrastructure	Internal IT partnerships, business process integration	External IT partnerships	IT management, Strategic vision of IT
Sambamurthy, Bharadwaj and Grover (2003)	Knowledge reach, Process reach	Knowledge richness, Process richness, Agility		Entrepreneurial alertness
Li, Chen and Huang (2006)	Knowledge reach, Process reach, Positional assets	Knowledge richness, Process richness, Agility		Entrepreneurial alertness
Peppard and Ward (2004)	Delivery solutions	Defining the IS contribution; Exploitation	Supply	Strategy, Defining the IT capability
Cragg, Caldeira and Ward (2011)	Delivery solutions	Defining the IS contribution; Exploitation	Supply	Strategy; Business & IS strategic thinking
Wade and Hulland (2004)	IS infrastructure, IS technical skills, cost-effective IS operations	IS development, external relationships, market responsiveness, IS business partnership		IS planning and change management
Feeny and Willocks (1998)	Design of IT architectures; Making technology work	Business system thinking; Business-IT relationship	Contract facilitation & monitoring; Informed buying; Vendor development	IS/IT Goverannce

Table 12.   Grouping of IS Capability classifications

achieve different goals. With regards to IS, organizations would have systems setup for handling specific IS objectives. These could include subsystems for mapping organizational IS strategy, one for coordinating IS processes and another for managing IS/IT infrastructures plus one for the IS organization among others. These IS subsystems are also defining macro components of the constituent IS capabilities identified in prior research.

If we represent each element by an ellipse as depicted in Figure 4, each component represent a composition of subsystems of constituent IS-Capabilities as expounded in Table 12. The measure of the IS Capability is a function of the interaction of these components with each other. Hence the IS capability of an organization is not simply the addition of these components but a synergetic combination of each component.
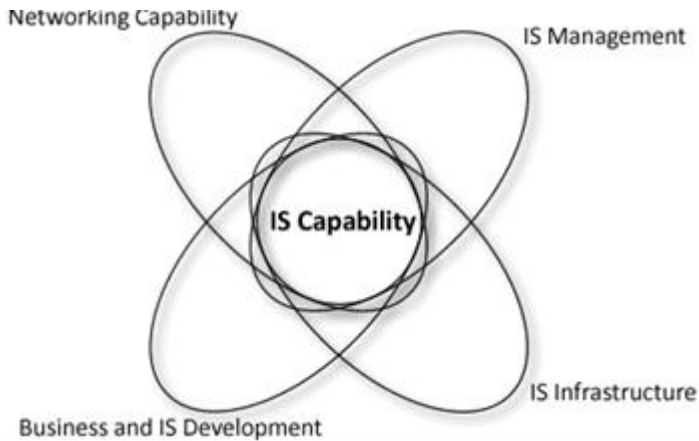
Figure 23.   The four Ellipse Model of Organizational IS Capability

The synergetic formation of IS capability from these four components stems from the complementary nature of capabilities. Synergy is about joint action or co-action. It means the ensuing IS capability of an organization from this interaction is such that the achieved capability is one which each component is individually incapable of achieving, hence the overlap in the ellipses (Li et al., 2006). The degree of overlap of these IS subsystems in an organization determines potency of the IS capability of the organization. When synergy and competitive advantage are aligned, the result is less likely to be imitated easily because such effect are usually achieved via a distinctive circumstance peculiar to the resources of the firm (Bharadwaj, Varadarakam and Fahy, 1993).

From the foregoing analysis and from the review of previous literature, the four ellipse model provides an overview for the conceptualization of IS capability. This is built on the various classifications that have been used to describe IS capability in different categorization. We posit that all this classifications can be largely grouped under the four axis of the ellipse model: IS Infrastructure, Business and IS development, Networking and IS Management Capability. Such a Meta representation provides a unification to the IS capability discussion.

IS Infrastructure Capability: This relates to the technological foundation which determines the extent to which an organization can exploit the benefits of most of its IS investments. Based on the definition of Broadbent, Weill and O'Brien (1996) The IS infrastructure capability of an organization includes not only its physical and tangible assets but also extends to its human resources and their inherent knowledge. The ability of an organization to exchange knowledge/information, align processes and remain competitive is associated with this component.

Business and IS Development Capability: This component describes the operational IS capabilities for strategic positioning. It has a lot to do with the ability of the organization to orchestrate and govern other IS related systems in relation to the business needs. This is the element of how well the IS activities of the organization fits or aligns with the business objectives. Significant tacit and intangible elements of Information System are embedded under this component.

IS Management Capability: While the Business and IS development capability of an organization addresses the operational capacity of the business, the IS management Capability is indicative

of the planning and foresight capacity of the organization. This component determines the capability of the firm to effectively manage and deploy the IS knowledge, IS skills, IS competences, IS personnel and relationships plus partnership within its domain as dictated by the dynamic nature of a business landscape. Summarily, it encompasses the capacity for an organization to assess its IS status and to spot business opportunity from IS to enhance its competitive and performance advantage.

Networking Capability: Today, most organizations operations are intertwined and directly dependent on the relationships with its external environment. The defining capability here is the ability of an organization to acquire value from its business environment. This relates to the degree of agile response an organization can attain via the information and resources that it can harness from outside the fore-walls of its business. It also defines its ability to understand the appropriate outsourcing model that suits its core business operation. The capability of an organization to know how to respond to emerging threats or changes that tests the agility of the organization is captured by the effectiveness with which it can effectively align its internal IS resources with the wealth of resources in its network.

A close consideration of the different classifications of IS capability and related constructs from the reviewed articles, shows that each of the classifications could fit in one or multiple sectors of the ellipse model. For ease of presentation each classification will be grouped into the most closely fitting grouping. This is demonstrated in Table 12. The list is a grouping from the compilation of classifications in the reviewed papers. The model and the list are open to be extended, reviewed, expanded and built upon with emerging knowledge. The constituent of each ellipse as grouped in Table 12 is made up of a combination of resources, competences and capabilities. These are fundamentally different, however based on the 3-tier distinction adopted from Peppard (2004), it can be logically deduced that their utility effectively adds up to forming the macro capability of the organization. From this perspective, an organizations IS capability can be seen as a reinforcing relationship between the IT competencies and IT resources of an organization. For instance, if we take an individual view, the IT personnel are the resources but the skills that they possess is their competency which is beneficial and transferrable to the organization.

As an extension, we can consider two organizations that have each employed a specific IT personnel to fill the same kind of position. What would advertently determine the edge in this investment is not the personnel (resource) itself but the quality and relevant extent of the skill (competency) that such a personnel brings along. However, this is still latent, it becomes part of the organizational capability when it is exploited and utilized in complementary with other organizational resources or competences. When the value of a resource or competence is enhanced due to the presence of another resource or competence, complementarity is said to exist. (Powell and Dent-Micallef, 1997 in Tippins et al, 2003).

5.2   Contributions for Practice

Due to the tangible and intangible nature of information system, it is of value for practitioners, particularly IS managers to be able to evaluate the IS capabilities that they possess in the organisation. Furthermore, IS managers and CIOs need to continuously argue for the significance of IT with respect to the organisational strategy. A unified view of IS capability reduces the ambiguity involved in defining and classifying the IS capability possessed by an organisation.

In addition, the paper provides IS managers with a consolidated view that encompasses all the identified possible classifications of IS capability in IS research. This ultimately provides a comprehensive checklist for better judgement and positioning of there is capability. This is such that

the decision makers can have a realization of the limitations/weakness and the strengths and opportunities that are inherent in their overall IS structure.

5.3 Limitations and further research

This is a literature review paper that has been conceptual developed to unify the different lose ends observable in the topic of IS capability, which implies that the limitations associated with this type of research would also apply in this case. Firstly, there is always the possibility of some articles missed out in the review. However to minimize this, the paper has been developed by adopting a systematic review process following the guidelines of Webster & Watson (2002). Secondly, being a conceptual paper indicates there are openings that only empirically driven research can validate. We therefore advance this as a call for IS researcher to empirically validate, build on, criticize and develop the research agenda that has been opened with the unified perspective of the study of IS capability.

6 SUMMARY

One contribution of IS research is that it introduces new and useful concepts. IS capability is one such concept that cuts across virtually all the facets of the IS setup of an organisation. Via a systematic literature review, this paper presents current knowledge on the concept and its utility. A lack of clarity in taxonomy, definition and classification hampers a consolidated advancement of this concept. Hence this paper presents a possible unified view of IS capability classification to lessen the increased divergence of the concepts. Furthermore, key Areas approaching maturity and some areas just emerging are highlighted to open an agenda for further scientific enquiries.

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Paper 5: IS Agility Research: An Assessment and Future Directions

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IS AGILITY RESEARCH:
AN ASSESSMENT AND FUTURE DIRECTIONS

Complete Research

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Abstract

In this paper, we briefly describe IS agility related research in four established IS research areas: IT infrastructure, IS development, IS organization, and IS personnel. We present a systematic literature review of articles published in leading scientific IS journals during the years 1990-2013. The main contribution of the paper is in the summary of research methods and results of agility related research in the four research streams. Our analysis will provide researchers with a foundation of prior research when designing future studies. Additionally, the paper raises concerns that the dominance of two research streams (i.e., flexible IT infrastructures and agile IS development methods), may overshadow the role of IS personnel characteristics and IS organisation design in agility studies. Future IS agility research could also benefit from studies adopting a broader theoretical perspective to integrate concepts and findings across all four research streams.

Keywords: IS agility, IS flexibility, dynamic capabilities, literature review.

INTRODUCTION

Because agility is both difficult and critical for Information Systems (IS) organizations, it has intrigued researchers in several IS research streams. The value of this paper rests on the identification and re-examination of agility related studies carried out in four different IS research streams concerned with IS development; organization; personnel, and infrastructure. Agility related studies were identified in a systematic literature review, where literature was searched using keywords such as agility, flexibility and adaptability. This review led to a sample of 47 articles that explicitly address agility related themes in IS.

The paper begins with a short introduction to the concept of agility in management and organization research, followed by a brief summary of the use of agility concept in IS research. The paper then proceeds to describe how the literature review was carried out, with summaries of prior research being presented within the context of the four research streams. The paper is brought to a close with a summary of the theoretical and practical implications and contributions arising from this study.

WHAT IS AGILITY?

Origins of agility concept in management research

The concept of agility was first used in the strategic management and manufacturing literature in the early 1990s (Goldman and Nagel, 1993; Goldman et al., 1995). Agility was introduced into

the literature with the argument that success in volatile industries requires a different set of capabilities than success in stable industries (Volberda, 1996; Volberda and Rutges, 1999). In such situations and industries, companies need to be agile – they need to be able to capitalize on or respond to the opportunities created by new market situations faster than their competitors (Goldman et al. 1995).

The key question then is, how can companies become agile – how can they build the required capabilities? And perhaps even more broadly – what exactly are these capabilities? This question has been addressed in several areas of strategic management and organization studies, rooting back to theoretical work that had started well before the concept of agility had been introduced.

Hence, there is an abundance of theories on strategic change that identify several alternative explanations for success. Among a number of examples, the dynamic capabilities literature emphasises the role of owners and managers in orchestrating fast business transformation (Teece et al., 1997). Agility originates from managers' capability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments (ibid., p. 515). Such high level capability can, however, also be seen as an outcome of routines and day-to-day practices that support strategizing between owners, senior management and other important strategy process participants, such as staff, business unit managers, and strategy consultants (Whittington 2006; Galliers 2007; Jarzabkowski and Spee, 2009).

There are, however, also theories that emphasise the role of professionals and middle level executives: according to those theories, strategic transformation is often contingent upon 'light touch' routines, mindfulness, bricolage and tinkering at relatively low levels of the organization (Eisenhardt and Martin 2000; Weick and Sutcliffe, 2006; Ciborra, 1992). These theories (among others) have been used as reference disciplines in IS agility research.

Use of the agility concept in IS research

In IS research, the concept of agility has increasingly been used in combination with terms such as flexibility, dynamic and organic. IS practitioners adopted the idea of "agile programming" in the early 1990s and it still dominates the interpretation of agility on the part of many IS professionals. In research, the concepts of flexibility and agility have been related to the broader challenge of combining complex IT systems with unexpected, sometimes surprising changes in user needs, business processes, company structure, strategy, markets and society at large.

In various IS research streams, there is the potential to add the sub-question: our results appear to apply in "normal conditions", but what about the "volatile environment"? Hence, while reviewing the literature, we identified many streams of research where the relationship between IS and organizational change has been addressed. When classifying these papers according to the research question, we used a tentative classification into seven different groups that seemed appropriate and sufficient for identifying similar papers (See table 1).

Field of Research	Relation to flexibility/agility
Strategic IS management	How the CIO and the senior management should make top-level decisions about IT in a volatile or turbulent environment?
Business agility and the value of IS applications	What is business agility and how do IS applications (e.g. DSS, CRM; SCM; BI; KMS) promote business agility e.g. by supporting rapid sensing and responding?
Design of IT infrastructure	How the IT infrastructure should be designed and maintained in order to enable timely support for rapid business changes?
Skills and competences of IS professionals	What kind of skills and competences of IS professionals are critical in the context of rapid business changes?

Design and govern- ance of the IS organ- ization	How should the IS organisation (including IS outsourcing relationships) be structured and governed to support rapid and continuous business change?
Methods used in IS development	What kind of methods should be used in IS development projects to deal with ambiguous and evolving business requirements?
Methods used in SW development and programming	What kind of methods should be used in software development and program- ming to deal with ambiguous and evolving system's requirements.

Table 1.   *Typology created while classifying IS agility/flexibility studies (Rows high- lighted with stronger borders identify research streams selected for this paper).*

Although the streams share the interest to understand agility, often drawing from the same refer- ence disciplines, each research stream has selected and defined its key questions and concepts. Even within the same stream, there is often more than one definition for agility, and concepts like agility, flexibility, organic or dynamic have been used interchangeably.

Selecting the focus for this study

The rationale for selecting the four streams (IT infrastructure, IS development, IS personnel and IS organisation) is that they address tasks that are controlled by the IS function and thus deal more directly with change capabilities of the IS organisation. The three excluded areas (strategic IS management; business agility and IS, and agile software development) are all sufficiently exten- sive research areas to deserve a literature review on their own (see, e.g., Tanriverdi et al. 2010; Overby et al. 2006; Dybå and Dingsøyr 2008). We do recognise, however, the close relationship between all seven areas.

Study design

The aim of this literature review was simple: to identify studies from prior IS research that address agility in the IS organisation context. In the following, we present details of how the literature review was undertaken.

The review took the form of a five-phase approach as recommended by Webster and Watson (2000). In the first phase, relevant articles were searched from leading journals in the IS and management arena, including all the AIS 'basket of eight' journals, six other high quality scien- tific journals (Database for Advances in Information Systems; Decision Sciences; Decision Sup- port Systems; Information & Management; International Journal of Information Management; Management Science) and four practitioner-oriented journals (Communications of the ACM; Harvard Business Review; Information Systems Management; Sloan Management Review).

Because there are many synonyms for agility that appear in the literature (see Sherehiy et al. 2007), several keywords and search fields were used to ensure comprehensive coverage. The keywords used, based on Sherehiy and colleagues, were: agility; agile; flexibility; flexible; adapt- ability; adaptive, and organic. In the case of business journals, the keyword "information system" was used to limit the search to the IS field. Articles were searched by the title, abstract and full text fields. Results were limited to articles published from 1990 onwards.

The second phase comprised screening the articles based on: first by title, then by abstract and finally by full text, to identify papers that address agility related themes in the context of the IS organization. The third and fourth phases complemented the search by reviewing the citations in the articles identified as a result of the screening done in the first two phases, and then by utilizing the Web of Science citation index to identify and review subsequent literature that referenced the articles found in the three first phases.

In the fifth and final phase, the articles were classified. The first classification was based on the research question, which led to the identification of the four research streams. Within each stream,

further classifications were then made according to the study design, distinguishing between studies where the key contribution is related to: (1) definition or measurement of key agility/flexibility variables; (2) antecedents of agility/flexibility variables, and (3) organizational impact or value of the agility/flexibility variables. (A recent update search this winter identified some additional articles. We were not able to include those to the paper, but they will appear in the conference presentation).

Results

In the following, the articles within each research stream are briefly described. The objective is to summarise research in each stream by presenting key definitions and main findings regarding antecedents and value of flexibility/agility.

Research stream: IT infrastructure

Research in IT infrastructure flexibility has benefited from the early conceptual work, first by Duncan (1995) and later by Byrd and Turner (2000). Although Duncan does not give a precise definition, the following description provides a starting point for understanding IT infrastructure flexibility:

> *Infrastructure flexibility determines the ability of the IS department to respond quickly and cost-efficiently to systems demands, which evolve with changes in business practices or strategies. The ideally flexible infrastructure would be one that was designed to evolve, itself, with emerging technologies and would support the continuous redesign of business and related processes (Duncan, 1995, p. 44).*

Later, Byrd and Turner (2000) developed a measurement instrument for IT flexibilty. The instrument was based on the assumption that IT infrastructure flexibility consists of eight dimensions: four in the technical base (IT connectivity; applications functionality; IT compatibility; data transparency), and four in the human component (technology management; business knowledge; management knowledge; technical knowledge).

One aspect of research on IT infrastructure flexibility has identified practices that are intended to lead to this flexibility (see table 2). The main lesson from these studies is that systematic architectural thinking – as described in, for example, enterprise architecture or service oriented architecture – is a prerequisite for flexible IT infrastructure (Allen and Boynton, 1991; Schmidt and Buxmann, 2011; Joachim, Beimborn, and Weitzel, 2013). New technological trends can constitute both a means to (Fink and Neumann, 2009) and a challenge (Benamati and Lederer, 2001) for IT infrastructure flexibility.

Definition and measurement of flexible IT infrastructure		
Duncan, 1995 (JMIS)	Group and semistructured interviews**:** high-level IS executives	Presents a framework for developing tools to evaluate infrastructure flexibility.
Byrd and Turner, 2000 (JMIS)	Survey**:** IS senior managers in Fortune 1000 companies	Defines the IT infrastructure flexibility construct and develops a valid, reliable measurement instrument for this construct.
Antecedents of IT infrastructure flexibility		
Allen and Boynton, 1991 (MISQ)	Conceptual**:** (research, case writing, and consulting experience)	Recommends a combination of centralised (high road) and decentralised (low road) solutions to face the dual challenge of "speed and flexibility" and "low cost and efficiency."

Benamati and Lederer, 2001 (CACM)	Survey: A field survey among IS professionals in the USA.	Describes the use of coping mechanisms with which IT organizations adapt to rapid IT change.
Fink and Neumann, 2009 (DB)	Survey: 293 IT managers in Israel, cross-sectional.	Results show that the implementation of Web services applications positively affects the flexibility of IT infrastructure and information flexibility.
Schmidt and Buxmann, 2011 (EJIS)	Survey: financial services, EU, North America and Australia	The implementation of an Enterprise Architecture Management function is supportive in the creation and sustainment of IT efficiency and IT flexibility.
Joachim, Beimborn, and Weitzel, 2013 (JSIS)	Survey: 81 IT managers in SOA using organisations in Germany	Identifies SOA governance mechanisms that effect infrastructure flexibility and reuse of services.

Table 2.   *Studies addressing the definition, measurement and antecedents of flexible IT infrastructure.*

Other researchers have tested hypotheses related to various positive business impacts and benefits of flexible IT infrastructure (Table 3). These studies have been able to associate IT infrastructure flexibility with, for example, rapid business process changes (Broadbent et al., 1999); success in global IT projects (Lim et al., 2006); sustained IT alignment (Tiwana and Konsynski, 2010); improved organisational responsiveness (Bhatt et al., 2010); strategic payoffs (Fink and Neumann, 2009); competitive advantage (Bhatt et al, 2010), and ultimately, firm performance (Kim et al., 2011; Liu et al., 2013).

Value of IT infrastructure flexibility		
Broadbent, Weill and St.Clair, 1999 (MISQ)	Exploratory case: four firms (retail and petroleum).	Firms with higher level of IT infrastructure capabilities were able to implement extensive (more innovative and radical) changes to their business processes over relatively short time frames.
Lee, Banerjee, Lim, Kumar, van Hillegersberg, and Wei, 2006 (CACM)	Case study: large life and casualty insurance company.	Synergistic use of agile IT strategy, agile IT infrastructure, and agile IT project management contributed to a highly successful globally distributed system development project.
Fink and Neumann, 2009 (I&M)	Survey: Data collected from 293 IT managers in Israel.	Achievement of perceived strategic payoffs of IT infrastructure enabled flexibility was explained by range of managerial IT infrastructure capabilities, and IT personnel knowledge and skills.
Bhatt, Emdad, Roberts and Grover, 2010 (I&M)	Survey: senior executives of 105 manufacturing and service firms.	IT infrastructure flexibility was positively related to information generation and dissemination, leading to improved organizational responsiveness and firm's competitive advantage.
Tiwana and Konsynski, 2010 (ISR)	Survey: 223 organizations (MIS and line managers).	IT architecture modularity helps sustain IT alignment by increasing IT agility. Decentralization of IT governance strengthens this relationship.
Ngai, Chau, and Chan, 2011 (JSIS)	Multiple case study: fashion and textile industries in Hong Kong.	Provides partial support for propositions that IT integration and IT flexibility are positively associated with supply chain agility.
Kim, Shin, Kim, and Lee, 2011 (JAIS)	Survey: Managers in Korean companies.	Results confirm the following route of causality: IT personnel expertise -> IT management capabilities ->

		IT infrastructure flexibility -> process-oriented dynamic capabilities -> firm financial performance
Liu, Ke, Wei, and Hua, 2013 (DSS)	Survey: 286 executives (e.g., CIO, CTO or COO) in China.	Survey data show that IT capabilities (i.e., flexible IT infrastructure and IT assimilation) affect firm performance through absorptive capacity and supply chain agility.

Table 3.   Studies addressing the value of flexible IT infrastructure.

Articles on IT infrastructure flexibility have been published in the leading IS journals (mainly 'basket of eight' journals), which provides an indication of the quality of these articles. Survey research has been the dominant research method in this stream. Although the distinction between antecedent variables, the definition of IT infrastructure flexibility variable, and various outcome variables is not entirely consistent, this research stream appears to form a genuine research area, where knowledge of the theme (flexible IT infrastructure) accumulates over time.

Research stream: IS development

In the IS development (ISD) research stream, agility related research has focused on the use of agile methods. Conceptual research has helped in defining key variables for research. Lee and Xia (2005) developed measurement scales for the two central components of ISD flexibility: response effectiveness and response efficiency. Later, based on a comprehensive review of the use of the concepts flexibility, agility and leanness in business studies, Conboy (2009) defines agility of an ISD method as follows:

> *The continual readiness of an ISD method to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value (economy, quality, and simplicity), through its collective components and relationships with its environment.(Conboy, 2009, 340).*

Several case studies have then tried to identify antecedents for flexibility or agility in ISD (Table 4). A central thesis is that companies should follow the principles of the so called agile ISD methods (Baskerville and Pries-Heje, 2004; Sarker and Sarker, 2009). It has, however, been recognised that the adoption of such methods is a slow learning process (Cao et al., 2009; Berger and Beynon-Davies, 2009; Wang et al., 2012). Many other variables, such as organizational context, various project attributes, and collective and individual mindfulness define project teams' ability to e.g. effectively deploy agile principles (Lyytinen and Rose, 2006; Zheng et al., 2011; Ramesh et al., 2012; Goh et al., 2013).

Definition and measurement of ISD Agility		
Lee and Xia, 2005 (EJIS)	Survey: Confirmatory factor analysis data from 505 ISDP managers	The study developed measurement scales of ISD project team flexibility along two dimensions: Response Extensiveness and Response Efficiency.
Conboy, 2009 (ISR)	Systematic literature review and case study (2 ISD projects).	The study develops a definition and formative taxonomy of agility in an ISD context, to be used as a starting point to study ISD method agility.
Antecedents of ISD Agility		
Baskerville and Pries-Heje, 2004 (ISJ)	Case study: 9 companies in the U.S. and 3 in Denmark.	Studies reveal that short cycle time systems development is a new form that can be clearly distinguished among other forms, based on five SD practices.

Sarker and Sarker, 2009 (ISR)	Case study: a multinational high-tech organization.	Agility in globally distributed ISD should be viewed as a multifaceted concept having three dimensions: resource, process, and linkage agility.
Zheng, Venters, and Cornford, 2011 (ISJ)	Case study: UK's computing grid for particle physics (GridPP)	This paper offers insights and implications for 'collective agility' in a global collaborative SD community through the dynamics of six improvisation paradoxes.
Ramesh, Mohan, and Cao, 2012 (ISR)	Case study: a multisite case study of three projects	Examines how case organizations developed contextual ambidexterity—the ability to pursue conflicting demands of agility and formality of distributed ISD simultaneously.
Wang, Conboy, and Pikkarainen, 2012 (ISJ)	Exploratory case study: Four ISD teams in different organizations.	Applies innovation assimilation stages to understand the acceptance, routinisation and infusion of agile practices by ISD teams.
McAvoy, Nagle, and Sammon, 2013 (ISJ)	Longitudinal case study: a 16 month study in an ISD organisation	The study explores the use of mindfulness as a theoretical framework to examine ISD agility, thus providing contributions around the value of mindfulness for ISD agility.
Lyytinen and Rose, 2006 (EJIS)	Multi-site longitudinal case study: seven ISD companies.	Describes ways how ISD organizations' practices changed from exploration (innovation) to exploitation (cost, risk and product quality) while innovating with Internet computing.
Cao, Mohan, Xu, and Ramesh, 2009 (EJIS)	Case study: semistructured interviews in four ISD projects.	Using adaptive structuration theory as a lens, the paper describes how the structure of agile methods, projects, and organizations affect the adaptation of agile methodologies.
Berger and Beynon-Davies, 2009 (ISJ)	Longitudinal ethnographic case study: a UK public sector organization.	Demonstrates problems experienced with the adoption of rapid application development, particularly in stakeholder involvement, suggesting that ISD method adoption is a dynamic and continuous process.
Goh, Pan, and Zuo, 2013 (JAIS)	Case study: IS projects in Beijing Capital International Airport.	IT project team capabilities and organizational control mechanisms are central in defining agile IS development practices in large-scale IT projects.

Table 4.   Studies addressing the definition, measurement and antecedents of agility in IS development

Some of the studies on agile ISD have also focused on the outcomes resulting from the use of agile ISD principles (Table 5). In the Holmqvist and Pessi (2004) case study, the use of short projects with comprehendible size is carefully linked to the successful business outcomes of the project. Other researchers have linked dimensions of agility practices into the more traditional ISD success measures (Sarker et al., 2009). Related to this, one study measured user satisfaction and intention to continue using systems that are under continuous development (Hong et al. 2011).

Value of Agility in IS development		
Holmqvist and Pessi, 2006 (EJIS)	Case study: Volvo's global initiative to sell spare parts over the Internet.	Demonstrates how agility in IS development through continuous implementation and comprehendible sized projects enabled innovation through new relations and channels.

| Sarker, Munson, Sarker, and Chakraborty, 2009 (EJIS) | Analytic hierarchy process**:** 8 respondents, technical and managerial. | Assesses the relative importance of the various types of agility types/facets with respect to different ISD success measures. Presents three ways to aggregate the preferences of the two groups (managerial and technical). |
| Hong, Thong, Chasalow, and Dhillon, 2011 (JMIS) | Survey: Fortune 500 company in the service industry, data from 477 users. | Utilizes constructs from e.g. UTAUT to explain users' intentions to use new features when they are released (surrogate for the ultimate success of agile IS). |

Table 5.   Studies addressing the value of agility in IS development

In addition to agility in the ISD process, flexibility can be built into the systems and their use processes (Table 6). Sometimes such flexibility results from conscious choices in systems design (Gebauer and Lee, 2008), but it can also result from users finding workarounds and stretching their work process rules in the context of existing systems (Goh et al., 2008; Azad and King, 2008). Gebauer and Schober (2008; 2011) have also studied the value of designed flexibility through conceptual modelling and simulation.

Antecedents of flexibility-to-change vs. flexibility-to-use		
Goh, Gao, and Agarwal, 2011 (ISR)	Longitudinal field study**:** health care organisation.	Provides understanding of the interplay between technology and patterns of clinical work embodied in routines. Proposes a dynamic process model of co-evolution.
Gebauer and Lee, 2008 (ISJ)	Case study**:** an electronic procurement system at a Fortune 100 firm.	Presents a roadmap that can guide flexibility and implementation strategies of enterprise systems based on both project and business process characteristics.
Azad and King, 2008 (EJIS)	Case study**:** Mediterranean teaching hospital.	The hospital's organizational environment allows for interpretive flexibility, in which physicians stretch rules to make adjustments to existing computer-based procedures.
Value of flexibility-to-change vs. flexibility-to-use		
Gebauer and Schober, 2006 (JAIS)	Conceptual modelling**:** flexibility-to-use and flexibility-to-change.	Flexibility-to-change is cost efficiently deployed to support a business processes with high structural and environmental uncertainty, whereas a low process uncertainty corresponds with IS flexibility-to-use.
Schober and Gebauer, 2011 (DSS)	Simulation experiment**:** value of IS flexibility.	A deterministic treatment of IS flexibility underestimates its value, whereas ROA can overestimate it. Findings highlight the need for the concrete measurement of IS flexibility.

Table 6.   Studies addressing flexibility-to-change and flexibility-to-use

Overall, research on agility in ISD is predominantly based on case research, supported by only few surveys and conceptual/analytical papers. Perhaps related to this, most of the 20 papers in this stream are published in three journals: European Journal of Information Systems (6), Information Systems Journal (6), and Information Systems Research (4). Hence, also this research

stream forms a genuine research tradition, accumulating knowledge towards a more detailed theory of the theme (Agility in IS development).

Research stream: IS personnel skills and competences

Skills and competences of IS personnel have been acknowledged as critical components of both flexible IT infrastructures and agile IS development. There are, however, two studies in our sample that address the capabilities of IS professionals more broadly than just in relation to IT infrastructure or ISD (Table 7). The starting point of these papers is that IS professionals will need change-agent capabilities (Markus and Benjamin, 1996) and mindfulness in dealing with surprising events (Butler and Grey, 2006). Papers argue that organizational structures and standardised roles and work practices may prevent IS professionals from adopting a more effective change agent role or to act mindfully in surprising situations.

Antecedents of change-readiness among IS personnel		
Markus and Benjamin, 1996 (MISQ)	Conceptual: IS specialists as agents of organizational change.	Describes the traditional change-agent role that is very commonly held by IS specialists. While well-intended and supported by structural conditions in IS work, it often has negative consequences for organizations and for the credibility of IS specialists. Proposes an alternative to the traditional role.
Butler and Gray, 2006 (MISQ)	Conceptual: the concept of mindfulness.	Considers a variety of implications of mindfulness theories of reliability in the form of alternative interpretations of existing knowledge and new directions for inquiry in the areas of IS operations, design, and management.

Table 7.   Studies addressing antecedents of change-readiness among IS personnel

Both papers are published in MIS Quarterly, which can be seen to be illustrative of the significance of the topic. Although neither of the papers provides empirical evidence, the studies do open the question of the role of IS personnel competences and skills in agility. Clearly, future research could focus on this issue, also outside the context of flexible IT infrastructure and agile IS development.

Research stream: IS organization design

Several researchers have also recognised the role of IS organisational structures and governance mechanisms of both internal functions and IS outsourcing relationships. Clark et al. (1997) provide the following definition for a change-ready IS organisation:

> *Change-readiness is the ability of an information systems (IS) organization to deliver strategic IT applications within short development cycle times by utilizing a highly skilled internal IS workforce. (Clark et al., 1997, p. 425)*

Requirements for IS organisation have been addressed in several conceptual papers (Table 8). One of the key antecedents for a flexible IS organisation is a partner relationship between the IS organisation and the business (Rockart et al., 1996). IS departments are advised to adopt a matrix organizational structure – one that enables managing technical knowledge as a competence centre but simultaneously supports customer-driven development and service processes. Often referred to as a Centre of Excellence structure (Clark et al. 1997; Boar 1998; Gerth and Rothman 2007), it enables the critical requirement of distinguishing technical and control oriented tasks from business development oriented tasks. In general, an IT organisation should aim at becoming an emergent organizing and create virtual teams to promote close collaboration with business units (Prager, 1996; Truex et al., 1999). An empirical study by Clark et al. (1997) provides support for these propositions: transformation of an IS organization to a Centre of Excellence structure led to

improved customer satisfaction, satisfaction with projects and higher percentage of projects being delivered on time for example (Clark et al. 1997).

Antecedents of flexible IS organization design		
Prager, 1996 (ISM)	Conceptual: aligned IT organization, implications for IT professionals.	The IT function should assume a new role of anticipating and meeting the infrastructure and information needs that support organizational flexibility.
Rockart, Earl, and Ross, 1996 (SMR)	Conceptual (Field studies in the U.S. Europe and Japan)	Explores changes in business and technology that are driving changes in the role and structure of IT units. Defines and discuss eight "imperatives" for IT organizations in responding to these changes.
Boar, 1998 (ISJ)	Conceptual: IT structures vs. rapid horizontal introduction of IT.	An organizational structure that combines the ideas of mini-businesses and the internal marketplace can provide a dynamic balance between stability and productivity and flexibility and innovation.
Truex, Baskerville, and Klein, 1999 (CACM)	Conceptual: emergent organizations, practices in the IT organization.	Introduces organizational emergence as a new theory of social organization. Uses the theory to describe influences for the IS practices and organisational design.
Gerth and Rothman, 2007 (ISM)	Conceptual: business changes, IS organization and IS capabilities.	Describes how the business world is becoming increasingly "flat" with regard to access to global markets and a global workforce. Argues that new emerging operational priorities require new IS capabilities.
Value of flexible IS organization design		
Clark, Cavannaugh, Brown and Sambamurthy, 1997 (MISQ)	Case study: IS unit at Bell Atlantic, a Regional Bell Operating Company.	Describes the transformation process to the Center of Excellence design in an IS organisation. Proposes it as a model worthy of consideration by other IS managers for developing change-readiness IT capabilities.

Table 8.   Studies addressing flexibility in IS organization design

Articles addressing the IS organisation are published mainly in practitioner and management oriented IS and business journals. Although authors sometimes refer to their prior empirical work or consulting, no empirical data are presented. Articles are carefully written to provide instructions for managers on how to develop "a new IS organization", indicating that the existing IS organisations are not sufficiently prepared for change. Although articles provide generic advice on various facets of IS management and work, they also raise a clear argument that the design of the IS organization may influence its ability to cope with change.

In addition to the internal IS organisation, the need for flexibility has also been recognized in research on IS outsourcing relationships (Table 9). Tan and Sia (2006) define IS outsourcing flexibility as follows:

> *"To cope with the dynamic environment, an outsourcing relationship should be capable of change or adaptation. Outsourcing flexibility is thus about the ability of an outsourcing relationship to change the extent, nature, or scope of business services delivered" (Tan and Sia, 2006, p. 184).*

Studies on flexible IS outsourcing have identified a large array of strategic and tactical manoeuvers and discussed their implications for IS success (Lacity et al., 1995; Tan and Sia, 2006; Sia et

al., 2008) One specific manoeuver, a dynamic outsourcing contract, appears to be a significant antecedent for IS outsourcing flexibility and beneficial in conditions of unforeseen changes (Susarla, 2012).

Definition and measurement of flexible IS outsourcing		
Tan and Sia, 2006 (JAIS)	Conceptual: Clarifies the multi-dimensional notion of flexibility.	Identifies four dimensions of outsourcing flexibility (robustness, modifiability, new capability, and ease of exit).
Antecedents of flexible IS outsourcing		
Lacity, Willcocks and Feeny, 1995 (HBR)	Conceptual (Field study: 40 large corporations and public-sector organizations in the U.S. and Europe).	Concludes that the "strategic-versus commodity" approach to outsourcing led to problems in ensuring IS outsourcing flexibility and control. Proposes a new framework.
Value of flexible IS outsourcing		
Sia, Koh and Tan, 2008 (Decision Sciences)	Survey: 171 outsourcing projects in Singapore.	Links the four dimensions of outsourcing flexibility (robustness, modifiability, new capability, and ease of exit) to different strategic maneuvers and IS outsourcing success.
Susarla, 2012 (Management Science)	Document analysis: 141 IT outsourcing contracts.	Building upon literature on incomplete contracts, posits that renegotiation can be Pareto improving by incorporating contingencies revealed ex post.

Table 9.   Studies addressing flexibility in IS outsourcing

Studies that explicitly address flexibility in IS outsourcing remain few. Nevertheless, in particular the studies by Tan and Sia (2006) and Sia et al. (2008) provide a sound conceptual basis for further studies on this subject.

Discussion

Research on IS agility and flexibility originated in the 1990s with conceptual papers that addressed new demands for the IS organization and IS personnel. Papers in managerially oriented journals (HBR, SMR, ISM) argued for a need for a new IS organisation, which is better prepared to deal with change. The role of IS personnel as a change agent was also recognized in a MISQ commentary article. These arguments were not, however, rooted to empirical research (with the exception of Clark et al. 1997).

After the year 2000, the original emphasis on IS organisation and IS personnel was, however, replaced by research that explains agility through the attributes of IT infrastructure, IS development methods, and IS outsourcing practices. Researchers in each stream rely on similar research methods and they also share the journals where they publish results: flexible IT infrastructure studies are largely based on survey research and results are often published in leading AIS 'basket of eight' journals; case research on agile IS development tends to be published in three journals (ISR, ISJ and EJIS) and the research stream on flexible IS outsourcing, which is only emerging, has been initially published in Management Science, Decision Sciences and JAIS.

Research on IS agility has thus been divided into three established IS research areas: IT Infrastructure, ISD, and IS outsourcing. An advantage of this "sub-stream approach" is that researchers can utilise concepts and frameworks of existing IS research traditions. By addressing "special conditions", they make a sufficient contribution to be able to publish their results in high quality journals. Because the focus is on one specific IS task, the results are also specific and thus useful and easy to communicate for practitioners.

The disadvantage is related to the lack of an overall view on IS agility and the duplication of work done in different research streams. It is difficult to avoid the impression that there is a lot of similarity in central arguments regarding antecedents and value of IS agility in different domains. It is also easy to share concerns raised by Conboy (2007) about lack of clarity, theoretical-glue and conceptual parsimony, not only in the agile IS development research stream, but across all research streams covered in this review.

Limitations

The research task underpinning this literature review was simple: to identify articles from prior IS research that address questions concerning the agility of the IT organization. The fact that we reviewed literature from several large IS research fields (rather than investigating a single field) added challenges to conducting the review. Some articles could have been classified into more than one research stream and there were borderline cases where the screening decision was not obvious. Focusing the review on journal publications left relevant books (e.g., Desouza, 2007) and scientific conferences outside the scope of the review. Important articles and findings may therefore have been omitted (cf. Galliers and Whitley, 2007). Nevertheless, we believe that the articles in leading IS journals and their findings presented above provide a reasonably representative sample of mainstream research related to IS agility.

Assessment and future directions

It seems likely that research around flexible IT infrastructures and agile IS development methods will continue to enrich theories and explanations for agility, as both streams have reached a critical mass of researchers and publications. These research streams do not completely ignore the role of individuals. On the contrary, one of the conclusions emerging from these streams is that individual mindfulness is central for agility. But because research is framed around technologies and development methods, the results are discussed primarily within these more focused contexts.

Hence, current research leaves room for empirical research that more directly focuses on the characteristics of individuals, organisational processes and structures that enable agility. Early conceptual papers addressing the role of the IS organization and IS personnel provide a starting point for such research. Research on the actual practices associated with agility, in line with similar research with respect to IS strategizing (Peppard et al., 2014) and alignment (Karpovsky and Galliers, 2015) might also be considered.

Furthermore, if we accept the view that agility is itself a synergistic concept (i.e., that agility in one IS task is of limited value if other tasks are not agile), then also a more holistic research approach or theory might be useful. A call for a more holistic theory is hardly a surprise in any research field. Holistic theories are inevitably at a higher level of abstraction, thus making them more difficult to validate empirically and to communicate to practitioners. Having said that, a more unified theory of IS agility could be based on the simple observation that in all research streams, agility appears to be related to choices in, for example, technology, practices/methods, personnel competences and organisation structures. Such a theory would not replace, but rather contextualise, clarify and add value to the research carried out in different sub-streams.

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Paper 6: Towards Discovering the role of IS/IT Capabilities in Disruptive Innovations

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