Implementing an Effective Strategic Renewal Process - An IT-enabled Agility Perspective

GOH CHONG LENG
(Master of Science, National University of Singapore, Singapore)

A THESIS SUBMITTED FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF INFORMATION SYSTEMS

NATIONAL UNIVERSITY OF SINGAPORE

2012

ACKNOWLEDGEMENTS

The journey towards a PhD degree is an enduring and difficult one. It requires great determination and perseverance. It is not for the faint of heart, especially not for someone who is taking this journey on a part-time basis. Hence, I have a lot of people who I am deeply indebted to at the end of my PhD journey. People who have helped, in one way or another, to make this journey of getting the illusive 'Dr' title an enriching and enjoyable one. The first person that I would like to thank is Professor Ooi Beng Chin, who is my Masters degree supervisor. He is one of the main reasons why I am determined to pursue a PhD. From him, I have learnt the importance of 'timing'. Without the right 'timing' to allow the development of my intellectual abilities, the journey towards my PhD would be suicidal. If his timely advice of telling me that I was unsuitable to take up PhD studies in 2000 hadn't occurred, I would have most certainly been 'dead' by now for attempting a PhD when I was not ready. He is partly the reason I have developed a 'never-say-die' attitude in every endeavor in my life.

The second and most important person that I am immensely grateful to is Professor Pan Shan Ling. Professor Pan Shan Ling is more than a teacher. He is a great mentor and a close friend. Till this date, I am still puzzled over Professor Pan's decision to admit a PhD student like me, who is academically not so strong, into his arms. For whatever the reason, I have to sincerely thank him for making a bet on me. It is for this reason that I have always worked really hard to repay his willingness and kindness to accept me as his student. Influenced deeply by his selfless sharing of knowledge and resources, I have excelled in my analytical thinking and conceptualization skills during these four-plus years of my PhD journey. For that, I am eternally grateful. Furthermore, I have also been

given golden opportunities to visit many large corporations in China. I know that such opportunities are privileges restricted to only a few selected PhD students. I can't possibly imagine the kind of obstacles that I would have to go through to get my PhD without Professor Pan's hard work to secure such quality case accesses for me. Under his wing, I have been able to see further and venture deeper into the world of knowledge with passion. I truly treasure every opportunity I have with him and I sincerely hope that I can continue to have the opportunity to work with and learn from him even after graduation.

Of course, the journey would also not have been enjoyable without the encouragement and help of many close friends. First, I would like to specially thank my PhD comrades a.k.a the Pan's Mountaineers: Barney Tan, Derek Du, Wang Zheng, Huang Pei Ying, Sitoe, Li Jia, Carmen Leong, and Mao Mao. Your presence has kept my spirit high on this long journey. Every moment of interaction with anyone of you has always been mutually beneficial. Through the many intense interactions with you, I have rekindled my passion in teaching and learning. If I were to take up a job as an academic in the near future, each and every one of you would have played a critical role in influencing this decision. Second, I would like to thank my close friends who have tirelessly helped to vet my papers and thesis. I know my weak command of the English language has made the vetting a difficult task but you have done it so willingly and without complaints. Despite your busy day-to-day work, you have also taken time and effort to give much timely advice throughout this journey. For that I am deeply grateful. I would particularly like to thank Candice Khor, Tan Wee Yeh, Goh Shen Tat, and Benny Loh. It has been a great joy in discussing my PhD experiences with you. Even though I know that my sharing can

be a little dry at times, you have always been patient enough to listen, and kind enough to interact with me in many fruitful discussions.

Finally, no journey of this great difficulty can be completed without the care, love, and sacrifice of my family members. To my beloved wife, Jenny, who endured all the bad temper moments during my ‘writing’ days, I would like to let you know that you are the ‘fuel’ behind every endeavor of my life. It is your love that keeps me going when the going gets tough. It is your care that catches me when I fall and helps me get onto my feet again. To my parents, god-parents, parents-in-law and brother and sister-in-law who have silently endured all the months of my not being able to meet up with you amid my busy work and PhD schedule – I am sorry. I hope that after I have completed this difficult and long journey I will be able to make up for the lost time with you. I hope what I have achieved will make your sacrifices worthwhile and that you will be proud of my achievements. Thank you for your unwavering love, support, and belief in my ability throughout these four-plus years. I wouldn’t have been able to complete my PhD without all this.

SUMMARY

Strategic renewal is increasingly becoming an important and necessary endeavor for an organization competing in a hypercompetitive environment. In such an environment, an organization's survival depends very heavily on its ability to renew its strategies, operations, and market relationships in a timely fashion to respond to disruptive environmental changes and/or to find and capture future opportunities. There are two types of strategic renewal identified in the extant literature and they are: (1) discontinuous strategic renewal – denotes a form of renewal that is typically forced by disruptive changes in the competitive environment and normally requires an organization to renew itself rapidly; and (2) incremental strategic renewal – denotes a form of renewal that involves a deliberate attempt by an organization to systematically and incrementally renew itself to capture potential opportunities in the market. In reviewing the literature of strategic renewal, we posit that a model detailing the role of IS during the process of strategic renewal is an important contribution to the extant literature. We argue that IT-enabled agility is an appropriate theoretical lens to understand the role of IS during the process of strategic renewal. This is because IT-enabled agility is defined as an organization's ability to sense and respond to opportunities inherent in a hypercompetitive environment. This ability in turn is aligned with the organization's need to enact strategic renewal.

By conducting two case studies, with each matching a type of strategic renewal identified in the literature, we attempt to offer an answer to this research question: *How can an effective strategic renewal be implemented within an organization through the development of IT-enabled agility?* In the first case study, we have identified the

development of IS development (ISD) agility as the main enabler that has helped Beijing Capital International Airport (BCIA) rapidly enact an effective discontinuous strategic renewal implementation for the 2008 Olympics. In the second case study, we have identified the development of Green Agility (an IT-enabled agility) as the main enabler that allows China Mobile Communication Co. Ltd to systematically enact an effective incremental strategic renewal implementation in response to the call for sustainability actions in business. Various inductive models were derived based on the two case studies, which provided an in-depth understanding and analysis of the role of IT-enabled agility in enacting an effective strategic renewal implementation. We conclude by stating the practical and theoretical contributions of these inductively derived models, the limitations of the two case studies and some future research directions.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

Brought forth by the forces of globalization and technology changes, the business competitive environment has been dynamically transformed (Agarwal et al. 2009). It is not uncommon for an organization competing today to face the frequent emergence of disruptive technologies, acute changes of regulatory requirements, intense time-to-market pressures, and rapidly changing customer preferences, which in turn threaten its ability to survive and thrive (D'Aveni 1995). Many researchers have deemed this competitive environment phenomenon as hypercompetitive and there is general consensus that such a hypercompetitive environment has increasingly become the norm of today's business environment in all industries (D'Aveni 1995; D'Aveni et al. 2010; Glenn 2009; Hamel et al. 2003; Sargut et al. 2011; Tanriverdi et al. 2010; Thomas Iii 1996). This consensus is best supported by some of the observations illustrated in several research papers: (1) sustained superior corporate performance is very rare across many industries even among the S&P 500 companies (Hamel et al. 2003; Tanriverdi et al. 2010; Wiggins et al. 2005); and (2) the duration on which successful companies can sustain the window of profitability has been shrinking over the years (Hamel et al. 2003; Wiggins et al. 2005).

One of the key reasons as to why it is so difficult to survive in a hypercompetitive environment is because strategy formation and implementation has become a very complicated and complex endeavor (Camillus 2008). The traditional process of strategy formation and implementation that focuses on a 'position defense' strategy (such as Porter's five forces analysis) is deemed as ineffective in a hypercompetitive environment, because the 'position' for organizations to defend has become dynamic and unpredictable in this environment (Camillus 2008; Tanriverdi et al. 2010). To survive and thrive in a

hypercompetitive environment, researchers have advocated that the focus on the illusive 'position' defense strategy should be dropped (D'Aveni et al. 2010; Tanriverdi et al. 2010). Instead, an organization should align itself with the environment (Day 2006) and focus its strategy and resources on developing capabilities which allow them to consistently and continuously enact effective strategic renewals (Agarwal et al. 2009; Hamel et al. 2003; Tanriverdi et al. 2010). Strategic renewal is a type of strategic change that specifically emphasizes the refreshment or replacement of strategic attributes (such as goals, products and services, resources and capabilities, and the like) of an organization that have the potential to substantially affect its long-term prospects (Agarwal et al. 2009). The main difference between strategic change and strategic renewal is that strategic change may include the extensions, additions or deletions of strategic attributes of an organization without any associated renewal (Agarwal et al. 2009). However, what constitutes the "refreshment" or "replacement" of a strategic attribute of an organization?

Agarwal et al. (2009) have identified several natures of "refreshment" or "replacement" during a strategic renewal process. First, they posit that the refreshment or replacement of strategic attributes does not mean that the original attributes must be refreshed or replaced to their pre-refreshment or pre-replacement state. Second, they advocate that the refreshment or replacement of a strategic attribute may be partial or full, which implies that the organization may choose to retain useful parts of the original strategic attribute and refresh or replace only the other parts of that attribute. Third, they highlight that the original strategic attribute of an organization may be extended beyond its original size or scope of application through the refreshment and replacement process. Finally, they

postulate that the refreshment process can be done through reconfigurations of the current attributes with or without any additions or deletions. They further explain that strategic renewal can be examined from three dimensions namely, the process of strategic renewal, the content of strategic renewal, and the outcomes of strategic renewal. Based on these characteristics of strategic renewal, they define strategic renewal as "*the process, content, and outcome of refreshment or replacement of attributes of an organization that have the potential to substantially affect its long-term prospects*" (Agarwal et al. 2009, pp 282). Accordingly, two types of strategic renewal are identified in the literature and they are: (1) discontinuous strategic renewal; and (2) incremental strategic renewal. Several conceptual papers (i.e. without support of data) on strategic renewal also suggested that the process of strategic renewal can be enacted via two approaches, namely top-down (e.g. Floyd et al. 2000; McGrath et al. 2009) and bottom-up (e.g. Ghoshal et al. 1996; Whitney 1996). In a top-down approach, a strategic renewal process gets initiated from the senior management and driven downward across the rest of the organization. In a bottom-up approach, a strategic renewal process happens at operation level/business unit and gets proliferate across the whole organization.

Notwithstanding the existing empirical studies done on strategic renewal, our literature review has revealed several gaps in the extant literature. First, most of the empirical studies conducted on strategic renewal are focused on identifying the critical factors that influence the organization's decision on enacting a strategic renewal process, such as organizations' R&D innovation behavior (Knott et al. 2009), herd behavior (Stienstra et al. 2004), industry participants (Kim et al. 2009), and on identifying the factors that influence the success of a strategic renewal process, such as organizational learning

(Crossan et al. 2003), selection capability (Capron et al. 2009), compensatory fit between formal and informal organization in a firm (Gulati et al. 2009), and context-specific managerial cognition (Eggers et al. 2009). While the identification of these factors is an important contribution to the extant literature, it is insufficient to provide a rich and in-depth understanding of the process to enact an effective strategic renewal. Specifically, an investigation on how to implement an effective strategic renewal process to detail and clarify the intertwining relationships between people, processes, and IT is unlikely to be uncovered through research which focuses purely on identifying critical factors. The proliferation of hypercompetitive-ness across all business competitive environments has also made this inquiry an important undertaking because the answer to this will help to shed valuable insight on guiding practitioners on how to enact an effective strategic renewal process. Second, none of the studies on strategic renewal that we have reviewed have taken into consideration the role of IT during the strategic renewal process. We posit that IT is an important consideration to be included in a strategic renewal study because the effective combination of IT and business resources will derive capabilities that can help to reduce risks and complexities when implementing a strategic renewal initiative, and will contribute significantly to its eventual effective implementation. In a recent call to the IS community, Tanriverdi et al. (2010) reiterate this point of reframing dominant IS strategy research from a focus on the sustained competitive advantage objective to an emphasis on understanding the role of IT and IT-enabled capabilities in the process of strategic renewal. This attests to our postulation on the importance and lack of empirical study in this area in the extant literature on strategic renewal. These gaps in the extant literature motivate the development of this thesis.

Several IS researchers have recognized the development of IT-enabled agility as one of the key strategies in surviving and thriving in a hypercompetitive environment (e.g. Goh et al. 2010; Overby et al. 2006; Sambamurthy et al. 2003; Seo et al. 2008; Tan et al. 2010). The development of IT-enabled agility can enhance the richness and reach of an organization's processes and knowledge, which in turn allows that organization to consistently and rapidly detect and seize opportunities in a hypercompetitive market (Sambamurthy et al. 2003). Implicitly, this suggests that the development of IT-enabled agility is the enabler and foundation for the enactment of effective strategic renewal implementation. Our assertion is best summarized in the words of Mathiassen and Pries-Heje (2006) where they described IT-enabled agility as an organization's *"ability to quickly change the type and flow of information within an organization"* and would inevitably lead to *"a rapid and graceful reorganization"* (Mathiassen and Pries-Heje 2006, p. 117). Based on this definition, we see a natural fit of using IT-enabled agility as a theoretical lens to understand the process on how an effective strategic renewal implementation can be enacted within an organization.

IT-enabled agility is advocated as having two set of capabilities namely, IT-enabled sensing capabilities and IT-enabled responding capabilities (Overby et al. 2006). We posit that these two sets of capabilities can be developed at two distinct levels of an organization, i.e. enterprise-wise level or project level. At enterprise-wise level, IT-enabled agility is often known as IT-enabled enterprise agility. At project level, one form of IT-enabled agility is IS development (ISD) agility. Relating this back to our discussion on strategic renewal, we have earlier identified that strategic renewal can happen via two approaches namely, bottom-up and top-down. In the case of the bottom-up approach, we

believe the development of ISD agility at project level is the key enabler. Through the development of IT-enabled sensing and responding capabilities within an IS development, organizations will acquire the ability to sense the evolving business requirements accurately and rapidly modify existing, or develop new IT systems to respond to these business requirements. This facilitates the rapid adoption of these IT systems that are intended to replace or refresh an organization's strategies, operations, and market relationships during a strategic renewal process. Hence, an effective strategic renewal process can be achieved through the development of IS development agility. In the case of the top-down approach, we believe the development of IT-enabled enterprise agility at enterprise level is the key enabler. Through the development of IT-enabled enterprise agility, the entire organization can systematically renew its strategies, operations, and market relationships incrementally through IT in accordance to the changes in its environment. Based on these two identified approaches, we have designed and conducted two case studies. The two case studies seek to answer the overarching research question of this thesis which is: *How can effective strategic renewal be implemented through the development of IT-enabled agility which comprises IT-enabled sensing and responding capabilities?* Each of the studies is designed to investigate into the role of IT-enabled agility in an effective top-down and bottom-up approach of enacting a strategic renewal process.

1.1 Studying the Role of IT-enabled Agility in a Bottom-up Discontinuous Strategic Renewal Process

To understand the role of IT-enabled agility in an effective discontinuous strategic renewal implementation, we conducted a case study on the Beijing Capital International Airport (BCIA) Terminal 3 IT program implementation. This study demonstrates how the

development of information system development (ISD) agility during the Terminal 3 project enabled BCIA to enact an effective discontinuous strategic renewal of the entire organization to meet the mandate by the Chinese government for seamless terminal operations during the 2008 Olympics. Due to the sheer size of the Terminal 3 implementation, it mandated significant replacement and/or refreshment of existing BCIA strategies, operations, and partner relationships to cope with the large increase in workload. There was also a 'hard' deadline to enact an effective strategic renewal. Missing the deadline was not an option because the nation's reputation was at stake.

We posit that ISD agility enables the effective strategic renewal process because as an organization develops its capability to be agile in its ISD practices, it will become highly efficient and effective in sensing business requirements, and in creating and/or adapting its IT systems to meet these requirements. This allows the IT systems to be readily adopted by the business users, which in turn contributes to the effectiveness of the strategic renewal process. As all the IT systems in Terminal 3 were realized rapidly due to the mandatory deadlines, the existing IT-enabled capabilities of managing the airport terminals in BCIA had been significantly refreshed and enhanced. This in turn allowed BCIA to achieve great success in ensuring smooth operations during the 2008 Olympic Games. It should be noted that each of the IT systems was implemented in parallel and the agile IS development practices were developed organically by the IT department during the systems implementation in Terminal 3. Hence, we believed that the development of ISD agility happened in an asynchronous way starting from the IT department and proliferate across the organization. This is one of the key reasons why we

have classified this particular case as a bottom-up discontinuous strategic renewal process.

1.2 Studying the Role of IT-enabled Agility in a Top-down Incremental Strategic Renewal Process

To understand the role of IT-enabled agility in a top-down incremental strategic renewal process, we conducted a study on the implementation of China Mobile Communications Co. Ltd (China Mobile)'s Green IS initiative. Green IS is defined as an integrated and cooperating set of people, processes, software and IT infrastructure to support the firm's efforts in achieving its sustainability objectives (Chen et al. 2009; Watson et al. 2008). The case study examined China Mobile's process of incremental strategic renewal of the company's strategies, operations, and partner relationships towards sustainability. We assert that this is an incremental strategic renewal process because it was a conscientious undertaking by China Mobile to align its organization towards the increasing emphasis on sustainability. While there were some environmental pushes towards sustainability by the Chinese Government, the process of strategic renewal implementation in China Mobile required a deliberate balancing between profitability and sustainability in order to effect a successful strategic renewal process. We have classified this case study as an investigation of a top-down incremental strategic renewal process because of three reasons: (1) The need to enact the strategic renewal process in China Mobile was initiated by senior management with the setup of a special task force at headquarter; (2) this special task force took measures to influence the management of the subsidiaries of China Mobile to implement its sustainability effort systematically across China Mobile; and (3) the management of each subsidiaries translated this senior management's intent to concrete sustainability actions on the ground.

In this study, we are interested in identifying the critical IT-enabled sensing and responding capabilities that allow an organization to systematically renew its strategies, operations, and market relationships towards sustainability. We posit that these critical IT-enabled capabilities are closely related to the development of a form of IT-enabled agility called 'green agility'.

1.3 Thesis Organization

This thesis is organized into five chapters. The first chapter focuses on highlighting the motivation behind the development of this thesis, and the research question that this thesis seeks to answer. The second chapter will provide a comprehensive review of the literature of our phenomenon (strategic renewal) and our theoretical lens (IT-enabled agility). The third chapter will present our case study on the process of developing ISD agility in a bottom-up discontinuous strategic renewal process. The fourth chapter will detail our case study on the process of developing Green Agility in a top-down incremental strategic renewal process. This is followed by the fifth chapter where the findings of the two case studies are consolidated and explained in relation to strategic renewal. The theoretical and practical contributions of the findings, limitations and opportunities for future research will also be discussed in this chapter.

CHAPTER 2: LITERATURE REVIEW

2.1 Review on Strategic Renewal

Agarwal et al. (2009) have identified four critical characteristics of a strategic renewal process, namely: (1) an organization's strategic renewal process must have the potential to substantially affect the long-term prospects of a company; (2) an organization's strategic renewal includes the process of renewing (process), the quality or state of being renewed (content), and "something renewed" (outcome); (3) an organization's strategic renewal involves the (partial or full) refreshment or replacement of strategic attributes (such as goals, products and services, resources and capabilities, etc.) of an organization; and (4) such refreshment or replacement of strategic attributes is done with the intention of providing a foundation for future growth or development for the organization. Based on these identified characteristics, strategic renewal is defined as "*the process, content, and outcome of refreshment or replacement of attributes of an organization that have the potential to substantially affect its long term prospects*" (Agarwal et al. 2009, pp 282). Two basic types of strategic renewal namely, discontinuous strategic renewal and continuous/incremental strategic renewal, are identified in the literature (Agarwal et al. 2009).

A discontinuous strategic renewal is typically brought forth by a sudden environmental change (such as an introduction of disruptive technology) that forces a company to radically change a large portion of its strategic attributes (such as goals, products and services, resources and capabilities, etc.) that have been rendered 'useless' by the change (Agarwal et al. 2009). Most discontinuous strategic renewal transformations are highly risky in nature because all, or substantial parts, of an organization will need to be

replaced/refreshed, which inevitably leaves an organization vulnerable to failure during the renewal process (Agarwal et al. 2009). The task of justifying which parts are to be replaced/refreshed, how much to replace/refresh, when to invoke the replacement/refreshment process, and how to implement it well given the limited organization resources at hand are all important considerations during a discontinuous strategic renewal process. Furthermore, discontinuous strategic renewal of an organization in a hypercompetitive environment is often time-bound where the transformation of that organization has to happen quickly and effectively (Wiggins et al. 2005). A continuous/incremental strategic renewal is an incremental enactment of the strategic renewal process by organizations to keep pace with, or even lead external environment changes (Agarwal et al. 2009). Incremental strategic renewal is a more typical response of an organization in a hypercompetitive environment as it involves lesser risk in development. However, when proactively done over a long period of time, incremental strategic renewal can have the same impactful results as discontinuous strategic renewal (Agarwal et al. 2009).

While a research paper may examine any combination of the process, content, and outcome of strategic renewal in an organization, we are interested in the process of strategic renewal in this thesis. Our literature review on the process of strategic renewal has revealed that existing empirical studies have a dominant focus on identifying the critical factors that will influence the process of renewing, with no or little elaboration on how an effective strategic renewal process can be implemented in an organization. Table 1 summarizes the list of empirical studies conducted on the process of strategic renewal.

Table 1: Empirical Studies on the Process of Strategic Renewal		
Empirical Studies Description	Types of Strategic Renewal	Factors Identified
Factors influencing organization's strategic renewal intent		
Kim et al. (2009) examined the role of innovation in racket design in triggering the strategic renewal of a mature tennis racket industry	Continuous/Incremental strategic renewal	Organizational imitation and contagion of an innovation by industry participants
Knott et al. (2009) identified R&D as a key mechanism for strategic renewal and examined the rate of replenishment of innovation assets through firms' R&D efforts and the industry factors that may influence this rate	Discontinuous strategic renewal	The intensity of firms' R&D efforts & its linkage to industry factors such as market size, market growth, the number of rivals, and the ease of expropriating spillovers
Stienstra et al. (2004) examined the effect of 'herd' behavior of rivals in influencing the strategic renewal decision of 5 Europe largest Telecom operators	Discontinuous strategic renewal	'Herd' behavior of rivals
Factors/Capabilities/Conditions influencing success of a strategic renewal process		
Crossan et al. (2003) linked the 4I framework in organization learning literature to explain the tension between exploration and exploitation during a strategic renewal implementation in Canada Post Corporation when the company moved from physical to electronic delivery of mail	Discontinuous strategic renewal	Organization learning
Eggers et al. (2009) investigated the effect and influence of context-specific managerial cognition on the degree and direction of strategic renewal of a firm	Discontinuous strategic renewal	Context-specific managerial cognition
Capron et al. (2009) identified a dynamic capability (called selection	Continuous/Incremental strategic renewal	Selection Capability

capability) in an organization that allows it to select the appropriate sourcing mode during a strategic renewal process. They argued that the success of a strategic renewal process of a firm is contingent upon this selection capability		
Gulati et al. (2009) identified compensatory fit between formal and informal organization in a firm as one of the key determinants of firm's ability to enact effective strategic renewal	Discontinuous strategic renewal	Formal and informal organizational structure and their compensatory fit

Several observations can be distilled from the review of the extant empirical studies on strategic renewal. First, most of the researches are conducted in recent years, demonstrating the nascent stage of existing research. Second, being a relatively new area of research, the efforts of extant literature have been channeled towards two key areas: (1) identifying a list of factors that will influence an organization's decision to enact a strategic renewal process (e.g. Kim et al. 2009; Knott et al. 2009; Stienstra et al. 2004); and (2) identifying factors/capabilities/conditions that are critical to the success of a strategic renewal process (e.g. Capron et al. 2009; Crossan et al. 2003; Eggers et al. 2009; Gulati et al. 2009). Beside empirical studies, several conceptual papers that focus on the process of strategic renewal were also proposed.

2.1.1 Enacting the Effective Strategic Renewal Process at Business Unit Level

One such paper presented the idea that a successful strategic renewal process within a business unit is dependent on the resolution of role conflicts between "*the need to institutionalize the managerial behavior associated with the current competencies and*

current strategies and the need to encourage the behaviors necessary to develop new competencies and new strategies" (Floyd et al. 2000, pp 154). Floyd et al. (2000) further classified strategic renewal as comprising of three sub-processes namely, competence definition, competence modification, and competence deployment; and proposed a theoretical model that described how the appropriate use of organization control mechanisms could resolve the role conflicts among various levels of management (top, middle, and operating) in each sub-process of strategic renewal. Fundamentally, Floyd et al. (2000) assumed that by resolving the role conflicts among management, the success of a strategic renewal process would also be assured because these resolutions were expected to reduce the inertia forces against the renewal embodied in an organization (Huff et al. 1992). This study hinted that effective strategic renewal processes require the development of organizations' capabilities to define competencies (sensing capabilities), modify, and deploy competencies (responding capabilities) at three different levels within an organization and that these capabilities should be developed progressively over time through a top-down managerial approach. Whitney (1996) also proposed the following steps to be undertaken during the strategic renewal process: (1) evaluate your customers; (2) evaluate your products or services; (3) use the analysis from steps 1 and 2 to complete the strategic-renewal matrices; and (4) consider the recommended strategic imperative. In evaluating the customers, products, and services during the strategic renewal process, three dimensions were identified and they were: (1) strategic importance – uncovered by asking questions such as 'does the customer truly value what we do well?' or 'does the customer provide an opportunity for us to grow?'; (2) significance – uncovered by asking questions such as 'does the customer provide substantial revenue or have the potential to

do so'; and (3) profitability – uncovered by focusing on identifying how dimensions 1 and 2 and their combination can help the organizations achieve profitability. The study hinted that strategic renewal process can be also initiated through a bottom-up approach where refreshment and replacement of strategic attributes of an organization can start from the operational level before spreading across the organization.

2.1.2 Enacting the Effective Strategic Renewal Process at Organization Level

Ghoshal et al. (1996) proposed that the strategic renewal process at organization level could be divided into three stages namely: (1) simplification - focuses on simplifying strategies, structure, and systems to build discipline and support towards the new strategies; (2) integration – focuses on aligning the trust relationships among business units and developing shared ownership towards stretch goals; and (3) regeneration – focuses on maintaining the balance among discipline, support and trust. They further argued that the appropriate analysis on how to enact a strategic renewal process is contingent on two factors and they are: (1) the quality of integration across business units; and (2) the quality of performance of each unit (Ghoshal et al. 1996). Using these factors, a 2x2 matrix was developed and an organization could map its portfolio of operations onto it and develop plans to migrate operations from the initial stage of simplification (Instilling discipline and support), to the stage of integration (Building stretch and trust) and to the final stage of regeneration (Balancing discipline, support, stretch, and trust) during a strategic renewal process. This study also hinted that strategic renewal process should go through three stages which originated from the bottom operation level before spreading across the organization.

From another organizational perspective, McGrath et al. (2009) described the strategic renewal process as "discovery-driven" where the emphasis for the organization is to

focus its managers on searching for the right answers and reduce the assumption-to-knowledge ratio. Three relevant practices were highlighted and they are: (1) initiating the renewal process; (2) evaluating change options using financial models; and (3) mapping the future growth portfolio (McGrath et al. 2009). These practices were argued to be particularly suited to keep an organization's core business processes relevant to the rapid changes in its business competitive environment (McGrath et al. 2009).

There are two key observations that can be distilled from the review of these conceptual papers on strategic renewal. First, it is suggested that strategic renewal process can be enacted in a top-down approach where the senior management makes a decision on the renewal process and drives the renewal process systematically across the rest of the organization (e.g. Floyd et al. 2000; McGrath et al. 2009). Second, it is also suggested that strategic renewal process can be enacted in a bottom-up approach where business units that are closer to the operations enact a series of renewal activities and then these renewal activities get proliferate across the organization (e.g. Ghoshal et al. 1996; Whitney 1996).

2.1.3 Gaps in Extant Literature on Strategic Renewal

Notwithstanding the empirical studies and conceptual papers on the process of strategic renewal, we postulate that several gaps still exist in the literature. First, we note that all the empirical studies on the process of strategic renewal are predominantly targeted at identifying 'critical success factors' that have a significant impact on the process of strategic renewal as well as on factors that will influence organization to enact strategic renewal (see Table 1). There are very little researches that shed lights into the process of how to enact an effective strategic renewal. As mentioned in our earlier section, we posit that being able to enact an effective strategic renewal process is an imperative endeavor

for organizations competing in a hypercompetitive environment. As a result, the current literature is unable to provide sufficient insights to aid the practitioner's world in enacting an effective strategic renewal process. Hence, we wish that our thesis can contribute to fill this gap in the literature. Second, while it may seem that the reviewed conceptual papers provide valuable insights into the process of strategic renewal, these are unfortunately not supported by data and in many cases highly abstract in nature. The lack of support from data on the proposed conceptual models means that the applicability of these approaches and models to the practitioner's world would be limited. The highly abstract nature of the conceptual models implies that there are many ways in interpreting the models, thereby making it very difficult for practical application. Third, our extensive literature review also identified that there is very little or no inclusion of IT in research on the process of strategic renewal. In today's business context, we believe that IT plays a strategic and critical role during the process of strategic renewal. The lack in consideration of IT in strategic renewal process research is a gap in the extant literature and an opportunity for the IS community to contribute to. This view is aligned with the recent call for action by the IS community to direct more research towards strategic renewal (Tanriverdi et al. 2010). These are the gaps in the literature on the strategic renewal process that this thesis seeks to address. To address these gaps, we posit that there is a need to develop a theory that can explain the process of how an effective strategic renewal implementation enabled through IT can be enacted within an organization. A theory-building process model is particularly suitable in this regard because much has yet to be known about the process of strategic renewal and the role of IT in this process (Eisenhardt et al. 2007).

IT-enabled agility is defined as a set of IT-enabled sensing and responding capabilities that allows an organization to effectively sense changes in the turbulent environment and respond to this change through the constant alignment of assets and capabilities in a timely, efficient and cost-effective way (Goh et al. 2010; Mathiassen et al. 2006; Sambamurthy et al. 2003; Seo et al. 2008). We assert that IT-enabled agility is the 'engine' that drives an effective strategic renewal implementation in an organization because an effective strategic renewal process akin to surfing is described as the ability of an organization to catch "*a great wave at the right time, even though the duration of the wave is likely to be short and the ride a precarious 'edge of chaos' experience where falling off is always a possibility*" (Bingham et al. 2011, pp 76). Under the definition of IT-enabled agility, we advocate that IT-enabled sensing capabilities will help organizations sense the 'great wave' and IT-enabled responding capabilities will help organizations respond to the 'great wave' at the right time and in the most effective way.

Through the investigation of IT-enabled agility in an effective strategic renewal implementation, we can: (1) detail the process on how an effective strategic renewal can be implemented via the development of IT-enabled sensing and responding capabilities; and (2) introduce IT into this discourse on the strategic renewal process. Hence, we postulate that the IT-enabled agility lens is an ideal theoretical lens to be used to understand the intricacy of an effective strategic renewal implementation.

2.2 Review on IT-enabled Agility

The dynamism of forces, such as frequent changes in regulations, rapid technological advancements and acute time to market pressures in a hypercompetitive environment introduces a large dose of uncertainties that constrains a firm's ability to spot growth

opportunities and/or to evade unfavorable circumstances (Sull 2009). It is advocated that organizations in hypercompetitive environments need to engage in a strategy that is based on the logic of opportunity (Bingham et al. 2011; Hamel et al. 1993) where the core competitive advantage of an organization is derived from its ability to spot and seize opportunities in its environment, and to translate these opportunities into competitive actions (Sambamurthy et al. 2003). It is under this context that the idea of IT-enabled agility was molded, and it is no surprise that IT-enabled agility is fast being recognized by IS researchers and practitioners as one of the key strategic imperatives for organizations to not just achieve competitive advantage (Glenn 2009; Sharifi et al. 2001) but also for their survival (Baskerville et al. 2005; Doz et al. 2008) .

IT-enabled agility can be divided broadly into three types namely: (1) IT-enabled customer agility – ability to co-opt customers in exploration and exploitation of innovation opportunities as sources of innovation ideas, as co-creators of innovation, and as users in testing ideas or helping other users to learn about the idea; (2) IT-enabled partnering agility – ability to leverage on assets, knowledge, and competencies of suppliers, distributors, contract manufacturers and logistics providers in the exploration and exploitation of innovation opportunities; and (3) IT-enabled operational agility - ability to accomplish speed, accuracy, and cost economy in the exploitation of innovation opportunities (Sambamurthy et al. 2003).

2.2.1 Role of IT in Developing Enterprise Agility at Organization Level

The enabling roles of IT towards the derivation and maintenance of enterprise agility within an organization is well-established among enterprise agility IS researchers (Baskerville et al. 2005; Sambamurthy et al. 2003; Tan et al. 2010; van Oosterhout et al. 2006; Zain et al. 2005). Sambamurthy et al. (2003) conceptualize the role of IT in the

derivation of enterprise agility as a form of digital options where an organization's processes and knowledge flows are digitized through IT and can be leveraged upon when an opportunity presents itself. Digital options are defined as a set of IT-enabled capabilities in the form of digitized enterprise work processes and knowledge systems (Sambamurthy et al. 2003). The derivation of digital options enables an organization to strengthen: (1) its digitized process capital - IT-enabled inter and intra-organizational work processes for automating, informating, and integrating activities, and creating a seamless flow of information (Davenport 1993; Garvin 1998); and (2) its digitized knowledge capital – IT-enabled repository of knowledge and the systems of interaction among organizational members to generate knowledge sharing of expertise and perspectives (Sambamurthy et al. 2003). Sambamurthy et al. (2003) further identified two dimensions of their proposed digital options namely, reach and richness. Table 2 shows the type of digital options that can be developed within an organization.

Table 2: Types of Digital Options (Sambamurthy et al. 2003)

Type of Digital Option	**Definition**
Process Capital	
Digitized process reach	Extent to which a firm deploys common, integrated, and connected IT-enabled processes. High reach is associated with processes that tie activity and information flow across departmental units, functional units, geographical regions, and value network partners
Digitized process richness	Quality of information collected about transactions in a process, transparency of that information to other processes and systems that are linked to it, and the ability to use that information to reengineer the process
Knowledge Capital	

Digitized knowledge reach	Comprehensiveness and accessibility of codified knowledge in a firm's knowledge base and interconnected networks and systems for enhancing interactions among individuals for knowledge transfer and sharing
Digitized knowledge richness	Systems of interaction among organizational members to support sense-making, perspective sharing and development of tacit knowledge

These digital options are argued to be the fundamental building block of enterprise agility. Enabled through digitized knowledge systems and enterprise work processes, an organization would possess strong sensing and responding capabilities respectively and these capabilities will allow an organization to effectively spot and capture opportunities inherent in its competitive environment (Sambamurthy et al. 2003). It is intuitive to conclude that when an organization successfully develops this form of IT-enabled agility, it will enable the organization to implement an effective strategic renewal process that is aligned with the opportunities in the environment. However, different organizations will have different maturity levels with regard to their sensing and responding capabilities, and the development of enterprise agility requires both capabilities to be equally strong and balanced in an organization (Overby et al. 2006). van Oosterhout et al. (2006) conceptualize a measurement called enterprise agility's gap that compares six change factors requiring enterprise agility (i.e. required business agility) versus six enablers and disablers of enterprise agility (i.e. current business agility). The six change factors requiring agility are: (1) Social/legal changes; (2) Business network changes; (3) Competitive environment changes; (4) Customer needs changes; (5) Technology changes; and (6) Internal changes (van Oosterhout et al. 2006). The six enablers and disablers of enterprise agility are: (1) Business Network Governance; (2) Business Network Architecture; (3) Information Technology; (4) Organization Governance; (5)

Organization Architecture (processes and products); and (6) Organizational Culture and Personnel (van Oosterhout et al. 2006). Using this measurement, an organization can determine the enablers and disablers of enterprise agility and work to narrow the identified enterprise agility's gap.

While IT can play a critical role in enabling enterprise agility, it can also hinder and prohibit the development of enterprise agility (Overby et al. 2006; Seo et al. 2008; van Oosterhout et al. 2006). For example, an old and proprietary customer-relationship system that is tightly coupled with the business processes in an organization cannot be easily enhanced or replaced. Such a system will inevitably affect an organization's ability to sense and respond to the changing conditions in a hypercompetitive environment. To address this double-edged sword of IT in the derivation of enterprise agility, Weill et al. (2002) identified 10 IT capability clusters that should be developed to enable enterprise agility. They further emphasized the relative importance of each cluster to agile implementations of organizations' business initiatives namely, an organization's position in its value net, the types of exchange, the types of innovations and whether such agile implementations should be done at business unit level or firm-wide. Weill et al. (2002) argued that by linking the nature of a business initiative to the IT capability clusters needed for the agile implementation of that initiative, it provides a clear roadmap to help an organization identify which IT capability clusters to invest into to enable enterprise agility. In so doing, their research also helps an organization avoid investments into IT capability clusters that are not deemed as enablers to the development of enterprise agility.

The development of enterprise agility is also tightly integrated with an organization's ability to develop complementary organization capabilities (Seo et al. 2008), practices (Börjesson et al. 2006; Hovorka et al. 2006) and organizational forms (Gallagher et al. 2008). Seo et al. (2008) viewed the development of enterprise agility as equivalent to the development of five organization capabilities and they are: (1) perception – the ability to sense changes in the environment; (2) processing – the ability to filter, evaluate, and process incoming signals; (3) responding – the ability to pro-act or react to signals collected or environment changes; (4) aligning – the ability to arrange or rearrange its IS in keeping with the environmental changes; and (5) learning – the ability to build on experience to continuously improve and be better prepared to deal with changing conditions. By enacting the process of perceiving, processing, responding, aligning and learning in a sequential and cyclical order, an organization can weigh the impact of the signals of changes and challenges versus the risks involved (sense), prioritize and redirect its IS resources to enact effective competitive actions (respond), and learn through the experience of enacting these actions before repeating the entire process again (Seo et al. 2008).

The alignment of organizational forms between the organization level and business unit level can also influence the development of enterprise agility (Gallagher et al. 2008). To optimize the development of enterprise agility between the organization and business units, Gallagher et al. (2008) identified integration and relational mechanisms as critical enablers in bridging the gaps between the two organization forms. The development of agile practices has also been deemed as important in enhancing an organization's enterprise agility (Börjesson et al. 2006; Hovorka et al. 2006). As an organization

develops agile practices that allow it to rapidly adapt to its environment, it naturally would respond more quickly and appropriately to the changes in the environment. For instance, Hovorka et al. (2006) highlighted the development of agile adoption practices that can help in the proliferation of the adoption of IT systems across different organizations in the New York State. In Hovorka et al. (2006)'s model, they emphasized the influence of network strength, an organization's absorptive capacity, and the organization's social information processing capability in driving its agile adoption of an IT system. The ability of an organization to quickly proliferate the adoption of an IT system will result in an its ability to capture the opportunities evident in the competitive environment (Goh et al. 2010), thereby leading to the derivation of enhanced enterprise agility.

2.2.2 Role of IT in Developing IS Development Agility at Project Level

IT can also influence the development of agility at the project level, particularly in IS development. It is believed that as an IT department acquires the ability to rapidly develop new, or modify existing, IT systems (a.k.a. IS development agility) in response to changing market conditions, the organization will be able to enhance its ability to sense and respond to opportunities in the market through this ability (Conboy 2009). This will have a direct impact on the derivation of IT-enabled agility which in turn can enhance the organization's ability to implement an effective strategic renewal process. A comprehensive literature review of the extant literature on IS development agility is presented in Chapter 3 Section 3.2.1.

2.3 Summary on Literature Review

Given the gaps identified in the extant literature of strategic renewal, we posit that the theoretical IT-enabled agility lens can be used to analyze and study the process of effective strategic renewal implementation. Specifically, we are interested to understand how the development of IT-enabled sensing and responding capabilities can lead to effective strategic renewal implementation in organizations. The next two chapters will present the two case studies of this thesis that demonstrate how the development of IT-enabled sensing and responding capabilities at project and organization level can lead to the success of a bottom-up discontinuous and a top-down incremental strategic renewal implementation correspondingly.

CHAPTER 3: DEVELOPING ISD AGILITY FOR EFFECTIVE BOTTOM-UP DISCONTINUOUS STRATEGIC RENEWAL IMPLEMENTATION

3.1 Introduction

Despite years of research in IS development and a large amount of experience gathered when implementing IS projects, IS project failures are still the norm and have continued to be a recurring problem to the IT software industry (McManus et al. 2007). The rapid advancement of technology and the unprecedented rate of change in business have introduced great volatility during IS project development that even the most experienced project team would find challenging to sense and respond to (Schmidt et al. 2001). For example, in a U.S. Department of Defense study, it was shown that 45% of software features in an IS project were unable to meet the business needs and requirements (Larman 2004). The agile IS development practices are deemed by practitioners and researchers as the answer to this recurring and challenging problem in the IT software industry (Abrahamsson et al. 2009). The underlying principles behind an agile IS development practice are emphasis on '*sense-and-respond, self-organization, cross-functional teams, and continuous adaption*' (Lee et al. 2010, pp 87) to the volatilities of business requirements during IS development.

So far, the development of agile IS development practices has been primarily driven by the practitioners (Abrahamsson et al. 2009; Conboy 2009; Lee et al. 2010). Even though this has ensured the relevance of agile IS development practices during project implementation, a practitioner-driven research has led to several problems (for comprehensive list of problems, see Conboy 2009). From the perspective of research, the literature on agile IS development has been '*largely anecdotal and perspective, lacking*

empirical evidence and theoretical foundation to support the principles and practices of agile development' (Lee et al. 2010, pp 87). This has led to a poor understanding on how agile IS development practices can help to address this recurring problem on IS project failure in the IT software industry. We hope to address this issue through our study.

Notwithstanding the growth of research in the area of agile IS development practices, there exists several gaps in the literature that this study attempts to fill. First, we note that despite the emergence of a coherent definition on what constitutes agility in an IS development (Conboy 2009), the literature is still fragmented in this regard. Confusions over what constitutes agility in IS development are still rampant (Conboy 2009; Dybå et al. 2008) and researchers are still adopting their own unique interpretation of agility in IS development (e.g. Lee et al. 2010). The lack of clarity of agility in IS development has made it difficult to establish a '*theoretical glue*' (Abrahamsson et al. 2009) that can be used to identify if an IS development methodology is indeed agile (Conboy 2009). Without building upon Conboy (2009)'s definition of an agile IS development practice (i.e. the '*theoretical glue*'), the objective of developing a cumulative tradition in agile IS development research can't be fulfilled and our understanding of the role of agile IS development practices towards IS project success will continue to be fragmented (Abrahamsson et al. 2009; Conboy 2009). This is one gap that we hope our study can address.

Second, the current application of agile IS development practices has been restricted to only '*small, co-located development teams, working on noncritical systems*' (Conboy 2009, pp 344). Little research in agile IS development practices has been extended beyond this context (Abrahamsson et al. 2009) especially in the context of large scale

mission-critical system implementations (i.e. large IT systems whose failure will cause core business operations of an organization to break down completely (Investopedia 2012)). While traditional IS development methods emphasize on controlling unexpected changes during development, agile IS development methods embrace changes and focus on how to better handle changes when they occurred during IS development (Highsmith et al. 2001). The emphasis of agile IS development methods lie with keeping customers satisfied through early and continuous delivery of parts of the software (Beck Kent et al. 2001). These two emphases of agile IS development methods create significant challenges for these methods to be adopted for large-scale mission-critical system implementation. This is because large-scale system implementations typically face four major issues: (1) Critical application domain knowledge essential to the success of the development effort resides in the minds of many developers that are scattered across the organization; (2) System requirements are typically almost incomplete due to the lack of application knowledge and these requirements are also likely to change during the period of development and/or are conflicting in nature because of the involvements of large number of stakeholders who will 'pull' the development efforts in various directions; (3) Significant efforts are required by the agile development team to coordinate and share information with a large number of stakeholders during software development; and (4) Large-scale system implementations are often subjected to time-to-market pressures (Cao et al. 2004). These issues are in conflict with the two emphases of agile IS development method. For example, any software development team assembled for a large scale project will have insufficient domain knowledge that challenges its ability to create parts of the software quickly and continuously due to the thin spread of application domain

knowledge. Users, who the agile IS development team needs to satisfy, are diverse and in large numbers and this pose a significant challenge in managing the expectations of these users and in coordinating and communicating development work with them. Yet, despites all these challenges in adapting agile IS development method to large-scale system implementations, some practices from agile IS development methodologies, such as iterative development, frequent testing and feedback, small release, and refactoring, have been recognized as highly suitable for large-scale projects (Elssamadisy 2001; Reifer 2003). With little research advocated in extending agile IS development method to large-scale mission-critical project, we postulate that such extension is an important undertaking because it will shed insight into how agile IS development practices can contribute to the agile software development community in helping them increase the success of software project implementations. This is also a timely response to the recent call by researchers to conduct more empirical research in this area (Abrahamsson et al. 2009; Ågerfalk et al. 2009; Dybå et al. 2008; Erickson et al. 2005). In summary, the goal of our study is to develop a theory to explain how an agile IS development practice (that conforms to Conboy (2009)'s definition) can be developed in large scale mission-critical system implementations.

To achieve this goal, we have leveraged upon the theoretical lens: trust-mediated organization control and IT capabilities. We advocate the use of organization control as our theoretical lens because IS development practices have been defined as a set of socially defined ways in system development to achieve a defined outcome and create the basis for responding appropriately to individual circumstances (Ashurst et al. 2008). Inevitably, '*a set of socially defined ways*' will require the application of organization

control mechanisms by the controller to ensure that the controllee conforms to the '*defined ways*' during system implementation (Kirsch 1997). The positive effects of the application of organization control mechanisms in increasing the quality of an agile IS development have also been demonstrated in several empirical studies (e.g. Harris et al. 2009; Maruping et al. 2009). Furthermore, we propose that the choice of organization control to be applied during IS development is often mediated through trust relationships among project stakeholders (Inkpen et al. 2004) especially in outsourcing partnerships (e.g. Rustagi et al. 2008). This relationship between trust relationships and organization control mechanisms is best described as follows: "*when the risk in a situation is greater than the trust (and, thus, the willingness to take risk), a control system can bridge the difference by lowering the perceived risk to a level that can be managed by trust*" (Schoorman et al. 2007, pp 346).

The application of control mechanisms often enables the emergence of IT capabilities within the project team during an IS development that influences the success of an IS project (Kirsch 2004; Kohli et al. 2004). Conversely, the availability of IT capabilities within a project team (e.g. capability to define tasks-related outcomes clearly) will also encourage the type of control mechanisms that are being enforced during system development (Kirsch et al. 2010; Kirsch et al. 2002; Rustagi et al. 2008). In addition, IT capabilities within a project team have also been recognized as critical in mitigating business requirement volatilities during system development (Fink et al. 2007; Sambamurthy et al. 2003; Vidgen et al. 2009). As such, we postulate that the '*ingredients*' of an agile IS development practice will most likely be consisting of trust-mediated organization control mechanisms and IT capabilities, and it is the interplay

between these two over time that enables the derivation of agile IS development practices. Using a case study on the Beijing Capital Airport Terminal 3 IT implementation, we seek to provide answers to the following research questions: (1) What types of agile IS development practices can be developed in such a context? and (2) How are agile IS development practices developed in a large scale mission-critical system implementation?

3.2 Theoretical Background

3.2.1 Agile IS Development Practices

The foundation of modern agile IS development practices such as XP, Scrum, etc. was derived from the 'Agile Manifesto' published in 2001 by the Agile Alliance, a non-profit organization that promotes software development according to the manifesto's principles. While the 'Agile Manifesto' advocates many agile practices to be enacted during IS development, not all of the modern agile IS development methodologies, such as XP or Scrum, have accepted every one of these advocated practices into their methodologies. Furthermore, each of these agile IS development methodologies has developed its unique agile practices on which was deemed critical in sensing and responding to changing user requirements (see Table 3).

Table 3: Key Principles and Practices of Practitioners' Agile Approaches/Methods (From (Lee et al. 2010))

Agile Approach/Method	**Principles/Practices Emphasizing Software Development Agility**
Agile Alliance Manifesto (Beck Kent et al. 2001)	• Welcome changing requirements, even late in development • Agile processes promote sustainable development • Deliver working software frequently • Continuous attention to technical excellence

Scrum (Schwaber et al. 2002)	• Software team determines features of each sprint from an evolving product backlog • Create an increment of potentially shippable software during each sprint
XP (Beck et al. 2005)	• The highest priority is to continuously satisfy changing customer needs • Rapid user review and feedback
DSDM (Stapleton 1997)	• Development is iterative, incremental, and driven by user feedback • Delivering a perfect system is less important than delivering a system that addresses the business needs
FDD (Coad et al. 1999)	• Customer/feature-centered iterative cycles • Regular build and inspection to ensure up-to-date systems

In the arena of research, the same state of confusion has also occurred among researchers on the definition of what constitutes agile practices in IS development (see Table 4).

Table 4: What Constitutes Agility in IS Development (Adapted from (Lee et al. 2010))

Literature	**Relevant Definitions/Concepts/Ideas**
Conboy & Fitzgerald (2004)	Agility is defined as the continual readiness of an entity to rapidly or inherently, proactively or reactively, embrace change, through high-quality, simplistic, economical components and relationships with its environment
Highsmith (2004)	Agility is the ability to both create and respond to change in order to profit in a turbulent business environment; it is the ability to balance flexibility and stability
Larman (2004)	Agility is rapid and flexible response to change
Erickson et al. (2005)	Agility is associated with such related concepts as nimbleness, suppleness, quickness, dexterity, liveliness, or alertness; it means to strip away the heaviness in traditional software development methodologies to promote quick response to changing environments and changes in user requirements
Henderson-Sellers & Serour (2005)	Agility refers to readiness for action or change; it has two dimensions: (1) the ability to adapt to various changes and (2) the ability to fine-tune and reengineer software development processes when needed
Lyytinen & Rose	Agility is defined as the ability to sense and respond swiftly to

(2006)	technical changes and new business opportunities; it is enacted by exploration-based learning and exploitation-based learning
Cockburn (2007)	Agility is being light, barely sufficient, and maneuverable
Qumer & Henderson-Sellers (2008)	Agility is a persistent behavior or ability of an entity that exhibits flexibility to accommodate expected or unexpected changes rapidly, follows the shortest time span, and uses economical, simple, and quality instruments in a dynamic environment; agility can be evaluated by flexibility, speed, leanness, learning and responsiveness
G. Lee & Xia (2010)	Agility is a software's team capability to efficiently and effectively respond to and incorporate user requirements during the project life cycle
Sarker & Sarker (2009)	Agility should be viewed as a multifaceted concept having three dimensions: resource, process, and linkage in the context of offshoring. Resource agility is based on the development team's access to necessary human and technological resources. Process agility pertains to agility that originates in the team's development method guiding the project, its environmental scanning and sense-making routines to anticipate possible crises, and its work practices enabling collaboration across time zones. Linkage agility arises from the nature of interactional relationships within the team and with relevant project stakeholders and is composed of cultural and communicative elements.

This has hindered the progression of practice and research on agile IS development (Abrahamsson et al. 2009; Conboy 2009) which has serious consequences to the practitioner's world. For example, many organizations have adopted agile IS development practices without a clear understanding on how agility in IS development is defined and what factors they can control to influence it (Lee et al. 2010). It is, therefore, not surprising to note that many agile IS development projects have also contributed to the 'IS project failure' phenomenon in the IT software industry (VersionOne 2010).

With the large amount of interest generated from the software industry towards the creation and proliferation of agile IS development practices (Abrahamsson et al. 2009; Dybå et al. 2008), and the potential substantial financial loss when an IS development practice is not agile (Austin et al. 2003), the quest to increase our understanding on what constitutes agility in an agile IS development practice is an important undertaking (Abrahamsson et al. 2009). This is because the development of a common understanding will help to provide the '*theoretical glue*' needed for the development of cumulative tradition in agile IS development research, which will then allow us to fully appreciate how agile IS development practices can lead to IS development success (Abrahamsson et al. 2009; Conboy 2009). To fill this gap in literature, Conboy (2009) defined an agile IS development practice, as shown in Table 5, based on a comprehensive review of literature from multi-disciplinary sources.

Table 5: Taxonomy of an Agile IS Development Practice (From (Conboy 2009))

1. To be agile, an IS development method component* must contribute to *one or more* of the following: (a) creation of change; (b) proaction in advance of change; (c) reaction to change; and (d) learning from change
2. To be agile, an IS development method component must contribute to *one or more* of the following and *must not perform poorly* in any one of it: (a) perceived economy; (b) perceived quality; and (c) perceived simplicity
3. To be agile, an IS development method component must be *continually ready* i.e. minimal time and cost to prepare the component for use

* An IS development method component refers to any distinct part of an IS method.

Two implications can be derived from this definition. First, the adoption of an agile IS development methodology such as XP or Scrum doesn't mean that an organization would have developed agility in IS development. Instead, under this definition, only a methodology that consists of IS development method components that exhibit the

characteristics of this agile IS development practice taxonomy by Conboy (2009) can be deemed as an agile IS development practice. Second, the positive effects of agile IS development practices towards IS project success will be most salient in an environment where uncertainties in project requirements are common, and urgency to complete the project is high (Meyer et al. 2002). This is because with few uncertainties in project requirements, changes during IS development are minimal and a traditional plan-based IS development practice would be more appropriate over an agile IS development one (Austin et al. 2003; Harris et al. 2009). With no urgency to complete the project, there is little need for IS development to be agile because the IT project team can take its time to incorporate changes in business requirements during system implementation.

Like many researchers (e.g. Abrahamsson et al. 2009; Conboy 2009), we posit that defining what constitutes agility in IS development is insufficient to achieve the goal of cumulative tradition in agile IS development research. More research on agile IS development practices will need to align to the definition as advocated by Conboy (2009) in order to advance our knowledge on agile IS development (Abrahamsson et al. 2009; Conboy 2009). Yet, as far as we know, there is almost no empirical research in agile IS development that has done this. We reckon that this is possibly due to the nascent stage of agile IS development literature. This is one of the key motivations behind our study.

Notwithstanding the growth of research in agile IS development, we have identified two gaps in the literature. First, the existing research on agile IS development practices has rarely studied the application of agile IS development practices in the domains that were seen as non-agile home ground, e.g. large systems and mission-critical systems (for comprehensive review, see Abrahamsson et al. 2009; Ågerfalk et al. 2009; Dybå et al.

2008). Answering to the call by Abrahamsson et al. (2009) and Ågerfalk et al. (2009), this study attempts to extend the applicability of agile IS development practices to the context of large scale mission-critical system implementation. Second, based on several comprehensive reviews of research on agile IS development practices, several researchers have criticized the studies in extant literature for its lack of rigor (Abrahamsson et al. 2009; Conboy 2009; Dybå et al. 2008; Lee et al. 2010). For agile IS development practice to fulfill its intended promise of assuring IS project success, understanding how agile IS development practices are being applied in the context of large scale mission-critical system implementations through a rigorous study is an imperative endeavor. This is one area in which this study hopes to contribute to. In doing so, we ask: what are the 'ingredients' that make up an agile IS development practice in a large scale mission-critical system implementation? We believe that the theoretical lenses of trust-mediated organization control and IT capabilities are the appropriate starting points to find answers to this question.

3.2.2 Trust-Mediated Organization Control & IT Capabilities

Extant literature about organizational control has generally converged in defining organizational control as '*encompassing all attempts to ensure that individuals in an organization act in a manner that is consistent with meeting the organization's goals and objectives*' (Eisenhardt 1985; Kirsch 1997; Ouchi 1980). A controller will not apply just one mode of control on the controllee. Most often, the controller will maintain a portfolio of control modes and apply them in combination as a whole (Choudhury et al. 2003; Nidumolu et al. 2003-4). Kirsch's (1997) organization control definitions have been widely established and adopted as the de-facto model of choice when organization control is discussed especially for studies on IS development. By extending Kirsch's

(1997) organization control definitions, the development of agile IS development practices will inevitably involve the controller applying some form of organization control mechanisms over its controllee to ensure conformance towards the defined agile IS development practices. Furthermore, several agile IS development researches have also demonstrated the positive effects of the application of organization control during agile IS development on the quality of an IS project (e.g. Harris et al. 2009; Maruping et al. 2009). It is for these reasons that we advocate that an agile IS development practice for a large scale mission-critical system implementation will comprise of organization control mechanisms as one of its key elements. Table 6 shows the definition of the control modes defined by Kirsch (1997).

Table 6: Definition of Control Modes (Adapted from (Kirsch 1997))

	Types	Definition
Formal Control	Behavior Control	The act of setting a set of specific rules and procedures that aligns the behavior of the controllee to whatever is deemed desirable in meeting the organization's objective
	Outcome Control	The act of setting a goal that is desirable in meeting the organization's objective and giving a reward to the controllee who meets it
Informal Control	Clan Control	Looks at the dissemination of desired values, beliefs and philosophies of the organization by socializing the individuals to a common set of norms and values within a clan
	Self Control	Looks at a mechanism that identifies and provides a conducive environment that rewards and encourages highly motivated individuals or group of individuals to exercise self-control in the best interest of meeting the organization's objective

The effectiveness of a control mechanism is dependent upon the trust relationships between the controller and controllee (Das et al. 1998; Inkpen et al. 2004; Rustagi et al. 2008). The need to undertake control measures by the controller on the controllee inherently implies a perception of risk in an IS development project. This perception of

risk is moderated by the amount of trust that exists between the controller and controllee (Inkpen et al. 2004; Rustagi et al. 2008). Furthermore, this relationship between controller and controllee is not necessarily applicable to just two individuals but can be extended to joint ventures between a company and its outsourcing vendors (e.g. Choudhury et al. 2003; Inkpen et al. 2004; Rustagi et al. 2008). When a perceived risk by the controller exceeds the amount of trust it has with the controllee, this discrepancy will be bridged via the implementation of control mechanisms which will help to lower the perceived risk to an extent where trust can take over (Schoorman et al. 2007).

In an IS development, this perceived risk is often derived from uncertainties in project requirements (Harris et al. 2009; Meyer et al. 2002) and an urgency to complete the project. This will, in turn, put demand on the project team to develop IT capabilities to sense-and-respond to this perceived risk (Fink et al. 2007; Lee et al. 2010). The availability of IT capabilities will influence the appropriate application of control mechanisms during IS development (Kirsch et al. 2010) and the application of control mechanisms can also lead to the development of IT capabilities that have been shown to have a positive effect on IS project success (Kirsch 2004; Kohli et al. 2004). For instance, on one hand, the IT capabilities of being able to establish clarity in tasks and project outcomes and develop in-depth knowledge on technology have been shown as key antecedents towards the selection of control mechanisms during IS development (Kirsch 1996; Kirsch 2004; Kirsch et al. 2010; Kirsch et al. 2002). On the other hand, the application of control mechanisms also enables the derivation of IT capabilities that assure the success of IS development (Kirsch 2004; Kohli et al. 2004). For example, Kirsch (2004) demonstrated that the application of control mechanisms throughout the IS

development process has enabled the development of IT capabilities such as sense-making, technical windowing and collaborative coordinating within the project team that leads to the success of IS development. Kohli & Kettinger (2004) also demonstrated that by exercising concertive control over time, an IT capability that allowed the project team to influence the behavior of the project's stakeholders was developed which led to the successful implementation of a health-care system.

In addition, it is well established in the extant literature that IT capabilities play a critical role in enabling the development of agility (e.g. Fink et al. 2007; Mathiassen et al. 2006; Overby et al. 2006; Sambamurthy et al. 2003; Seo et al. 2008; van Oosterhout et al. 2006; Weill et al. 2002; Zain et al. 2005). For instance, Fink & Neumann (2007) have identified and demonstrated the positive effects of IT capabilities during IS development towards the derivation of agility in IS development. Sambamurthy et al. (2003) have also identified IT capabilities as the foundation of which agility is achieved. Given the enabling role of IT capabilities, it has been argued that the development of these IT capabilities will enhance a project team's ability to sense-and-respond to changing business requirements which in turn will lead to IS project success (Ashurst et al. 2008; Lee et al. 2010). In summary, based on our literature review on the theoretical lens, we posit that the development and interplay between trust-mediated organization control and IT capabilities are the "ingredients" of which agile IS development practices can be derived. As these agile development practices are developed, organizations will be able to rapidly develop new, or modify existing, IT systems so as to adapt to the changing business requirements that are heavily influenced by the volatilities in the organizations' competitive environments (Austin et al. 2003).

3.3 Research Methodology

Method Selection and Research Setting. This study adopts the case research methodology because of two reasons. First, the main research question is concerned with "how" agile IS development practices are developed within an organization (Walsham 1995). Second, we are interested to uncover the complex relationships among IT capabilities within the project team, controls, and trust to create agile IS development practices during a large scale mission-critical system implementation. The case method has been identified as the most appropriate method under such a context (Pentland 1999). Terminal 3 of Beijing Capital International Airport was selected during our industry short-listing for suitable case-candidates because of the following reasons: First, the Terminal 3 IT program implementation, consisting of many large and mission-critical IT systems, had to be ready within an ambitious deadline of around two years and in time for the 2008 Olympics. Second, these mission-critical IT implementations were highly complicated, risky in nature, and required close coordination among multiple stakeholders in order to achieve its success. We believe these two elements created an environment where the perceived risk of failure would be extremely high (arising from the urgency to complete the project amidst significant project uncertainties) if agile IS development practices were not developed during the project implementation. More importantly, the resulting Terminal 3 program has been deemed as a successful one (Beijing-Capital 2009) and hence it demonstrates a case where a project's uncertainties within and across multiple critical system implementations have been successfully and rapidly mitigated during IS development.

Data Collection. Access to the case site was first negotiated and gained in June 2009. Subsequently, the study adopted a multiple case design where *six major IT systems and two terminal command centers* that were crucial to the success of the entire Terminal 3 IT program's implementation were identified. The unit of analysis is at project level. In each IT system chosen for the study, we sought to identify the *dominant* IT capabilities and *dominant* trust-mediated control mechanisms that were developed in the project which we advocate are the '*ingredients*' of agile IS development practices. In total, interviews involving 27 persons' time were conducted. Each interview's duration is around 120-180 minutes on average. All the content of the interviews were digitally recorded and transcribed for subsequent data analysis. All interviewees were carefully selected based on the critical roles that they played in ensuring the successful implementation of the Terminal 3 large scale mission-critical systems (see Table 7 for interviewees' profiles).

Table 7: Details of Interviews Conducted

Description	**Job Title of Interviewees (Role in T3 IT project in Brackets and Bolded)** *Unless otherwise specified, interviewee belongs to the IT Dept, BCIA*	**No**
Off-site Preliminary **Individual** Interviews	General Manager, Information Dept, Capital Airports Holding Company (**BCIA Management**)	1
Overview Interview	Deputy Manager/Chief Engineer (**Project Manager, Western SOCC Project**) and Chief Engineer (**Project Manager, Data Center System Project**)	2
AODB System Project	Deputy Manager/Chief Engineer (**Project Manager, Western SOCC Project - First generation AODB administrator**), Business Manager, Production Control (**Business Process Lead, AODB System Project**) and Engineer (**Technical Lead, AODB & Data Center System Project - Current AODB administrator**)	3
Airport Departure System Project	Departure System Services Engineer (**Technical Lead, Departure System Project**) and Business Manager, IT	2

	Services Engineer (**Business Process Lead, Luggage System Project**)	
Airport Security System Project	Engineer, Eastern SOCC (**Project Manager, Security System Project**) and Engineer, Eastern SOCC (**Technical Lead, Security System Project**)	2
Airport Data Center Project	Deputy Manager/Chief Engineer (**Project Manager, Western SOCC Project**), Chief Engineer (**Project Manager, Data Center System Project**) and Engineer (**Technical Lead, AODB & Data Center System Project**)	3
Airport Flight Display System Project	Business Manager, System Services (**Business Process Lead, Flight Display System Project**) and Engineer, Eastern SOCC (**Technical Lead, Flight Display System Project**)	2
Airport Luggage System Project	Deputy Manager/Chief Engineer (**Project Manager, Western SOCC Project**), Vice Manager, Terminal Building Eastern Management Dept (**Project Manager, Luggage System Project**) and Business Manager, IT Services Engineer (**Business Process Lead, Luggage System Project**)	3
Terminal & System Command Centers	Deputy Manager/Chief Engineer (**Project Manager, Western SOCC Project**), Business Manager, Western System Operation Control Center (**Business Process Lead, Western SOCC Project**) and Business Manager, Production Control (**Business Lead, AODB System Project**)	3
Final Interviews and Findings Presentation	Executive Vice President cum CIO, BCIA (**BCIA Management**), Manager (**BCIA Management**), Deputy Manager/Chief Engineer (**Project Manager, Western SOCC Project**), Chief Engineer (**Project Manager, Data Center System Project**), Engineer (**Technical Lead, AODB & Data Center System Project**) and Business Manager, IT Services Engineer (**Business Process Lead, Luggage System Project**)	6

In our case study, four out of the six large-scale mission-critical systems were featured. These four systems were selected because of their sheer size of implementation, their complexity in dealing with large groups of internal and external stakeholders (e.g. airline staff, customs officers, IT staff, business unit personnel, vendors and/or government agency personnel), their unique nature of project uncertainty, and their mission criticality

to the whole Terminal 3 program. See Table 8 for a detailed description of the large-scale mission-critical systems featured in our study.

Table 8: Detailed Description of Mission-Critical Systems Featured in this Study

System Name	Brief System Background
Airport Operation Database (AODB)	The 'core hub' that allows information captured within other systems in the airport to be seamlessly stored, analyzed and shared to ensure the smooth running of all aspects of its operations (a.k.a the 'heart' of the airport operations)
Airport Departure	System that manages the entire process of checking in and boarding the passengers and their luggage which all airlines in Terminal 3 are required to use
Airport Security	System that handles all forms of security-related processing within Terminal 3. The security system of the airport can be classified into 5 levels of security checks (Airport-int 2009). Due to the huge number of country leaders and foreign visitors involved during the Olympic Games in 2008, the highest level of security 5 was mandated in Terminal 3
Airport Data Centre	System that facilitates the billing for services rendered in Terminal 3 by the BCIA. From BCIA's perspective, this system demands one of the highest priorities because it deals with the company's revenue generating activity

The questions asked during the interview were open-ended and tailored specifically to the role of the person to be interviewed. Generating rich and thick descriptions during our interviews was critical in our study. Hence, we followed two of the proposed interviewing techniques namely, appreciative and laddering interviewing techniques, as advocated in Schultze et al. (2011) to achieve this goal. A large amount of secondary data comprising project documents, books, photos and videos was also collected during the onsite interview sessions.

Coding and Data Analysis. The theory-building process used in several case method researches in the field of IS (e.g. Leidner et al. 2009; Pan et al. 2007; Ravishankar et al. 2011) and prescribed by Pan et al. (2011) was leveraged upon to develop a guide to our

case-study. Before the start of the study, a one-month long data analysis using a thematic coding technique was conducted on data obtained from secondary sources and from preliminary offsite emails and phone interviews to derive an initial theoretical model that could explain the possible relationships between our phenomena (i.e. agile IS development practice) and theoretical lenses (i.e. trust-mediated organizational control and IT capabilities). This preliminary theoretical model serves as a "sensitizing device' (Klein et al. 1999) to guide the subsequent data collection process. The onsite interviews were then conducted. Data analysis was performed concurrently with the data collection activities. Break-out sessions attended only by the research team were conducted between interviews to ensure the data collected was aligned to the theoretical model (Eisenhardt et al. 2007). During these sessions, the researchers applied the principles of dialogical reasoning and multiple interpretations to ensure rigor in the data analysis process (Klein et al. 1999). The data analysis work followed an iterative process of moving back and forth among empirical data, the theoretical lens, relevant literature, and the proposed model until 'theoretical saturation' was reached (Pan et al. 2011). The eventual models were presented to the respective stakeholders at BCIA's IT department for validation of accuracy and correctness (Walsham 2006). Another round of confirmatory data analysis was conducted using selective coding techniques after the onsite interviews that took into account the data from the new interviews and large amount of project documents collected (project schedule, system design diagrams, etc.). To ensure construct validity and reliability of our empirical data, we adopted measures deployed in a similar case design research published in a top-tier IS journal (e.g. Ravishankar et al. 2011) and reinforced it further with measures proposed in Yin (2009) (see Table 9).

Table 9: Steps to Ensure Construct Reliability and Validity (Adapted from (Ravishankar et al. 2011; Yin 2009))	
Reliability through	**Validity through**
1. Case study protocol Informant profiles and contact information Project documentation List of other potential themes to be explored in the interviews Data from one project team used to validate the reliability of another project Strategies to conduct interviews to maximize the possibility of data triangulation, e.g. cross-checking data collected in one project team with another and break-out sessions in-between interviews to identify if data extracted from project implementation can be generalized to represent the organization **2. Case study database consisting of the following:** Recorded audiotapes, interview transcripts, transcripts of e-mail and telephonic discussions with informants Field notes: Impressions of informal conversations with informants Project-related documents relating to each implemented system Websites, books, magazines relating to the Terminal 3 implementation	**1. Multiple sources of evidence** Primary data sources: field notes, interview transcripts and telephone and e-mail discussions Secondary data sources: project-related documents, websites, books, etc. Strive to ensure that each construct proposed in our models can be supported by at least two data sources **2. Establishing chain of evidence** Data collection and analysis follow established case study strategies (Pan et al. 2011) that provide detailed descriptions on how the models are derived Any modifications to the theoretical models are documented extensively to ensure that rationale and logic for the changes are comprehensively captured **3. Review of derived models** Initial drafts of the derived models are reviewed by key informants to ensure correctness and accuracy **4. Triangulation of observations** Data collection is conducted by multiple researchers and cross-checked among researchers for correctness and accuracy

3.4 Case Description

Organization Background. The Beijing Capital International Airport (BCIA) Company Limited is a state-owned enterprise that manages the main airport of Beijing, China. Under its charge, BCIA manages the Beijing Capital International Airport that consists of three airport terminals, namely Terminal 1, 2 and 3. As the capital airport of China, BCIA

is constantly under intense pressure to cope with the rapid growth of air traffic to and from Beijing. In 1990, Terminal 1 was built and it occupies a floor space of around 90,000 square meters. In a span of 10 years, Terminal 2 was constructed and went live in operation in year 2000. It occupies a total floor space of 336,000 square meters. The purpose of constructing Terminal 2 was to provide a 'breathing' space when Terminal 1's facilities were overhauled and refurbished. In 2004, when the refurbishment project for Terminal 1 was at the final stage, i.e. during the time of handover from the vendor, the Terminal 3 project was initiated. The colossal Terminal 3 was specially designed and constructed for the 2008 Olympic Games and has a floor area of 986,000 square meters. Its floor space is more than *twice* of the size of Terminals 1 and 2 *combined*. The scale of IT system implementations for Terminal 3's program was also unprecedented in BCIA's history. In addition, the BCIA was given the tall order of ensuring the accomplishment of '*zero incidents, zero accidents and zero complaints*' throughout the 2008 Olympic Games by the Chinese Government. Our case story is focused on BCIA's IT department. We elaborate on how the IT project team mitigated the various project uncertainties inherent in four different large-scale mission-critical IT development projects during the implementation of the Terminal 3 IT program.

3.4.1 Airport Departure System

The Airport Departure System's main functionality is to allow the airlines' departure systems to 'hook up', support the process of checking in passengers and facilitating passenger boarding. The development work of the system for Terminal 3 started in 2006 and was completed in early 2008. The business process of checking in and boarding passengers has remained similar across the air transportation industry for many decades. However, various customizations on the system were necessary in order to meet the

varying needs of the airlines to serve their passengers. Managing the airlines' expectations and linking this system with the various airlines' departure systems seamlessly were the critical success factors for this project. However, when the project was awarded to the vendor, the IT project team doubted the capability of the vendor to deliver. As a vendor that served many customers, BCIA was just another account to them. The vendor's project team maintained its proprietary software overseas. This implied that the speed of implementation and the quality of the customizations were difficult to control. In addition, the vendor's staffs deployed to this project were inexperienced. As controlling the conflicting demands from the various airlines on this system were non-trivial tasks, especially when the vendor's capability to deliver the system was in question, a significant risk of schedule slips was evident.

Mitigating the Challenges. In order to mitigate the risk of schedule slips, the IT project team identified two key elements which they had to address. Firstly, the scope and uncertainty specific to each customization request by the airlines had to be accurately identified throughout system development to minimize the occurrences of rework. Secondly, the vendor involved in the project had to be closely managed to ensure the timely delivery of the system requirements or change requests. To address the first element, the IT department appointed one of its subject domain experts in the Airport Departure System as the technical lead. In addition, they also convinced all the airlines to send in their subject domain experts in their respective airline departure systems to form the project steering committee. This project steering committee was placed in charge of the initial tender proposal, project planning and subsequent iterative project implementation and change review processes. As the technical lead and airline subject

domain experts knew each other from the Terminal 1 or 2 projects and respected each other, the alignment of shared goals to serve passengers was quickly established early in the project and upheld throughout the whole duration of the project's implementation. While changes to the requirements were evident during system implementation, the project steering committee was instrumental in identifying the requirements for the customizations accurately in each change request and this reduced occurrence of the need for rework during system development.

To address the management issue with vendors, a series of training sessions was conducted by the IT project team at the beginning of the project to the local members of the vendor. These training sessions were designed to impart to the vendor important information pertaining to Beijing Capital International Airport (BCIA)'s culture, practices, work attitudes and standards before implementation commenced. Once the project commenced, a rigorous and detailed 'Backward Planning' (interpreted as setting hard deadlines and planning backward for milestones) methodology was adopted to communicate expected deliverables and their deadlines to the vendor. Weekly meetings were held to track the development progress of the vendor and findings were presented to the project steering committee to ensure constant alignment of deliverables with the identified system requirements and change requests. The technical lead of the project even went to the extent of detailing a daily schedule of work activities for the vendor. Staffs were stationed beside the vendor to ensure conformance to the daily schedule and to ensure the quality of the completed tasks. Through leveraging upon the project steering committee to accurately identify user requirements in change requests, and maintaining tight control over the work of its vendor, the IT project team was able to keep the project

on schedule amidst the large number of customizations and changes requested. Table 10 shows the representative quotations extracted from our case data.

Table 10: Representative Quotations on Airport Departure System Case Data

Empirical Observations	Theoretical Observations	Theoretical Constructs
"If you have a chance to read the ***requirements submitted*** *(for the departure system)* ***by each airline****, you will be surprised to realize* ***how deep into the future their predictions are for the airline industry*** *…* ***and the needs of their passengers*** *... Because our customers are airlines, the* ***requirements gathered from them are all very accurate in predicting the eventual use****"*	IS Planning Capability	IT capabilities in the Project Team
"We provide training to our vendor. Through the training, we ***transfer our company (BCIA)'s management methodology, procedures, norms****, including the details on our existing system operations and things to look out for during requirements study. We* ***want them to meet the quality of our work standards. Make their thought patterns, beliefs, work attitudes be in sync with us****"*	Behavioral Conditioning Capability	
*"****Every week we have project meetings to discuss the progress*** *of the previous week."* *"We* ***make use of a backward planning methodology****. We look at our deadline, how many days it will take (before we reach it), then make milestones starting backward."*	Formal Outcome Control	Organization Control
"The plans are very clear … ***work details up to every day, some even up to every few hours****. That is to say* ***if the work on that day can't be completed, everyone*** *will have to* ***do OT****"* *"We are* ***with the vendors the whole day*** *… because we are* ***seated together****."*	Formal Behavior Control	
"They (vendor) guard their technical knowledge very strictly… and because their technology is proprietary and not open-source … we ***honestly feel that this is not a healthy development into our future relationship****"*	Trust (Vendor)	Trust relationships among project stakeholders

*"... This allows us to see eye to eye on issues and also **not allowing them (vendor) to do whatever they want** ..."*		
*"... I have been working on the Airport Departure System for 9 years. Every detail (of the system) whether it is good or bad, I know it very well. We have the **most professional people** (refer to members of the project steering committee which also includes the eventual users of the system) **doing the professional work**"*	Trust (Users)	

3.4.2 Airport Operation Database (AODB) System

The AODB system is the platform on which the entire airport terminal's data is integrated and exchanged across all mission critical systems. The first custom-built AODB system was installed in Terminal 2 in 1999. When Terminal 1 was refurbished, the custom-built AODB system was integrated into Terminal 1's operations, allowing one AODB system to manage two terminals' operations. The implementation of a new AODB system in Terminal 3 was started in 2006 and delivered in early 2008. During the tendering process of this project, the IT department was aware of two integration challenges in this project. Firstly, the new AODB to be installed in Terminal 3 was an off-the-shelf system that differed significantly from the custom-built AODB system in Terminals 1 and 2. Secondly, all the AODB systems had to integrate with the Airport Traffic Control (ATC) System managed by the Air Traffic Control Authority in Beijing. The ATC system is a system that feeds important flight and weather information to the AODB systems. At the time during the development of the Terminal 3 AODB system, the information systems in the ATC were also undergoing a major upgrade. This meant that there existed significant uncertainty on how all these integration challenges could be overcome.

Mitigating the Challenges. Given the great complexity and the unlimited possibility of how any AODB system could be used in an airport terminal, it was difficult for the management to explicitly define the outcome of a project of such a nature. As a result, the IT department had been advocating constant experimentation of the system as a 'way of life' for all AODB administrators (who are both the eventual system users and members of the IT project team of AODB projects) since 1999. The IT department frequently sent key AODB administrators to visit established airport terminals in the world (e.g. Changi Airport in Singapore) to acquire new insights into AODB system management. The results of this promotion of 'experimentation' and frequent overseas visits are: (1) a comprehensive methodology in managing AODB systems was developed in 2002 that laid the foundation for the future administration and maintenance of AODB systems; (2) the experiences motivated the setup of two Terminal Command Centers that consolidated all existing AODB-related systems and terminal operations for more effective operational management; and (3) the IT department had the ability to craft tender requirements that were highly pre-emptive in mitigating potential uncertainties and risks inherent in this project, and this ability to pre-empt problems was also particularly useful in addressing uncertainties during system implementation.

When project implementation commenced, leaders of the IT project team placed great trust in the hands of the highly experienced AODB administrators and the outsourced vendor. The same culture of learning and sharing was reinforced and nurtured within the project environment by leaders. Project members and the vendor were encouraged to explore all possible ways to deal with the inherent uncertainties in integrating the two AODB systems, and in integrating the AODB systems with the Airport Transport Control

(ATC) system. Such a culture resulted in the enactment of several desirable member behaviors such as the selfless sharing of knowledge and proactive problem anticipation and solving during the implementation of this project. The selfless sharing of knowledge was best exemplified through the *informal* mentor-apprentice relationships, whereby past AODB administrators (who were not directly involved in this project) served as mentors to the AODB administrators in charge of this project. The proactive problem anticipation and solving was best exemplified through the pre-emptive development of a highly flexible component in the AODB systems that could accommodate almost all kinds of changes anticipated in the upgrading exercise of the ATC system. Consequently, regardless of how the ATC system was upgraded, the component in the AODB systems was able to integrate easily with it in the midst of the system development. The above measures were effective in helping the project team pre-empt problems and control the uncertainties in the project, which in turn kept the project on schedule. Table 11 shows the representative quotations extracted from our case data.

Table 11: Representative Quotations on the Airport Operation Database System's Case Data

Empirical Observations	**Theoretical Observations**	**Theoretical Constructs**
"Because ATC was changing their system, when we completed our AODB project, they were still developing theirs. Because of ***the experiences gained from our constant experimentations, we were able to come up with a lot of contingency plans*** *... at the end,* ***regardless of how they (ATC) changed, we could easily accommodate our system to interface with theirs (ATC system)*** *(capability evolution mechanisms)"* *"The setup of the two Terminal Command Centers* ***consolidated and replaced all the old systems and processes*** *(capability substitution and*	Capability Reconfiguration	IT Capabilities in the Project Team

transformation mechanisms)"		
"In 2000, I took the lead with a few other colleagues to look into a system backup and business continuity in-depth study (for the AODB) … during that time, we didn't leverage upon outside help and we did ***all the research on our own …*** *From 2000 to 2002, we* ***came up with a maintenance standard operation procedure handbook****. Till today, our maintenance strategy is dependent on this handbook. (identify & assimilate internal and external knowledge)"* *"Because of our in-depth knowledge of T2's (Terminal 2) business operations, we could easily make a comparison between T2 and T3 (Terminal 3) and highlight the weaknesses and strengths of T2's system (AODB system), and* ***we could use this knowledge to inform the vendors to improve their system by absorbing T2's strengths and eliminating its weaknesses*** *(exploit internal and external knowledge)"*	Absorptive Capacity	
"… our IT department had a ***very strong learning culture … we invented many system maintenance strategies*** *(experimentation culture)"* *"He (Head of IT department)* ***encourages us to continuously do research and innovate*** *… we are very* ***willing to do it*** *and willing to make this industry better (proactive problem solving culture)"*	Informal Clan Control	Organization Control
"We have an ***unofficial master-apprenticeship mechanism and a backup mechanism*** *… if the apprentice is good at work, the master will have the opportunity to do other things and can also be promoted. This serves as a big motivation for the master (to coach the apprentice)."*	Informal Self Control	
"They (vendor) have ***very unique recommendations and understanding on system development*** *… during the project, especially at the last stage, they* ***could make predictions on the future maintenance model and preemptively did a lot of work****."*	Trust (Vendor)	Trust Relationships among Project's Stakeholders
"At that time, the stress exerted on the department was the largest … ***our most trusted and valuable staff*** *(refer to the AODB Administrators who were also eventual users of the system) had left for the Terminal 3 project."*	Trust (Users)	

3.4.3 Airport Security System

The tender for this system was awarded in October 2005 and the system went live in March 2008. As one of the most critical systems that was directly linked to the '*zero incidents, zero accidents and zero complaints'* objective, the airport security system was of utmost importance. To meet this requirement, the most stringent security screening processes were mandated (see Table 12 for details).

Table 12: Industry Standard Five-Level Security Screening Processes (From (Airport-int 2009))

Level	Requirements
1	Automated evaluation of x-ray images by x-ray machines
2	Operator analysis of Level 1 images at workstation(s) by customs personnel, carried out while bags continue in transit
3	A more in-depth analysis of the original Level 1 images at separate workstation(s), or subjecting the bags to a separate x-ray process using a different x-ray technology. For example, Computer Tomography (CT Scanner)
4	Reuniting a passenger and bag and carrying out a manual search
5	In the event that a passenger cannot be found, then the bag is considered as bomb threat and dealt with accordingly

At level 5, all previous levels must be fulfilled. This means that to fulfill up to the level 4 security screening process, there is a need to automate the process of screening of thousands of bags. When a manual search is deemed necessary, the system must be able to accurately pinpoint the location of the bag's owner in the huge Terminal 3 floor area and contact the ground crew to locate the owner so as to unite him/her with his/her bag. It is obvious that such requirements would be almost impossible to achieve in Terminal 3 (due to its sheer size and the volume of bags that need to be processed) without close collaboration among all stakeholders (e.g. customs officer, ground security crew, baggage ground crew, IT staff and etc.) and the automation of screening processes through the IT system. Push this one more level up to level 5, the emergency and bomb squad personnel need to be readily contactable and activated when necessary to deal with bomb threats. The ground crew members need to be informed to control the orderly evacuation of the crowd within the Terminal 3 when necessary.

While there existed security systems within Terminals 1 and 2, none of them were as complex and in as large a scale as Terminal 3's airport security system. Due to the sheer size of Terminal 3, the level of close collaboration among stakeholders was also unprecedented. Consequently, the project contained a lot of uncertainties that could not be accurately forecasted during the tender preparation phase.

Mitigating the Challenges. To mitigate these challenges, the IT project team spent a significant amount of their time visiting many vendors/terminals around the world to acquire knowledge for the implementation of the airport security system. The knowledge acquired from these visits was subsequently used in multiple feasibility studies. Together with the experience accumulated in maintaining and implementing the Airport Security Systems in Terminals 1 and 2, the tender requirements were drafted. To ensure close collaboration among stakeholders was achieved, the IT project team tried to instill a sense of pride in all the stakeholders of this project. They developed multiple channels of communication, especially in the extensive use of encouragement slogans to motivate stakeholders to answer to the higher calling of their work. These measures were effective in inducing a shared sense of pride and privilege to be associated with the 'novelty' of the security system implementation. When project implementation commenced, the IT project team developed several practices which promoted risk-taking and self-learning to resolve unforeseeable situations that might occur during project implementation. For example, a scheme on 'joint responsibility deposit' was derived. The vendor, users and team members were asked to make proposals on how to resolve unforeseen problems that occurred during project implementation, and were asked to 'put their money where their proposals are' under this scheme. If the vendor, a user or team member made a proposal

and was able to resolve the problem in a timely fashion, they would have this deposit returned to them with additional monetary rewards. However, if their proposal failed, they would risk losing some or all of their deposit.

A low trust environment of all stakeholders (users and vendor) was highly evident in this project. This resulted in the setting up of an independent audit team to inspect all project deliverables. Without the endorsement of quality by the audit team, the subsequent implementation of the system would not be able to proceed. In addition, payments to the vendor were done in a 'milestone' style, i.e. they were only paid when the audit team certified that they had met all the requirements for that milestone. Key IT project and vendor members were mandated to stay onsite during the entire system development period. The project was expected to run 24 by 7. Frequent site inspections and weekly meetings by leaders across all levels were conducted to instill the sense of urgency and importance to get things done right on the first attempt. The leaders in the IT project team led by example to demonstrate the commitment and will to successfully complete the project on time. Progress meetings were held on weekends and site inspections were often conducted at night. Often, leaders had to work longer hours than their subordinates. As a result of all this, they were able to keep the schedule on track. Table 13 shows the representative quotations extracted from our case data.

Table 13: Representative Quotations of Airport Security System's Case Data

Empirical Observations	Theoretical Observations	Theoretical Constructs
*"With regards to work culture … the slogan in our canteen can best represent that and it says '**If you are afraid of death, don't become a communist. If you are afraid of hard work, don't take up the system development work of T3!**'"*	Shared Ideology	IT Capabilities in the Project Team

*"Everyone who is participating in this project will have **a revelation that this is the most political and critical project** (in T3) … As far as security is concerned, this system is **first of its kind in China**"*		
*"… In April 2005 before the beginning of the tender, we did **a number of visits and research on a number of airports** … we involved the design unit in T2 (Terminal 2) to **consolidate our findings into the tender specification** for the security system in T3 (Terminal 3)"*	Knowledge Integration	
*"If you achieve your target, you will be given a monetary reward, if you don't, money is deducted… once we establish the target, everyone will **come up with the 'responsibility' deposit, if you don't hit it (target) we deduct money from the deposit. You complete it, we give you the reward**. (promote risk-taking measure)"* *"… **our audit is very strict**, every night they will check each work station and inspect the work progress and condition"*	Formal Behavior Control	Organization Control
*"This doesn't just apply to us, it applies to the vendor as well. I recall when a vendor's staff joined us, his wife just gave birth to a baby … he **stay onsite for 4 years before he returned home to Xiamen.**"* *"… some **leaders will follow us to inspect the work site** (at night). This means that there is **no rest day, it is like 24 by 7** … if you have to deal with some situations at home, you can go back to settle it fast … but basically **at night you will be back to the work site**."*	Informal Clan Control	
*"We have an independent audit team … you (vendor) complete an amount of work, the **audit team must validate it first before we pay you** (vendor)"* *"Our initial tender is very specific, when we check on the work of the vendor… and we realized that the initial requirements can't be fulfilled … **we will make a request … to discards it (the requirements in the initial tender) and request for a new requirement to be implemented."***	Trust (Vendors)	Trust Relationship among Project's Stakeholders
*"… we have a **change management process that is very stringent.** Any change (proposed by the*	Trust (Users)	

vendor/users) needs to ***go through the engineer in the audit team first****. Only when there is sufficient evidence, it goes up* ***to our change management committee for approval****"*		

3.4.4 Airport Data Centre System

The implementation of the system started in late 2007 and it was delivered within six months in March 2008. The system's functionalities were to collate all data related to terminal operations from the various systems so as to provide information to aid decision making, and to provide a single authoritative source of bill calculation for all the internal stakeholders of Beijing Capital International Airport (BCIA). It was to support the revenue generating activities for BCIA and was also expected to subsume some of the key functionalities previously executed within the existing Enterprise Resource Planning (ERP) and Terminal Operations systems. The system was concerned with generating billing details. Hence, it had to be accurate and error-free, otherwise bills generated from the system would not be trusted by BCIA customers (namely, airlines, shop owners in terminals etc.), who were to be the main users of this system. As it involved subsuming existing functionalities of the ERP and Terminal Operations systems, this meant that there would be a change in how information was distributed. Hence, political conflicts and resistance from staff were expected, but the extent of which was unknown. The project suffered from many uncertainties during system implementation that were inherent in managing the users' expectations and navigating through the 'political minefields' across BCIA's departments. Many of these 'project-destroying' uncertainties were impossible to forecast and required a significant amount of tact and improvisation to overcome them when they happened.

Mitigating the Challenges. To address the uncertainties inherent in this project, the IT department appointed a well-respected IT staff within the airport as the project manager. The project manager was well-respected by everyone in the company for his extensive technical and business knowledge, strong communication, relationship management, and improvisation capabilities. When project implementation commenced, the project manager immediately executed a comprehensive communication plan. The plan was set to align all users' interests towards fulfilling the accounting regulatory requirements mandated by the Chinese Government and to advertise the key advantages, which the new system could provide. Through close coordination and many intense negotiations with all the users, the project manager was able to secure the buy-in and commitment of all of them. As changes to the system requirements were expected, the project manager instituted a rigorous change management procedure to control change. He was able to do this because he was given complete authority and autonomy to run this project by the management of BCIA. Due to the ambitious deadline, the project manager leveraged upon his close working relationships with the local partners of the outsourced vendor to start the project before the signing of the contract. This had serious consequences because the outsourced vendor, company CX (a large multinational company), had decided to exit the project (because the company had decided to pull out from the China market) before project implementation commenced. The project manager managed to convince BCIA's management to award the contract to a local partner of the outsourced vendor, Company LP. Key staff belonging to company CX who were initially deployed to BCIA were laid off due to this sudden change. However, the project manager and company LP's project manager managed to convince them to join company LP.

The project manager trusted the knowledge and capability of the company LP's project manager and gave him complete freedom in implementing all the system requirements. As a result, the company LP's project manager was constantly willing to do extra in return. For example, he was proactive in reporting the status of the project and was flexible to take up ad-hoc work of a smaller scale not specified within the initial terms of contract. He did many of these jobs at no extra cost to BCIA. However, the same trusting relationships were not extended to eventual users of the system because the project manager did not believe that these users (who had more interest in maximizing their profits than with the development of an integrated bill payment system) would serve in the best interest of the project. As changes to the system requirements were expected, the project manager instituted a rigorous change management procedure to control change. Weekly progress meetings were held that involved all key users and company LP's team. Project requirement changes and progress were meticulously tracked and reported during the meetings. Payments to Company LP were made only when all the project requirements were endorsed (by the involved users) as fulfilled. Despite his best effort to control changes, three unforeseen late change requests related to the billing functionality of the system were raised for implementation by the users. If the requests for change were approved, it will mean a schedule slip and the system would not be ready for the Olympic Games. Leveraging upon his expertise and close working relationships with users, the project manager managed to persuade the users to postpone the implementation of these requests to the second phase of the project, which was scheduled to start after the Olympics. These measures undertaken by the project team had kept the project scope in

check and the project on schedule. Table 14 shows the representative quotations extracted from our case data.

Table 14: Representative Quotations of Case Data for the Airport Data Centre System

Empirical Observations	Theoretical Observations	Theoretical Constructs
"… The most critical success factor about this system implementation is about ***coordinating and managing all the stakeholders of this project****"*	Stakeholder Management	IT Capabilities in the Project Team
"During the Olympics we do not allow any changes, that is to say ***all change requests can only be processed during the system testing phase*** *… for instance if you want to* ***add a new rule*** *in computing your finance billing, then that will* ***require you to submit a change request****."*	IT Change Management	
"We have meetings. For this project, ***we have one every week*** *… every day, the project manager (vendor) will analyze the work progress of every item in this project. Since there is WBS (work breakdown structure)* ***...*** *you can* ***verify the progress of all the tasks using it (WBS)****.* ***Every week they (vendor) need to present the report*** *(during the meeting)"*	Formal Outcome Control	Organization Control
""…the core team (vendor team) comprises team members that ***possess in-depth business domain knowledge, strong technical skills and experience*** *in this area … the entire team has also done data centre work in another company. As a result they are very familiar with data centre knowledge which helps them significantly in communicating with all airlines (users) … you* ***don't need to explain things in detail to them****."*	Informal Self Control	
"… if we have another vendor, the ***pressure on us would be really great and we will probably have to work overtime every day****"*	Trust (Vendor)	Trust Relationships among Project's Stakeholders
*"****If you let the users control the process, you will face the challenge of frequently changing requirements*** *… because they (users) represent their own interest."*	Trust (Users)	

3.5 Discussion

In any complex IT project involving multiple stakeholders, project uncertainty is an inevitable element that often troubles even the most experienced project manager (Meyer et al. 2002). A study has shown that the main reasons behind this are: (1) many managers have failed to recognize that different types of project uncertainty require the use of different management approaches in planning, monitoring, and controlling (Meyer et al. 2002); and (2) traditional project management approaches often assume that most of the tasks and uncertainties of a project can be identified right from the onset so that plans can be put into place to address them (Meredith et al. 1995). However, this is not always true especially in complex large-scale IT projects, e.g. ERP system implementations (Lyytinen et al. 2006; Meyer et al. 2002). We adopted the use of an uncertainty-based project management approach that advocates the matching of a management approach towards an uncertainty profile (Meyer et al. 2002) to analyze our case. In so doing, we systematically scanned our case data of six IT systems and two command center system implementations for uncertainty profiles that matched the four uncertainty types that are identified in the literature. This resulted in the selection of the four IT systems presented in this paper. Each of the four IT projects is being classified under an uncertainty profile as shown in Table 15.

Table 15: Project Uncertainty Classification for Each IT Project in Our Case Data

IT Project Name	Project Uncertainty Type (From (Meyer et al. 2002))	Definitions of Project Uncertainty Type (Adapted from (Meyer et al. 2002))	Justifications
Airport	Variation	Many small	Although the business process of

Departure System		influences that will cause the cost, time, and performance levels of a project to vary randomly, but in a predictable range.	passenger check-in has remained similar for decades, the main requirement for the system is to perform small customizations tailored for airlines, which vary from one airline to another. This makes the project outcome vary randomly but within a predictable range.
Airport Operation Database System	Foreseen Uncertainty	A few known factors that will influence project outcomes significantly, but in unpredictable ways.	The integration between AODB systems in T1, 2 & 3 and the integration between the AODB systems and the Airport Transport Control system are all identified as major factors that will influence project outcome. However, the team was unable to ascertain the extent of this influence towards the project outcome.
Airport Security System	Unforeseen Uncertainty	One or more major factors that will influence project outcomes significantly but are not known in advance.	The novelty of developing a system to fulfill level 5 security requirements for the airport terminal and the unprecedented scale of implementation and level of coordination among multiple stakeholders are two major influencing factors of the project outcome that could not be accurately forecasted in advance for this project.
Airport Data Centre System	Chaos	Unforeseen events that happen during project implementation and completely invalidate the project's target, planning and approach	The sudden withdrawal of the main vendor, company CX in initial phase of the project, and the last minute change requests submitted near the end of the project were all unforeseen events that could completely invalidate the project's target, planning and approach.

In addition, like other researchers, we posited that to address the volatilities in system development, IT project teams need to develop various kind of IT capabilities (Fink et al.

2007; Sambamurthy et al. 2003). The first two uncertainty profiles correspond to uncertainties that can be mitigated through developing IT capabilities that have an emphasis on sensing '*potential show-stoppers*' before and during system implementation and developing solutions for them (Meyer et al. 2002). The next two uncertainty profiles will require the development of IT capabilities that have an emphasis on responding to problems rapidly and capturing the experience of dealing with these problems (Meyer et al. 2002). Besides project uncertainty, we also wish to emphasize that the urgency to complete all projects within the deadline of around 2 years, in time for the 2008 Olympics, is one of the key reasons why the IT department was 'forced' by circumstance to derive effective mechanisms to manage the vendor and the system's eventual users. We noted in our case data that the continuous application of the organization control mechanisms by the IT project team had resulted in the effective and timely delivery of system features during implementation despite the changing business requirements. Consequently, the IT capabilities to cope with the project uncertainty were enhanced. This enhancement of IT capabilities further encouraged the IT project team to continue to apply the same organization control mechanisms on its vendors and users. We postulate that this interplay between trust-mediated organization control and IT capabilities is a form of agile IS development practice. We shall now look at how agile IS development practices were developed in each IT project to mitigate the risks brought forth by the projects' uncertainty and completion urgency. Table 16 shows a summary of all constructs and their definitions in our models that are inductively derived from the data collected.

Table 16: Summary of Constructs and their Definitions Used in Models	
Construct	**Definition**
IT Capabilities	
IS planning capability	The ability to anticipate future changes and growth, to choose platforms that can accommodate this change (Feeny et al. 1998), and to effectively manage the resulting technology change and growth (Mata et al. 1995).
Behavioral conditioning capability	The capability of an organization to influence its stakeholders to exercise the appropriate behaviors during task execution (Fink et al. 2007)
Capability reconfiguration	The capability whereby an organization can reconfigure its existing capabilities through the mechanisms of substitution, evolution and transformation in response to changes in the environment (Lavie 2006)
Absorptive capacity	The ability to identify, assimilate, and exploit knowledge from the environment (Cohen et al. 1990)
Shared ideology	The capability to create an attractive identity and a collective interpretation of reality shared by all project stakeholders (van Den Bosch et al. 1999)
Knowledge integration	The capability of an IT project team to negotiate, achieve, and refine a shared understanding among all project stakeholders through interaction, sense-marking and collective learning (Ayas et al. 2001; Boland et al. 1995)
Stakeholder management capability	The ability to manage linkages between IS functions and stakeholders outside the firm and to align and integrate the processes between IS functions and other functional areas of the firm (Wade et al. 2004)
IT change management capability	The ability of IS managers to understand how technologies can and should be used, as well as how to motivate and manage IS personnel through the change process (Bharadwaj 2000)
Organization Control Modes (From (Kirsch 1997))	
Formal Behavior Control	The act of setting a set of specific rules and procedures that aligns the behavior of the controllee to whatever is deemed desirable in meeting the organization's objective
Formal Outcome Control	The act of setting goals that are desirable in meeting the organization's objectives and giving rewards to the controllees who meet it
Informal Clan Control	Looks at the dissemination of desired values, beliefs and philosophies of the organization by socializing the individuals to a common set of norms and values within a clan
Informal Self	Looks at mechanisms that identify and provide a conducive

Control	environment that rewards and encourages highly motivated individuals or groups of individuals to exercise self-control in the best interests of meeting the organization's objectives
Agile IS Development Practices	
Precision-based	These practices allow an organization to effectively and accurately sense variations (a form of project uncertainty) and ensure precise fulfillment of requirements to address project completion urgency risk within a large-scale mission-critical IT project
Preemptive-based	These practices allow an organization to effectively preempt problems of foreseen uncertainty (a form of project uncertainty) and promote proactive problem solving to address the project completion urgency risk within a large-scale mission-critical IT project
Adeptness-based	These practices allow an organization to develop an adept capability that encourages calculated risk-taking, learning behaviors, and effective resource management to address the problems of unforeseen uncertainty (a form of project uncertainty) and the project completion urgency risk within a large-scale mission-critical IT project
Improvement-based	These practices allow an organization to develop strong coordination and business-IT alignment capabilities to effectively manage stakeholders and changes so as to overcome chaos (a form of project uncertainty) and mitigate the project completion urgency risk within a large-scale mission-critical IT project

3.5.1 Airport Departure System Case Analysis

To address the project uncertainty of "*variation"*, our case data reveals that the IT department leveraged upon two dominant IT capabilities within the project team namely, IS planning capability and behavioral conditioning capability. IS planning capability is defined as the ability to anticipate future changes and growth, to choose platforms that can accommodate this change (Feeny et al. 1998), and to effectively manage the resulting technology change and growth (Mata et al. 1995). This capability was developed by the IT project team through the setup of a project steering committee comprising subject-domain experts from airlines and the IT department. Behavioral conditioning capability is

defined as the capability of an organization to influence its stakeholders to exercise the appropriate behaviors during task execution (Fink et al. 2007). This capability is enacted in our case data through the way in which: (1) the technical lead had managed to align all the interests of members of the project steering committee towards the shared goal of enhancing passengers' departure experience; and (2) the training program for the vendor was conducted to infuse BCIA's culture, practices and norms. This is consistent with the extant literature where planning and behavioral conditioning capabilities of an IT project team had been identified as significant influencing factors in the IT project team's ability to accommodate changes that are related to how users access and use the information in an IT system (Fink et al. 2007).

The setup of the IT project steering committee helped in the establishment of a strong trust relationship between the IT project team and the system's eventual users. This trust relationship allowed the task-related outcomes and behaviors during system or change request implementation to be accurately defined. The low trust relationship between the IT project team and vendor had mandated the application of behavior control mechanisms to limit the vendor's opportunistic behaviors. This observation is consistent with the extant literature on organization control that posits that when trust is low and task uncertainty is small, formal control mechanisms are preferred by IT project teams during system implementation (Rustagi et al. 2008). As a result of these trust relationships, the IT project team had imposed two dominant control mechanisms, namely the formal outcome control and the formal behavior control, to enhance its ability to complete the project within the tight deadline. With the IT capabilities to identify system requirements accurately and the control mechanisms applied upon the vendor and users to ensure

timely implementation, we posit that a precision-based agile IS development practice was developed over time. We define precision-based agile IS development practices as practices that allow an organization to effectively and accurately sense variations (a form of project uncertainty) and ensure precise fulfillment of requirements to address project completion urgency risk within a large-scale mission-critical IT project. Figure 1 shows our inductively derived model.

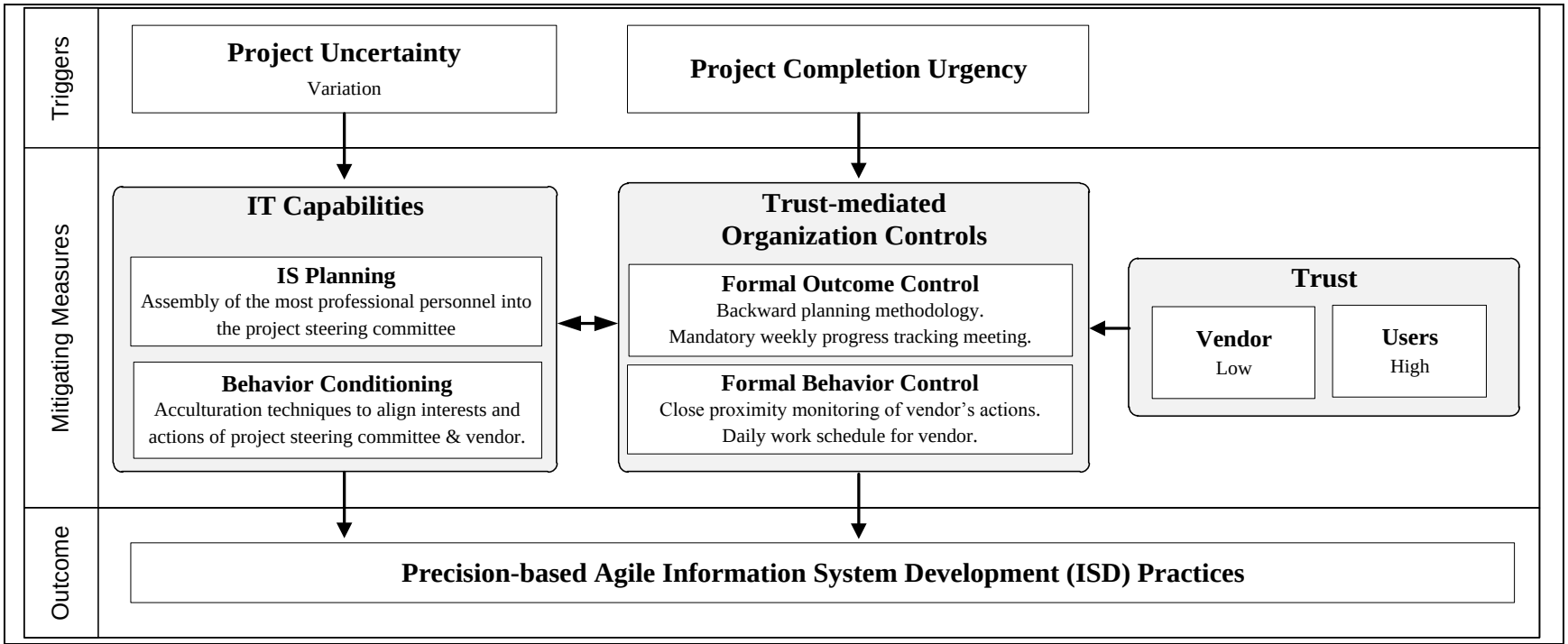

Figure 1: Airport Departure System - Precision-based Agile IS Development Practices

3.5.2 Airport Operation Database System Case Analysis

To address the project's uncertainty of "*foreseen uncertainty*", our case data reveals that the IT department leveraged upon two dominant IT capabilities within its project team namely capability reconfiguration and absorptive capacity. Capability reconfiguration is defined as a capability whereby an organization can reconfigure its existing capabilities through the mechanisms of substitution, evolution and transformation in response to changes in the environment (Lavie 2006). Absorptive capacity is a firm's ability to identify, assimilate, and exploit knowledge from the environment (Cohen et al. 1990). These are capabilities that are best exemplified through the consolidation of AODB experiences to setup the Terminal Command Centers (capability reconfiguration), and assimilation of knowledge acquired through overseas visits and vendors to deliver world class AODB administration processes (absorptive capacity). The capabilities of an IT project team in constantly providing high quality infrastructural services (through capability reconfiguration) and developing in-depth technical knowledge of a system (through adsorptive capacity) are identified as significant factors in a team's ability to be agile during system implementation (Fink et al. 2007).

Our case data reveals that there exists a strong trust level between the IT project team and AODB administrators (eventual users) and between the IT project team and vendor. This can be attributed to the long history of working on similar AODB projects in Terminals 1 and 2 since 1999. As a result, two organization control mechanisms, namely the informal clan control and the informal self control, were applied to ensure the fulfillment of the tight project deadline. The informal clan control is most exemplified in the development of a proactive problem solving attitude among the IT project team, users and vendor. The informal self control is most exemplified in the way AODB administrators were given

"freedom" for system experimentations as well as the informal mentor-apprentice arrangements. This is supported by the extant literature on organization control because of two reasons. First, the controller will typically apply informal clan control on the controllee when the task-related behaviors and outcomes required during IS development cannot be clearly specified (Kirsch 1996). Second, the controller will apply informal self control on the controllee if the controllee is intrinsically motivated and is engaged in self monitoring and self evaluation processes (Kirsch 1996). With IT capabilities that help to develop strong problem sensing abilities and the control mechanisms to nurture proactive learning and problem solving, we posit that a preemptive-based agile IS development practice is formed over time. These practices allow an organization to effectively preempt problems of foreseen uncertainty (a form of project uncertainty) and promote proactive problem solving to address the project completion urgency risk within a large scale mission-critical IT project. Figure 2 shows our inductively derived model.

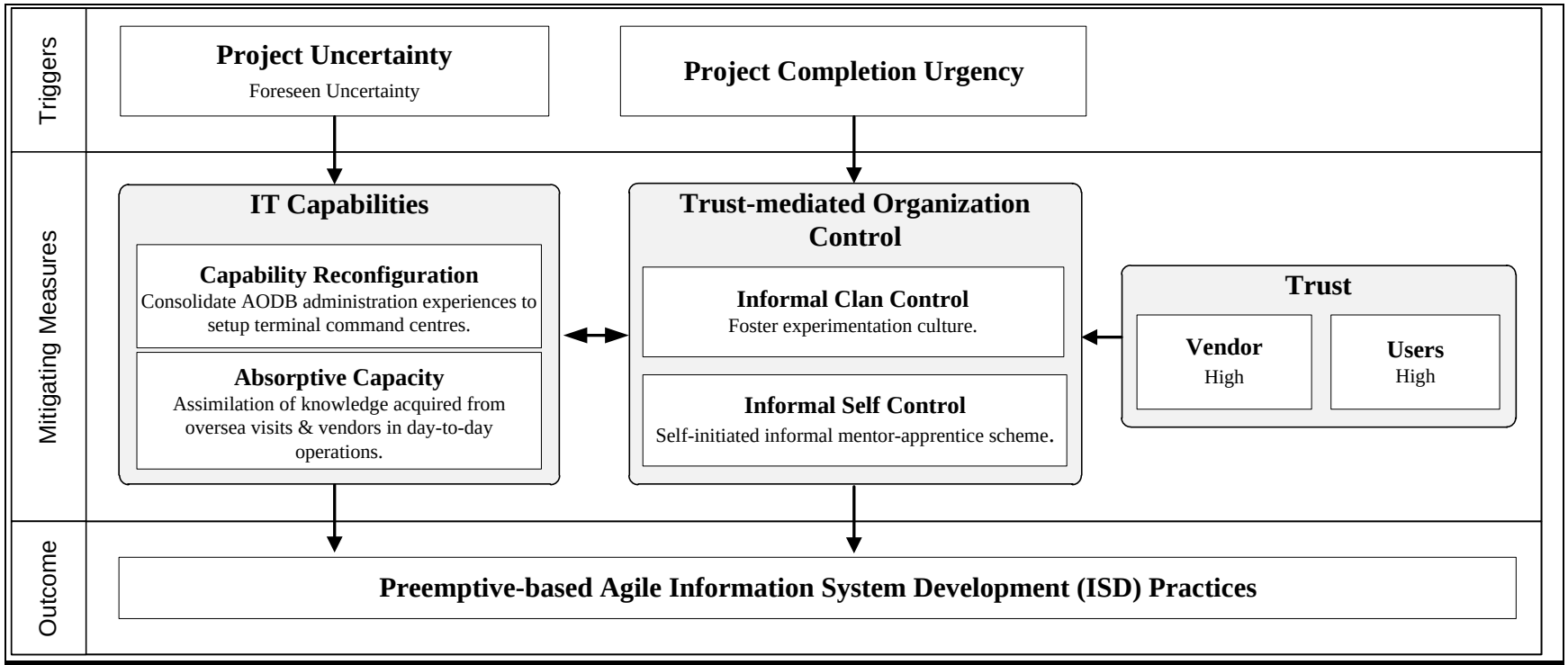

Figure 2: Airport Operation Database System – Preemptive-based Agile IS Development Practices

3.5.3 Airport Security System Case Analysis

The nature of the "*unforeseen uncertainty*" type of project uncertainty is particularly evident in this project. The two dominant IT capabilities within the project team identified are shared ideology and knowledge integration. Shared ideology is the capability to create an attractive identity and a collective interpretation of the reality shared by all project stakeholders (van Den Bosch et al. 1999). This was evident in our case data where the IT project team had developed comprehensive communication plans to nurture the development of a shared ideology among project stakeholders. Knowledge integration is the capability of an IT project team to negotiate, achieve, and refine a shared understanding among all project stakeholders through interaction, sense-marking and collective learning (Ayas et al. 2001; Boland et al. 1995). This was evident throughout the project especially in the initial tender proposal stage where the IT project team spent a significant amount of time in making overseas visits before coming up with the eventual tender specifications. The development of these capabilities allowed the IT project team to align the project stakeholders towards a common purpose which enabled the integration of knowledge and social relationships critical in responding to the uncertainties inherent in the project. This is supported by the extant literature. The ability to understand the business environment (through knowledge integration) of an IT project team has a positive effect on the team's ability to respond efficiently and effectively to market changes (Fink et al. 2007). The ability to create a collaborative environment (through shared ideology) has a positive effect on the team's ability in accommodating changes in systems without incurring significant penalty in time and cost (Fink et al. 2007). Both of these capabilities enhanced the IT project team's ability to cope with the '*unforeseeable uncertainty*' type of project uncertainty inherent in this project.

When project implementation commenced, it was evident that the trust level for users and the vendor was low. Yet, the IT project team knew that it was necessary to inculcate a 'risk-taking' culture in them in order to ensure the fulfillment of the tight project deadline. Two control mechanisms namely, formal behavior control and informal clan control, were implemented. The two control mechanisms are most exemplified by the 'joint-responsibility deposit scheme' (formal behavior control) and 24 by 7 work culture expectation (informal clan control). We posit that these controls created an environment that promoted risk-taking and learning and helped to keep the schedule and scope in check. This is supported in the literature of organization control where behavior control is often applied to situations where desired behaviors during project development can be clearly identified (Kirsch 2004) and informal clan control is applied when the development of a cross-departmental culture towards a common purpose is critical to the IS project's success (Kohli et al. 2004). The interplay between the IT capabilities and control mechanisms over time contributes to the development of adeptness-based agile IS development practices. These practices allow an organization to develop an adept capability that encourages calculated risk-taking, learning behaviors, and effective resource management to address the unforeseen uncertainty (a form of project uncertainty) and the project completion urgency risk within a large-scale mission-critical IT project. Figure 3 shows our inductively derived model.

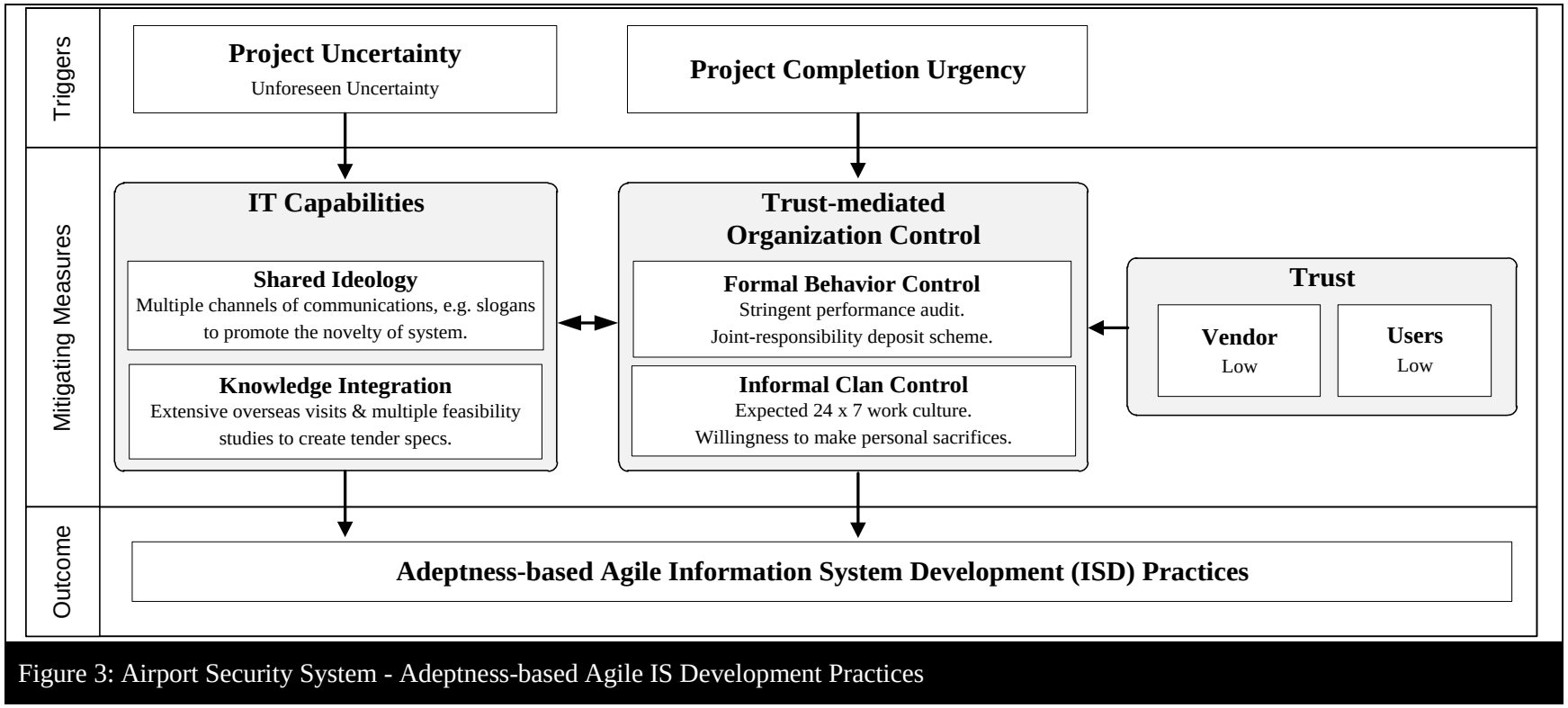

Figure 3: Airport Security System - Adeptness-based Agile IS Development Practices

3.5.4 Airport Data Centre Case Analysis

The final project uncertainty is "*chaos*" and it was highly evident in this project. The IT department knew that the project would face many human related issues such as the presence of resistance from ERP and Terminal Operations system users that had the potential of completely invalidating the project's targets, plans and approach. As such, the IT department identified two IT capabilities within the project team, namely stakeholder management and IT change management, as essential in ensuring the success of the project. Stakeholder management capability is defined as a firm's ability to manage linkages between IS functions and stakeholders outside the firm and to align and integrate the processes between IS functions and other functional areas of the firm (Wade et al. 2004). IT change management capability is defined as the ability of IS managers to understand how technologies can and should be used, as well as how to motivate and manage IS personnel through the change process (Bharadwaj 2000). The most vivid examples on how the IT project team had developed these capabilities were the institution of a well-respected expert as project manager and a stringent change management process. These two capabilities are identified as critical antecedents for IT project teams *'to generate more competitive actions and greater action repertoire complexity*' (Sambamurthy et al. 2003, pp 244) to cope with the highest level of project uncertainty, '*chaos*'.

When project implementation commenced, the effects of the project's uncertainty of '*chaos*' were highly salient in our data. Examples include the main vendor, company CX, deciding to withdraw from China and the project, and three unforeseen change requests that were mandated by the partners to be implemented. The trust level between the IT project team and vendor was high while the trust level for the eventual users was

expectedly low (due to the potential opportunistic behaviors of users when monetary transactions were involved). This combination of trust levels induced the use of two control mechanisms namely, formal outcome control and informal self control. The formal outcome control was tailored to ensure a rigorous change management process and the alignment of interests of all users and the vendor towards delivering the system on time. The informal self control was specially applied towards the vendor. The two control mechanisms are most exemplified by the weekly change and progress meetings (formal outcome control) and the complete freedom given to the project manager of company LP to implement the project (informal self control). The application of outcome control is also consistent with the extant organization control literature. We have advocated this because of two reasons. First, the trust between the IT project team and its users (i.e. shop owners and airlines) was low. Second, the task-related outcomes and impact of every change requested submitted by the users could be accurately assessed by the experienced IT and vendor project managers. Extant literature advocates that under these two reasons, the IT project team will likely impose one of the two formal control mechanisms (namely, behavior and outcome control) on the controllees (Rustagi et al. 2008). As there was a high level of trust between the IT project manager and the vendor's manager, the vendor's manager exhibited strong self-monitoring and self-evaluation behaviors in our case data. Under such a context, the extant literature supported our observation on the application of self control in this project (e.g. Kirsch 1996). The interplay between the IT capabilities and organization control mechanisms contributed to the development of the improvement-based agile IS development practices. These practices allow an organization to develop strong coordination and business-IT alignment

capabilities to effectively manage stakeholders and changes so as to overcome chaos (a form of project uncertainty) and mitigate the project completion urgency risk within a large scale mission-critical IT project. Figure 4 shows our inductively derived model.

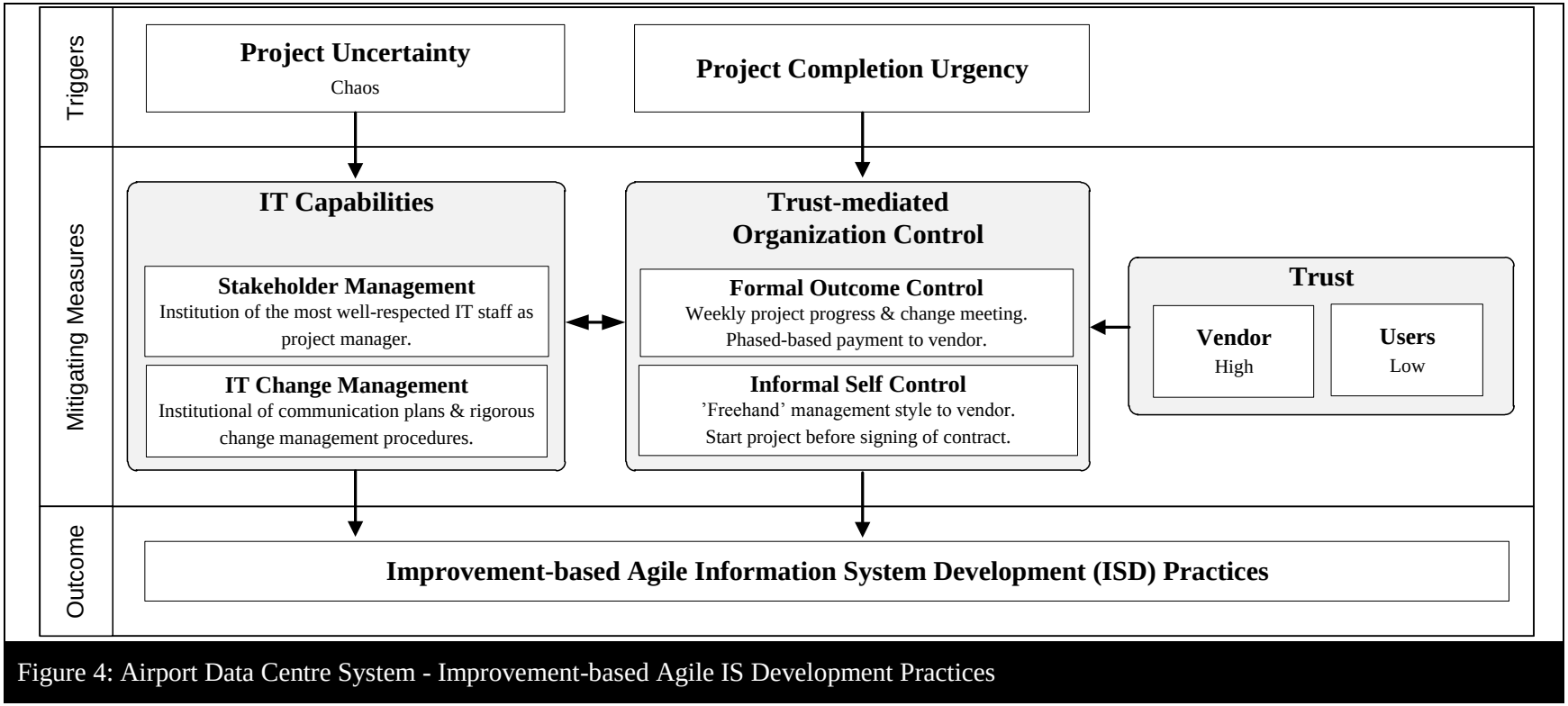

Figure 4: Airport Data Centre System - Improvement-based Agile IS Development Practices

3.5.5 Cross Case Analysis

Based our case analysis, we have classified the four practices into two types as shown in Table 17. This is aligned with the extant literature on agile IS development practices, as agility in IS development is often defined as having two components: sensing and responding to changes (e.g. Lee et al. 2010; Sarker et al. 2009). We posit that when an organization is subjected to the urgency of project completion, it can choose to develop one of these practices or a combination of these practices depending on the nature of uncertainty inherent in the large-scale mission-critical project. This is evident in our case data as we noted that many of these practices have been incorporated into other IT projects not featured in this paper.

Table 17: Types of Agile IS Development Practices

	Agile IS Development Sensing Practices		**Agile IS Development Responding Practices**	
Agile IS Development Type	Precision-based	Preemptive-based	Adeptness-based	Improvement-based
Project Uncertainty	Variation	Foreseen uncertainty	Unforeseen uncertainty	Chaos
Definition	A set of agile IS development practices that are *sensing centric* where the focus is to develop capabilities to accurately sense the project uncertainties stated above and the urgency of project completion and capabilities that allow for proactive response to these uncertainties.		A set of agile IS development practices that are *responding centric* where the focus is to develop capabilities that can flexibly respond to unpredictable project uncertainties stated above and the urgency to complete the project and capabilities that allow learning from that experience.	

As shown in Table 18, we justified that the agile IS development practices that we have identified conform to the taxonomy of agile IS development practices as advocated by Conboy (2009).

Table 18: Conforming to the Taxonomy of Agile IS Development Practices	
Taxonomy of Agile IS Development Practices	**Trust-mediated Organization Control & IT Capabilities**
Practices' components must contribute to one or more of the following: (a) Creation of change (b) Proaction in advance of change (c) Reaction to change (d) Learning from change	We have shown in our models of agile IS development practices that the trust-mediated organization control and IT capabilities are fundamental to the creation of change (a), the proaction in advance of change (b), reacting to change (c) and learning from change (d).
Practices' components must contribute to one or more of the following and must not detract from any: (a) Perceived economy (b) Perceived quality (c) Perceived simplicity	We have also shown in our models of agile IS development practices that the trust-mediated control and IT capabilities increase the overall perceived quality (b) and simplicity (c) in managing IS development and this in turn contributes to the perceived economy (a) of using it for IS development.
Practices' components must be continually ready	These identified trust-mediated control and IT capabilities have been readily applied to other IT projects (not featured in this case study) in the Beijing Terminal 3 program implementation.

3.6 Conclusion

By presenting models detailing four distinct types of agile IS development practices that can be developed in large-scale mission-critical system implementations; this study makes several important theoretical and practical contributions. Firstly, this study has aligned its definition of agile IS development practices to the definition advocated by Conboy (2009). To the best of our knowledge, our study is the one of the first empirical studies that attempts to do that. In so doing, we help to contribute to the development of a cumulative tradition on what constitutes agility in IS development. Secondly, our study has shed light into the underlying process on how agile IS development practices can be

developed in large-scale mission-critical system implementations and thus has answered to the call to investigate agile IS development beyond its current context (Abrahamsson et al. 2009; Ågerfalk et al. 2009) We posit that our study has provided practitioners a roadmap on how they can develop agile IS development practices in a large scale mission-critical system implementation. As far as we know, we believe our study is one of the few that highlights the important relationships among agile IS development practice, project uncertainty, and project completion urgency. It provides further support to the view of advocating a contingency perspective during agile IS development (Austin et al. 2009; Maruping et al. 2009). In our case, the contingency perspective is on the types of agile IS development practices to adopt when faced with a certain type of project uncertainty and project completion urgency situation during IS development. In so doing, our models have provided a research-driven alternative in agile IS development practices in contrast with the practitioner-driven agile methods such as XP or Scrum. These are, in our opinion, of significant value to both practitioners and researchers. Finally, this study contributes to the area of organizational control and trust. The extant literature on organizational control is predominantly focused on identifying the various factors that will influence the selection of specific control mechanisms during system development activities (e.g. Kirsch 1997; Kirsch et al. 2002; Kohli et al. 2004). The relationship between trust and control is rarely examined together in IS development (Pavlou et al. 2006). Yet, we know that control mechanisms are often intertwined with trust especially in a joint venture relationship like outsourcing (Inkpen et al. 2004). Furthermore, among the limited research that has investigated on the relationship between trust and control, only the trust relationship between IT project team and vendor has been considered (e.g.

Rustagi et al. 2008). Our study has shown that the trust level between the IT project team and eventual users of the system is also an important factor that can influence the selection and application of organization control mechanisms during IS development. This is another important contribution to the extant literature on organization control in IS development. Answering to the call of Inkpen & Currall (2004), this study contributes to the literature by providing empirical evidence that clarifies the intertwining relationships between control mechanisms and trust relationships among the IT project team, users and vendor during IS development.

Future Research Direction & Limitations. As an exploratory study, the purpose of this study is to develop a theory to enrich our understanding of agile IS development in a large-scale mission-critical system implementation (an under-explored phenomenon) (Eisenhardt et al. 2007). One future research direction is for the theory developed in our study to be used in other research methods, e.g. survey, to achieve statistical generalization. Our study has not looked into the effects of culture in agile IS development and we know from extant literature that culture plays a significant role in the success of IS development (e.g. Ravishankar et al. 2011). Hence, another potential research direction is to understand the role of organizational culture in contributing to agile IS development. Here, we propose that a good standing point is to look at studies on organizational citizenship behavior (OCB) dimensions (Lee et al. 2003, pp 235) and design a study that looks into the influence of OCB on an organization's culture that leads to the development of IS development agility.

CHAPTER 4: DEVELOPING GREEN AGILITY FOR EFFECTIVE TOP-DOWN INCREMENTAL STRATEGIC RENEWAL

4.1 Introduction

The link between human activities and climate change is now overwhelmingly clear (IPCC 2007; Stern 2007). The human race is fast approaching a crossroad that requires us to choose between fundamentally changing our activities or face the disastrous consequences of a climate meltdown (Adams 2006; IPCC 2007). Not surprisingly, the world's opinion on this issue has converged; led by a newfound resolve among a majority of developed nations (Glenn et al. 1998). Aligned with this opinion, businesses across the globe have begun making environmental sustainability a strategic priority (McKinsey 2009). Unfortunately, a significant majority of contemporary business organizations are still struggling to implement environmental initiatives effectively (IBM 2008). Having achieved some measure of success, organization often find itself in a state of constant struggles between fulfilling its *"sense of obligation to contribute to environmental sustainability*" (Elliot 2011, pp 219) and addressing the significant uncertainties with regards to the impact of environmental initiatives towards its financial bottom lines.

Some researchers and practitioners have suggested the need for the balanced attainment of a *"triple bottom line"* that consists of economic sustainability, environmental sustainability and social sustainability (e.g. Adams 2006; Elliot 2011; Haugh et al. 2010; Melville 2010). It is advocated that by enacting activities that are at the intersection of the three dimensions, an organization can significantly reduce its carbon footprint (environmental sustainability), generate financial and reputational benefits (economic sustainability), and at the same time, fulfill its corporate social responsibility (social

sustainability) (Adams 2006; Elliot 2011). Yet, even as research in this area is growing, most of the existing organization sustainability's studies have focused on disparate issues such as the motivation (e.g. Bansal et al. 2000; Branzei et al. 2004; Sharma 2000; Sharma et al. 2005), drivers (e.g. Chen et al. 2009; Corbett et al. 2001; Vastag 2004) and potential benefits (e.g. Aguilera et al. 2007; Bronn et al. 2009; McWilliams et al. 2001; Michalisin et al. 2010; Orlitsky et al. 2003) of environmental initiatives in isolation and have not considered the '*triple bottom line*' holistically (For comprehensive reviews, see Elliot 2011; Jenkin et al. 2011). This is the first gap in sustainability research that this study is attempting to fill.

Based on a number of literature reviews (e.g. Elliot 2011; Jenkin et al. 2011), we noted that sustainability initiative will require fundamental changes at various level of an organization. For example, Porter & Reinhardt (2007, pp 22) emphasize the need for organization to '*include initiatives to mitigate climate-related costs and risks in its value chain*' during strategy formulation and implementation. Hart & Milstein (2003) derive a sustainable value framework that advocates the need for organization to develop capabilities at operational level to minimize waste and emissions. Several research have also highlighted on the need to integrate an organization's strategies and activities with external stakeholders (such as value chain partners, industry peers, and customers) to create sustainable societal impacts at market level (e.g. Hart et al. 2003; Porter et al. 2006; Sharma et al. 1998). Hence, we posit that in order for organization to fulfill the '*triple bottom line*' holistically, sustainability efforts need to be driven at three levels of an organization namely, strategy, operation, and market. Unfortunately, few studies in

sustainability have analyzed sustainability efforts from these three levels. This is the second gap in sustainability research that this study is attempting to fill.

Finally, this study is interested to uncover the relationships between IT and organization capabilities in enabling fundamental changes in an organization's strategy, operation, and market activities towards the fulfillment of the '*triple bottom line*' holistically. This interest is motivated by several factors. First, the potential of IT in driving sustainability initiative is well recognized among IS researchers (e.g. Hart 1995; Jenkin et al. 2011; Melville 2010). For example, some have noted that IT can be crucial *"in shaping beliefs about the environment, in enabling and transforming sustainable processes and practices in organizations, and in improving environmental and economic performance"* (Melville 2010, pp 1). Others have suggested that IT can play a pivotal role in influencing societal changes (Hart 1995; Jenkin et al. 2011; Porter et al. 2006; Porter et al. 2007) or driving innovations that allow business activities to be conducted in a more *'environmentally sustainable'* way (Chen et al. 2008; Watson et al. 2010a; Watson et al. 2008). Yet, sustainability studies from the IS perspective are rare (Elliot 2011; Melville 2010; Watson et al. 2010a). The rarity of IS sustainability's empirical studies has led to our poor understanding of the role of IT in helping organization implement effective sustainability practices that can '*tackle sustainable development while improving productivity, reducing costs, and enhancing profitability*' (Watson et al. 2010a, pp 24). This is a missed opportunity for the IS community to contribute to the sustainability literature (Watson et al. 2010a) and many IS researchers are calling for more IS research to address this gap (e.g. Elliot 2011; Melville 2010; Watson et al. 2010a). Second, notwithstanding the current stage of IS sustainability's research, there is a growing

demand from the practitioner's world to understand how to leverage upon IT to achieve success in an organization-wide sustainability's initiative. For example, CIOs have placed great emphasis on 'Green IT' as an important strategic technology for 2008 (Thibodeau 2007). The increasing emphasis on Green IT by practitioners has driven the Green IT service market. By 2013, this market is expected to reach nearly $15 billion (Mines 2008). Motivated by this growing demand for knowledge in using IT to drive sustainability efforts from the practitioner's world, our study hopes to provide a timely response to it. This is the third gap in the sustainability research that this study hopes to fill.

To analyze the relationship between IS and sustainability, we use the Belief-Action-Outcome (BAO) framework proposed by Melville (2010) as our theoretical lens. The framework is particularly useful in IS sustainability research because it incorporates both micro (i.e. strategy and operation levels) and macro (i.e. market level) perspectives of an organization during a sustainability initiative's implementation (Melville 2010, pp 5). As a result, it provides an encompassing approach (Melville 2010) that can address our study's objective to understand how the '*triple bottom line*' can be fulfilled holistically through the enactment of activities at an organization's strategy, operation, and market level. We further posit that as organization enacts activities to develop strong sustainability belief and formulate effective sustainability actions at various levels, valuable organizational capabilities will be derived and these organizational capabilities can be enabled through the appropriate application of IT. Several examples from existing sustainability and IS sustainability literature supported this assertion. First, Sharma & Vredenburg (1998) had shown that the proactive implementation of sustainability's

strategies will lead to the development of valuable organization capabilities. Second, IT has been shown to be able to enhance the effective flow of information within organization which resulted in the development of valuable organization capabilities (Watson et al. 2010b). Third, the combination of IT and organization capabilities can enable and motivate economic and behaviorally driven solutions to overcome environmental sustainability challenges in an organization (Watson et al. 2010a). We advocated that the BAO framework can be applied to analyze how IT-enabled organization capabilities can be developed at three levels (namely strategy, operation, and market) of an organization in an effective Green IS initiative (i.e. an initiative that involves integrating a set of people, processes, software, and IT infrastructure towards the goal of achieving the sustainability '*triple bottom line*' (Chen et al. 2009; Watson et al. 2008)).

In summary, this study seeks to accomplish two objectives: (1) build a theory to explain how a Green IS initiative can be effectively implemented; and (2) develop a roadmap to guide practitioners on the appropriate application of IT towards the development of organization capabilities that are critical in meeting the environmental objectives of their firms. By conducting a case study on China Mobile Telecommunications Co. Limited (China Mobile)'s Green Action Plan project, we attempt to address the research question: *How to implement an effective Green IS initiative through the development of IT-enabled organization capabilities?*

4.2 Literature Review

4.2.1 Environmental Sustainability and Green IS

In recent years, the '*triple bottom line*' of economic, environmental and social sustainability has been cited by numerous scholars as the key to successful environmental initiatives (e.g. Adams 2006; Dao et al. 2011; Melville 2010). Economic sustainability is about the organization's economic performance amidst its pursuit of sustainable development (Dao et al. 2011). Environmental sustainability is concerned with the *"degree to which an organization's business processes, activities and operations positively or negatively affect the natural environment"* (Jenkin et al. 2011, pp 19). Social sustainability advocates the development of a partnership between business and society to nurture an environment towards sustainable development that is mutually beneficent (Haugh et al. 2010). Given that tensions can exist between the three forms of sustainability, achieving the '*triple bottom line*' is a non-trivial task (Adams 2006). Moreover, contemporary business organizations tend to be surrounded by several highly volatile forces that may render its sustainability efforts futile (Jenkin et al. 2011). These forces include: (1) ecological forces (e.g. rate of resource renewal, regenerative capability of resources); (2) organizational forces (e.g. strong leadership, employee stewardship); (3) political-economic forces (e.g. laws and regulations); (4) socio-cultural forces (e.g. institutions, norms); and (5) technological forces (e.g. cloud computing) (Jenkin et al. 2011). The need to maintain the delicate balance between the three aspects of the '*triple bottom line*' while managing the potentially disruptive influences of these forces makes the path to sustainable development fraught with difficulties.

To overcome these difficulties, several researchers have suggested the need to find a sweet spot at the strategic level of an organization that can create both stakeholder and

sustainable value as it embarks on environmental initiatives (e.g. Dao et al. 2011; Hart 1995; Hart et al. 2003; Porter et al. 2006). This sweet spot will provide justifiable economic returns, strengthen the organization's competitiveness, and allow the organization to benefit society (Porter et al. 2006). At the operational level, the sustainability literature has suggested two types of *'eco-goals'* that are crucial to environmental sustainability (e.g. Dylick et al. 2002). The first is *'eco-efficiency',* which emphasizes the optimal usage of organizational resources to maintain product and/or service quality, while progressively reducing the organization's negative environmental impacts to an acceptable, environmentally friendly level (DeSimone et al. 1997; Jenkin et al. 2011). The second is *'eco-effectiveness'* which involves a revolutionary approach aimed at completely eliminating the negative environmental impacts of an organization (Jenkin et al. 2011) and emphasizes the "*working on the right things instead of making the wrong things less bad*" (McDonough et al. 2002). At the market level, the goal of the social sustainability of the '*triple bottom line*' is to look beyond the boundaries of an organization and emphasizes the development of social and corporate norms that promote fair distribution of environmental resources both within and across generations (Gladwin et al. 1995; Watson et al. 2010a).

Although research on environmental sustainability is growing, we contend that several gaps exist. First, few studies have conducted a holistic investigation of the three dimensions of the '*triple bottom line*' simultaneously. Instead, existing studies tend to focus on a specific dimension (e.g. environmental sustainability) or operational and tactical level issues (for comprehensive reviews, see Elliot 2011). The three dimensions will inevitably involve conflicting tensions that can drive an organization's strategic

directions (Porter et al. 2007). Managing tensions across these three dimensions holistically and simultaneously is important because it is deemed as one of the main causes of failure in sustainability efforts in an organization (Adams 2006). Second, it is suggested by a number of literature reviews (e.g. Elliot 2011; Jenkin et al. 2011) and highlighted in the Introduction section of this paper, effective sustainability endeavor requires fundamental changes at various levels of an organization namely, strategy, operation, and market. Yet, few of the existing studies have examined sustainability from these three levels. Third, few studies have looked at the role of IT in facilitating the effectiveness of a sustainability initiative (for comprehensive reviews, see Elliot 2011; Jenkin et al. 2011; Melville 2010; Watson et al. 2010a). The lack of empirical sustainability studies without consideration of IT is a missed opportunity for the IS community (Watson et al. 2010a).

To address these gaps, we propose a study that will seek to examine the role of IT in facilitating the fulfillment of the three dimensions of '*triple bottom line*' holistically and from a multi-level perspective. Since the need to change a firm's activities in pursuit of sustainability will necessitate the development of new belief and effective action within an organization (Melville 2010), we turn to the literature on the Belief-Action-Outcome (BAO) framework to shed some light on the capabilities that could be crucial to the implementation of an effective Green IS initiative. A Green IS initiative is defined as integrating a set of people, processes, software, and IT infrastructure towards the goal of achieving the sustainability '*triple bottom line*' (Chen et al. 2009; Watson et al. 2008).

4.2.2 Theoretical Foundation: IT-enabled Agility and Belief-Action-Outcome Framework

As mentioned in the literature review on IT-enabled agility, the essence of agility is in its ability to enact effective competitive actions quickly to capture growth opportunities and/or to mitigate the risks of losses caused by an unfavorable circumstance in the turbulent environment (Sambamurthy et al. 2003). We posit that organization needs IT-enabled agility to achieve a successful implementation of Green IS (a strategic renewal initiative). This is because the dynamism of the forces creates a large dose of uncertainties for any firm that is trying to balance its sustainability's triple bottom lines (Dao et al. 2011). These uncertainties will impair firm's ability to mobilize resources and therefore will reduce the positive environmental impacts which firm seeks to achieve. Eventually, this may lead to the failure of a Green IS initiative. Hence, for the firm to mitigate the risk of Green IS failure, it needs to develop capabilities that allow it to sense, respond to changes and learn from the 'application' experiences. Together with the urgency to drive sustainability effort in business (Stern 2007), we populate that organization needs IT-enabled agility to maximize its chance of successful Green IS implementation. In addition, we argue that this definition of IT-enabled agility is aligned with the Belief-Action-Outcome Framework as proposed by Melville (2010).

We adopt the Belief-Action-Outcome (BAO) framework (Melville 2010) derived from the Coleman's model (1986) to guide our inquiry. This is in line with the recommendations of Melville (2010), who suggested that the BAO framework is particularly appropriate for guiding research at the intersection of information systems and sustainability (e.g. Green IS). The BAO framework posits that an environmental initiative will go through a cyclical process that begins with belief formation (where

psychic states about the natural environment are formed) and action formation (where psychic states about the natural environment translate to actions), before it eventuates in an outcome that influences the antecedent social and organizational systems (Melville 2010). We suggest that IT-enabled belief formation capabilities is akin to IT-enabled sensing capabilities and IT-enabled action formation capabilities is akin to the IT-enabled responding capabilities of IT-enabled agility. The cyclical process of the enactment of sensing, responding and outcome learning activities is how enterprise agility is derived (Sambamurthy et al. 2003; Seo et al. 2008). Successive iterations of BAO is a dynamic change processes in an organization (Melville 2010) that will eventually lead to the effective implementation of a Green IS initiative. We, therefore, posit that at each level (i.e. strategy, operation, and market) of an organization, a set of belief and action formation's capabilities will need to be developed to assure the effective implementation of a Green IS initiative.

As tensions among stakeholders in an organization are expected during new belief formation (Melville 2010), we posit that some form of organization capabilities will need to be developed to mitigate this tension. These organization capabilities will help to mitigate the conflicts among organization's members at various levels in terms of its underlying values (e.g. short-term profit motive and the long-term sustainability drive) so as to form a new sustainability's belief (Melville 2010). This is aligned with the sustainability literature. For example, Starkey & Crane (2003, pp 220) advocate that '*environmental belief and action depend crucially on how our understanding of the state of nature, as well as our relationship to it, is constructed*' within an organization. They argued that the development of green narrative (an organization's belief formation

capability) can '*sensitize management thought to green issues and to offer a narrative that provides one way of making sense of what is likely to prove a profound and perhaps irreversible process of change*' (Starkey et al. 2003, pp 232). In similar light, Hart & Milstein (2003) also posit in their sustainable value framework that firm needs to develop the belief formation capabilities to create a shared roadmap among external stakeholders and to integrate their views into business processes for sustainable development.

Beside belief formation capabilities, organization will also need effective action formation organization capabilities to transform the newly formed belief into reality. This assertion is also supported in the extant sustainability literature. For example, Sharma & Vredenburg (1998)'s study revealed that a proactive corporate environmental strategy will lead to the development of several action formation capabilities (e.g. higher-order learning, and continuous innovation). Hart & Milstein (2003) highlighted two action formation organization capabilities in their sustainable value framework namely, clean technology (sustainable competencies of the future) and pollution prevention (capability to minimize waste and emissions from operations) that can maximize the value of sustainable development in an organization.

We posit in our study that IT can play a critical role in the initiating, enabling and catalyzing the development of new belief and effective action formation organization capabilities needed to ensure the effective implementation of a Green IS initiative. To theorize this role of IT in our study, we adapt the categorization as proposed by Dao et al. (2011). The categorization is developed specifically for the context of Green IS (e.g. Chen et al. 2008; Dao et al. 2011), and it has its roots in the robust and well-established frameworks of Schein (1992) and Zuboff (1988). The different roles that IT can

potentially play in the development of new belief and action formation organization capabilities are summarized in Table 19.

Table 19: Role of IT (Adapted from Dao et al. [31])			
Transform	**Informate**	**Automate**	**Standardize**
IT resources that restructure or reconstitute business/industry assets, capabilities, practices, processes, and/or relationships to help firms develop new belief and action formation's capabilities that can contribute to the fulfillment of sustainability's triple bottom line	IT resources that provide timely and accurate data to stakeholders so as to depict accurate work situations. This, in turns, influences the belief and actions of stakeholders towards sustainability contributing to the fulfillment of sustainability's triple bottom line	IT resources that automate the existing manual business processes and eliminate/reduce any wastage of resources. This helps to reinforce the sustainability's belief and promote the spread of effective sustainability's action across an organization which in turns contributes to the fulfillment of sustainability's triple bottom line	IT resources that focus on developing standardized IT services, IT innovations, and IT infrastructure that form the foundation for the activities of automate, informate, and transform to be enacted. It also helps to reinforce the sustainability's belief and promote the spread of effective sustainability's action across an organization.

4.3 Research Methodology

Case Selection Criteria. We scouted various industries for an organization that has demonstrated a strong ability in implementing an effective Green IS initiative. We eventually selected China Mobile because of the following reasons. First, as a state-owned enterprise, they were given clear environmental directives by the State-owned Assets Supervision and Administration Commission (SASAC) of the Chinese government to reduce its carbon emissions as measured in 2005 by 40% to 45% per business unit by 2010 (China-Mobile 2010a). Second, as we are examining the role of IT in facilitating sustainable development, IT is an integral part of China Mobile. Third, the

Green Action Plan project of China Mobile was launched in 2007 and had proved to be highly successful by 2009, meeting the target set by the SASAC one year in advance and the company has continued to enjoy significant growth in its profitability throughout this period (China-Mobile 2010a). Four, China Mobile has more recently leveraged upon its centrality and clout within the telecommunications value chain to motivate its industry peers, value chain partners, and customers to participate in its Green Action Plan project (China-Mobile 2010b). Overall, our initial findings revealed that China Mobile had demonstrated its ability to derive new belief towards sustainability and form effective actions to achieve the sustainability '*triple bottom line*' with its Green IS initiative (i.e. Green Action Plan project) across multiple levels.

Method Selection. The case research method is deemed as an ideal research methodology to fulfill our study objectives because of two reasons. First, as Green IS implementation inevitably involves complex interactions between people, processes, software, and IT infrastructure, and is inseparable from its organizational context (Pentland 1999), we find the case method as one of the most effective research methods to flesh out these complex interactions by interpreting the shared understanding of the relevant stakeholders (Klein et al. 1999). Second, given that there is little research to date that can provide insights into the relationship between IS and sustainability (Melville 2010) and on how effective Green IS implementation can be achieved, a method (i.e. an exploratory case study) centered on developing a theory on this unexplored phenomenon through the collection of rich data in real world context is highly recommended (Eisenhardt et al. 2007; Pan et al. 2011).

Data Collection: Data were collected over a 5 months period from early November 2010 to late March 2011. The entire process can be broken down into three phases namely, preliminary, onsite interview, and post-hoc. In the preliminary phase, emails were exchanged and interviews were conducted with senior management and key directors in China Mobile to obtain important information about the Green Action Plan. In addition to leads provided by informants, a comprehensive archival analysis of secondary sources such as websites, published articles, and books especially those written by independent authors was conducted. The preliminary research design and interviewees for the subsequent onsite interview phase were identified based our study objective and the data collected in this phase. This resulted in the selection of key individuals from China Mobile's headquarters, business units, customer base (i.e. its customers), and business network (i.e. its value chain partners and industry peers). In the onsite interview phase, interviews were conducted onsite at China Mobile and several of its partners' offices by a team of researchers. Each interview lasting an average of 2 hours. All the interviews were digitally recorded and transcribed. As generating rich and thick descriptions on Green IS implementation from interviewees are critical to our study objective, we developed interview strategies based on two proposed rich-data interviewing techniques namely, appreciative and laddering (Schultze et al. 2011) (see Table 20 for more details).

Table 20: Generating rich and thick descriptions from interviewing techniques (Adapted from (Schultze et al. 2011))

Interviewing techniques	**Sample interviewing approach**	**Sample questions**
Appreciative interviewing technique – we made of this technique as a retrospective inquiry (e.g. eliciting highpoints) that catalyzes a prospective act (e.g. drawing	We started our interviews by asking a series of questions to let people share with us their personal experiences in the Green Action Plan implementation.	We typically start with questions similar to below: *"Share with us your experiences of*

paths to ideal types). **<u>Design Principles</u>** Interview's questions are designed to guide our interviewees to '*alternate between retrospective and prospective reflection, between past and future trajectories, and between personal and collective frames of reference*' (Schultze et al. 2011, pp 6) with regard to their implementation experiences of the Green Action Plan in China Mobile. Interview questions are also design to maximize interviewee's opportunity to '*reflect on and share their most outstanding personal experiences, ideas about what works well, hopeful aspirations and desired future*' (Schultze et al. 2011, pp 6) of the Green Action Plan in China Mobile.	We then asked another set of questions to ask the interviewee to reflect upon the key achievements of the Green Action Plan and share with us what their contributions towards these achievements are. Following what is advocated by (Schultze et al. 2011), we asked questions to help the interviewee envisions a blueprint of an ideal Green Action Plan implementation and then followed up with questions to guide interviewee to construct a path towards this ideal stage.	*participating in the Green Action Plan in China Mobile?"* *"Tell us, in your opinion, what are the key achievements of the Green Action Plan?"* When key achievements were identified clearly, we asked questions similar to below: "*What is one of your contributions towards the Green Action Plan's achievements that you are most proud of?*" "*What have you or your team done to achieve this significant contribution to the Green Action Plan's achievements?*" We then tried to ask questions similar to those stated below to guide interviewees to envision an ideal state in the Green Action Plan and to construct a path towards that ideal stage: "*Tell us what kind of personal or organization capabilities that you feel are important in fulfilling the requirements of the*

		Green Action Plan" "*Tell us, in your opinion, how these capabilities can be developed or are developed within you or your team that lead to the fulfillment of the Green Action Plan?*"
Laddering interviewing technique – we made use of this technique to capture the content and the structure of people's internal ideas or theories of how the world works as these are both the antecedents and outcomes of people's attempts to order their lived experiences (Schultze et al. 2011). **<u>Design Principles</u>** Interview questions are designed to generate as much insights as possible from interviewee's limited experiences in contributing to the Green Action Plan implementation in China Mobile. Questions are designed to guide interviewees' to access the multiple layers of meaning associated to their life in China Mobile. However, we place an emphasis on generating participants' meaning on the constructs defined in our preliminary research model such as balancing capabilities, resource-leveraging capabilities and the role of IT.	We asked open ended questions to get interviewee to think about a unique challenge of implementing the Green Action Plan at a specific level of an organization (dependent upon the interviewee's position in China Mobile). We then asked them to share with us their experiences in deriving a solution so as to address the identified challenge. We then asked them to think of a few other challenges of implementing the Green Action Plan in their capacity and its corresponding solutions. Then we asked them to compare and contrast these identified challenges and the corresponding solutions. Then we iteratively and repeatedly asked them a chain of 'why this is important' questions on the identified challenges/solutions that are critical to the Green Action Plan implementation to establish the means-ends	We typically start with questions similar to below: "*Share with us a unique challenge that you have encountered in the Green Action Plan?*" "*How do you overcome this challenge?*" Then we probed them for at least two more challenges "*Can you tell us another two more challenges and how do you overcome each one of them?*" Then we iteratively asked them the why questions to tease out the means-ends chain. For example, one answer that is uncovered in this process is 'balancing strategic priorities' is a challenge, hence this question was asked "*Why is balancing strategic priorities*

	chain.	*important?*" Answer: Because we need to convince the stakeholders "*Why is convincing the stakeholders important?*" and so on.

These techniques allowed us to achieve our goals of generating rich and thick descriptions during all our interviews.

In addition, field visits to China Mobile's headquarters, Beijing subsidiary, and partners' offices were made that generated additional data in the form of 16 videos (with total playtime of approximately 65 minutes) and 80 photos. We were also privileged to be granted access to a number of project documents as well as an independent audit report (Yang et al. 2009) on the Green Action Plan prepared by the World Wide Fund for Nature (Beijing Office). These documents and report were particularly useful in ascertaining that the Green Action Plan and its documented results were not simply an exercise in *'greenwashing'*. During the interviews and field visits, extensive field notes were also being documented by the team of researchers. The data collection process during the onsite interview phase had helped to generate approximately 400 pages of text. Break-out sessions were conducted at the middle and at the end of every day to reconcile the collected data and field notes to corroborate our interpretation of the events that have unfolded during the data collection process (Pan et al. 2011). In the post-hoc phase, we followed additional leads provided by the informants during the onsite interviews phase to scout for more secondary data sources. We created a case study database to consolidate and index all the primary and secondary data collected which also includes the diagrams

and photos that captured the evolution of our inductively derived model (Dube et al. 2003) (see Table 21 for summary of data collected and interviewee profiles).

Table 21: Summary of Data Collected and Interviewees' Profiles of Our Study

Phase	Data Collected	Interviewees' Profile
1	Emails, SMS, summary of phones' interviews, preliminary on-site interviews with management, researcher's field notes, websites, books, and articles.	**China Mobile Communications Corporation (Management)** Vice President Director Assistant Director
2	On-site interviews' data, project documents, researchers' field notes, videos, photos, independent auditor's report on Green Action Plan, and documents capturing the evolution of our research model with justifications.	**China Mobile Communications Corporation (Core Team)** Head of Green Action Plan Working Group Project Managers from Green Action Plan Working Group **China Mobile Communications Corporation (Business Units - Headquarters)** Project Managers from various departments **China Mobile Group Beijing Co., Ltd (Business Unit - Subsidiary)** Head of Beijing Green Action Plan Working Group Project Managers from various departments Manager and Customer Manager from various departments Green Exhibition Hall Commentators (**staff interacting with the general public**) **Industry Peers, Value Chain Partners, and Customers** Chief Engineers Energy-saving Project Managers
3	Additional websites, articles, and books based on leads provided by informants.	N.A.

Coding and Data Analysis. Our data analysis process was conducted in a fashion that iterates repeatedly among the primary and secondary data as mentioned above, theoretical

observations, and existing literature (Eisenhardt et al. 2007; Locke 2001). In the preliminary phase, we conducted a broad thematic analysis of the collected data based on our reviews of the literature to develop a set of theoretical observations (Miles et al. 1984; Olsson et al. 2008; Turner et al. 2012), such as new belief and effective action formation's organization capabilities and the categorization of the various roles of IT (Dao et al. 2011), to establish the assumptions and potential constructs of our study (see Figure 5 for illustration).

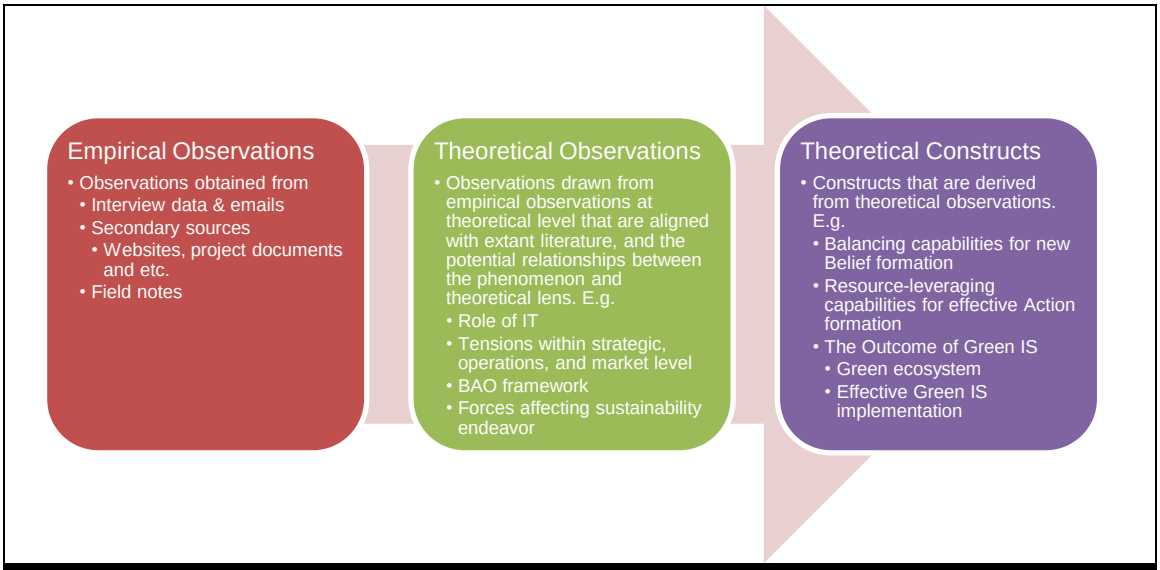

Figure 5: Coding Techniques Used Case Analysis

A preliminary research model comprising of the potential constructs and their relationships was then derived to serve as a *"sensitizing device"* (Klein et al. 1999, pp 75) that is used to guide our subsequent onsite interviews. This process unfolds iteratively in the preliminary phase until a state of theoretical confidence was reached (i.e. confidence that the derived preliminary model can be used for the onsite interview phase) (Pan et al. 2011).

In the onsite interview phase, as the interview data were being collected, our data analysis process iterated among the research model, interview data, and literature to validate and refine the preliminary theoretical model (Eisenhardt et al. 2007). The preliminary theoretical model was gradually extended and verified with the key informants until the state of theoretical saturation is reached (Pan et al. 2011; Strauss et al. 1998) i.e. significant overlaps began to manifest in the subsequent data collected and the additional data did not provide new insights to corroborate, extend or refute the propositions of our emergent model (Eisenhardt 1989; Eisenhardt et al. 2007). We also took advantage of having a team of researchers onsite to ensure adherence to the principles of dialogical reasoning (i.e. sensitivity to possible contradictions between our preliminary research model guiding the research and actual findings) and multiple interpretations (i.e. sensitivity to possible differences in interpretations among the participants) (Klein et al. 1999) during the aforementioned break-out sessions. To maintain the logical chain of evidence (Yin 2009) on how our eventual model was inductively derived, we took comprehensive field notes and documented the justifications for the multiple iterations of modifications of our models in diagrams and photos (Dube et al. 2003; Yin 2009).

In the final post-hoc phase, a final round of confirmatory data analysis, which lasted two months, was conducted in which the technique of selective coding was employed (Strauss et al. 1998). At this point in time, we have systematically categorized and coded all our data according to the model derived. By scanning the entire case study database repeatedly for data that may reveal any inconsistencies and inaccuracies within our model, the reliability and validity of our model were strengthened. We resolved all the inconsistencies through cross-checking researchers' field notes, discussions with

colleagues (Walsham 2006), and clarifications with informants. To ensure the validity and reliability of our data, we adopted several measures (summarized in Table 22) that were deployed in a number of seminal studies in the discipline of IS (e.g. Kirsch 2004; Levina et al. 2003; Levina et al. 2005; Olsson et al. 2008; Ravishankar et al. 2011; Walsham et al. 1999), and reinforced them with the recommendations of a number of well-established case research methodology books and papers (e.g. Dube et al. 2003; Eisenhardt et al. 2007; Goetz et al. 1984; Klein et al. 1999; Pan et al. 2011; Yin 2009).

Table 22: Steps to Ensure Reliability and Validity in China Mobile's Study (Format Adapted from (Ravishankar et al. 2011))

Reliability through	Validity through
1. Case study protocol (Kirsch 2004) Defined procedures to be followed in identifying and selecting our case. Identified the appropriate informant profiles based on theoretical sampling method. Prepared interview protocol based on preliminary research models and identified "seed categories" to guide interview process but make sure that we are not constrained by it (Levina et al. 2003; Miles et al. 1984; Walsham et al. 1999). Derived strategies to conduct interviews to maximize the possibility of data triangulation, e.g. cross-checking data collected in one interview with data in another interview or from secondary sources (Dube et al. 2003). Designed data collection approaches that limit bias. For example, securing highly knowledgeable informants who view the Green Action Plans phenomenon from diverse perspectives in China	**1. Multiple sources of evidence (Yin 2009)** On-site data collection through direct empirical observations of what people did and on interviews with key participants (Levina et al. 2005) was conducted by multiple researchers and researchers paid close attention in upholding the principle of dialogical reasoning and principle of multiple interpretation (Klein et al. 1999). Large amount of data from multiple sources were collected and analyzed to ensure that each construct within the derived model can be supported by at least two sources of collected data (Pan et al. 2011). **2. Member-checking the research results with key informants (Yin 2009)** Descriptions of the constructs within the derived model were shared with key informants to validate and confirm the appropriateness of its use in our model.

Mobile (Eisenhardt et al. 2007). **2. Method of vending to avoid the problem of multiple realities (Goetz et al. 1984)** Collected data, its interpretations and the research model were discussed with professional colleagues for correctness and accuracy (Goetz et al. 1984; Levina et al. 2003; Walsham et al. 1999). One researcher asked questions while the other six researchers listened and took notes that allowed for the capturing of extremely detailed field notes and for detailed discussion within the research team after the interview (Olsson et al. 2008). **3. Case study database (Dube et al. 2003; Yin 2009) consisting of the following:** Recorded audiotapes, interview transcripts, e-mail, recorded telephonic discussion with informant, and on-site visit's videos and photos. Field notes: Impressions of informal conversations with informants and site visits to China Mobile headquarters, subsidiaries' and partners' offices. Project-related documents relating to Green Actions Plan. Websites, books, magazines, and audit report especially those written by independent audit firms and authors to mitigate issues of 'greenwashing'.	**3. Establishing chain of evidence (Yin 2009)** Systematic identification and development of seed categories, concepts, themes, and issues was conducted and validated by multiple researchers (Walsham et al. 1999). Data analysis followed established case study strategies (Pan et al. 2011) to ensure a logically chain of evidence leading to the resulting model were kept. Derived model was developed using data coding techniques advocated by Strauss and Corbin (1998) on multiple sources of data to ensure rigor of data analysis process (Olsson et al. 2008). Modifications to the theoretical models were made based on consensus across all seven researchers and documented to ensure that rationales and logic for the change were captured (Dube et al. 2003). Adopted data presentation techniques for single case study as advocated by Eisenhardt and Graebner (2007) so as to ensure that theory and evidence are clearly articulated and can be easily followed.

4.4 Case Description

China Mobile is a state-owned enterprise officially established on 20th April 2000. The State-owned Asset Supervision and Administration Commission of the State Council (SASAC) of the Chinese government is its main investor. China Mobile's headquarters is based in Beijing but it currently also has 31 subsidiaries in the various provinces, autonomous regions and directly administered municipalities in China. As of 31st December 2009, it was estimated that China Mobile possessed a market share of approximately 70.6% in Mainland China (China-Mobile 2011a). It had a registered market capital of more than US$7.8 billion and a sprawling customer base of more than 500 million (China-Mobile 2010b). This makes China Mobile the largest mobile telecommunications operator in the world by network size and number of customers (China-Mobile 2010b).

4.4.1 The Sustainability Movement in China

Three decades after the introduction of reforms that liberalized its economy, China has become the second largest economy in the world. Unfortunately, this achievement came at a price. Amidst rapid economic growth and massive urbanization, China has imposed tremendous strains on energy resources as well as its environment (Woetzel et al. 2009). To sustain its economic growth for the long-term, the Chinese government realized that the country needs to find a way to reduce its consumption of energy and curb the negative impacts of its industrial activities on the environment. In a reflection of this, Chinese policymakers have declared environmental sustainability as a matter of national priority (Woetzel et al. 2009). Yet, this is an immense challenge given the sheer enormity of the population and economy of China. To overcome this challenge, the Chinese government

has installed an extensive body of policies and regulations towards improving energy efficiency and reducing the negative environmental impacts of businesses (Woetzel et al. 2009). In fact, some observers have noted that "C*hina is making green a central pursuit of business, not a side issue"* (Winston 2010). In 2005, the Ministry of Environmental Protection in China issued its 11th five-year plan that ranges from 2006 to 2010. The plan set out a vision to reduce the energy consumption per GDP unit by 20% and the emission of major pollutants by 10% across all businesses in 5 years (China-Mobile 2010a). Based on the 11th five-year plan, the SASAC issued an order to all state-owned enterprises "*to change the mode of economic growth, reduce the consumption of energy and raw material and control the emission of pollutants*" (China-Mobile 2010a, pp 4). Under this directive, state-owned enterprises are required to reduce its carbon emissions by 40% to 45% from the last measurement taken in 2005 by 2010 (China-Mobile 2010a, pp 4). As a state-owned enterprise under the direct control of the SASAC, the management of China Mobile had to respond to this directive. In addition, by virtue of its sheer size, China Mobile also recognized the important catalytic role that it can play in transforming its industry and the Chinese business landscape. This led to the launch of a major Corporate Social Responsibility (CSR) program in 2006 which is aimed not only at fulfilling the environment-related directives mandated by the SASAC, but the enactment of a diverse range of corporate social responsibility activities to benefit society at large as well. Table 23 describes the major milestones of this program since its inception in 2006 to 2009.

Table 23: Milestones of China Mobile's CSR (From (China-Mobile 2010b))

2006	**2007**	**2008**	**2009**
Set vision and principles and	Clarified Strategy and established	Built management system and achieved	Promoted CSR integration and

wrote CSR Report	frameworks	CSR breakthroughs	comprehensive improvement
• Set the China Mobile CSR vision • Reviewed global standards and best practice in CSR • Began writing first CSR report	• Released first CSR report from China's telecommunications industry • Introduced the tripe bottom lines and clarify CSR strategies • Released policy to guide company's CSR approach, set up framework for CSR management	• Set up CSR Steering Committee and two-tiered CSR management system • Created 3-year CSR management and 5 major CSR programs • Ran first internal CSR case competition • Set up a CSR KPI management system • Recognition for Green performance by being accepted into the listing on the Dow Jones Sustainability Indexes	• Completed CSR risk management pilot program • Created a China Mobile sustainability index • Established CSR management policies • Continued to be recognized on Dow Jones Sustainability Index
Learnt from global standards and best practices and set consistent world-class CSR objectives and released first CSR report	Drove 4 key CSR workstreams across the business and promoted a CSR management system. Applied for listing in the Dow Jones Sustainability Index	Established CSR KPI management system and implemented 5 major CSR programs. Received global recognition of performance	Refined CSR management approach, explored CSR risk management and integrated CSR into daily operational management

By the end of 2007, the CSR initiative was formalized with five programs. These programs are the (1) Rural Program, the (2) Life Program, the (3) Culture Program, the (4) Green Program, and the (5) Employee Volunteer Program. As the focus of our study is on sustainability and Green IS, we now examine the Green Program of China Mobile in greater depth.

4.4.2 The Green Action Plan

Under the Green Program, the Green Action Plan project was launched in 2007. The vision statement of the Green Action Plan is *'Responsibility makes perfection'*. Its core values are to realize the economic, social and environmental responsibilities of China Mobile with honesty and integrity. The Green Action Plan's target was twofold: (1) to reduce the corporate carbon emissions of China Mobile by 40% to 45% by 2010 without compromising its economic and social responsibilities; and (2) to influence the stakeholders in its value chain to support its Green Action Plan project (China-Mobile 2010a). The stakeholders in China Mobile's value chain can be divided into seven major groups namely, customers, shareholders and investors, employees, government authorities and regulators, value chain partners, industry peers, and the general public (China-Mobile 2011b, pp 10). For each of these groups of stakeholders, China Mobile developed a set of engagement methods to ensure that all the key concerns of each group of stakeholders are adequately met (A comprehensive list of these engagement methods can be found in China-Mobile 2011b, pp 10). These engagement methods are aligned with the dimensions of the sustainability triple bottom line. For example, in line with economic sustainability, the need to protect and add value to assets is emphasized in its engagement with shareholders and investors. Aligned with environmental sustainability, meeting the CSR requirements of governments and regulators are highlighted in its engagement with government authorities and regulators. Finally, in line with social sustainability, communications and cooperative projects on CSR management are emphasized in its engagement with industry peers. Table 24 provides a summary of major milestones of the Green Action Plan project.

Table 24: Milestones of Green Action Plan (Adapted from (China-Mobile 2010a))			
2007	**2008**	**2009**	**2010**
• Launch of Green Action Plan	• Reduced energy consumption by 11% per business unit as compared to 2007 • Became one of the first China members of the Climate Group • Joined the UN Global Compact's "Caring the Climate" • Won the title "China's Green IT Enterprise" in 2008 • Recognized on the Dow Jones Sustainability Indexes (DJSI) since 2008	• IT product "Green Packaging" won silver model of "2009 China Packstar" and gold model of "Worldstar Sustainable Packaging Award" from the World Packaging Organization • "Green Action Plan" chosen by SASAC as "Excellence Practice in Social Responsibility of Central State-owned Enterprises" • Appointed as exemplary CO_2 emission reduction model unit by SASAC • First enterprise to sign the "Voluntary Compliance Agreement on Energy Consumption" with China's Ministry of Industry and Information • Reduced energy consumption by 14% per business unit as compared to 2008 level. • Conserved the use of 18 billion kWh of electricity. • In total, reduced energy consumption by 49% per business unit as compared to 2005 level. Thus, realized the SASAC's mandates one year earlier than required	• "China Mobile's Practice on Energy Conservation and Emission Reduction" selected as a teaching case by the University of Michigan Business School • Won title of "China Top Ten Businesses in Energy Conservation" from China Energy Conservation Association • Won title of "Well-performed Enterprise in Energy Conservation and Emission Reduction" from All-China Environment Federation • Entered into Strategic Cooperation Memorandum of Understanding on "Green Action Plan" with 53 major suppliers around the world

4.4.3 The Implementation of the Green Action Plan

A working group was established and tasked with the execution of the Green Action Plan. The group is helmed by a Vice President and comprises seven employees based in

China Mobile's headquarters in Beijing. More importantly, the implementation of the Green Action Plan project underwent a process that weaved across three levels within the organization. The three levels are the strategy, operation and market levels.

Strategic Renewal. The working group's first challenge when implementing the Green Action Plan was to define the notion of *'green'* for the rest of the organization. As a business that had enjoyed great commercial success, the traditional focus of the organization was on financial performance and on generating shareholder value. While this has helped the organization in sustaining its impressive growth in terms of revenue and number of subscribers from 2007 to 2010 (see Table 25), the challenge for the working group was to nurture a new culture that incorporated sustainability considerations without diminishing the previous emphasis on profitability.

Table 25: Trend of Green Action Plan Project's KPIs from 2006 to 2010

KPIs	2007	2008	2009	2010
Economic Responsibility				
Number of subscribers (million)	369	457	522	584
Operating revenue (billion RMB)	357.5	411.8	452.1	485.2
Wireless connection rate (%)	99.20	99.20	99.22	99.26
Cumulative number of patent applications filed	-	1,806	2,733	3,580
Complaint rate per million customers (cases)	-	11.4 *	11.75	8.53
Cumulative number of customer complaints related to unhealthy content addressed (million)	0.71	7.63	15.00	21.84
Employees deployed for emergency response purposes (person-times)	124,792	1,379,260	204,754	354,822

Environmental Responsibility				
Energy use (GWh)	8,160	9,350	10,620	-
Annual reduction in electricity consumption per unit of telecommunications traffic (%)	-	15	13	14.8
Carbon dioxide emissions (million tonnes)	6.92	7.94	9.02	10.63
Number of base stations using alternative energy	-	2,135	6,372	7,795
Percentage of services conducted through e-channels (%)	-	43	48	44 **
Social Responsibility				
Cumulative number of mobile phones and accessories recycled (million pieces)	2.6	3.95	5.31	6.74
Cumulative number of administrative villages covered via the Village Connected project	39,784	41,843	43,714	45,514
Cumulative number of natural villages covered via the Village Connected project	5,367	19,904	34,122	43,570
Agricultural Information Service customers (million)	26.43	38.68	46.14	56.87
Number of Campus Information Service customers (million)	-	-	32.16	44.41
Total hours of employee volunteer activities (million hours)	-	0.63	0.79	1.22
Number of children orphaned by AIDS or living in extreme poverty sponsored	-	6,011	9,791	12,229
* the average value from the second quarter to the fourth quarter of the year 2008 ** Since 2010, this indicator is calculated based on all channels (e-channels, our proprietary sales outlets, and cooperative channels) instead of our own channels (e-				

channels and our proprietary sales outlets) used previously

To overcome this challenge, the working group began by developing and communicating the long-term vision towards sustainability across China Mobile (China-Mobile 2010a, pp 8). They developed initial environmental initiatives that overlapped with traditional profitability benefits such as corporate image enhancement, industrial chain growth, and social benefits through a variety of channels for internal communications (e.g. emails, newsletters, posters and presentations) and got it systematically enacted across all the business units of China Mobile. Over time, this led to the clarity and diffusion of the *'green'* intent of the top management to the various departments and subsidiaries (i.e. business units). It enabled the management of the business units to understand the association and mutually reinforcing nature of sustainability and profitability.

Once this notion and importance of being *'green*' was nurtured, the working group leveraged upon the distributed resources that resided in the business units to pilot *'big ticket'* energy conservation IT and non-IT innovations. These innovations, developed in close partnership with business units, industry peers, value chain partners, and customers, involved experimenting with novel applications of cutting-edge technologies that can reduce both energy consumption and operating costs significantly. Successful pilots were then actively shared across all business units, especially with the provincial subsidiaries so that they too can replicate the results in their locality. In addition, awareness programs such as the internal eco-contests, green case competitions and green campaigns that demonstrated the value of these innovations were frequently organized throughout the

year. These programs served to sustain the enthusiasm towards environmental initiatives and provide a platform where ideas and lessons can be readily shared.

To assure the continuity of the Green Action Plan, the working group established special Key Performance Indicators (KPIs) across the whole of China Mobile (See Table 25 for trends of green KPIs). These KPIs were decomposed into unit-specific KPIs that were made mandatory targets for the business units by the top management. These KPIs were tied to monetary incentives. To ensure the proper measurement of business unit performance in relation to the KPIs, a centralized performance management IT system was also developed. The system used an internationally accepted formula to compute a *'green performance score'* for each business unit. These scores were then subject to both internal and external audits. The transparency and visibility of data on the business units' performance in the performance management system created an environment of healthy competition among the business units which motivated its management towards the enactment of sustainability initiatives.

Operational Reconfiguration. With the instillation of the green KPIs, the respective management of the business units had to actualize the green KPIs while at the same time continue to fulfill its profitability KPIs at the operation level. This created a dilemma. Existing resources, capabilities and IT systems are well tuned to allow the business unit to meet its profitability KPIs, but may not be directly applicable to meet the new green KPIs. Given the limited resources available in the business unit, changes in resource allocation to fulfill green KPIs should not, as much as possible, hinder the fulfillment of its profitability KPIs. To address this dilemma, the business units in China Mobile initiated intense interactions with China Mobile's value chain partners and industry peers.

As a result, the business unit's management uncovered the potentials of IT-enabled eco-efficiency and eco-effectiveness innovations (Chen et al. 2008; Watson et al. 2010a) that can potentially be used to fulfill both the profitability and green KPIs.

Subsequently, the business units took these steps. First, they identified the IT-enabled eco-efficiency innovations within their operational context that can easily be extended to the fulfillment of the green KPIs. For example, IT-enabled eco-efficiency innovations that were focused on the automation of existing business processes were the first to be considered in this process as these innovations also helped to reduce the cost of operations or to increase profits. For instance, video-conferencing technology that can reduce the travelling needs of staff helps to cut down the business unit's operational expenses while at same time reduce the unit's carbon footprint. Second, business unit's management scouted across China Mobile and its partnership networks for IT-enabled eco-effectiveness innovations (e.g. IT-enabled renewal energy innovations) that have the potential to completely eliminate its unit's carbon footprint and substantially reduce its operating cost over time for its operations. This is because the business unit's management recognized that a pure focus on IT-enabled eco-efficiency innovations will not be sufficient to meet the mandated green KPIs and that there is a need to fundamentally change the way how their operations were being carried out that will benefit the unit in the long term. Third, business units proactively proposed large-scale IT-enabled innovations implementation, which could benefit all China Mobile's business units, to the central working group and collaborated with them for pilot implementation. In so doing, they systematically developed a vision on how to create a well-rounded basket of IT-enabled innovations that can contribute to the fulfillment of their

profitability and green KPIs consistently (see Table 26 for prominent examples of the IT-enabled innovations launched at the various business units in China Mobile).

Table 26: Selected Examples of IT-Enabled Innovations Launched at China Mobile

Innovation	Type	Description
Network based on IP protocol	Eco-efficiency	A world-leading green communications network based on IP technology was developed and institutionalized across the entire organization. The initiative created savings of a total building area of 50,500 square meters and 1.45 billion kWh of electricity (China-Mobile 2010b, pp 37)
Process Automation	Eco-efficiency	The scope of IT use in support of business processes across the entire organization was consciously expanded. Many new IS were launched including office automation systems, workflow management systems, and group support systems. This created savings for China Mobile by reducing or eliminating the need for printing or travelling.
Switching to renewable energy	Eco-effectiveness	Where possible, business units across China Mobile made the switch to renewable energy sources (e.g. wind, solar, hydropower, geothermal energy and fuel cell technology). These energy sources were integrated with their existing facilities through the use of IT, which played a crucial role in monitoring and controlling energy consumption. To illustrate, 7,795 of China Mobile's base stations were powered by renewable energy by 2010 (China-Mobile 2011b, pp 31).
Intelligent ventilation and heat transfer systems	Eco-Effectiveness	Natural means of ventilation and cooling (for equipment) were adopted at many business units across China Mobile. These means were controlled by IT-based intelligent ventilation and heat transfer systems. Through the adoption of these means, China Mobile was able to reduce the energy consumption for ventilation and cooling at their business units by 20-80% (China-Mobile 2009, pp 38).

As the vision was being developed, each business unit leveraged upon its existing IT capabilities to enable the identified portfolio of IT-enabled innovations that are necessary to fulfill both its profitability and green KPIs. As some IT-enabled innovations can be used to meet both KPIs, existing IT capabilities can be readily leveraged upon. This leverage of IT capabilities does not only happen within a business unit but also happen across business units in China Mobile. For example, piloted proof-of-concept implementations of IT-enabled innovations were readily shared and business unit's management leveraged upon the IT capabilities developed during the proof-of-concept to implement the IT-enabled innovations within its unit. This has helped to quickly spread the positive environmental impacts originated from these innovations across China Mobile. For new IT capabilities that required investment and development (e.g. the appropriate use and maintenance of IT-enabled renewal energy for base station), business units developed detailed plans to: (1) acquire these IT capabilities from its value chain partners; and/or (2) leverage upon IT resources from central working group or other business units to jointly develop these IT capabilities; and/or (3) redeploy its existing IT resources to develop that IT capabilities. By leveraging upon these developed IT capabilities across China Mobile and its value chain partners, business units were able to consistently meet their profitability and green KPIs since the inception of the Green Action Plan in 2007.

Market Redefinition. As China Mobile's successful environmental initiatives were widely publicized (see Table 24), a corporate image of environmental leadership began to take shape within China. As a result, many value partners and industry peers of China Mobile look upon them for directions in sustainable development. Leveraging its newly

established reputation, China Mobile began to work towards influencing its industry peers, value chain partners, and customers to collaborate on its environmental objectives. However, as relationships within its business networks were traditionally formed for economic exchanges, the relationships tended to be uncoordinated, loosely coupled and motivated by individual interests as the network entities lacked a common vision. As a result, China Mobile realized that in order to motivate the partners within its business network it had to establish a vision that balance the development of economic and ecological activities with its partners.

Drawing on its clout and the experience gleaned from implementing and coordinating environmental initiatives internally, China Mobile developed this vision progressively and iteratively by enacting two types of activities. First, China Mobile engaged its value chain partners in a number of high-profile collective environmental initiatives that have significant or potential high economic incentives. One prominent example is a joint venture with two value chain partners that led to the creation of a patented IT server resource virtualization technology. The technology has been tested to be able to reduce energy consumption by 42%, demand 40% less physical space, achieve cost savings of 15.9%, and an increase in IT infrastructure usage by more than twofold. Second, China Mobile took advantage of its centrality in the telecommunications value chain and established reputation for environmental leadership to exert normative pressures on value chain partners and industry peers to enact their own environmental initiatives. For example, they created an energy conservation rating standard (with ratings of A, B, and C) to label all China Mobile's equipment suppliers. Enforced through a central IT-based procurement system, they established the rule that for large equipment tenders, only

equipment rated at A or B for energy efficiency will be considered. This energy efficiency equipment rating is raised by 10-20% every two years. Over a period of enacting of these two activities, China Mobile was able to develop a balanced partnership development approach to co-opt its value chain partners towards its sustainability initiative. This is particularly evident in China Mobile's recent signing of a memorandum of understanding with 53 value chain partners to make them formal partners of China Mobile's Green Action Plan.

To establish itself as the leader in these partnerships, China Mobile established detailed programs that promote social sustainability. One prominent example is the Connected Village and Rural Information Services projects. These projects were aimed at resolving the problem of mobile signal coverage and promoting the adoption of information services in rural areas. Overall, besides contributing towards reducing the negative environmental impacts of the traditional modes of communications (i.e. mainly paper-based) that were prevalent in these areas, the projects also served to create awareness of environmental issues among the rural populace as well. To encourage more value chain partners to partner with China Mobile, China Mobile openly co-created some of its IT-enabled eco-efficiency and eco-effectiveness innovations with its customers to help them reduce costs, increase productivity, and engage in sustainability development. This act of value co-creation by China Mobile created the publicity needed to attract more value chain partners to participate in China Mobile's Green Action Plan. One prominent example is an Integrated Logistics Information Service Platform (ILISP) that was co-created with the Henan Provincial Government. The ILISP was an IT system that provided real-time precision tracking of the delivery of products using China Mobile's

technologies. This served to significantly reduce communications and transportation costs, as well as the negative environmental impacts associated with logistics activities. To date, a total of 16,218 logistics firms in the Henan province had signed up for this service (China-Mobile 2009, pp 44). Through these partnerships, China Mobile was able to identify and develop new IT-enabled eco-efficiency and/or IT-enabled eco-effectiveness innovations that are beneficial in reducing the carbon footprints in the society. The various interactions and engagements with industry peers, value chain partners, and customers enhanced China Mobile's experiences and exposures towards the effective use of IT-enabled innovations in addressing sustainability issues which in turn helped China Mobile identified new strategies towards sustainability to be enacted internally.

In contrast with China Mobile's competitors, China Mobile has won several awards in its implementation of its green IS initiative. Some of these awards include "China Top Ten Businesses in Energy Conservation" awarded by China Energy Conservation Association, "Well-performed Enterprises in Energy Conservation and Emission Reduction" awarded by All-China Environment Federation, and "Worldstar Sustainable Packaging Award" awarded by World Packaging Organization (China-Mobile 2010a). China Mobile's success story in implementing its green IS initiative has also been chosen by the SASAC (the State-owned Assets Supervision and Administration Commission of the State Council) as "Excellent Practice in Social Responsibility of Central State-Owned Enterprises" and is the first enterprise that has signed the "Voluntary Compliance Agreement on Energy Conservation" with the China's Ministry of Industry and Information in 2009 (China-Mobile 2010a). This demonstrated China Mobile's

leadership in the area of sustainability endeavor in constrast to its competitors. While China Mobile has achieved some measure of success in its environmental initiatives to date, a number of challenges remain. In particular, with the increased turbulence and competitiveness of the contemporary business landscape (Hargrave et al. 2006), China Mobile has to find ways of enhancing economic sustainability without compromising environmental and social sustainability if its environmental efforts are to be sustained. Moreover, to bring about even greater successes, China Mobile will likely have to invest more on developing costlier IT-enabled eco-effectiveness innovations that may affect its financial performance. To overcome these challenges will require conviction and unwavering commitment. Jianzhou Wang, Chairman of China Mobile, explained:

"The Group's development faces new challenges amid the already high mobile penetration rate and the intensifying competition in China's telecommunications market. Meanwhile, the convergence of telecommunications, Internet and TV networks, and the innovation of business models brought about by technological advancement also brought changes to the Group's future development environment … Our commitment is unwavering – we will create value for shareholders by building a prosperous and sustainable business."

4.5 Discussion

China Mobile's Green Action Plan was targeted at objectives that were closely related to the sustainability '*triple bottom line*'. From the case data, we noted that one of the key preconditions of being able to lead its industry peers, value chain partners, and customers towards collective Green IS initiatives effectively is the establishment of *'green'* credentials. This observation is consistent with the findings in several studies in the

extant literature of sustainability (e.g. Hart 1995; Hart et al. 2003). Consequently, China Mobile opted to focus on the internal development of environmental initiatives first and this approach is also known as '*inside-out linkages*' (Porter et al. 2007). To this end, China Mobile had to first establish a coherent internal green vision (e.g. clarifying the concept of *'green'*) at strategic level and a set of measurable green KPIs. With these elements in place, China Mobile's management was then able to incorporate environmental values in its organizational mindset to induce a cultural change (Lubin et al. 2010; Starkey et al. 2003). Next, at the operational level, China Mobile developed IT-enabled eco-efficiency and eco-effectiveness innovations for the purpose of fulfilling the green KPIs. Through constant experimentation to create the right mix of IT-enabled innovations, China Mobile was able to develop consistently ways to fulfill its green KPIs and project the image of being an environmental leader. By leveraging this corporate image, as well as its centrality and clout within the telecommunications value chain, China Mobile was able to canvass its industry peers, value chain partners, and customers to support its environmental cause at market level. The strong partnership redefined the market and heightened China Mobile's understanding of its own and the market's sustainability needs. This creates a virtuous cycle that would feed into subsequent iterations of strategic renewal, operational reconfiguration, and market redefinition (Porter et al. 2006; Porter et al. 2007). This is also known as the '*outside-in linkages*' during the implementation of a sustainability imitative (Porter et al. 2006).

Our case data revealed that China Mobile was confronted with distinct forms of tensions at three levels (i.e. strategic, operational, and market) in the implementation of its Green IS initiative. At the strategic level, the tension was manifested in the organizational

mindset as its traditional focus on profitability was confronted by the new consideration of sustainability. At the operational level, the tension laid in the means of achieving its green KPIs. In particular, the dilemma stemmed from the potential trade-offs between efficiency (doing less of the wrong thing) and effectiveness (doing the right thing). At the market level, the tension stemmed from the distinct approaches to managing external partnerships namely, managing economic connections to partners versus managing ecological systems of partners. Applying the BAO framework as our theoretical lens, we argue that an organization can defuse these tensions through the development of IT-enabled balancing capabilities at the identified levels within an organization. These balancing capabilities are fundamental in nurturing the development of a new sustainability belief and are defined as capabilities that allow an organization to balance the paradoxical long-term and short-term goals of fulfilling the sustainability '*triple bottom line*'. Through these capabilities, an organization establishes clarity in its sustainability belief for the subsequent enactment of environmental initiatives by both internal and external stakeholders.

As clarity in sustainability belief is established, effective actions towards sustainability at each level must follow. However, the enactment of environmental actions within a firm will likely be confronted with obstacles that stem from the natural inclination to resist change (Melville 2010) especially in the initial phase of implementation. This is because there is little motivation for stakeholders to change when the existing ways of doing things have already proven to be successful. Such a situation may lead to a withdrawal of resources. To mitigate the risk, the focal organization must develop the mechanisms for leveraging the requisite resources quickly so that an initial momentum for the new

initiative can be created and maintained. This is consistent with a study in the extant sustainable literature that advocates that firm must be proactive in driving environmental initiative to create fundamental changes in the way people work towards sustainable development (Michalisin et al. 2010). Therefore, we advocate that the firm will need to develop a form of capabilities that we term *'resource-leveraging capabilities'* (Hagel III 2002; Pavlou et al. 2006). Resource-leveraging capabilities are defined as capabilities that enable an organization to assemble and mobilize internal and/or external resources quickly to amplify and sustain the impacts of its environmental efforts for the attainment of the '*triple bottom line*'. We posit that these resource leveraging capabilities are crucial to effective action formation following the manifestation of a clear organization's sustainability belief (Melville 2010).

Strategic Renewal through Nurturing a Green Culture. To defuse the tension between sustainability and profitability at the strategic level, narratives were used. This is in line with prior research on narratives, which suggests that the use of narratives can facilitate strategic renewal (Sonenshein 2010), the creation of organizational innovations (Bartel et al. 2009), and the formation of new relationships between a business organization and the natural environment (Starkey et al. 2003). Narratives is about *'meaning making'* where versions of events are constructed as *'sensemaking'* currency in the interpretation and communication of meaning (Starkey et al. 2003). In particular, two types of narratives featured prominently in the case of China Mobile. The first is progressive narratives that link experiences or events in a way that is inclined towards *'good'* evaluative dimension (Sonenshein 2010). The second is regressive narratives that link experiences in a way that is inclined towards the *'bad'* evaluative dimension (Sonenshein 2010). In our research

context, we define two new kinds of narratives: sustainability and profitability narratives. Sustainability narratives are progressive and regressive narratives surrounding the experience and implications of engaging in environmental initiatives. These narratives communicate that sustainability activities is all about building the foundation for long-term success and its potential drawbacks (Dylick et al. 2002). Profitability narratives are progressive and regressive narratives surrounding the experience and implications of engaging in profit-seeking activities. These narratives communicate that profit-seeking activities are essential for the short-term gain (e.g. in quarterly reporting) and its potential weaknesses (Dylick et al. 2002). Our case data revealed that the top management and the Green Action Plan working group of China Mobile adopted a balanced narrative approach between these two narratives to successfully induce the formation of an environment-oriented culture. Maintaining the balance between sustainability (long-term) and profitability (short-term) narratives requires a specific organizational capability. This capability is a balancing capability that facilitates the development of a coherent green vision during the process of strategic renewal. This capability is developed over time from the experiences of enacting a balanced approach in the use of narratives to concentrate the organization's culture towards the identified green vision. We called this belief formation capability as **sustainability acculturation**.

As the culture was being developed, the top management and working group leveraged upon it to channel and align all its organization's internal resources towards the fulfillment of its green vision. The newly formed green culture legitimized the sustainability mandates issued by the top management and working group to its business units. It re-enforced and accelerated the process of aligning all China Mobile's

employee's actions towards the green vision. Over time, the capability to leverage upon its organizational culture to mobilize and argument existing resources for effective action formation towards sustainability is developed. This is a form of resource-leveraging capability which we term it as **augmentative culture leverage**. Based on our case data, we contend that this capability is developed through socialization (e.g. green campaigns) and the implementation of an incentive system (e.g. green performance measurement system). This is in line with findings from prior studies that suggest that these two mechanisms are the key managerial tools for the leverage of organizational culture (e.g. Chatman et al. 2003). The sustainability acculturation and augmentative culture leverage combine to produce the outcome of an effective strategic renewal process towards the fulfillment of China Mobile's green vision.

Our case data has identified an IT system (the centralized performance management IT system) that played a critical role in the enabling, catalyzing, and developing the balancing and resource-leveraging capabilities at strategic level. By facilitating the accumulation and dissemination of the performance data of its various business units, the system enhances transparency and influences the beliefs and actions of the involved stakeholders. For example, when a business unit was identified as poor in meeting its green KPIs, the performance data in the system induced their proactive actions to learn from the leading business unit. This created a culture of healthy competition and active sharing of best practices of sustainability among business units towards the fulfillment of the collective green vision. Consequently, the balancing and resource-leveraging capabilities of all business units were enhanced through this process. As such, we posit that the primary role of IT at strategic level is informate (See Table 19). This is in line

with a study in the IS sustainability literature which advocates that the appropriate combination of information provided through IT system and business activities can induce the formation of energy reducing behavioral changes and accelerate the development of effective actions towards sustainability (Watson et al. 2010a; Watson et al. 2010b).

Table 27: Relevant Observations and Constructs at Strategic Level

Challenges		
Empirical Observations		**Theoretical Observations**
*"Top management has a series of KPIs for us … **if we are to do energy conservation, we will gain some benefits.** No doubt, it will make us look good. **But if this (push for energy conservation) should cause an incident (operation abnormality) and get reported to management, we will need to take into consideration the impact of this report to us** … for example, an incident may cause us to **lose 1 point in our KPI and enacting Green Action Plan may give us 0.5, we will definitely be more inclined to focus on operational safety**." – Head of Beijing Working Group, Planning & Construction Department, China Mobile Group Beijing Co. Ltd.*		Tension between sustainability and profitability
Processes		
Empirical Observations	**Theoretical Observations**	**Theoretical Constructs**
*"**Headquarters will emphasize the Green Action Plan's objectives (reporting) in some of our work progress reports and in our work plan**… every level of the **organization will start to play serious attention to it** and correspondingly create appropriate project team or structure (in response to this headquarters emphasis)" – Project Manager, Sales Plan Section, Group Customer Department, China Mobile Communications Corporation*	Communicating sustainability narratives	Sustainability Acculturation (a form of Belief formation capabilities)
*"2007, I remembered that our company started a **'Network Slimming Program'** … it is like slimming down but applied onto our network infrastructure. **We***	Communicating profitability	

extracted the essence and removed the 'fats' in equipment, retaining only the design that is essential to meet the needs of our business and customer*." – Working group Member A, Working Group of Green Action Plan, Department of Planning, China Mobile Communications Corporation*	narratives	
*"**Even through the 11th 5-year plan mentioned about energy conservation being the top priority strategy for the Nation (China), it is only in 2006 or 2007 before we (China Mobile) began to drive this (Green Action Plan)** ... At that time, the pressures externally asserted from the Country (Government) ... and internally from headquarters **strategy to reduce wastage in the use of resources (under the Network Slimming Program) had forced us to take the perspective of saving cost and increase productivity … to drive this strategy (Green Action Plan) into realization**" – Working group Member A, Working Group of Green Action Plan, Department of Planning, China Mobile Communications Corporation*	Balancing profitability and sustainability narratives	
*"Now it is much smoother (refers to the Green Action Plan). In the first year, we (Green Action Plan Working Group) did a lot of things ... but everyone (in China Mobile) isn't that excited ... they have other more important things to do ... now **after we have gotten results (on Green Action Plan) for our efforts and its impacts are more visible, everyone began to realize it and under all these influences, people are all starting to act (on Green Action Plan). The culture (Green culture) has become better.**" – Working group Member A, Working Group of Green Action Plan, Department of Planning, China Mobile Communications Corporation*	Leveraging on culture to meet Green vision	Augmentative culture leverage (a form of Action formation capabilities)
*"We **took those better case studies (on Green Projects), behaviors (on enacting Green activities) or related stuff and make a video for all to see**. We will also link up with the union activities to **organize a gathering (on Green sharing) for people to discuss and critique each other's work (on Green Projects)**. If there is something good that come out of this, in the subsequent year, we will **bring this up to the company's Nation-wide campaign of experiences (on**	Building Green culture through socialization mechanisms	

Green implementation) sharing *…" – Project Manager, Sales Plan Section, Group Customer Department, China Mobile Communications Corporation*		
"In the beginning of the year, I (top management) give you (provincial subsidiary) a fix spending budget … then out of this amount ***80% will be for the normal day to day work and will not be removed from your budget. But the remaining 20% is based on your (provincial subsidiary) overall KPIs performance, some of these KPIs are linked to the Green Action Plan's objectives****." – Working group Member B, Working Group of Green Action Plan, Department of Planning, China Mobile Communications Corporation*	Building Green culture through the use of reward system	
The Role of IT		
Empirical Observations		**Theoretical Observations**
"In order to fulfill these KPIs (Green) and responsibilities (Green), we actively reconfigured our resources to pre-empt problems. ***It follows a series of actions to perform planning, to collate data, and to analyze data so as to input it into the KPI (Green) performance management (IT) system for the whole company****." – Working group Member A, Working Group of Green Action Plan, Department of Planning, China Mobile Communications Corporation*		Dominant role of IT at strategic level is informate

Operational Reconfiguration through IT Capabilities. At the operational level, the case data revealed that the management of China Mobile's business units realized that IT would be a crucial enabler of its Green IS initiatives (Elliot 2011; Melville 2010; Watson et al. 2010a). Yet, the use of IT-enabled innovations raised the dilemma of the potential trade-offs between efficiency and effectiveness. IT-enabled eco-efficiency innovations tend to have shorter-term effects on the environment (Dylick et al. 2002) and are focused on *"making the wrong things less bad"* (McDonough et al. 2002). On the other hand, IT-

enabled eco-effectiveness innovations tend to have longer-term effects on the environment and are focused on *"working on the right things"* (McDonough et al. 2002). However, the choice between the two forms of IT-enabled innovations during the initial phase is not so straightforward. Business units had to understand how to strike a balance between the two forms of IT-enabled innovations so as to meet the ambitious green KPIs without compromising its profitability KPIs consistently. This was a particularly important consideration at China Mobile as many of its business units have stringent operational requirements (e.g. safety and industry regulations) that will impact its organizational performance. Any failure to meet these requirements in pursuit of environmental objectives will hinder the subsequent sustainability development in China Mobile. This need to balance economic and environmental sustainability considerations is consistent with several studies in the extant sustainability literature (e.g. Adams 2006; Elliot 2011) and it is highly salient in our case data. For example, our data showed that the business units knew that an exclusive focus on IT-enabled eco-efficiency innovations may help fulfill part of their green KPIs, but it is insufficient. This motivated the business units to explore IT-enabled eco-effectiveness innovations which potentially will increase their research and switchover cost in operations and risks of failure. Creating a portfolio with the right mix of IT-enabled eco-effectiveness and eco-efficiency innovations within the business units is, therefore, imperative and demands another form of balancing capabilities. Our case data revealed that this capability is developed through continuous experimentation to establish a balanced IT-enabled innovations portfolio that can maximize the potential environmental impacts of these innovations towards the fulfillment of the green KPIs. We term this capability as **IT magnification**.

As the vision on creating a balanced portfolio of IT-enabled innovations was developed, the business units needed a different form of resource-leveraging capabilities to quickly amplify the IT-enabled innovations' impacts on the environment in order to sustain the sustainability movements at operation level. In this regard, the business units leveraged upon IT capabilities across China Mobile and its value chain partners to achieve this. This form of capability is developed through the acquisition, deployment, and leverage of IT resources, which include IT business partnerships, external IT linkages, business IT strategic thinking, IT business process integration, IT management, and IT infrastructure, to shape and support business strategies and value chain activities in China Mobile and this way of developing IT capabilities is consistent with several studies in extant IT capabilities literature (e.g. Bharadwaj et al. 1999; Pavlou et al. 2006). We term this capability as **accretive IT leverage**. Together the IT magnification and accretive IT leverage helped to provide the outcome of an effective operational reconfiguration process in China Mobile towards the fulfillment of the green KPIs.

Our data showed that IT at the operational level was used mainly for the automation of business processes (e.g. implementation of e-services) and the standardization of technologies (e.g. the adoption of IP technology in its network) in order to meet the mandated green KPIs (See Table 26 for examples). The constant emphasis on automation and standardization of IT towards the fulfillment of the green KPIs enhanced the balancing capabilities of the business units and extended the available IT capabilities that can be leveraged upon for future sustainability endeavors. By automating and standardizing proven sustainability's IT-enabled innovations across the organization, sustainability's behavioral changes are proliferated through the adoption of these

innovations and it's positive environmental impacts rapidly amplified. This way of inducing sustainability behavioral changes is consistent with a study in the extant IS sustainability literature (e.g. Watson et al. 2010b). Therefore, we posit that the dominant role of IT at the operational level are automate and standardize.

Table 28: Relevant Observations and Constructs at Operational Level

Challenges

Empirical Observations	**Theoretical Observations**
*"We **created a table of content for energy efficiency technologies (which include IT-enabled eco-efficiency and eco-effectiveness innovations and its potential positive environmental impacts). After which we let each business unit takes its pick.** If you think this is suitable for you (business unit), you will push for adoption. On the other hand, **once you have decided on the technology, you must implement it. After implementation, you will be audited.**" – Working group Member B, Working Group of Green Action Plan, Department of Planning, China Mobile Communications Corporation*	Tension between IT-enabled eco-efficiency and eco-effectiveness innovations

Processes

Empirical Observations	**Theoretical Observations**	**Theoretical Constructs**
*"In the past, when we need to have a meeting in Beijing with 31 provincial subsidiaries, **each subsidiary at least need to send 1 to 2 persons down by planes or other kind of transportations, we often chose to use video conferencing technologies (a type of IT-enabled eco-efficiency innovation) to hold such meetings now** … to us our productivity has increased significantly." – Project Manager, Division of Service and Supporting Network Planning, Department of Planning, China Mobile Communications Corporation*	Extracting positive environment impacts from IT-enabled innovations	IT magnification (a form of Belief formation capabilities)

*"**Natural free cooling (a type of IT-enabled eco-effectiveness innovation) is used in our base station** … **this intelligent ventilation system (the system that is joint developed with value chain partners) acts like a fan …** when the temperature outside falls, we turn off the air-conditioning turn on the fan to bring in the cold air (from outside) and eject the warm air (inside the base station)." – Working group Member B, Working Group of Green Action Plan, Department of Planning, China Mobile Communications Corporation*	Borrowing internal & external resources to maximize positive environment impacts from IT-enabled innovations	
*"Basically **we took … these technologies (IT-enabled eco-efficiency and eco-effectiveness innovations) and perform a review … figure out which are those (IT-enabled eco-efficiency and eco-effectiveness innovations) that we feel are really suitable for us (business unit)**. Then **we divide these technologies into categories …** those that are suitable to be shared with others (in the business unit)… those (IT-enabled eco-efficiency and eco-effectiveness innovations) we think are unsuitable … and those (IT-enabled eco-efficiency and/or eco-effectiveness innovations) that we think we should keep in view for the future…" - Head of Beijing Working Group, Planning & Construction Department, China Mobile Group Beijing Co. Ltd.*	Balancing the use of IT-enabled eco-efficiency and eco-effectiveness innovations	
*"We have **an e-learning platform** which provides many courses in different categories: technical, management, and social … everyone (in China Mobile) can login to learn … **this platform is also green because we don't need to have a room and get everyone into it to train people.**" – Project Manager, Division of Service and Supporting Network Planning, Department of Planning, China*	Leveraging on IT capabilities to meet Green KPIs	Accretive IT leverage (a form of Action formation capabilities)

Mobile Communications Corporation		
*"Our unit has **a system monitoring system that will check on the activities of our individual PC**. For example, if the system found that your PC is idling, it will **send you an SMS to advise you to switch it off**." - Project Manager, Division of Service and Supporting Network Planning, Department of Planning, China Mobile Communications Corporation*	Building IT capabilities by acquiring, leveraging, and deploying IT resources	

The Role of IT	
Empirical Observations	**Theoretical Observations**
*"Between late 2009 and 2010, we basically looked at all our processes and technologies and reviewed them. We had **observed the ones that best suited us (business unit's needs in sustainability), made a selection on the technologies we wanted and standardized them across our unit… our leader called this standardization process**." – Head of Beijing Working Group, Planning & Construction Department, China Mobile Group Beijing Co. Ltd.*	Dominant role of IT at operational level is standardize
*"Our call centre service staff can stay at home to take phone call. The process begins by dialing 10086, as we have **a call routing IT system (an IT-enabled innovation), it will check if you (a call centre service staff) are available and also if you have this system installed at home before it routes it to your home number**." - Project Manager, Division of Service and Supporting Network Planning, Department of Planning, China Mobile Communications Corporation*	Dominant role of IT at operational level is automate

Market Redefinition through the Formation of a Green Ecosystem. As China Mobile's environmental initiatives gained local and international recognition, a corporate image for being an environmental leader is established. This is consistent with several studies in the

extant sustainability literature that posit that an organization needs to establish social legitimacy in its value chain so as to gain the rights to mobilize other firms towards sustainable development (e.g. Hart 1995; Hart et al. 2003; Michalisin et al. 2010). Leveraging its *'green'* credentials and its centrality and clout within the telecommunications value chain, China Mobile began to push for the formation of partnerships with its industry peers, value chain partners, and customers (e.g. the signing of memorandum of understanding with 53 value chain partners to enact its Green Action Plan project) at the market level. This was, in effect, the deliberate creation of a business ecosystem, that is defined as an ecosystem of organizational entities engaged in collaborative environmental initiatives, for the purpose of social sustainability (i.e. one of the dimensions of the '*triple bottom line*'). However, to foster the formation and growth of the business ecosystem, China Mobile had to balance the different needs of its industry peers, value chain partners, and customers (Tan et al. 2009). This is consistent with several studies in the business ecosystem literature which advocates that a firm that wants to assume the role of a keystone (i.e. centre of an business ecosystem) needs to provide benefits to the rest of the ecosystem (Iansiti et al. 2004a; Iansiti et al. 2004b). On one hand, China Mobile had to establish a shared vision for environmental sustainability that would align the motivation and secure the commitment of its network partners. We term this consideration ecological sustainability development which aims to develop key resources that an organization can rely on to ensure long-term viability (Hart 1995). On the other hand, China Mobile had to consider the economic implications of the collective environmental initiatives, which may create additional costs for their network partners. We term this consideration economic sustainability development and some researchers

have suggested that a single-minded focus on economic sustainability development can only lead to short-term success (e.g. Chen et al. 2008). The capability to constantly balance and account for the ecological and economic sustainability development needs of its network partners is another balancing capability that allowed China Mobile to induce the formation of environmental beliefs among ecosystem entities that ensures their commitment to sustainability. We term this capability as **partnership molding**.

While this balancing capability created a shared vision among China Mobile's partners, it is insufficient in itself for the creation of a *'green ecosystem'* (Iansiti et al. 2004a). A business ecosystem requires the formalization of the relationships between ecosystem entities which serves as a platform to attract more adherents (Iansiti et al. 2004a). At China Mobile, its efforts to nurture a green ecosystem were manifested in the way it engages its network partners in the co-ownership of environmental initiatives (e.g. joint ventures in research and development for an environmentally friendly packaging telecommunications and IT equipment). This is another form of resource-leveraging capabilities which we term it as **proliferative partnership leverage**. By engaging its network partners in collaborative environmental initiatives, China Mobile was able to achieve three important benefits. First, it was able to entrench itself the centre of the ecosystem, and thus wield considerable power within its industry. Second, these collaborative initiatives served as the *'glue'* that strengthened the relationships between China Mobile and its network partners. Third, the critical mass of the ecosystem and the publicity that is attached to large-scale collaborative environmental initiatives served to increase ecosystem membership. It is through the collaborative environmental initiatives that a healthy green ecosystem is created and sustained. Prior works in the area of

business ecosystems support our arguments here. For instance, in a study of ecosystem development, researchers have found that activities that entrench the core firm at the centre of the ecosystem and encourage participation was crucial to the growth and sustenance of the ecosystem (e.g. Tan et al. 2009). The two capabilities namely, partnership molding and proliferative partnership leverage combined to drive an outcome of an effective market redefinition that leads to the formation of a healthy green ecosystem.

At the market level, the dominant role of IT is to encourage ecosystem membership and participation. For this to happen, we suggest that the use of IT must be targeted at supporting collaboration that is consistent with a study in the IS business ecosystem literature (Tan et al. 2009). From the case data, China Mobile and its stakeholders implemented many collaborative environmental initiatives that were underpinned by IT (e.g. City-level energy consumption monitoring system with the Beijing City Council). Moreover, these collaborative environmental initiatives had the tendency to induce fundamental changes in the participants' business processes (e.g. the energy conservation rating standard that forces China Mobile's suppliers to meet its environmental standards). The constant engagement with participants in its green ecosystem through IT projects allows new belief about effective sustainable development to form which fuels new ideas to enhance China Mobile's internal and external sustainability efforts. By leveraging upon its partnerships in the green ecosystem, innovative and effective sustainability IT projects, which benefit the society and entitles of the green ecosystem, were rapidly implemented. The success of these IT projects attracted more companies to join the green ecosystem which in turns enhanced and accelerated the process of new belief and

effective action formation towards sustainability at market level. Based on these observations, we propose that the dominant role of IT at the market level is transform.

Table 29: Relevant Observations and Constructs at Market Level

Challenges		
Empirical Observations		**Theoretical Observations**
*"Definitely **the weaker partners** (that produce telecommunication equipment for China Mobile) **will resist** (because of the China Mobile's policy to tag an energy conservation rating on all telecommunication products), **the more advanced partners** (that produce telecommunication equipment for China Mobile) **will definitely not stop us** (from implementing this policy)… they (weaker partners) will say this is unfair to us, we can't meet your specification (on high energy efficiency)." – Working group Member A, Working Group of Green Action Plan, Department of Planning, China Mobile Communications Corporation*		Tension between ecological sustainability and economic sustainability development focus for business partners
Processes		
Empirical Observations	**Theoretical Observations**	**Theoretical Constructs**
*"**This project (a joint venture Green project) is done by three companies. We are one of them, infrastructure supplier (value chain partner) is another and software development house (value chain partner) is another**. We come up with the idea, software development house implements it, then we construct it (with the help from the infrastructure company) for testing … **our common goal is to get a patent out of this technology … a joint patent (which potentially can generate new revenue streams) has since been submitted.**" – Head of Beijing Working Group, Planning & Construction Department,*	Enacting economic sustainability development activities with business partners	Partnership molding (a form of Belief formation capabilities)

China Mobile Group Beijing Co. Ltd.		
"In the earliest period, it is a reactive and acceptance process. That is whatever the partners sold to us we will just use it. ***We (China Mobile) feel that we need to tell the suppliers what we want, then push them to be involved in our product design phase. We think this will change the reactive to proactive approach to influence our supplier's product design (towards sustainability)."*** *– Working group Member B, Working Group of Green Action Plan, Department of Planning, China Mobile Communications Corporation*	Enacting ecological sustainability development activities with business partners	
*"****We (China Mobile) are balanced (in approach), because it is impossible for us to be too pushy****. If we insisted that everything needs to be of the highest possible standard (on energy conversation), maybe only one supplier at the end will completely dominate, and this may not be the best solution for us. That is why we have divided into A, B and C level (on the energy conversation level of supplier's equipment).* ***Most suppliers are placed in the middle, 'A' only restricted to a few*** *…* ***we conduct a review*** *(on this suppliers' categorization process)* ***every two years. After two years … we deliberately increase the standard (on energy conversation) by 10 to 20%****" – Working group Member A, Working Group of Green Action Plan, Department of Planning, China Mobile Communications Corporation*	Balancing the enactment of economic and ecological sustainability development with business partners	
*"****China Mobile develops a Night Lighting IT management system (with suppliers) for Beijing City Government (customer)****. Through wireless network, you can control the street lights and*	Leveraging on business partnerships to create Green	Proliferative partnership leverage (a form of Action formation capabilities)

building's lights and etc. … in Beijing there are around 200,000 street lights that can automatically detect if it is faulty and report it via this system. ***We installed a circuit board in the light (through our suppliers) that can monitor the electricity flow and pressure,*** *if it is unstable or too low, it will automatically send a message (via the wireless network) to a backend system.* ***The backend system will know the exact location of this circuit board and then dispatch the ground crew (of Beijing City Government) to get it fixed*** *… you can also control the lights remotely via the system including lightings within a building, floor by floor." – Project Manager, Group Business Experience Hall, Group Customer Department, China Mobile Group Beijing Co. Ltd.*	business ecosystem	
*"****Basically every two weeks we will meet up with the suppliers once.*** *Communication frequency (among China Mobile, value chain partners and industry peers) is very high.* ***They (value chain partners & industry peers) will give us (China Mobile) a lot of attention, sometime even more proactive than us (China Mobile)****. For example, company like Hua Wei (a world-leading telecom solution provider), at the time* ***when they realized we started our Green Action Plan, they (Hua Wei – partner) immediately started their own Green Action Department*** *… that governs (on energy conservation and CO_2 emission control) across all their other departments" – Working group Member B, Working Group of Green Action Plan, Department of Planning, China Mobile Communications Corporation*	Building Green business ecosystem by establishing centrality through brand development	

"The value chain partners would request from you (China Mobile) to allow them to work on the entire building (in China Mobile). They (partners) in turn will guarantee you a reduction of 20% (energy conservation). Equipment cost is paid by them (partners) and they have also paid for the whole construction process. Hence, we (China Mobile) don't have to pay a single cent. ***Their investment in research on our infrastructure, installation and maintenance, are all borne by them (partners)****.They (partners) guarantee that it will save a certain amount of energy, meeting our common goal (between China Mobile and value chain partners) which is to drive energy conservation.* ***Under the precondition of safety, conserve energy … the money we saved (from the reduction of energy bill) will be split equally****." – Working group Member A, Working Group of Green Action Plan, Department of Planning, China Mobile Communications Corporation*	Building Green business ecosystem by enacting in value co-creation activities with business partners	
The Role of IT		
Empirical Observations		**Theoretical Observations**
*"****Our energy consumption monitoring system*** *(a joint green project between China Mobile and China Academy of Building Research for the China Ministry of Construction)* ***can plot a map with various rating. Through this map, you can see every province's energy consumption, just like weather report****. We use color to categorize the different amount in energy consumption, for instance green for those who are lesser in consumption. You can then click to zoom in one at a time … one click to Hebei province, then next click down to Tang Shan City, then next click down to all the buildings …" - Chief Engineer, China Academy of Building Research, Beijing Large Scale Public Building Energy-saving Project, Software Research Institute*		Dominant role of IT at market level is transform

The Final Outcome. Drawing from the BAO framework, we posit that both balancing capabilities and resource-leveraging capabilities are required for the effective implementation of a Green IS initiative. The balancing capabilities would allow the organization to instill a vision for sustainability development, while the resource-leveraging capabilities are required to elicit actions that are necessary for the attainment of the sustainability '*triple bottom line*'. These capabilities, in turn, are developed and enhanced through a cyclical process of belief formation, action formation, and learning from outcomes. We posit that this is a form of IT-enabled enterprise agility called **Green Agility**. We define Green Agility as a set of IT-enabled balancing capabilities that allow organization to instill a vision based on the changes in the environment, to guide its response and a set of IT-enabled leveraging capabilities, to respond efficiently and effectively in a timely and cost-effective way, in fulfilling the sustainability's triple bottom lines. Through constant interactions with its network partners and enacting a number of internal and collaborative environmental initiatives, China Mobile was able to accumulate knowledge on sustainability best practices across many of its business activities. In this way, a virtuous sustainability cycle is created since the knowledge that originated from the market results in the formation of new environmental strategies (at the strategic level), that were subsequently enacted (at the operational level) to launch internal and collective environmental initiatives (Porter et al. 2006; Porter et al. 2007). Successful environmental initiatives would further reinforce the corporate image of China Mobile, which provided the organization with the credibility to initiate and sustain the development of a healthy green ecosystem. This, in turn, would induce changes in the

external forces in the competitive environment (at the market level). A member of the Green Action Plan working group of China Mobile explained:

"For our upstream suppliers, our push on their production, design and research (towards energy efficiency) reduces their supply chain energy consumptions ... The signing of memorandum with value chain partners (to solicit their commitments on Green Action Plan) is also the results of our influence on them"

Figure 6 illustrates the summary of our discussion section.

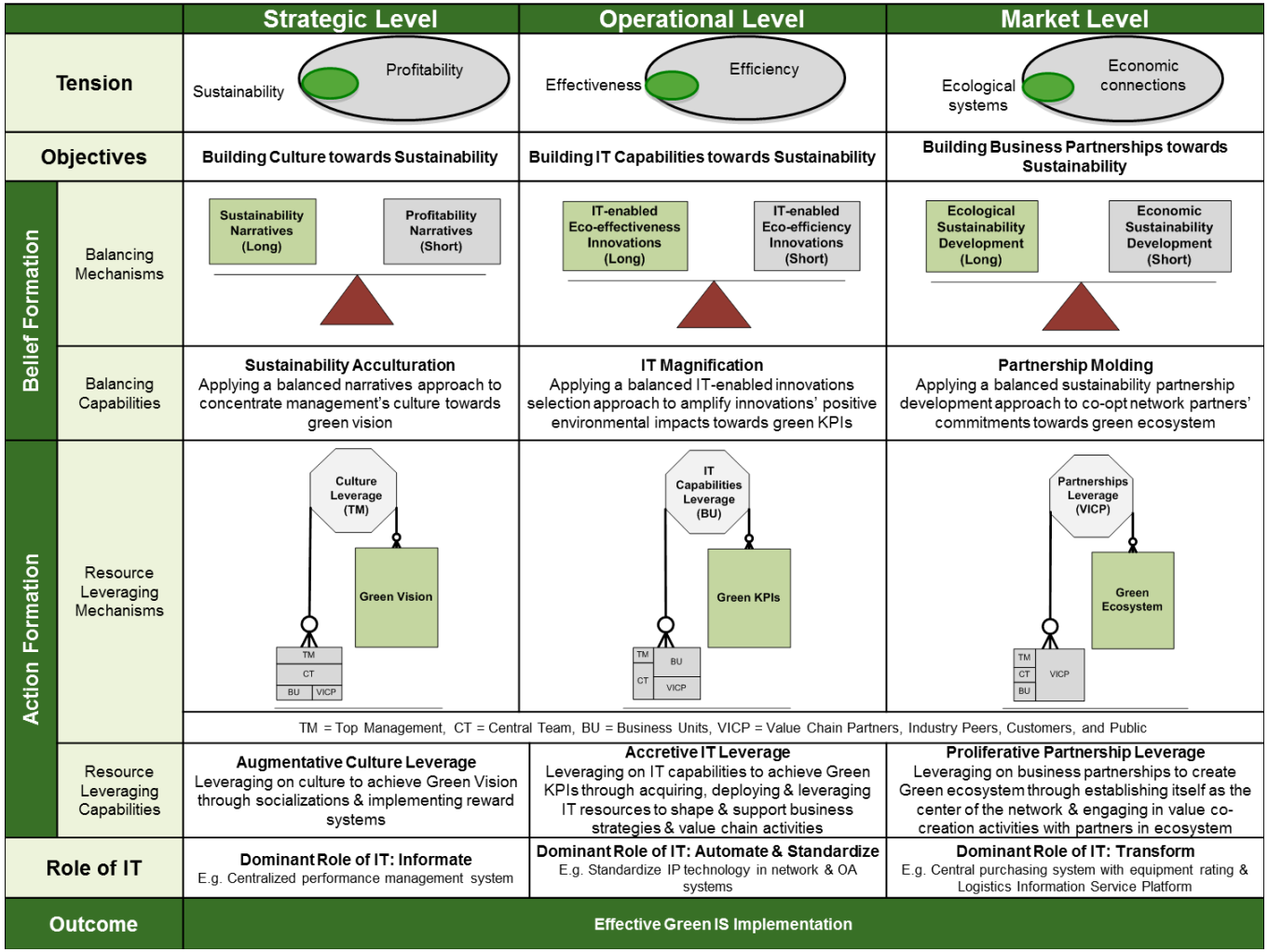

Figure 6: Summary of Discussion

4.6 Conclusion

Our research question was "*How to implement an effective Green IS initiative through the development of IT-enabled capabilities?".* Based on the case of China Mobile, we argue that an organization can implement an effective Green IS initiative through the development of two capabilities namely, balancing and resource-leveraging capabilities at three distinct levels (strategic, operational and market levels) within an organization. We propose three forms of balancing and resource-leveraging capabilities that correspond to the strategic, operational, and market levels during an effective Green IS implementation with support from our case data and literature. Figure 7 presents a process model that describes how the development of these capabilities (that are enabled by IT) enables an organization to attain the sustainability '*triple bottom line*' and help to develop a healthy green ecosystem.

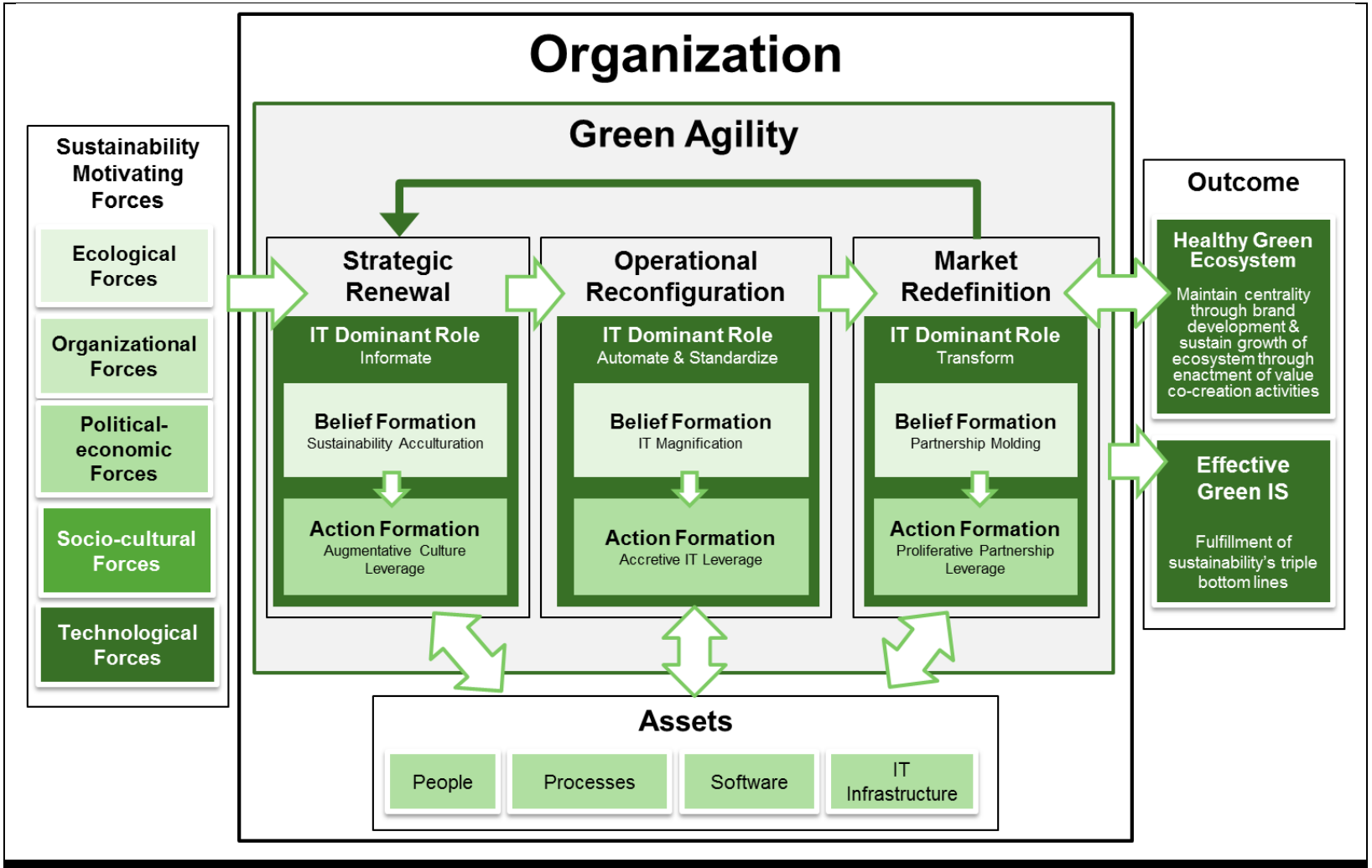

Figure 7: Process Model Depicting How to implement an Effective Green IS Initiative through IT-enabled Balancing and Resource-leveraging Capabilities (a.k.a Green Agility)

From our case data, we suggest that the dominant and embedded role of IT in enabling the development of balancing and resource-leveraging capabilities is distinct at each level of an organization. The dominant role of IT at strategic level is informate, automate and standardize at operational level, and transform at market level. We further contend that without the influence and support of IT, the development of balancing and resource-leveraging capabilities will be difficult. For example, without the support of the performance management IT system, it will be difficult for the new environment-oriented culture at China Mobile to take hold. Without the standardization and automation of the IT-enabled innovations and its corresponding IT capabilities, the green KPIs will not be so easily achieved consistently by the business units at operational level. Likewise, without the energy conservation rating standard embedded within IT-based central procurement system, it might be challenging for China Mobile to co-opt its network partners in collaborative environmental initiatives, and a green ecosystem would be difficult to create and sustain. This underscores the importance of IT in an effective Green IS initiative.

Theoretical and Practical Implications. By addressing our research questions, this study has made a number of theoretical and practical contributions. First, our study is one of the few that investigates sustainability from an IS perspective. Based on our inductively derived model, we have developed a theory of IT-enabled BAO capabilities (a.k.a Green Agility) in driving an effective Green IS implementation. It is a theory that explains the capability development process of IT-enabled balancing (sensing) and resource-leveraging (responding) capabilities at strategic, operational, and market level in an organization that are needed to fulfill the '*triple bottom line*' holistically during an

effective Green IS implementation. As such, our theory can serve as a roadmap for businesses (especially those in telecommunications sector) and may be helpful in increasing their chances of implementing Green IS initiatives effectively. Given that combating climate change is a matter of urgency (Lubin et al. 2010), our study will be timely and will provide actionable prescriptions to address practical needs. Second, our study contributes to the literature on sustainability by describing an approach through which the sustainability '*triple bottom line*' can be achieved holistically. Numerous researchers have suggested that the sustainability '*triple bottom line*' is difficult to accomplish (e.g. Adams 2006) because *"sustainability phenomena are complex and multilayered, often characterized by uncertain dependencies and nonlinearities"* (Melville 2010, pp 4). To the best of our knowledge, the theory derived from our case data is the first holistic attempt in the literature that demonstrates that it is possible to achieve the illusive '*triple bottom line*' simultaneously. It is also, as far as we know, one of the few theories that analyses sustainable development at strategic, operational, and market level within an organization. As such, we believe that our multi-level theory will serve to structure and enrich future discourse on environmental sustainability. Third, our study contributes to the BAO framework as proposed by Melville (2010) as it is one of the few studies that have demonstrated its usefulness in the context of IS sustainability. In particular, our findings reveal that balancing capabilities can be identified as a means for belief formation and resource-leveraging capabilities as a means of action formation. By constantly developing these two capabilities in a cyclical manner through the three levels within an organization, an effective Green IS initiative can be achieved. In doing so, we have effectively extended the BAO framework to include the consideration of multiple

levels within an organization and explained how Green IS implementation may cycle between the BAO processes at the different levels. We believe this new insight on the BAO framework to be of significant value for future IS sustainability research.

Limitations and Future Research. In our study, we have developed a theory that explains how an effective Green IS initiative can be implemented. Although it is beyond the scope of our paper, the inductively derived theory can certainly be tested by statistical means in future studies so that the statistical generalizability of our theory can be established. Second, the journey towards sustainability is long and difficult (Adams 2006) and our inductively derived theory has merely demonstrated how to implement an effective Green IS initiative. It does not shed light on how the success of the initiative can be sustained over time. Consequently, adopting a longitudinal view on the success of a Green IS initiative might be a promising avenue for future research. How to sustain the success of a Green IS initiative through IT-enabled capability? Addressing this question may be as important as the research question of the present study.

CHAPTER 5: CONCLUSION

5.1 Findings Related to the Strategic Renewal Process

5.1.1 Beijing Capital International Airport (BCIA) Terminal 3 IT Implementation

In this study, we have shown that the key enabler of an effective strategic renewal process in BCIA is its IS development (ISD) agility. Through the development of agile IS development practices, BCIA was able to rapidly and accurately respond to the volatilities of business requirements during the IS development of mission-critical systems. We noted in our study that the development of agile IS development practices are localized within the IT department. The IT department developed several agile IS development practices to cope with the challenges to deliver all the IT projects on time in an environment of various forms of uncertainty. With each successful completion of an IT system, the agile IS development practices get infused into the day-to-day work culture of the organization. This allowed BCIA to significantly and rapidly refresh all its mission-critical systems to meet the mandate by the China Government for the 2008 Olympics. This led us to conclude that this is an effective bottom-up discontinuous strategic renewal process.

Our case findings include the identification of four types of agile IS development practices that were highly salient in four mission-critical systems in BCIA during the Terminal 3 IT program implementation. We have uncovered from our case data that the agile IS development practices consist of two key method components namely, trust-mediated organization control mechanisms and IT capabilities. These two key method components were essential in enabling the IT department to sense and respond to project uncertainties and urgencies to fulfill all the scopes of the mission-critical systems on

time. We have also categorized these agile IS development practices into sensing and responding practices. In so doing, we have developed a capability development theory of ISD agility in mission critical system implementations which is responsible to the successful enactment of a strategic renewal process in BCIA. Through leveraging upon these established agile IS development practices during IS development, BCIA was able to very quickly refresh and extend its strategies, operations, and partner relationships in managing its mission-critical systems in its Terminals 1, 2 and 3.

5.1.2 China Mobile Communications Co Ltd's Green IS Initiative

In the study of China Mobile's Green IS initiative, we discovered that a sustainability endeavor in an organization requires a tactful balancing act to meet both sustainability and profitability requirements. Our case findings show that China Mobile initiated the strategic renewal process via a top-down approach that started at the strategic level first, then systematically refreshed and/or replaced its strategic attributes at operational level prior to refreshing and/or replacing its partners' relationships at market level. This allowed us to classify China Mobile's Green Action Plan implementation as an effective top-down incremental strategic renewal process. We have shown how IT-enabled balancing (a form of sensing capability) and resource-leveraging (a form of responding capability) can be developed in the strategic, operational, and market level of China Mobile. More importantly, our study revealed the different roles of IT in enabling these IT-enabled balancing and resource-leveraging capabilities at the three levels. We termed these sets of IT-enabled balancing and resource-leveraging capabilities as Green Agility and argued that it is this Green Agility that enables China Mobile to rapidly and incrementally refresh and/or replace its strategic attributes at its various levels towards

the fulfillment of the sustainability's triple bottom line. In so doing, we have developed a capability development theory of IT-enabled BAO capabilities (a.k.a Green Agility) in driving an effective Green IS implementation in organization.

5.2 Theoretical and Practical Contributions

Besides the theoretical and practical contributions that are detailed in the two case studies presented in Chapter 3 and 4, we also posit that the inductively derived IT-enabled agility theories contribute to the extant literature of strategic renewal. This is because through these theories, the role of IT-enabled agility in an effective strategic renewal process is clarified and empirically tested. Our case findings highlight that ISD agility is essential in enabling an effective discontinuous strategic renewal via a bottom up approach for BCIA. It also demonstrates that Green Agility is imperative in driving an effective incremental strategic renewal via a top-down approach for China Mobile. In so doing, we believe that the theories have provided an answer to the overarching research question of this thesis which is: *How can effective strategic renewal be implemented through the development of IT-enabled agility which comprises IT-enabled sensing and responding capabilities?*

In addition, these two theories also address the extant literature gap in strategic renewal in several other ways. First, the two case studies that these theories are based on are one of the few empirical studies in strategic renewal literature that focuses on the process of enacting an effective strategic renewal. Second, these two theories address the criticism of extant strategic renewal process research as being too abstract and conceptual. Third, these two theories provide a clear roadmap to practitioners on how to enact an effective strategic renewal implementation through the development of IT-enabled agility especially in an Airport transportation or telecommunication industry. This is, in our

opinion, of significant value to the practitioners. Finally, these two theories have introduced IT into the discourse of strategic renewal processes and this answered to the call of several IS researchers (e.g. Tanriverdi et al. 2010).

5.3 Limitations and Future Research

As in any single case study, the findings uncovered in these two studies are contextual and can't be easily generalizable to other organizations. However, similar to studies that are based on experimental method, the two exploratory case studies presented in this thesis aim to provide theoretical insights that can serve as basis for future research. Although it is beyond the scope of our study, we believe the inductively derived theories in ISD agility and Green Agility can be tested by statistical means (e.g. surveys) in future studies so that the statistical generalizability of our arguments can be established. This will allow the theories developed in the two studies to achieve higher external validity. Having said that, we believe that the theoretical models developed in our studies can also serve as a preliminary 'roadmap' to guide practitioners in finding their ways in enacting an effective strategic renewal process especially given the nascent stage of existing research in this area. Companies competing in the same or similar industries of our two case organizations (i.e. airport terminal and telecommunications) should find our models immediately useful to them in enacting an effective strategic renewal process through the development of IT-enabled agility.

In addition, there are two more kinds of strategic renewal that can be explored for future research (see Figure 8) namely, the top-down discontinuous strategic renewal process and bottom-up incremental strategic renewal process. Studies can be directed at uncovering the role of IT-enabled agility in the two kinds of strategic renewal process that are not

covered in this thesis. With the role of IT-enabled agility clarified in all four quadrants, comparative studies can be performed to shed more insight on the role of IT-enabled agility in a strategic renewal process. Specifically, it would be insightful to understand which approach would be most ideal under certain circumstances to enact an effective strategic renewal process. This will be of significant value to practitioners and will also extend the external validity of the theories developed to enact an effective strategic renewal process.

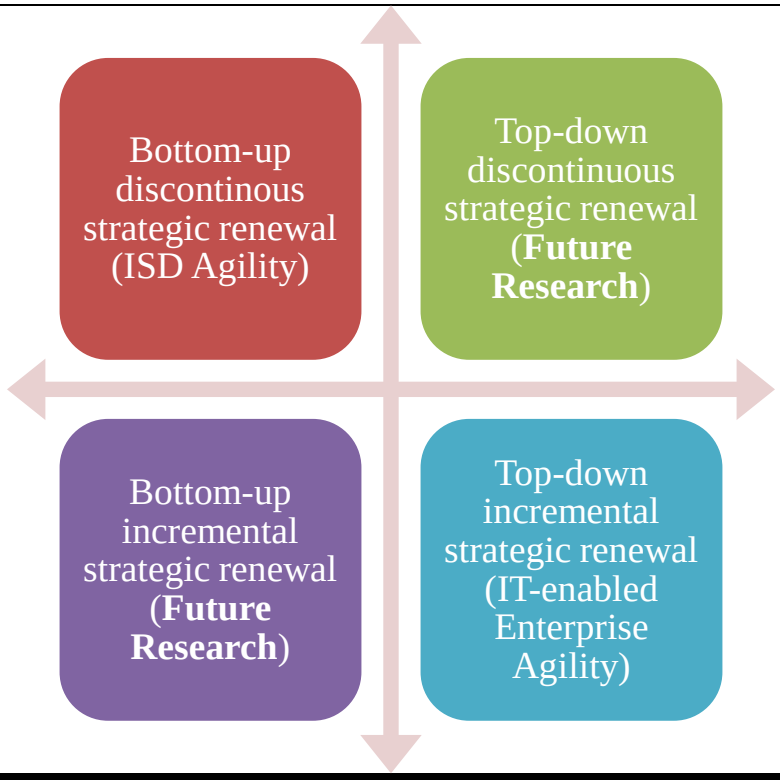

Figure 8: Future Research Directions

REFERENCES

Abrahamsson, P., Conboy, K., and Wang, X. "'Lots done, more to do': The current state of agile systems development research," *European Journal of Information Systems* (18:4) 2009, pp 281-284.

Adams, W.M. *The future of sustainability: re-thinking environment and development in the 21st century* The World Conservation Union, 2006.

Agarwal, R., and Halfat, C.E. "Strategic renewal of organizations," *Organization Science* (20:2) 2009, pp 281-293.

Ågerfalk, P.J., Fitzgerald, B., and Slaughter, S.A. "Flexible and distributed information systems development: State of the art and research challenges," *Information Systems Research* (20:3) 2009, pp 317-328.

Aguilera, R.V., Rupp, D.E., Williams, C.A., and Ganapathi, J. "Putting the S back into corporate social responsibility: A multi-level theory of social change in organizations," *Academy of Management Review* (32:3) 2007, pp 836-863.

Airport-int "Hold baggage screening systems," Airport-int International, 2009.

Ashurst, C., Doherty, N.F., and Peppard, J. "Improving the impact of IT development projects: the benefits realization capability model," *European Journal of Information Systems* (17) 2008, pp 352-370.

Austin, R., and Devin, L. *Artful making: what managers need to know about artists work* Financial Times, Prentice Hall, Boston, 2003.

Austin, R.D., and Devin, L. "Weighing the benefits and costs of flexibility in making software: toward a contingency theory of the determinants of development process design," *Information Systems Research* (20:3) 2009, pp 462-477.

Ayas, K., and Zeniuk, N. "Project-based learning: building communities of reflective practitioners," *Management Learning* (32) 2001, pp 61-76.

Bansal, P., and Roth, K. "Why companies go green: A model of ecological responsiveness," *Academy of Management Journal* (43:4) 2000, pp 717-737.

Bartel, C.A., and Garud, R. "The role of narratives in sustaining organizational innovation," *Organization Science* (20:1) 2009, pp 107-117.

Baskerville, R.L., Mathiassen, L., and Pries-Heje, J. "Agility in fours: IT diffusion, IT infrastructure, IT development and business," in: *Business Agility and Information Technology Diffusion,* R.L. Baskerville, L. Mathiassen, J. Pries-Heje and J.I. DeGross (eds.), Springer, New York, NY, 2005.

Beck, K., and Andres, C. *Extreme programming explained: embrace change* Addison-Wesley, Boston, 2005.

Beck Kent, Beedle, M., van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B., Martin, R.C., Mellor, S., Schwaber, K., Sutherland, J., and Thomas, D. "Principles behind the Agile Manifesto," 2001.

Beijing-Capital *The 52nd gold medal* Beijing Capital International Airport Co. Ltd, 2009.

Bharadwaj, A., Sambamurthy, V., and Zmud, R.W. "IT Capabilities: theoretical perspectives and empirical operationalization," in: *International Conference on Information Systems,* Charlotte, NC, 1999, pp. 378-385.

Bharadwaj, A.S. "A resource-based perspective on information technology capability and firm performance: An empirical investigation," *MIS Quarterly* (24:1) 2000, pp 169-196.

Bingham, C.B., Eisenhardt, K.M., and Furr, N.R. "Which strategy when?," *MIT Sloan Management Review* (52:1) 2011, pp 70-78.

Boland, R.J., and Tenkasi, R.V. "Perspective making and perspective taking in communities of knowing," *Organization Science* (6) 1995, pp 350-372.

Börjesson, A., Martinsson, F., and Timmerås, M. "Agile improvement practices in software organizations," *European Journal of Information Systems* (15:2) 2006, p 169.

Branzei, O., Ursacki-Bryant, T.J., Vertinsky, I., and Zhang, W. "The formation of green strategies in chinese firms: Matching corporate environmental responses and individual principles," *Strategic Management Journal* (25) 2004, pp 1075-1095.

Bronn, P.S., and Vidaver-Cohen, D. "Corporate motives for social initiatives: Legitimacy, sustainability or the bottom line?," *Journal of Business Ethics* (45:3) 2009, pp 78-97.

Camillus, J.C. "Strategy as a wicked problem," *Harvard Business Review* (86:5) 2008, pp 98-106.

Cao, L., Mohan, K., Xu, P., and Ramesh, B. "How extreme does extreme programming have to be? Adapting XP practices to large-scale projects," Proceedings of the 37th Annual Hawaii International Conference on System Sciences (HICSS'04), 2004.

Capron, L., and Mitchell, W. "Selection capability: How capability gaps and internal social fricitions affect internal and external strategic renewal," *Organization Science* (20:2) 2009, pp 294-312.

Chatman, J.A., and Cha, S.E. "Leading by leveraging culture," *California Managemenr Review* (45:4) 2003, pp 20-34.

Chen, A.J., Boudreau, M.-C., and Watson, R.T. "Information systems and ecological sustainability," *Journal of Systems and Information Technology* (10:3) 2008, pp 186-201.

Chen, A.J., Watson, R.T., Boudreau, M.-C., and Karahanna, E. "Organizational adoption of Green IS & IT: An institutional approach," in: *Thirtieth International Conference on Information Systems*, Phoenix, USA, 2009.

China-Mobile *Growing together harmoniously: Green growth - meeting our commitments - driving forward* China Mobile Limited, Beijing, CN, 2009.

China-Mobile *Green - we are in action* China Mobile Limited, Beijing, CN, 2010a.

China-Mobile *Growing together harmoniously. The change: building a responsible future* China Mobile Communication Corporation, Beijing, CN, 2010b.

China-Mobile "China Mobile Limited company profile," 2011a.

China-Mobile "China Mobile: Enabling a better life (China Mobile Limited 2010 sustainability report)," China Mobile Limited, Beijing, CN.

Choudhury, V., and Sabherwal, R. "Portfolios of control in outsourced software development projects," *Information Systems Research* (14:3) 2003, pp 291-314.

Coad, P., De Luca, J., and Lefebre, E. *Java modeling in color* Prentice Hall, Englewood Cliffs, NJ, 1999.

Cockburn, A. *Agile software development: The cooperative game* Addison-Wesley, Boston, 2007.

Cohen, W.M., and Levinthal, D.A. "Absorptive capacity: A new perspective on learning and innovation," *Administrative Science Quarterly* (35:1) 1990, pp 128-152.

Coleman, J.S. "Social theory, social research, and a theory of action," *American Journal of Sociology* (91) 1986, pp 1309-1335.

Conboy, K. "Agility from first principles: Reconstructing the concept of agility in information systems development," *Information Systems Research* (20:3) 2009, pp 329-354.

Conboy, K., and Fitzgerald, B. "Towards a conceptual framework of agile methods," in: *Proceedings of the 2004 ACM Workshop on Interdisciplinary Software Engineering Research*, Newport Beach, CA, 2004, pp. 37-44.

Corbett, C.J., and Kirsch, D.A. "International diffusion of ISO 14000 certification," *Production and Operations Management* (10:3) 2001, pp 327-342.

Crossan, M.M., and Berdrow, I. "Organizational learning and strategic renewal," *Strategic Management Journal* (24:11) 2003, pp 1087-1105.

D'Aveni, R.A. "Coping with hypercompetition: Utilizing the new 7S's framework," *Academy of Management Executive* (9:3) 1995, pp 45-60.

D'Aveni, R.A., Dagnino, G.B., and Smith, K.G. "The age of temporary advantage," *Strategic Management Journal* (31) 2010, pp 1371-1385.

Dao, V., Langella, I., and Carbo, J. "From green to sustainability: Information Technology and an integrated sustainability framework," *Journal of Strategic Information Systems* (20:1) 2011, pp 63-79.

Das, T.K., and Bing-Sheng, T. "Between trust and control: Developing confidence in partner cooperation in alliances," *Academy of Management Review* (23:3) 1998, pp 491-512.

Davenport, T.H. *Process innovation: Reengineering work through Information Technology* Harvard Business School Press, Cambridge, MA, 1993.

Day, G.S. "Aligning the organization with the market," *MIT Sloan Management Review* (48:1) 2006, pp 40-49.

DeSimone, L.D., Popoff, F., and Development, W.B.C.f.S. *Eco-Efficiency: The business link to sustainable development* MIT Press, Cambridge, MA, 1997.

Doz, Y., and Kosonen, M. "The dynamics of strategic agility: Nokia's rollercoaster experience," *California Management Review* (50:3) 2008, pp 95-118.

Dube, L., and Pare, G. "Rigor in Information Systems positivist case research: Current practices, trends and recommendations," *MIS Quarterly* (27:4) 2003, pp 597-635.

Dybå, T., and Dingsøyr, T. "Empirical studies of agile software development: A systematic review," *Information and Software Technology* (50:9-10) 2008, pp 833-859.

Dylick, T., and Hockerts, K. "Beyond the business case for corporate sustainability," *Business Strategy and the Environment* (11:2) 2002, pp 130-141.

Eggers, J.P., and Kaplan, S. "Cognition and renewal: Comparing CEO and organizational effects on incmbent adaptation to technical change," *Organization Science* (20:2) 2009, pp 461-477.

Eisenhardt, K.M. "Control: Organizational and economic approaches," *Management Science* (31:2) 1985, pp 134-149.

Eisenhardt, K.M. "Building theories from case study research," *Academy of Management Review* (14:4) 1989, pp 532-550.

Eisenhardt, K.M., and Graebner, M.E. "Theory building from cases: opportunities and challenges," *Academy of Management Journal* (50:1) 2007, pp 25-32.

Elliot, S. "Transdisciplinary perspectives on enviromental sustainability: A resource-based and framework for IT-enabled business transformation," *MIS Quarterly* (35:1) 2011, pp 197-236.

Elssamadisy, A. "XP on a large project - a developer's view," Proceedings of XP/Agile Universe, Raleigh, NC, 2001.

Erickson, J., Lyytinen, K., and Siau, K. "Agile modeling, agile software development, and extreme programming: The state of research," *Journal of Database Management* (16:4) 2005, pp 88-100.

Feeny, D.F., and Willcocks, L.P. "Core IS capabilities for exploiting Information Technology," *Sloan Management Review* (39:3) 1998, pp 9-21.

Fink, L., and Neumann, S. "Gaining agility through IT personnel capabilities: The mediating role of IT infrastructure capabilities," *Journal of the Association for Information Systems* (8:8) 2007, pp 440-462.

Floyd, S.W., and Lane, P.J. "Strategizing throughout the organization: managing role conflict in strategic renewal," *Academy of Management Review* (25:1) 2000, pp 154-177.

Gallagher, K.P., and Worrell, J.L. "Organizing IT to promote agility," *Information Technology and Management* (9:1) 2008, pp 71-88.

Garvin, D.A. "The processes of organization and management," *Sloan Management Review* (39:4) 1998, pp 33-50.

Ghoshal, S., and Bartlett, C.A. "Rebuilding behavioral context: A blueprint for corporate renewal," *Sloan Management Review* (37:2) 1996, pp 23-36.

Gladwin, T., Kennelly, J., and Krause, T. "Shifting paradigms for sustainable development: Implications for management theory and research," *Academy of Management Review* (6:2) 1995, pp 874-907.

Glenn, J.C., and Gordon, T.J. *State of the future: issues and opportunities* American Council for the United Nations University, Washington, DC, 1998.

Glenn, M. "Organizational agility: How business can survive and thrive in turbulent times," The Economist.

Goetz, J., and LeCompte, D. *Ethnography and qualitative design in educational research* Academic Press, Orlando, FL, 1984.

Goh, J.C.L., Zuo, M.Y., and Pan, S.L. "Transforming organizational capabilities into agile IT adoption: A case study of Beijing International Airport " in: *Thirty First International Conference on Information Systems*, St Louis, US, 2010.

Gulati, R., and Puranam, P. "Renewal through reorganization: the value of inconsistencies between formal and informal organization," *Organization Science* (20:2) 2009, pp 422-440.

Hagel III, J. "Leveraged growth: Expanding sales without sacrificing profits," *Harvard Business Review* (80:10) 2002, pp 68-77.

Hamel, G., and Prahalad, C.K. "Strategy as stretch and leverage," *Harvard Business Review* (71:2) 1993, pp 75-84.

Hamel, G., and Valikangas, L. "The quest for resilience," *Harvard Business Review* (81:9) 2003, pp 52-63.
Hargrave, T.J., and Van De Ven, A.H. "A collective action model of institutional innovation," *Academy of Management Review* (31:4) 2006, pp 864-888.
Harris, M.L., Collins, R.W., and Hevner, A.R. "Control of flexible software development under uncertainty," *Information Systems Research* (20:3) 2009, pp 400-419.
Hart, S.L. "A natural resource-based view of the firm," *Academy of Management Journal* (20:4) 1995, pp 986-1014.
Hart, S.L., and Milstein, M.B. "Creating sustainable value," *Academy of Management Executive* (17:2) 2003, pp 56-69.
Haugh, H.M., and Talwar, A. "How do corporations embed sustainability across the organization," *Academy of Management Learning and Education* (9:3) 2010, pp 384-396.
Henderson-Sellers, B., and Serour, M.K. "Creating a dual-agility method: The value of method engineering," *Journal of Database Management* (16:4) 2005, pp 1-23.
Highsmith, J. *Agile project management* Addison-Wesley, Boston, 2004.
Highsmith, J., and Cockburn, A. "Agile software development: The business of innovation," *IEEE Computer* (34:9) 2001.
Hovorka, D.S., and Larsen, K.R. "Enabling agile adoption practices through networked organizations," *European Journal of Information Systems* (15:2) 2006, pp 159-168.
Huff, J.O., Huff, A.S., and Tomas, H. "Strategic renewal and the interaction of cumulative stress and inertia," *Strategic Management Journal* (13) 1992, pp 55-75.
Iansiti, M., and Levien, R. *The keystone advantage: What the new dynamics of business ecosystems mean for strategy, innovation and sustainability* Harvard Business School Press, Boston, MA, 2004a.
Iansiti, M., and Levien, R. "Strategy as ecology," *Harvard Business Review* (82:3) 2004b, pp 68-78.
IBM "Enterprise for the future: Global CEO study," IBM Corporation, Somers, NY.
Inkpen, A.C., and Currall, S.C. "The coevolution of trust, control, and learning in joint ventures," *Organization Science* (15:5) 2004, p 586.
Investopedia "Definition of 'mission critical'," Investopedia, 2012.
IPCC "Climate change 2007: Synthesis report," Intergovernmental Panel on Climate Change, 2007.
Jenkin, T.A., Webster, J., and McShane, L. "An agenda for 'Green' information technology and systems research," *Information and Organization* (21) 2011, pp 17-40.
Kim, H.E., and Pennings, J.M. "Innovation and strategic renewal in mature markets: a study of the tennis racket industry," *Organization Science* (2009:20) 2009, p 2.
Kirsch, L.J. "The management of complex tasks in organizations: Controlling the systems development process," *Organization Science* (7:1) 1996, pp 1-21.
Kirsch, L.J. "Portfolios of control modes and IS project management," *Information Systems Research* (8:3) 1997, p 215.
Kirsch, L.J. "Deploying common systems globally: The dynamics of control," *Information Systems Research* (15:4) 2004, p 374.

Kirsch, L.J., Ko, D.-G., and Haney, M.H. "Investigating the antecedents of team-based clan control: Adding social capital as a predictor," *Organization Science* (21:2) 2010, pp 469-489.
Kirsch, L.J., Sambamurthy, V., Ko, D.-G., and Purvis, R.L. "Controlling Information Systems development projects: The view from the client," *Management Science* (48:4) 2002, pp 484-498.
Klein, H.K., and Myers, M.D. "A set of principles for conducting and evaluating interpretive field studies in information systems," *MIS Quarterly* (23:1) 1999, pp 67-93.
Knott, A.M., and Posen, H.E. "Firm R&D behavior and evolving technology in established industries," *Organization Science* (20:2) 2009, pp 352-367.
Kohli, R., and Kettinger, W.J. "Informating the clan: Controlling physicians' costs and outcomes," *MIS Quarterly* (28:3) 2004, pp 363-394.
Larman, C. *Agile & iterative development: A manager's guide* Addison-Wesley, Boston, 2004.
Lavie, D. "Capability reconfiguration: An analysis of incumbent responses to technological change," *Academy of Management Review* (31:1) 2006, pp 153-174.
Lee, A.S., and Baskerville, R.L. "Generalizing generalizability in information systems research," *Information Systems Research* (14:3) 2003, pp 221-243.
Lee, G., and Xia, W. "Toward agile: An integrated analysis of quantitative and qualitative field data on software development agility," *MIS Quarterly* (34:1) 2010, pp pp 87-114.
Leidner, D.E., Pan, G., and Pan, S.L. "The role of IT in crisis response: Lessons from SARS and Asian Tsunami disasters," *Journal of Strategic Information Systems* (18:2) 2009, pp 80-99.
Levina, N., and Ross, J.W. "From the vendor's perspective: Exploring the value proposition in Information Technology outsourcing," *MIS Quarterly* (27:3) 2003, pp 331-364.
Levina, N., and Vaast, E. "The emergence of boundary spanning competence in practice: Implications for implementation and use of Information Systems," *MIS Quarterly* (29:2) 2005, pp 335-363.
Locke, K. *Grounded theory in management research* Sage, Thousand Oaks, CA, 2001.
Lubin, D.A., and Esty, D.C. "The sustainability imperative," *Harvard Business Review* (88:5) 2010, pp 42-50.
Lyytinen, K., and Rose, G.M. "Information systems development agility as organizational learning," *European Journal of Information Systems* (15:2) 2006, pp pp 183-199.
Maruping, L.M., Venkatesh, V., and Agarwal, R. "A control theory perspective on agile methodology use and changing user requirements," *Information Systems Research* (20:3) 2009, pp 377-399.
Mata, F.J., Fuerst, W.L., and Barney, J.B. "Information Technology and sustained competitive advantage: A resource-based analysis," *MIS Quarterly* (19:4) 1995, pp 487-505.
Mathiassen, L., and Pries-Heje, J. "Business agility and diffusion of information technology," *European Journal of Information Systems* (15:2) 2006, p 116.

McDonough, W., and Braungart, M. *Cradle to cradle: Remaking the way we make things* North Point Press, New York, 2002.
McGrath, R.G., and MacMillan, I.C. "How to rethink your business during uncertainty," *MIT Sloan Management Review* (50:3) 2009, pp 24-30.
McKinsey "Tackling socipolitical issues in hard times (McKinsey global survey)," McKinsey & Company.
McManus, J., and Wood-Harper, T. "Understanding the sources of Information Systems project failure: A study in project failure," *Management Services* (51:3) 2007, pp 38-43.
McWilliams, A., and Siegel, D. "Corporate social responsibility: A theory of the firm perspective," *Academy of Management Review* (26:1) 2001, pp 117-127.
Melville, N.P. "Information Systems innovation for environmental sustainability," *MIS Quarterly* (34:1) 2010, pp 1-21.
Meredith, J.R., and Mantel, S.J. *Project management - A managerial approach* John Wiley & Sons, New York, 1995.
Meyer, A.D., Loch, C.H., and Pich, M.T. "Managing project uncertainty: From variation to chaos," *Sloan Management Review* (43:2) 2002, pp 60-67.
Michalisin, M.D., and Stinchfield, B.T. "Climate change strategies and firm performance: An empirical investigation of the natural resource-based view of the firm," *Journal of Business Strategies* (27:2) 2010, pp 123-149.
Miles, M., and Huberman, A. *Qualitative data analysis: A sourcebook of new methods* Sage Publications, Beverley Hills, CA, 1984.
Mines, C. *The dawn of Green IT services: A market overview of sustainability consulting for IT organizations* Forrester Research Report, Cambridge, MA, 2008.
Nidumolu, S.R., and Subramani, M.R. "The matrix of control: Combining process and structure approaches to managing software development," *Journal of Management Information Systems* (20:3) 2003-4, pp 159-196.
Olsson, H.H., Conchuir, E.O., Agerfalk, P.J., and Fitzgerald, B. "Two-stage offshoring: An investigation of the Irish bridge," *MIS Quarterly* (32:2) 2008, pp 257-279.
Orlitsky, M., Schmidt, F.L., and Rynes, L. "Corporate social and financial performance: A meta-analysis," *Organization Studies* (24:3) 2003, pp 493-441.
Ouchi, G.W. "Markets, bureaucracies and clans," *Administrative Science Quarterly* (25) 1980, pp 129-141.
Overby, E., Bharadwaj, A., and Sambamurthy, V. "Enterprise agility and the enabling role of information technology," *European Journal of Information Systems* (15:2) 2006, p 120.
Pan, S.L., Pan, G., Chen, A.J.W., and Hsieh, M.H. "The dynamics of implementing and managing modularity of organizational routines during capability development: Insights from a process model," *IEEE Transactions on Engineering Management* (54:4) 2007, pp 800-813.
Pan, S.L., and Tan, B.C.C. "Demystifying case research: A structured-pragmatic-situational (SPS) approach to conducting case studies," *Information & Organization* (21:3) 2011, pp 161-176.
Pavlou, P.A., and El Sawy, O.A. "From IT leveraging competencies to competitive advantage in turbulent environments: The case of new product development," *Information Systems Research* (17:3) 2006, pp 198-227.

Pentland, B.T. "Building process theory with narrative: From description to explanation," *Academy of Management Review* (24:4) 1999, pp 711-724.

Porter, M.E., and Kramer, M.R. "Strategy & society: The link between competitive advantage and corporate social responsibility," *Harvard Business Review* (84:12) 2006, pp 78-92.

Porter, M.E., and Reinhardt, F. "A strategic approach to climate," *Harvard Business Review* (85:10) 2007, pp 22-26.

Qumer, A., and Henderson-Sellers, B. "An evaluation of the degree of agility in six agile methods and its applicability for method engineering," *Information and Software Technology* (50:4) 2008, pp 280-295.

Ravishankar, M.N., Pan, S.L., and Leidner, D.E. "Examining the strategic alignment and implementation success of a KMS: A subculture-based multilevel analysis," *Information Systems Research* (22:1) 2011, pp 39-59.

Reifer, D.J. "XP and CMM," *IEEE Software* (20:3) 2003.

Rustagi, S., King, W.R., and Kirsch, L.J. "Predictors of formal control usage in IT outsourcing partnerships," *Information Systems Research* (19:2) 2008, pp 126-143.

Sambamurthy, V., Anandhi, B., and Varun, G. "Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms," *MIS Quarterly* (27:2) 2003, p 237.

Sargut, G., and McGrath, R.G. "Learning to live with complexity," *Harvard Business Review* (89:9) 2011, pp 68-76.

Sarker, S., and Sarker, S. "Exploring agility in distributed Information Systems development teams: An interpretive study in an offshoring context," *Information Systems Research* (20:3) 2009, pp 440-461.

Schein, E.H. "The role of the CEO in the management of change: the case of information technology," in: *Transforming Organizations*, T.A. Kochan and M. Useem (eds.), Oxford University Press, 1992.

Schmidt, R., Lyytinen, K., Keil, M., and Cule, P. "Identifying software project risks: An international Delphi study," *Journal of Management Information Systems* (17:4) 2001, pp 5-36.

Schoorman, F.D., Mayer, R.C., and Davis, J.H. "An integrative model of organizational trust: Past, present, and future," *Academy of Management Review* (32:2) 2007, pp 344-354.

Schultze, U., and Avital, M. "Designing interviews to generate rich data for information systems research," *Information & Organization* (21:1) 2011, pp 1-16.

Schwaber, K., and Beedle, M. *Agile software development with Scrum* Prentice-Hall, Upper Saddle River, NJ, 2002.

Seo, D., and La Paz, A.I. "Exploring the dark side of IS in achieving organizational agility," *Communications of the ACM* (51:11) 2008, pp 136-139.

Sharifi, H., and Zhang, Z. "Agile manufacturing in practice - Application of a methodology," *International Journal of Operations & Production Management* (21:5/6) 2001, pp 772-794.

Sharma, S. "Managerial interpretation and organizational context as predictors of corporate choice of environmental strategy," *Academy of Management Journal* (43:4) 2000, pp 681-697.

Sharma, S., and Henriques, I. "Stakeholder influences on sustainability practices in the Canadian forest products industry," *Strategic Management Journal* (26) 2005, pp 159-180.

Sharma, S., and Vredenburg, H. "Proactive corporate environmental strategy and the development of competitively valuable organizational capabilities," *Strategic Management Journal* (19:8) 1998, pp 729-753.

Sonenshein, S. "We're changing - Or are we? Untangling the role of progressive, regressive, and stability narratives during strategic change implementation," *Academy of Management Journal* (53:3) 2010, pp 477-512.

Stapleton, J. *Dynamic systems development method* Addison-Wesley, Harlow, England, 1997.

Starkey, K., and Crane, A. "Toward green narrative: Management and the evolutionary epic," *Academy of Management Review* (28:2) 2003, pp 220-237.

Stern, N. *The economics of climate change: The Stern review* Cambridge University Press, Cambridge, UK, 2007.

Stienstra, M., Baaij, M., van Den Bosch, F., and Volberda, H. "Strategic renewal of europe's largest telecom operators (1992-2001): from herd behavior towards strategic choice?," *European Management Journal* (22:3) 2004, pp 273-280.

Strauss, A., and Corbin, J. *Basic of qualitative research: Grounded theory procedures and techniques (2nd ed.)* Sage Publications, Thousand Oaks, CA, 1998.

Sull, D.N. "How to thrive in turbulent markets," *Harvard Business Review* (87:2) 2009, pp 80-88.

Tan, B.C.C., Pan, S.L., Chou, T., and Huang, J. "Enabling agility through routinized improvisation in IT deployment: The case of Chang Chun Petrochemicals," in: *International Conference on Information Systems*, St Louis, USA, 2010.

Tan, B.C.C., Pan, S.L., Lu, X., and Huang, L. "Leveraging digital business ecosystems for enterprise agility: The tri-logic development strategy of Alibaba.com," in: *International Conference on Information Systems*, Phoenix, USA, 2009.

Tanriverdi, H., Rai, A., and Venkatraman, N. "Reframing the dominant quests of information systems strategy research for complex adaptive business systems," *Information Systems Research* (21:4) 2010, pp 822-834.

Thibodeau, P. "Garnter's Top 10 strategic technologies for 2008," in: *Computerworld*, 2007.

Thomas Iii, L.G. "The two faces of competition: Dynamic resourcefulness and the hypercompetitive shift," *Organization Science* (7:3) 1996, pp 221-242.

Turner, S.F., and Rindova, V. "A balancing act: How organizations pursue consistency in routine functioning in the face of ongoing change," *Organization Science* (23:1) 2012, pp 1-23.

van Den Bosch, F.A.J., Volberda, H.W., and De Boer, M. "Coevolution of firm absorptive capacity and knowledge environment: Organizational forms and combinative capabilities," *Organization Science* (10:5) 1999, pp 551-568.

van Oosterhout, M., Waarts, E., and van Hillegersberg, J. "Change factors requiring agility and implications for IT," *European Journal of Information Systems* (15:2) 2006, pp 132-145.

Vastag, G. "Revisting ISO 14000 diffusion: A new "look" at the drivers of certification," *Production and Operations Management* (13:3) 2004, pp 260-267.

VersionOne "5th annual state of agile survey," VersionOne Inc, 2010.
Vidgen, R., and Wang, X. "Coevolving systems and the organization of agile software development," *Information Systems Research* (20:3) 2009, pp 355-376.
Wade, M., and Hulland, J. "Review: The resource-based view and Information Systems research: review, extension and suggestions for future research," *MIS Quarterly* (28:1) 2004, pp 107-142.
Walsham, G. "The emergence of interpretivism in IS research," *Information Systems Research* (6:4) 1995, pp 376-394.
Walsham, G. "Doing interpretive research," *European Journal of Information Systems* (15:3) 2006, pp 320-330.
Walsham, G., and Sahay, S. "GIS for district-level administration in India: Problems and opportunities," *MIS Quarterly* (23:1) 1999, pp 39-65.
Watson, R.T., Boudreau, M.-C., and Chen, A.J. "Information Systems and environmentally sustainable development: Energy informatics and new directions for the IS community," *MIS Quarterly* (34:1) 2010a, pp 23-38.
Watson, R.T., Boudreau, M.-C., Chen, A.J., and Huber, M.H. "Green IS: Building sustainable business practices," in: *Information Systems*, R.T. Watson (ed.), Athens, GA, USA: Global Text Project, 2008.
Watson, R.T., Boudreau, M.-C., Chen, A.J., and Sepulveda, H.H. "Green projects: An information drives analysis of four cases," *Journal of Strategic Information Systems* (20:1) 2010b, pp 55-62.
Weill, P., Subramani, M., and Broadbent, M. "Building IT infrastructure of strategic agility," *Sloan Management Review* (44:1) 2002, pp 57-65.
Whitney, J.O. "Strategic renewal for business units," *Harvard Business Review* (74:4) 1996, pp 84-98.
Wiggins, R.R., and Ruefli, T.W. "Schumpeter's ghost: is hypercompetition making the best of times shorter?," *Strategic Management Journal* (26:10) 2005, pp 887-911.
Winston, A. "The buzz on green business in China," Harvard Business Review, 2010.
Woetzel, J., and Joerss, M. "China's green evolution: Prioritizing technologies to achieve energy and environmental sustainability," McKinsey & Company, 2009.
Yang, T., Hu, Y., Zheng, P., and Dennis, P. *Based on the case study of China Mobile which helped society to reduce more than 55 million tons of CO2 in 2009 with low carbon ICT services* World Wide Fund for Nature Beijing Office, 2009.
Yin, R.K. *Case study research: Design and methods*, (4th ed.) SAGE Publications Inc., 2009.
Zain, M., Rose, R.C., Abdullah, I., and Masrom, M. "The relationship between information technology acceptance and organizational agility in Malaysia," *Information & Management* (42:6) 2005, pp 829-839.
Zuboff, S. *In the age of the smart machine: The future of work and power* Basic Books, New York, NY, 1988.

APPENDIX A: SELECTED BEIJING TERMINAL 3 CASE PHOTO ARCHIVE

Figure 9: Beijing Capital International Airport Terminal 1, 2 and 3 Actual Size Comparison (Map Courtesy of Search Result from Google Maps)

Figure 10: Site Visit to Terminal Command Centre in BCIA

Figure 11: Actual Interview Photo in BCIA

Figure 12: Secondary Materials and Researcher's Observation Notes Captured during Case Study

APPENDIX B: SELECTED CHINA MOBILE CASE PHOTO ARCHIVE

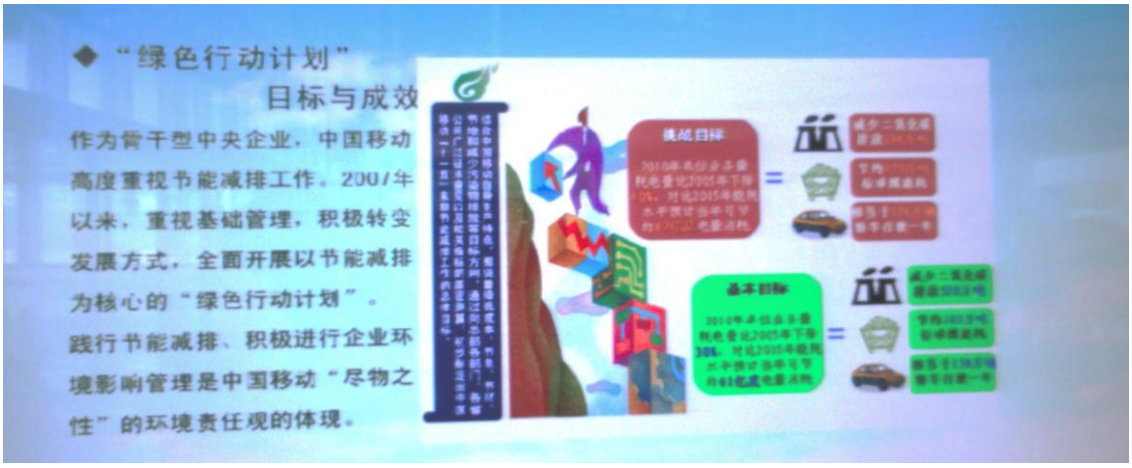

Figure 13: Descriptions of Green Targets Set for China Mobile

Figure 14: Descriptions of Technologies Used in the China Mobile’s Green Data Centre

Figure 15: Descriptions of Innovations & Green Initiatives to Develop Green Ecosystem

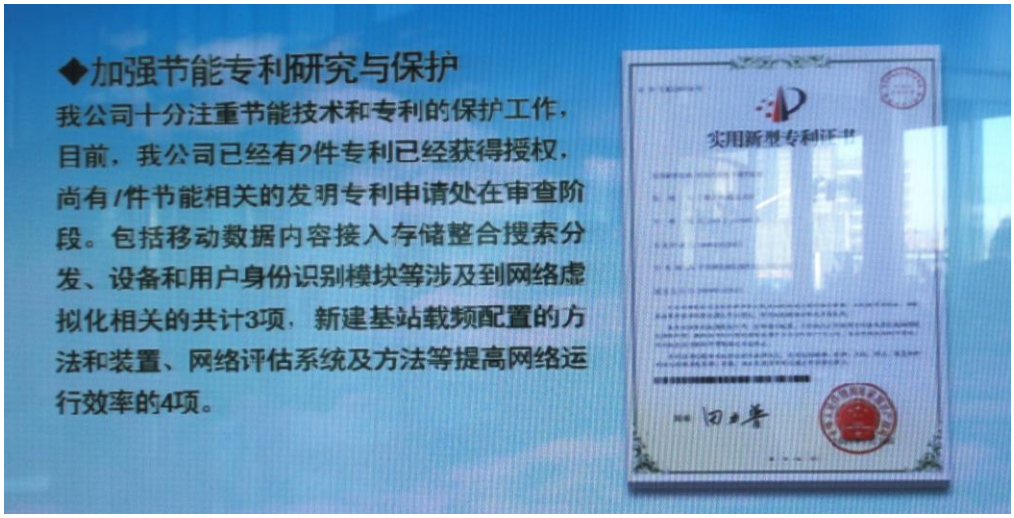

Figure 16: Descriptions of China Mobile’s Patents on Green Technologies Used

Figure 17: 2008 China Green IT Enterprise Award for China Mobile

Figure 18: Models to Illustrate the Green Design of its Base Station & Building

Figure 19: Intelligence Green Cooling System Installed at Roof Top of China Mobile's Beijing Subsidiary Office

Figure 20: Site Visit to China Mobile's Customer

Figure 21: Books, Independent Audit Report, Annual Reports and Other Secondary Materials Collected Before, During, and After Case Interviews

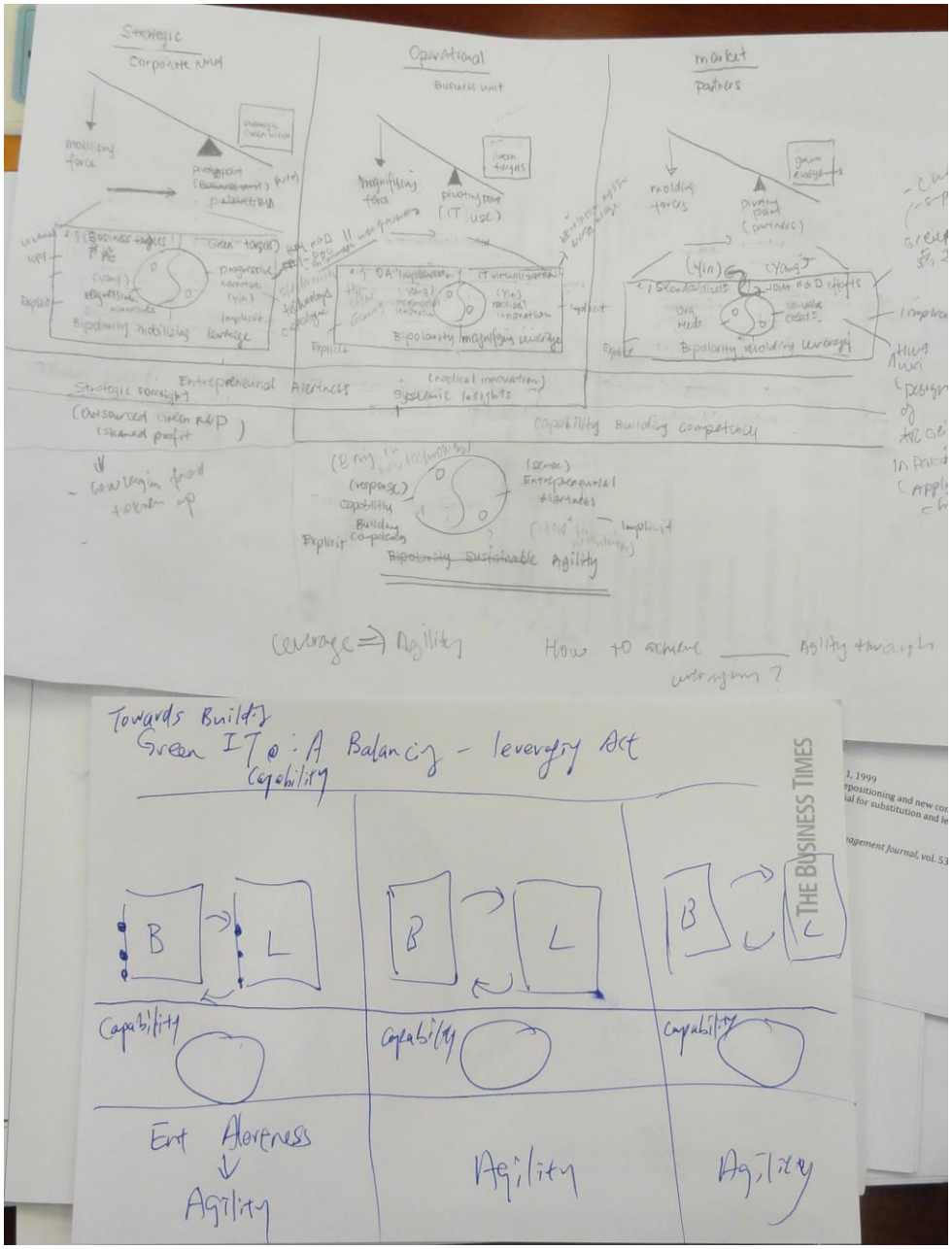

Figure 22: Diagrams that Capture 'Logical Chain of Evidence' of How the Theoretical Model was Inductively Derived