BPR PROJECT IMPLEMENTATION AND OUTCOMES

BUSINESS PROCESS REDESIGN PROJECT IMPLEMENTATION AND OUTCOMES - A PROPOSED MODEL AND ITS VALIDATION

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ABSTRACT

Business process redesign (BPR) has been studied extensively since its initial widespread application in the late 1980s. Although a great deal has been learned by both practitioners and researchers about the best ways to use BPR for business process improvement, the overall failure rate of BPR projects is still reported to be high. This failure rate indicates that there is still a need for a comprehensive success factor model, validated with empirical evidence, to provide direction to practitioners that will help to improve the outcomes of business process redesign projects. Up to this point, few studies have identified and empirically tested the possible facilitators of BPR project success.

This is an exploratory study, where Social-Technical Theory was applied in the context of BPR project implementation to explain the impact of success factors on BPR project success. The proposed conceptual research model includes the following factors: BPR project champion, top management support, change management, process redesign, and Information and Communication Technology Infrastructure (ICTI) improvement. The model considers critical factors from both the social and technical aspects of BPR project practices and the relationships among them. Facets of BPR project outcomes, including operational quality improvement, organizational quality improvement, cost savings, and productivity, were also examined.

A survey of 145 managers and executives from medium and large-sized companies was used to validate the model. The results show that a BPR project champion is a critical success factor for BPR project success, mediated through top management support, and that top management support must be emphasized through the whole BPR project implementation procedure. More specifically, change management has a better likelihood of success if it is strongly supported by top management, while other factors play an important role in helping to encourage process redesign and ICTI improvements.

This study also shows that three BPR project implementation components: change management, process redesign, and information and communications technology infrastructure (ICTI) improvement, are all critical to BPR project success. However, change management occupies the most important position because it impacts significantly the success of all four facets of BPR project outcomes (operational quality improvement, organizational quality improvement, cost savings, and productivity). Among these outcomes, the study showed that productivity is no longer the top focus of companies; instead, operational quality and organizational quality have become more important.

This study makes a significant contribution to both theory and practice. The establishment of a BPR project implementation model based on socio-technical theory, and the development of new instruments for change management and process redesign, provide a foundation for future BPR project research. With respect to practice, the specification of three BPR project implementation components presents managers with clear guidance regarding BPR project implementation. The validated model will help practitioners to understand in advance what major obstacles they may face

(change management, process redesign, or information technology) and how they should implement BPR projects in a way that will achieve their expected goals.

As such, this study represents a significant advance over the existing literature, in the development of a valid model to explain the relationships between success factors and outcomes within a BPR project context.

Dedication

To my father Wenxing Xiang, and my mother Yanping Shen

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Chapter 1: Introduction

Business process redesign (BPR) has been studied extensively since its initial widespread application in the late 1980s. Although a great deal has been learned by both practitioners and researchers about the best ways to use BPR for business process improvement, the overall failure rate of BPR projects is still reported to be high. This indicates that there is still a need for further studies to improve the outcomes of business process redesign projects.

This chapter starts with the definition of BPR and BPR projects, followed with the research background and research objectives of this study.

1.1 Business Process Redesign

Business Process Reengineering, a term that is similar to Business Process Redesign, was originally defined as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed" (Hammer and Champy 1993). Both Business Process Redesign and Business Process Reengineering (with the same acronyms BPR) will be considered to be the same concept in this thesis because they have been used interchangeably in the literature and no differences between them have been emphasized (Jarvenpaa and Stoddard 1998). However, the terminology Business Process Redesign is used because Business Process Reengineering bears an impression of "all or nothing", which has been shown to be unnecessarily counterproductive.

The definition of BPR adopted in this study is that BPR is a deliberate (planned) change, typically enabled by information technologies (IT) in an attempt to redesign and implement business processes to achieve performance breakthroughs in quality, speed, customer service, cost, etc. (Grover and Jeong 1995).

The central tenet of BPR is that organizing business activities around processes rather than functions will lead to considerable improvements in organizational effectiveness and competitive advantage (Newell, Swan and Robertson 1998). Other similar terminologies that have appeared in the literature tend to focus on certain aspects of process change. These include Business Process Transformation, Business Process Change (Guha and Grover 1997), Business Process Management (Žabjek and Štemberger 2009), Organizational Change (Lee and Ahn 2008), Business Process Improvement (Bhatt 2001a; Law and Ngai 2007b), Continuous Process Improvement, Process Workflow Redesign (Kock, Danesh and Komiak 2008), Management Engineering, etc.

The concept of BPR has evolved in two directions during the past two decades. The first direction is a change in emphasis from "business process redesign" to an inclusion of organizational change management (Grover 1999). This required a change from a narrow focus on processes to a more complete, complex, and wider view of BPR. In this wider view, BPR consists of five elements (process, people, technology, communication, and organizational structure) and three levels (strategic, managerial, and operational) (Grant 2002).

The second direction of evolution has been from an emphasis on radical change to a more moderate and reasoned change role. These two approaches to BPR implementation (revolutionary versus evolutionary) have been argued for some time (Jarvenpaa and Stoddard 1998). However, researchers soon realized that the dichotomy between radical and evolutionary change is false, and better results are obtained when organizations start BPR with a revolutionary design phase, followed by actually implementing changes in an evolutionary manner (Jarvenpaa and Stoddard 1998). For example, a recent study (Law and Ngai 2007a) revealed that the BPR approach (revolutionary or evolutionary) is not significantly related to the extent of business process improvement, and only 15 of 96 companies surveyed reported that the more radical revolutionary approach was adopted for business process changes.

To summarize the evolution of BPR, its concepts and practices have been reconciled with a more holistic approach, including consideration of Information Technology (IT), organizational structure, strategy, information, change management, evaluation methods, and more incremental process change methods such as total quality management (TQM) (Guha and Grover 1997; Harkness, Segars and Kettinger 1996).

1.2 BPR Projects

BPR, as described above, is an organizational initiative to design business processes to achieve significant (and sometimes breakthrough) improvements in performance (Guha and Grover 1997). A BPR initiative is usually implemented through projects that have as one of their main objectives changes in organizational processes.

A project is a temporary endeavor, having a defined beginning and end, undertaken to meet particular goals and objectives (Nokes and Kelly 2008). As a temporary endeavor, a BPR project is "a deliberate (planned) change, typically enabled by information technologies (IT) in an attempt to redesign and implement a business process to achieve performance breakthroughs in quality, speed, customer service, cost, etc" (Grover and Jeong 1995). Having a defined beginning and end, a BPR project involves stages such as initiation, planning, execution, monitoring, and closing.

BPR project implementation is complex and not easily accomplished, involving the manipulation of relationships among management, employees, information technology, organizational structure, and business processes (Grover and Jeong 1995). Such projects are often done in conjunction with the implementation of systems and/or software that support (or even drive) the redesigned business processes and related organizational structure changes (e.g. the implementation of ERP - Enterprise Resource Planning systems) (Al-Mudimigh 2007).

1.3 Research Background

The initial motive for redesigning business processes came from the desire to maximize the benefits of introducing information technology, and from its potential for creating improved cross-functional integration in companies (Davenport and Short 1990). The initiative was rapidly adopted and extended by a number of consultancy companies and “gurus”(Hammer 1990).

Attracted by success stories about performance improvement (Teng, Jeong and Grover 1998), many companies used BPR projects to implement significant process changes. However, BPR failed to live up to the expectations of many organizations, as suggested by a failure rate of 70 percent in the early 1990s (Bashein and Markus 1994), followed later by a failure rate of 60 to 80 percent reported by Holland and Kumar (1995). Although a great deal was learned by both practitioners and researchers about the best ways to use BPR for business process improvement, the overall failure rate of BPR projects was still reported to be as high as 45% in a study published in 2001 (Al-Mashari, Irani and Zairi 2001). The failure rate for BPR projects which were carried out during ERP systems implementation was reported to be even higher (50% to 90%) (Žabjek and Štemberger 2009). This has led to a reputation for BPR as a methodology with a high opportunity but also associated with a high risk.

Unsuccessful BPR projects may result in considerable penalties to their companies. The "hard" costs include money, time and organizational morale; the "soft" costs include the reputation of the firm within the market, the image and reputation of the firm and its leadership, etc. However, successful BPR projects may bring significant benefits. Firms such as American Express and AT&T have estimated millions or even billions in dollars of annual savings from process improvements through BPR projects (Hammer and Stanton 1995).

Given that the failure rate of BPR projects is still high, how can a company improve its chances to succeed in order to gain rather than lose from a BPR project? Success/failure factors and best practices from many studies (case studies or empirical investigations), have been used to guide BPR project practices (Al-Mashari and Zairi 1999; Grover and Jeong 1995; Grover and Malhotra 1997; Kotter 1995; O'Neill and Sohal 1999).

Research on BPR project implementation has focused on reporting success factors from various case studies in the first decade since its initial use (early 1990s to mid 2000s). It seems that almost all the success factors have been extracted and several literature review studies have pooled and further organized all the known success factors (Al-Mashari and Zairi 2000; Paper and Chang 2005). However, few theories have been applied to BPR project implementation research (Barua, Lee and Whinston 1996; Guha and Grover 1997; Motwani, Kumar, Jiang and Youssef 1998). There is a need for empirical evidence to be expressed in a model that supports success factors conclusively (George and Michalis 1999; Grover, Teng, Segars and Fiedler 1998). Therefore, researchers have been trying to fill the gap during the second decade of BPR implementation research (from mid 2000s till present), by applying theories from other areas in the BPR context

(Newell, Swan and Galliers 2000; Sarker and Lee 2002; Sarker, Sarker and Sidorova 2006), as well as developing "frameworks", "models", and "constructs" (Grover and Jeong 1995; Guha and Grover 1997; Ifinedo and Nahar 2009; Law and Ngai 2007b). Nevertheless, not enough progress has been made to fill this gap. This can be further explained from three different aspects.

Firstly, most BPR project success factors suggested in the literature have been extracted from a single or a small number of case studies. Different cases may emphasize different success factors, and success factors for one case may not make sense for another. For example, employee resistance was rejected as a failure factor in one study (Ahadi 2004), and was identified ironically as the number one obstacle to success in another study (Prosci 2005). In the most extreme situations, conflicting results from success factors were shown in various studies (Bradley 2008). Besides, the current situation of critical success factors in BPR projects is that all the factors have been pooled together from various studies (case studies, empirical studies, etc.). Few prior studies have categorized all the critical success factors based on existing theories. One of the rare examples is the study reported by Bradley (2008) which selected management-based critical success factors and classified them into the five functions of management theory.

Secondly, few studies have identified and quantitatively tested possible facilitators to BPR project success and the relationships among these facilitators. Most empirical studies have reported individual results as frequencies, ranks, or categories for success factors (Al-Mashari et al. 2001; Caccia-Bava, Guimaraes and Guimaraes 2005; Grover and Jeong 1995; Prosci 2005). The study done by Fenelon (2002) seems similar to the study reported in this thesis. However, it is very different from this study in that the success factors identified in that study were only separately tested for whether they were influencing project success or failure. Only a few studies, for example, (Bee Wah and Kok Wei 2006; Bradley 2008; Kock, Verville, Danesh-Pajou and DeLuca 2009; Law and Ngai 2007a) have attempted to fill this gap by proposing and testing conceptual models, but each had a different focus from this thesis.

Thirdly, most studies have emphasized what a company should have (i.e., the ability and readiness of an organization to change) *before* embarking upon a BPR project (Abdolvand, Albadvi and Ferdowsi 2008; Fenelon 2002; Law and Ngai 2007b), while there was little emphasis on what a company should do in order to achieve success outcomes *during* the implementation of a BPR project.

1.4 Research Objectives

Given the discussion above, the objectives of this research are to fill some of the gaps still existing in the current literature. The basic objective of this study is to establish that there are a number of factors that impact the likelihood of successful implementation of BPR projects, as well as to examine the relationships among these factors. This objective, although it is similar to previous studies, is distinguished from previous studies through several characteristics.

- The study's research model is based on Socio-Technical Theory (STT). Even though the models suggested in previous literature are detailed, the main criticism is that there has been little effort to use existing theory to develop and test a comprehensive and integrated model of BPR project implementation (Motwani et al. 1998). STT, mentioned in several BPR studies (Grover and Jeong 1995; Mumford and Beckma 1994; Sarker and Lee 2002), has shown its appropriateness in this field, because of its ability to explain the implementation of both the social systems and the technical systems involved in BPR projects. STT is applied in this study to guide the selection of key success factors for BPR project implementation.
- Unlike most studies that emphasize what a company should have before embarking upon a BPR project or during BPR project planning, (for example, the ability and readiness of an organization to change), this study focuses more on what a company should do during the implementation of a BPR project in order to achieve a successful outcome. That is, this study focuses on the implementation period of a BPR project.
- The relationships between BPR project implementation components and different facets of BPR project outcomes were studied. Through these relationships, it is possible to examine which implementation components contribute most to which outcome facets. As far as the author knows, no existing research has looked into this issue. However, it is important and

useful to understand these relationships because a single BPR project may not be able to achieve all the desired outcomes, and companies may focus different BPR projects on achieving different outcomes. Therefore, when a BPR project is to achieve a specific outcome (e.g., cost savings), most of the effort should be put into the implementation components that contribute most to that expected outcome.

- The relationships between BPR project outcomes and ultimate success are studied in this work, showing which outcome facets contribute most to BPR project overall success. We need to be careful in defining BPR project success. A successful BPR project does not mean one that achieves all the possible successful outcomes (cost savings, productivity improvement, quality improvement, etc.). For example, a BPR project can be judged as an overall success as long as its defined project goals (e.g., productivity improvement) have been met. Managers must understand what outcome aspects contribute to overall success as they define it, so they can choose to place the emphasis on the implementation components that will be more likely to result in a project that is successful.

In summary, the research conducted for this study provides useful insights into the BPR project implementation factors that are essential for BPR project success, as well as the relationships between these factors and the various facets of BPR project outcomes. This research is valuable because the findings will be beneficial to both research and practice, providing helpful information on the relationships among the various components that are critical for successfully implementing a BPR project.

1.5 Organization of the Thesis

This work consists of six chapters. Chapter 1 has briefly addressed the problem under investigation through a discussion of the research background, motivation, and opportunity for studying the BPR project implementation problem.

Chapter 2 presents a literature review on BPR project implementation and related areas.

Chapter 3 comprises a review of the social-technical theory, upon which the theoretical model for this work is based, and seven sets of research hypotheses are developed.

Chapter 4 describes the methodological approach that is used in this study to test the hypotheses and answer the study's research questions. This includes a discussion of instrument development, data collection methods, participant selection, and data analysis tools and approaches.

Chapter 5 presents the study's data analysis and findings. Results from analyzing the measurement model, structural model, hypothesis tests, mediation role examination, and effect size are presented.

Chapter 6 contains a discussion of the study's results and the conclusions from the research. Contributions and limitations of this study are described, and possible directions for future research are presented.

Chapter 2: Literature Review

The literature review has two basic objectives: 1) to review the status of BPR project research in order to understand the strengths and weaknesses in this area; and 2) to review the existing literature and idenfity important information as the basis for this study, including BPR project implementation components and BPR project success or failure factors.

2.1 Stages in BPR Projects

Like other projects, BPR projects involve several stages (i.e., initiation, planning, execution, monitoring, and closing), as discussed in section 1.2. There is no standard integrated methodology for BPR projects. However, several models have been proposed to guide practitioners through the process of innovation and change. Though this is not the focus of this study, it is necessary to outline the normal stages used when undertaking a BPR project in order to understand the key components involved in implementing a BPR project. For this purpose, two BPR project models are briefly presented here (Klein 1994; Motwani et al. 1998). The first (Klein 1994) is based on experience from industry practice; the second (Motwani et al. 1998) is generated from a review of the academic literature. Both of the BPR project models present similar stages for BPR projects.

Klein (1994) summarized the stages of a BPR project from his company's practices as:

1. Preparation stage. This includes mobilizing, organizing, and energizing the people who perform the reengineering project.
2. Identification stage. This involves developing a customer-oriented process model of the business.
3. Vision stage. This includes selecting the processes to reengineer and formulating redesign options capable of achieving breakthrough performance.
4. Solution stage. This includes defining the technical and social requirements for the new processes and developing detailed implementation plans.
5. Transformation stage. This involves implementing reengineering plans, for both the technical and social aspects of the project.

The second BPR project model was proposed by Motwani et al. (1998). This is a synthesis of the BPR literature. In their model, BPR projects consist of six phases described as follows:

1. Understanding. During this phase, top management recognizes the need for change, and work is undertaken to define and develop a complete understanding of the BPR initiative.
2. Initiating. This phase mainly includes creating a vision, selecting processes that need to be redesigned, defining objectives and forming BPR project teams.

3. Programming. During this phase, the efforts of the project team are focused on identifying breakthrough opportunities and designing new work steps that will create gains and advantages.
4. Transforming. This phase involves actual transformation of the reinvented process. This should take place in a pilot environment.
5. Implementing. During this phase, the new reengineered processes are fully implemented and integrated into the organization. Successful implementation requires an effort to decrease resistance from employees.
6. Evaluating. This phase involves evaluating the success of the BPR project against the expressed performance objectives. This phase is important for continuous commitment to the process of reengineering.

Implementation (i.e., Phase #5 in both previous models) is the focus of this study and it is arguably the most important phase which determines, to the most extent, the fate of BPR projects. As argued by Goodhue and Thompson (Goodhue and Thompson 1995), accepting a methodology per se will not necessarily lead to higher performance, but it is its appropriate implementation that will ultimately determine performance improvement. While planning the implementation of a BPR project, the project team may need to consider: i) what implementation components are involved; ii) what aspects of changes should be carried out; iii) what enablers and success factors are important; and, iv) what outcomes can be achieved through the BPR project. Answers to these questions are revealed in the following sections.

2.2 BPR Project Implementation Frameworks

This section reviews BPR project implementation components with the help of several fundamental BPR project frameworks. In order to successfully implement BPR projects, it is important to first investigate what activities are involved and how they affect each other. A framework is a good means of addressing the complex issues that are typical of BPR projects. By using a framework, the important components or dimensions of BPR project implementation and the relationships among them can be clearly examined.

The first framework that will be reviewed is a comprehensive framework for business process change projects. It includes almost all the elements that need to be considered in a BPR project. The second framework outlines the four most important BPR project drivers and inhibitors. The third framework emphasizes the impact of the Information Systems (IS) Department on BPR project success. This is reviewed because of the special role of the IS department in BPR projects.

2.2.1 Framework for Business Process Change

A frequently cited Business Process Change (BPC) project implementation framework was originally proposed by Kettinger and Grover (1995) and further utilized in many subsequent studies (Grover and Jeong 1995; Guha and Grover 1997; Lai and Mahapatra 2004; Motwani 2003). The concept of BPC in these studies is defined as "an organizational initiative to design business processes to achieve significant (breakthrough) improvement in performance (e.g., quality, responsiveness, cost, flexibility, satisfaction, shareholder value, and other critical process measures) through changes in the relationships between management, information, technology, organizational structure, and people" (Guha and Grover 1997, p.121). Since the only difference between BPC and BPR is the degree of radical change, the literature has come to consider BPC a concept that is similar to BPR because, as discussed previously, BPR has evolved to include more moderate changes within organizations. The general thesis of this BPC framework is that

> "...any significant business process change requires a strategic initiative where top managers act as leaders in defining and communicating a vision of change. The organizational environment, with a ready culture, a willingness to share knowledge, balanced network relationships, and a capacity to learn, should facilitate the implementation of prescribed process management and change management practices. Process and change management practices, along with the change environment, contribute to better business processes and help in securing improved quality of work life, both of which are requisite for customer success and, ultimately, in achieving measurable and sustainable competitive performance gains" (Guha and Grover 1997, p.121).

Process change usually begins with *strategic initiatives* such as envisioning, commitment, and enabling from the senior management team. Strategic initiatives could be a reaction to a need, or a proactive push to leverage potential opportunities. *Learning capacity* of an organization is the ability of the organization to adapt and improve, to build internal and external knowledge, and to achieve higher levels of learning that may be critical to successful business process change. Organization *culture* may facilitate or inhibit the integration of individual learning with organizational learning by influencing an organization's ability to learn, share information, and make decision. *Culture readiness* can be enabled by leadership or change agents, and it can open communication and define the risk-taking propensity of the firm. *IT* is an organizational resource which provides a necessary means to accomplish required knowledge processing, and induces organizational change. *IT* communication infrastructure and the extent of knowledge sharing can create an environment facilitative of successful BPR projects. Balancing *network relationships*, including internal and external networks, is suggested to proactively leverage boundaries during change processes. *Change management* involves countering resistance to change. *Process management* is defined as a set of concepts and practices aimed at better stewardship of business processes.

This comprehensive framework considers both the change environment and the outcomes of change; and it involves issues ranging from change initiatives to change implementation. It outlines what a company should have before embarking on a change project (e.g., strategic initiatives, a culture that is ready for change, a willingness to share knowledge, balanced network relationships, and a capacity to learn), and what aspects a company should focus on during the change process (e.g., process management and change management).

Because the study in this thesis focused on the implementation stage of a BPR project, process management and change management in Guha and Grover's BPC project framework (Guha and Grover 1997) were the objectives considered in this study. Regarding other elements, Guha and Grover classified cultural readiness and IT leveragability in the change environment. However, it is more meaningful to examine how culture could be managed or changed to secure the success of a BPR project, rather than to examine static status of culture readiness, because it is hard to say if an organization is ready enough for a BPR project; even if the culture in an organization is evaluated to be ready, there would be new challenges the organization may encounter during the implementation phase of the BPR project. Therefore, effective change management practices for culture should be considered seriously during the implementation phase of a BPR project. The same arguments were made about IT capability. That is, IT facility improvement, rather than the status of IT capabilities, is an important component for implementing a BPR project.

2.2.2 Framework for Implementing BPR Projects

Change and Powell (1998) proposed a framework for implementing BPR projects in Small and Medium sized Enterprises (SMEs). Their framework emphasizes four elements in an organization with regard to BPR project challenges: structure, resources, culture, and technology.

(1) Structure defines lines of communication and the degree of individual or collective responsibility and accountability (Ascari, Rock and Dutta 1995), as BPR project implementation emphasizes cross-functional teams.

(2) Resources are financial capacity, human resources, research and development, and previous quality management experiences.

(3) Culture is a set of interdependent processes by which work gets done within an enterprise. Behavioural and cultural change is necessary for effective organizational change. The way to have an enduring competitive advantage is to create a culture that continuously produces the next technology by promoting learning and innovation (Covey 1996).

(4) Most reengineering is technology driven, with the role of IT changing from producing data to integrating processes with functions (Ribbler 1996). The goals of the IT function have shifted from cutting costs to increasing knowledge and flexibility. Enablers of IT involve Information Technology/Information Systems (IT/IS) infrastructure, IT/IS expertise and end-user skills, etc.

This framework highlighted two important components (culture and technology) for implementing BPR projects and another two necessities (proper structure and enough resources) that are required for BPR projects. Usually, proper structure and enough resources are made available before BPR project implementation; culture change and IT improvement are realized during the BPR project. Again, the study in this thesis focuses on BPR project implementation, so culture change and IT improvement will be examined.

2.2.3 Framework for Relating the Role of ISD to BPR Projects

Lai and Mahapatra (2004) proposed a framework relating the role of the Information Systems Department (ISD) to BPR project success. They investigated the impact of six key facets of the IS role on BPR project success. Their six facets are:

(1) Support of top IS management. This includes top IS management support, and existence of a project champion.

(2) Support of change management. This includes resistance management, transition management, technical support, and IT training.

(3) Quality of IS planning. This covers planning quality, IS-business integration, and IS resource control.

(4) Competency of IS staff. This includes the experience and the capability of IS personnel.

(5) Success of end-user computing. This includes user computer skills and the extent of computer usage.

(6) Maturity of the IS department. This covers the sophistication of corporate information architecture and information architecture integration.

The results of their research showed that support of top IS management, the existence of a technology champion[1], the management of resistance to change, the quality of IS planning, the integration of an IS-business strategy, the sophistication of user's computer skills, and the extent of integration of the information architecture are the most critical ISD roles in BPR project success.

Though Lai and Mahapatra's study (2004) focused on the impact of the Information Systems Department on BPR project success, most of the attributes

[1] A technology champion is a champion in the Information System Department who promotes the BPR project actively and vigoriously (Lai and Mahapatra 2004).

of the IS department are applicable and necessary to other departments throughout the company since BPR project implementation is cross-functional. For example, support of top management, the management of resistance to change, and competence of staff, are necessary to all departments for successful BPR project implementation.

2.2.4 Summary of BPR Project Implementation Components

All the elements discussed in the foregoing review of BPR project frameworks are organized into two categories (those emphasized in stages before implementation and those during the implementation stage), in Table 2-1. Two conclusions can be drawn from the table: i) change management has been emphasized in all the frameworks for BPR projects; ii) process management and IT improvement are two other important elements in BPR project implementation.

Table 2-1: A Summary of BPR Project Components

Framework Reference	Components in Stages *before* Implementation	Components *during* the Implementation Stage
(Guha and Grover 1997)	- Culture Readiness - Learning Capacity - Strategic Initiative - IT Leveragability and Knowledge Capability - Relationship Balancing	- Process management - Change management
(Chang and Powell 1998)	Structure: -Size and control - Team-based operation - External relations Resources: - Financial Capacities - Human resources - Quality management experiences	Culture management: - Risk attitude - Employee empowerment - Management support and communication - Strategic and business planning Technology: - IT/IS infrastructure - End-user skills training - IT investment
(Lai and Mahapatra 2004)	- Competency of (IS) Staff - Maturity of IS Department - Quality of IS planning	Change management: - Resistance management - Transition management - Technical support - IT training IS management: - Top IS management support - Existence of champion

2.3 Success Factors in BPR Projects

In order to improve the success rate of BPR projects, researchers and practitioners have been involved for some time in observing, re-defining and analyzing success and failure factors for BPR projects (Ahadi 2004; Al-Mashari and Zairi 1999; Attaran 2000; Bashein and Markus 1994; Caccia-Bava et al. 2005; Chrusciel and Field 2006; Grover and Jeong 1995; Holland and Kumar 1995;

McAdam and Donaghy 1999; Paper and Chang 2005; Prosci 2005; Raymond, Bergeron and Rivard 1998; Terziovski, Fitzpatrick and O'Neill 2003).

2.3.1 Assessing Success/Failure Factors

In the early years of BPR practice, positive and negative preconditions for BPR project success were obtained by interviewing BPR consultants (Bashein and Markus 1994; Holland and Kumar 1995). According to a study conducted by Bashein and Markus (1994), senior management commitment and sponsorship, realistic expectations, and empowered and collaborative workers were frequently mentioned as positive preconditions to success; some other preconditions include strategic context of growth and expansion, shared vision, sound management processes, appropriate people who participated full-time in the process, as well as sufficient budgets.

From the opposite point of view, Holland and Kumar (1995) revealed two frequent causes for the failure of reengineering programs: i) targeting wrong or meaningless processes, and, ii) a lack of balanced and sustained executive support. In order to overcome the first obstacle to BPR project success, the authors suggested carefully defining customer needs and the resources that the company needs or already has. As for the second obstacle (lack of balanced and sustained executive support), challenges for executives include vision and perspective, as well as time and energy.

A study conducted by Grover and Jeong (1995) explored the failure factors in implementing reengineering projects and how the severity of these problems related to BPR project success. The finalized categories of BPR project implementation problems obtained from their study were management support problems, technological competence problems, process delineation problems, change management problems, project planning problems, and project management problems. The two categories that were found to be most critical to BPR project success were *change management* and *technological competence*. Negative factors in the change management category included: failure to anticipate and plan for organizational resistance to change, the need for managing change was not recognized, necessary changes in human resource policies for BPR project implementation were not made, inadequate training was provided for personnel affected by the redesign process, etc. Negative factors in the technological competence category included: limited database infrastructure, limited IS (Information Systems) application portfolios, failure to aggressively use IT enablers, limited telecommunication infrastructure, etc. Other factor categories were found to be less important, although they did relate to BPR project success.

BPR project success factors were divided into two groups in a study by Ahadi (2004). One group of factors involved process redesign and the other group of factors was related to change management. In the process redesign group, three categories of success factors were included: i) factors of process, ii) factors of project team management, and iii) IT-related factors. In the change management group, another three categories were involved: i) people-oriented factors, ii) managerial and iii) administrative factors, and organizational factors. Failure factors reported in this study were resistance to change, lack of resources, unrealistic expectations, narrowly defined process, etc. The results showed that:

(1) six success factors (top management support, change management, centralization of decision making, formalization of procedure, organizational culture, and customer involvement) were positively associated with successful implementation of BPR projects; and,

(2) lack of resources was negatively associated with successful implementation of BPR projects.

Some other efforts to assess BPR project success factors are briefly reviewed as follows. Through factor analysis, Caccia-Bava and Guimaraes (2005) divided BPR project success factors into several groups: cross-functionality, BPR process related factors, process expertise, technology support, and leadership/motivation. The factors deemed most important for successful BPR projects in the public sector included top management support, commitment and understanding of BPR initiative, communication, empowerment, and alleviation of downsizing fears (McAdam and Donaghy 1999). The key challenges for successful BPR project implementation were changing attitude and culture, ensuring extensive communications, and dealing with resistance to change by middle management (Chrusciel and Field 2006; Terziovski et al. 2003).

With the accumulation of BPR project experience, more and more success or failure factors have emerged. It is not necessary and almost impossible to list all of the literature that reported BPR project success factors. However, there are researchers who have presented extensive reviews of this area. These will be discussed next.

2.3.2 Reviews of Success Factors

Several researchers (Al-Mashari and Zairi 1999; Paper and Chang 2005) have reviewed and organized BPR project success factors, providing the basis for further studies of BPR project success.

Al-Mashari (1999) conducted a holistic literature review relating to the hard and soft factors that cause success and failure of BPR project implementation, and categorized these factors into five classes.

(1) Change of Management Systems and Culture. Success factors belonging to this class involve revision of motivations and rewards systems, effective communication, empowerment, people involvement, training and education, creating an effective culture for organizational change, and simulation of receptivity of the organization to change. Failure factors in this class involve problems with communication, organizational resistance, lack of organizational readiness for change, problems related to creating a culture for change, and lack of training and education.

(2) Management Competence. Success factors in this class are committed and strong leadership, championship and sponsorship, and management of risk. Failure factors are problems related to commitment, support, and leadership, and problems related to championship and sponsorship.

(3) Organizational Structure. Success factors include an adequate job integration approach, effective BPR project teams, appropriate jobs, and definition and responsibilities allocation. Failure factors include ineffective BPR project teams, problems related to integration mechanisms, job definitions, and responsibility allocation.

(4) BPR Project Management. Success factors involve alignment of the BPR strategy with corporate strategy, effective planning and use of project management techniques, setting performance goals and measures, adequate resources, external orientation and learning, effective process redesign, etc.

(5) IT Infrastructure. Success factors include adequate alignment of IT infrastructure and BPR strategy, building an effective IT infrastructure, adequate IT investment and sourcing decisions, adequate measurement of IT infrastructure effectiveness on BPR projects, effective reengineering of legacy IS systems, increasing IT function competency, etc.

Among these five classes of success factors, both change in management systems and culture and organizational structure involve change management issues. Management competence emphasizes the existence and commitment of a champion and top management support. IT infrastructure deals with IT investment and improvement regarding its effect on BPR projects. Although BPR project management includes success factors for BPR project success, it is not considered to be a component within the BPR project implementation framework; instead, it involves organizing and carrying out BPR project implementation.

A study by Paper and Change (2005) proposed a synthesized model that facilitates the identification of success factors for BPR projects. The theoretical lens in Paper and Chang's model consists of five interdependent components:

(1) Environment (E) factors that lead to structural change include "top-management support, risk disposition, organizational learning, teaming, compensation and reward systems, information sharing, and resources" (Paper and Chang 2005, p.125).

(2) People (P) success factors include "training, education, politics resolution, ownership, and empowerment" (Paper and Chang 2005, p.126).

(3) Methodology (M) success factors include "appropriate guiding principles, buy-in, direction, continuous monitoring, graphical process map, and customer support" (Paper and Chang 2005, p.127).

(4) IT Technology (I) success factors include "IT knowledge, IT belief system, and IT architecture" (Paper and Chang 2005, p129).

(5) Transformation Vision (V) success factors include "vision development, vision communication, vision deployment, and vision flexibility" (Paper and Chang 2005, p.130).

Paper and Change's classification of success factors also covers change management issues (i.e., Environment, People, and Transformation Vision), as well as IT Technology issues. However, it includes another classification (methodology), which deals with how to do a BPR project instead of what to do when implementing a BPR project.

Table 2-2 below summarizes the categories of published success factors we have discussed, combined with the components of BPR project implementation from section 2.2.

Table 2-2: Summary of Success Factors

<table>
<tr><th>Issue</th><th>Category</th><th>Success Factor Group</th></tr>
<tr><td rowspan="5">BPR Project Implementation Components</td><td rowspan="2">Change Management</td><td>- Change of management systems and culture
- Organizational structure</td></tr>
<tr><td>- Environment
- People
- Transformation vision</td></tr>
<tr><td>IT Infrastructure</td><td>- IT investment
- Effectiveness of IT infrastructure</td></tr>
<tr><td rowspan="2">Process Redesign/ Management</td><td>- Best practices in process redesign and management
- Effective process redesign</td></tr>
<tr></tr>
<tr><td>Important Enablers</td><td>Management Competence</td><td>- Project champion
- Top management support</td></tr>
<tr><td rowspan="2">Others</td><td>Methodology</td><td>- Principles
- Direction of design</td></tr>
<tr><td>Project Management</td><td>- Project management techniques</td></tr>
</table>

2.4 ERP Systems Implemented Through BPR Projects

BPR projects are often carried out when companies implement enterprise resource planning systems (Velcu 2007). An enterprise resource planning (ERP) system is a packaged business software system that integrates core business processes such as logistics, financial planning, sales, order processing, production, and material resource planning, and has the potential to link suppliers, customers, and business partners in order to integrate value chain activities (Martin and Huq 2007).

ERP implementation projects have been found to result in changes to processes (Gattiker and Goodhue 2002) because organizations often reengineer business processes to fit the software instead of trying to modify the software to fit the organization's current business processes (Sumner 1999). Hence, a certain level of BPR is typically needed for ERP implementation (Ngai, Law and Wat 2008).

Many studies have investigated the critical success factors in ERP adoption and implementation (Bradley 2008; Ehie and Madsen 2005; Hong and Kim 2002; Ifenedo 2007; Ifinedo and Nahar 2009; Motwani, Subramanian and Gopalakrishna 2005; Nah and Delgado 2006; Ngai et al. 2008; Sumner 1999). Generally, the study conducted by Ngai et al. (2008) extracted 18 factors for ERP success, which included "business plan/vision/goals/justification", "business process reengineering", "change management culture and program", "communication", "ERP teamwork and composition", "monitoring and evaluation of performance", "project champion", "project management", "software/system development", "testing and troubleshooting", "top management support", "data management", "ERP strategy and implementation methodology", "ERP vendor", "organizational characteristics", "fit between ERP and business process", "national culture", and "country-related functional requirement". Top management involvement, leadership, and support, are usually mentioned as the most critical success factors in ERP implementation projects (Loonam and McDonagh 2005; Ngai et al. 2008).

The impacts of organizational contingencies on successful ERP system implementation have also been examined. For example, Ifenedo (2007) revealed the positive influence of organizational size, structure, and culture on ERP systems success. Hong and Kim (2002) investigated the impact of the organizational fit of ERP (e.g., data fit, process fit, and user fit) on ERP implementation success, and the interaction influence of several contingency variables such as ERP adaptation level, process adaptation level, and organizational resistance.

Project management impacts all BPR/ERP projects. Effective project management allows companies to plan, coordinate, and monitor various activities in different stages of implementation (Somers and Nelson 2004). Some project management based factors, such as choosing the right full time project manager, training of personnel, and the presence of a project champion, have been shown to be critical to ERP project success (Bradley 2008). Another recent study (Chen, Law and Yang 2009) examined how poor project management (e.g., scope creep, poor risk management, inadequate allocation of human resources over time, and poor vendor management etc.) could imperil the successful implementation of an ERP system.

2.5 Summary

The literature review on BPR project implementation is summarized as follows.

Firstly, the concept of BPR has evolved to be wider and more moderate, compared to its original definition as "process focused" and "radical change". BPR projects, as other projects, have several stages in their lifecycle. The implementation of BPR projects is the focus of this study.

Secondly, the current literature has not differentiated the components that influence BPR project implementation from the components that precede the project implementation stage. This study organizes influential BPR project components into two categories: components that influence the stages before implementation, and components that influence the implementation stage. This is useful because implementation is the most critical stage of BPR projects, and it will directly determine the fate of BPR projects (Grover and Jeong 1995). Many studies have examined success factors regarding the readiness of BPR projects and BPR project planning (Fenelon 2002), but few have focused on implementation.

Thirdly, the majority of the studies on BPR project implementation have focused on reporting BPR project success factors. In a few cases, relevant theories have been applied to BPR research (Grover and Jeong 1995; Sarker and Lee 2002). However no study, so far, has utilized quantitative research methods to conclusively validate a model based on an appropriate theory that comprises success factors in BPR project implementation.

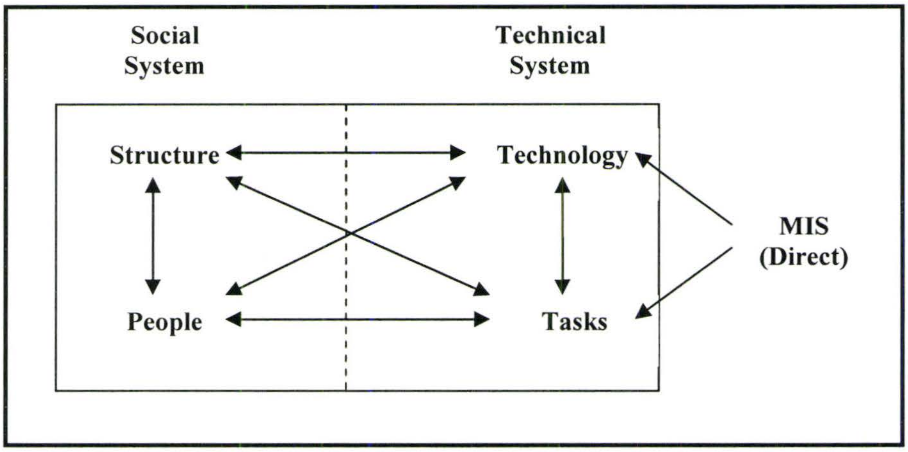
This study aims to fill these gaps, by focusing on the BPR project implementation stage and examining success factors from the socio-technical perspective.

Chapter 3: Theoretical Background and Research Model

3.1 Applying Socio-Technical Theory

Bostrom and Heinen were among the first to advocate the need and importance of Socio-Technical Theory (STT) in Management Information Systems research (Bostrom and Heinen 1977a; Bostrom and Heinen 1977b). STT is illustrated in the framework of Figure 3-1.

Figure 3-1: The Interacting Variable Classes Within a Work System (adapted from Bostrom and Heinen 1977a)



The basic idea from this framework is that "the STT approach views the organization as a work system with two interrelated subsystems, the technical system and the social system; *the technical system* is concerned with the processes, tasks, and technology needed to transform inputs such as raw materials to outputs such as products; *the social system* is concerned with the relationships among people and the attributes of these people such as attitudes, skills, and values. The outputs of a work system are a result of the joint interaction between these two systems" (Bostrom and Heinen 1977a). STT has been utilized in many IS studies (Al-Mudimigh, Zairi and Al-Mashari 2001; Frohlich and Dixon 1999; Iivari and Hirschheim 1996; Land 1987; Markus 1983).

3.1.1 Implementation Components

This study considers both the technical and the social dimensions and their interactions during BPR project implementation. Grover and Jeong (1995) pointed out that the socio-technical theory emphasizes the changes to technical and human resources in light of altered tasks or processes. The technical and human resources, as well as the altered tasks/processes, are reflected in this study as the three main implementation components: Information and Communication Technology Infrastructure (ICTI), change management, and process redesign, respectively.

Information and Communication Technology Infrastructure is the technology foundation dealing with the IT capabilities on which processes and humans rely, such as networks, databases, data inter-exchange, etc. for transforming inputs to outputs (Law and Ngai 2007b).

Change management includes the methods through which attitudes, skills, and values of the people in the system are managed and transformed (Huq, Huq and Cutright 2006). Change management is the soft part of the change since it solves people-side problems within organizations such as employee resistance and structural adjustments. Technology use is customized by organizational, inter-organizational, and institutional arrangements in the process of enactment, combining features of the objective technology with the ways users take advantage of them (Luna-Reyes, Zhang, Gil-García and Cresswell 2005).

Finally, the *redesigned processes* can be thought of as the interaction of the social and technical aspects of socio-technical theory because people (such as employees, customers, etc.) work to get expected outputs by following a company's specific business processes, that are implemented through information technologies. When applying socio-technical theory to BPR project implementation it can be understood that, whether companies have fixed process goals (e.g., BPR projects through ERP systems implementation) or they design processes that fit their own requirements, the new processes cannot work well unless any related people problems are solved and unless IT support is suitable. The effects of ICTI (Information and Communication Technology Infrastructure) and change management will be reflected through the redesign processes. Business processes can never work without both operators (people) and carriers (technical implementation).

3.1.2 The Two Most Important Enablers

Besides the three implementation components, another two important enablers for BPR project success, regarding the social aspect of STT, are BPR project champion and top management support.

A champion is a charismatic individual who throws his or her weight behind an innovation, thus overcoming indifference or resistance that the new idea may provoke in an organization (Rogers 2003). The role of a project champion lies essentially in promoting and selling a project in order to obtain resources and organizational support by demonstrating the feasibility of a project to what may be a reluctant top management (Roure 2001). A project champion will educate managers and users about an innovation, such as a BPR project, and create awareness about the organization's need for it.

Top management plays an important role in BPR projects as suggested by Socio-Technical theory (Markus 1983). A fairly consistent finding in most organizational research is that top management support has been found to be necessary for successful organizational change (Burgelman 1983; Grover 1993; Lucas Jr 1978). "This type (supportive) of leadership offers a vision of what could be and gives a sense of purpose and meaning to those who would share that vision. It builds commitment, enthusiasm, and excitement. It creates a hope in the future and a belief that the world is knowable, understandable, and manageable. The collective energy that transforming leadership generates, empowers those who participate in the process..." (as cited in Lashway 2006, p91; Roberts 1984). As claimed in project management research, "top management support is the most important critical success factor for project success and is not simply one of many factors" (Young and Jordan 2008, p1). This is consistent with findings of the importance of top management support in IS projects (Ein-Dor and Segev 1978; Lucas Jr 1978).

3.1.3 Why Not Use Other Theories?

The studies that have applied theories in BPR research have focused on three different areas. The first area is research on BPR adoption. Innovation Diffusion theory has been utilized to explain the diffusion of BPR adoption by Newell et al. (Newell et al. 2000). Forces regarding BPR adoption have been analyzed through the mechanism of impetus and resistance by using the principles and methods of systems analysis, in conjunction with the theory of mechanical dynamics (Yi, Wang, Wang and Yu 2008). The theory of memetics has been applied to help explain the diffusion of management innovations, such as BPR, as a dynamic evolutionary process (O'Mahoney 2007).

The second area of focus is research on BPR project implementation. Sarker and Lee (2002) used Socio-Technical Theory (STT) in the BPR project context and concluded that both social and technical dimensions, as well as their interactions, are needed to explain the successful implementation of a BPR project. Sarker et al. applied Actor Network Theory (ANT) to explain BPR project implementation failures (Sarker et al. 2006).

The third area of focus involves BPR modeling techniques. Social Network Analysis theory (SNA) has been applied to support the task of designing

IT-enabled business processes by providing social network measures for evaluating alternative process designs (Hassan 2009).

For the purpose of this study, which is to examine the successful implementation of BPR projects, the second group of theories (i.e., theories for BPR project implementation) is appropriate.

In preparation for this work, ANT (Actor Network Theory) was also examined. ANT is a theory which creates heterogeneous networks comprising humans and nonhuman artifacts, analyzes the connections and interactions among them, and claims societal order is an effect that is caused by such networks running smoothly (Callon and Latour 1981). There are two reasons why ANT was not chosen. First, ANT is a sociological theory which investigates the social balance among all the possible actors in the social network, and the analysis is more focused on the individual level (Callon 1986). ANT is good at explaining the social aspects of undertaking a BPR project; however, it does not pay enough attention to the technical aspects. The objective of this study is to evaluate how BPR project implementation components affect organizational performance. BPR project implementation involves both social and technical aspects, and both are critical enablers of BPR project success, and ANT is weaker than STT in explaining both of these aspects. Besides, the examination unit of this study is at the organizational level, for which STT is more suitable than ANT, given that STT applies to both individual and organizational examination (Bostrom and Heinen 1977a).

Second, ANT treats both human and non-human actors in the same way; it also requires the elimination and abandonment of all a priori distinctions between technological, natural, and social phenomena (Walsham 1997). The focus of this study, again, is on BPR project implementation, which requires changes in both social and technical systems, as well as their interaction. The technical part and the social part are different from each other, so their distinctions should not be eliminated. STT is more appropriate because STT emphasizes that any organizational system will maximize performance only if the interdependency of the subsystems (social and technical subsystems) is explicitly recognized (Bostrom and Heinen 1977a).

3.2 Research Questions

Based on the foregoing discussion, research questions that this study will address include:

RQ1: What is the influence of a BPR project champion on top management support?

RQ2: What are the major implementation components for successfully implementing a BPR project?

RQ3: What is the influence of top management support on BPR project implementation components? Does top management support mediate the relationships between the BPR project champion and the components of a BPR project implementation?

RQ4: How do the components of BPR project implementation affect BPR project outcomes?

RQ5: How do the BPR project outcomes contribute to the overall success of a BPR project?

RQ6: How do the components of a BPR project implementation directly affect the overall BPR project success?

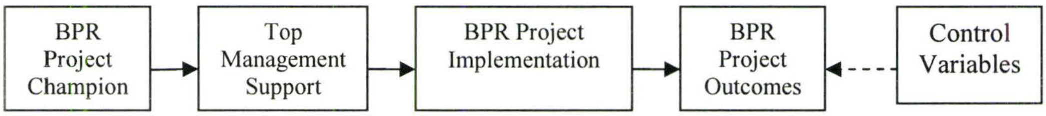
These research questions are more specific to BPR projects than other IS implementation projects because common IS implementation projects rarely involve redesigning processes. The research questions form the background for constructing a number of specific hypotheses which are described below.

3.3 Hypothesis Development and Research Model

Socio-Technical Theory is utilized in this study to choose and organize the most important and necessary success factors for successful BPR project implementation. This is useful because it is possible to pay too much attention to less important factors and thus to miss the most necessary and important factors when faced with a large pool of success factors collected from diverse sources and experiences. According to STT, the three main components of BPR project implementation (change management, ICTI improvement, and process redesign) should be the most important part of our research model. Besides, the presence of a project champion and top management support are essential enablers for success because of the difficulty that management encounters when developing and implementing BPR projects.

Therefore, the research model comprises five major areas (as shown in Figure 3-2): i) BPR project implementation, which involves three components; ii) BPR project champion; iii) top management support; iv) BPR project outcomes and project success; and, v) control variables. This section will discuss each of them in turn, and develop the relevant hypotheses and research model.

Figure 3-2: The Preliminary Model



3.3.1 BPR Project Implementation Components

As discussed, BPR project implementation involves three important components: process redesign, change management, and ICTI (information and communication technology infrastructure) improvement.

3.3.1.1 Process Redesign

Optimizing business processes is one of the basic reasons for implementing a BPR project. Many derived benefits result from improved business processes.

Processes should be redesigned such that they result in improvements regarding organizational goals (Reijers and Mansar 2005). Different BPR projects may aim at different positive outcomes (e.g, time, cost, quality or flexibility). Although these outcomes are ideally desired simultaneously, the reality is that improving upon one such dimension may have a weakening effect on another (Reijers and Mansar 2005). For example, task elimination would potentially reduce cost and time, but quality and flexibility might be reduced as an unexpected result.

Another aspect of process redesign is that the reengineered processes must fit the organization within which the processes are performed. One best practice for a company may be nonsense for another. Hence, picking the right process and taking the right action to redesign the process are important determinants of the success of BPR projects.

A study done by Mansar and Reijers (2005) identified and validated a framework of best practices for redesigning business processes, to assist designers in selecting the proper best practice(s). This list of best practices in redesigning processes provides practitioners with guidance about possible solutions.

Process redesign practices can be classified into two dimensions according to Attaran (2003): i) technical design, during which information is consolidated, alternatives are redefined, process linkages are reexamined, and controls are relocated prior to applying technology; ii) social design, which focuses on the human aspects and involves employees who will affect corporate changes. Whether or not the processes are appropriately redesigned will determine the fate of a BPR project.

3.3.1.2 Change Management

Change management is a structured approach to transitioning individuals, teams, and organizations from a current state to a desired future state (Worren, Ruddle and Moore 1999). The current definition of change management includes both organizational change management processes and individual change management models, which together are used to manage the people side of change (Hiatt 2003).

Change management effectively balances the forces in favour of change over the forces of resistance (Archer 2003; Archer 2005; Strebel 1992). Davenport (1993) pointed out that "to focus only on information and associated technologies as vehicles for process change is to overlook other factors that are at least as powerful, namely, organizational structure and human resources policy." The opinion of some change management researchers is that a BPR program is just a change management program (Aladwani 2001; Taylor 1998). Although this viewpoint is extreme, it explains the important role of change management (Albizu, Olazaran and Simon 2004; Bradley 2008; Grover 1999; Teng, Grover and Fiedler 1996).

During the whole procedure of change, managing resistance to change is critical for successful outcomes. Organizations, groups, and individuals will resist changes that are perceived as a threat to their frame of reference (Markus 1983). BPR studies have shown that resistance to change is a key barrier to achieving expected BPR project outcomes (Grover and Jeong 1995; Guha and Grover 1997; Motwani 2003; Prosci 2005).

Grover (1999) found that the severity score of change management was high and the relationship between change management and BPR project success was strong. This demonstrates the central importance of change management in BPR project implementation success. Another study (Ahadi 2004) also showed evidence that "effective change management is positively associated with successful implementation of BPR".

Change management involves the following aspects (Al-Mashari and Zairi 1999; Hall, Rosenthal and Wade 1993):

(1) Revising reward and motivation systems, facilitating redesigning efforts, and smoothing the insertion of new processes;

(2) Effective communication is a key factor during the change process at all levels in the organization;

(3) Empowerment establishes a culture in which employees at all levels feel more responsible and accountable;

(4) Direct personal involvement ensures that all people are openly and actively involved;

(5) Training and education are necessary and important factors for successful BPR projects, suggesting an ongoing endeavor in training;

(6) Creating an effective culture for organizational change is critical for success, as well as

(7) Stimulating the organization's receptiveness to change, and

(8) Preparing the organization to respond positively to BPR-related change.

Communication is also important for stakeholders during a BPR project. A business process is an activity in which stakeholders interact to achieve desired results (Grady and Hammer 1996). Regular communication with key stakeholders has been found to be an important factor in BPR projects (Oakland and Tanner 2007). A business process is not just a series of activities or steps using resources and methods to achieve a desired result, but it is where stakeholders come together, interact, communicate and negotiate (Grady and Hammer 1996). Stakeholders include all those affected by the activities of a corporation: employees, customers, suppliers, wholesalers, retailers, stockholders, bondholders, bankers, debtors, and others (Shoaf 1996). Key stakeholders have to be favorably disposed to change in order for change strategies to have any real chance of success (Galliers and Baker 1995). Therefore, any attempt to improve work must consider each stakeholder's interest. Otherwise, the organization as a whole will not benefit. Paper and Change (2005) identified an additional success factor for BPR projects – top management should proactively sell the vision to key stakeholders before they try to implement change.

In summary, the literature has suggested three dimensions of Change Management (Al-Mashari et al. 2001; Grover and Jeong 1995; Teng et al. 1996):

(1) Change management at the *organizational level*, referring to organizational culture change and human resources system change (Al-Mashari and Zairi 1999; Bee Wah and Kok Wei 2006; Grover and Jeong 1995).

(2) Change management at the *employee level*, referring to the management of employee resistance through empowerment, communication and training (Al-Mashari and Zairi 1999; Grover and Jeong 1995).

(3) Change management at the *stakeholder level*, referring to the management of stakeholder resistance and commitment (Kettinger and Teng 1997; Nwabueze 2000; Paper and Chang 2005; Teng et al. 1996).

3.3.1.3 ICTI Improvement

Information Technology as an enabler of BPR project success was observed in the early stage of BPR evolution (Bhatt and Stump 2001; Davenport 1993; Hammer 2007; Mitchell and Zmud 1999; Mitchell and Zmud 2006). The impacts of IT on process innovation were described by Davenport as: automational (eliminating human labor from a process), informational (capturing process information for purposes of understanding), sequential (changing process sequence or enabling parallelism), tracking (closely monitoring process status and objects), analytical (improving analysis of information and decision making), geographical (coordinating processes across distances), integrative (coordination between tasks and processes), intellectual (capturing and distributing intellectual assets) and disintermediating (eliminating intermediaries from a process) (Davenport 1993). IT, in the form of communications networks and shared databases, usually underpins the relevant architecture of business process redesign (Earl and Khan 1994).

ICTI (i.e., Information and Communication Technology Infrastructure) is defined as the foundation of the IT portfolio (including both technical and human assets), shared throughout the firm in the form of reliable services, and usually coordinated by the IS (Information Systems) group (Abdolvand et al. 2008; Broadbent, Weill, Clair and Kearney 1999; McKay 1989; Weill, Broadbent and St. Clair 1996). Conceptually, ICTI includes networks, management and provision of large-scale computing, electronic data interchange, management of shared customer databases, and research and development aimed at identifying emerging technologies (Davenport 1993; Davenport, Hammer and Metsisto 1989). The capabilities of ICTI consist of a wide spectrum of components, including ICTI platforms, standards, policies, and different types of service arrangements (Law and Ngai 2007b).

Factors related to ICTI have been increasingly considered by many researchers and practitioners as a vital component of successful BPR project efforts (Al-Mashari and Zairi 1999). Reliable IT infrastructure resources can ensure the success of IT architecture, ultimately enhancing support for changing business needs (Karimi, Somers and Bhattacherjee 2007). A multiple-case study conducted by Broadbent et al. (1999) indicated that the firms that had developed a higher level of ICTI capabilities, before or concurrent with undertaking business process redesign, were able to implement extensive changes to their business processes over relatively short time frames. Other studies also showed that ICT infrastructure capabilities are critical for successful BPR projects (Bee Wah and Kok Wei 2006; Bhatt 2000b; Chang and Powell 1998).

Note that the implementation type (outsourcing or in-house) of the ICTI is not the focus of this research. Rather, this study looks at ICTI improvement, which is defined as the improvement of ICTI capabilities within a company through a BPR project, whether the company achieves improvements through outsourcing or through in-house development and implementation.

3.3.2 BPR Project Champion

In the IS literature, some studies have shown positive relationships between strong champions and successful diffusions of innovation (Brown, Booth and Giacobbe 2004; Grover 1993; Lindsey and Cheney 1990; Schon 1963). Lindsey and Cheney (1990) indicated that the presence of responsive and visionary champions is critical to IT implementation success. Champions often play the roles of opinion leader, change agent, or top management surrogate, and set the right technological policy for the creation of an environment conducive to technology innovation. Brown et al. (2004) found that the three factors at the higher level (top management support, internal champion support, and large organizational size), could initiate adoption of an innovation within an organization. The continuity of champion involvement has also been highlighted in some studies (Beath 1991; Newman and Sabherwal 1996).

As an organizational innovation, BPR projects need a strong champion for their survival. As Schon stated, "The new idea either finds a champion or dies" (Schon 1963). Past research has shown that the existence and commitment of an innovation champion is a critical success factor for BPR projects (Davenport 1993; Kettinger and Teng 1998; Lai and Mahapatra 2004; Ngai et al. 2008; Paper and Chang 2005). Change management as part of a BPR project also depends on a champion to ensure success (Bradley 2008; Oakland and Tanner 2007).

Rogers (2003) emphasized that for costly, visible, or radical projects, the champion needs to be a powerful individual with a high office in the organization. In the context of a BPR project, strong champions are important in BPR project success because reengineering often requires adjustments to reward systems, changes in authority or responsibility patterns, alteration of business practices, or shifting of power centres. These are often met with some resistance (Lindsey and Cheney 1990). Other BPR project literature has also indicated that the strong commitment of champions is necessary for BPR project success (Davenport 1993; Kettinger and Teng 1998; Paper and Chang 2005).

Project champions contribute not just to the adoption stage of an innovation, but also to its implementation stage. This is particularly true for an innovation which hinges on overall organizational commitment and perseverance, such as ERP implementation and BPR projects (Fui-Hoon Nah, Zuckweiler and

Lee-Shang Lau 2003). This requires someone to be placed in charge to "champion" the project throughout the organization (Stefanou 1999; Sumner 1999).

It is often a champion who realizes the need of a BPR project first. And then champions usually aim first to obtain top management support for their innovative ideas, to ensure that their project will be able to move ahead (Rogers 2003). Throughout the entire BPR project, a BPR project champion is expected to positively affect top management support, posited as the following hypothesis:

H1. The extent to which BPR project champions commit during the BPR project will positively affect the strength of top management support.

3.3.3 Top Management Support

Numerous surveys and case studies have shown that top management support is one of the most highly ranked success factors in BPR project practice (Ahadi 2004; Al-Mashari and Zairi 1999; Attaran and Wood 1999; Caccia-Bava et al. 2005; Prosci 2005). A lack of such support would likely lead to project failure (Fui-Hoon Nah et al. 2003; Grover and Jeong 1995; Herzog, Tonchia and Polajnar 2009). Grover and Jeong (1995) identified the lack of top management support as a serious problem in the success of business process reengineering practices. Strong support from top management is also necessary to resolve any conflict of interest among the various parties involved (Ahadi 2004; Grover and Jeong 1995).

This study posits that top management support is critical to successful BPR project implementation (Ahadi 2004; Al-Mashari and Zairi 1999; Attaran and Wood 1999; Caccia-Bava et al. 2005; McAdam and Donaghy 1999; Prosci 2005). As discussed, three components of BPR project implementation will decide the fate of a BPR project: change management, ICTI improvement, and process redesign. Therefore, top management support is hypothesized to positively relate to these three aspects as follows:

H2a. Stronger top management support will result in more comprehensive change management for a BPR project.

H2b Stronger top management support will result in more comprehensive process redesign for a BPR project.

H2c. Stronger top management support will result in a higher level of ICTI improvement for a BPR project.

As a result of H1 and H2, top management support is hypothesized to play a mediating role in the relationships between the BPR project champion and the three components of a BPR project implementation. The model rationale for these two hypotheses is that BPR project champions will positively affect BPR project success, directly mediated by top management support; and indirectly mediated by the BPR project implementation components (i.e., change management, process redesign, and ICTI improvement).

3.3.4 BPR Project Outcomes and Project Success

BPR project success is the ultimate dependent variable in this study. BPR project success is defined as the advantageous outcomes that a BPR project achieves for an organization. It is impossible and improper to use a single financial criterion (e.g., cost reduction itself) to evaluate BPR project outcomes. Grover used two different perspectives: perceived level of success and goal fulfillment, to evaluate redesign success (Grover and Jeong 1995). The perceived level of success seeks to assess the degree of attainment in relation to the targets, and the goal fulfillment perspective determines success by attainment of a normative state (Hamilton and Chervany 1981). The perspective of perceived level of success is an overall assessment of BPR project success and has been used in other studies (Ahadi 2004; Sun, Yazdani and Overend 2005). In similar examples, respondents were asked to give a percentage indicating the level of BPR project success (Al-Mashari et al. 2001); BPR project success has also been defined as the benefits the institution has derived from the BPR project according to top manager opinion (Caccia-Bava et al. 2005; Herzog et al. 2009).

The second perspective, goal fulfillment, is based on the commonly emphasized goals of BPR projects. For example, Davenport listed five objectives: cost reduction, cycle-time reduction, customer satisfaction level increase, worker productivity increase, and defect reduction (Davenport 1993). Grover and Jeong used this set of goals to assess BPR project success in a study conducted in 1995 (Grover and Jeong 1995); they utilized three categories of outcomes to evaluate the success of redesign: project outcomes (improved cycle times, improved customer service, reduced cost, improved quality of products/services and improved organizational responsiveness), people outcomes (improved employee morale, or layoffs), and structural outcomes (changed organizational structures).

Raymond et al. (1998) identified and tested five dimensions of BPR project outcomes:

(1) greater market coverage (measured by the number of new products or services offered, by an increase in sales and market share, and by an enlarged client base);

(2) improved quality in goods and services (e.g., customer service and satisfaction), that is called operational quality improvement;

(3) improved quality of organizational coordination and communication (less managerial hierarchy, task enrichment, reduced bureaucracy), that is called organizational quality improvement;

(4) administrative and production cost savings (in terms of return on investment, personnel costs, operational costs, and profits); and

(5) increased productivity from workers and managers (more units produced, fewer delays).

This study adopted the latter four dimensions to evaluate BPR project success. They are: operational quality improvement (OpQI), organizational quality improvement (OrQI), cost savings (CS), and productivity (PROD). The first dimension (market coverage) was not used because few other BPR project studies included this consideration of BPR project outcomes. A similar evaluation of BPR project outcomes has been applied in other studies (Guimaraes and Bond 1996; Herzog et al. 2009).

BPR project implementation has great potential to directly affect its project outcomes (Grover and Jeong 1995; Herzog et al. 2009; Raymond et al. 1998). The three BPR project implementation components are hypothesized to directly affect the four dimensions of BPR project outcomes. These will be examined through hypotheses 3 to 5.

H3a. More comprehensive change management will result in a higher level of operational quality improvement for a BPR project.

H3b. More comprehensive change management will result in a higher level of organizational quality improvement for a BPR project.

H3c. More comprehensive change management will result in greater cost savings for a BPR project.

H3d. More comprehensive change management will result in a higher level of productivity for a BPR project.

H4a. More comprehensive business process redesign will result in a higher level of operational quality improvement for a BPR project.

H4b. More comprehensive business process redesign will result in a higher level of organizational quality improvement for a BPR project.

H4c. More comprehensive business process redesign will result in greater cost savings for a BPR project.

H4d. More comprehensive business process redesign will result in a higher level of productivity for a BPR project.

H5a. A higher level of ICTI improvement will increase operational quality improvement for a BPR project.

H5b. A higher level of ICTI improvement will increase organizational quality improvement for a BPR project.

H5c. A higher level of ICTI improvement will increase cost savings for a BPR project.

H5d. A higher level of ICTI improvement will increase productivity for a BPR project.

All of the specific BPR project outcomes are expected to contribute to the overall BPR project success (Grover and Jeong 1995). Note that BPR project success in this study refers to improvement success resulting from a BPR project, instead of the success of project completion (e.g., under budget, within time constraints, etc.). However, it is not known how they contribute. Hence, Hypotheses H6a-d were developed to examine the effects of the four dimensions of goal-fulfillment BPR project outcomes on overall BPR project success:

H6a. A higher level of operational quality improvement from a BPR project will result in a higher level of BPR project success.

H6b A higher level of organizational quality improvement from a BPR project will result in a higher level of BPR project success.

H6c. A higher level of cost savings from a BPR project will result in a higher level of BPR project success.

H6d. A higher level of productivity from the BPR project will result in a higher level of BPR project success.

3.3.5 Control Variables

Several control variables (company size, the country where the company is located, and the company's position in industry) have been indicated by the literature to have a potential impact on BPR project implementation.

- **Company Size**

Larger companies, with their larger operating budgets, technology base, and resources, are generally able to implement more extensive BPR projects. On the other hand, large companies tend to be less flexible than smaller companies because they need more communication, coordination, and support to effect radical innovations (Nord and Tucker 1987). Some research has shown that the relationships between BPR project success factors and the attainment of advantage will differ between small and medium sized enterprises (SMEs) and large enterprises (Raymond et al. 1998). The ERP literature also suggested that the adoption and implementation of ERP systems (Buonanno, Faverio, Pigni, Ravarini, Sciuto and Tagliavini 2005; Laukkanen, Sarpola and Allikainen 2005) depend on company size, and ERP benefits and success differ according to company size (Ifenedo 2007; Mabert, Soni and Venkatraman 2003).

- **Organizational Culture**

Organizational culture has been found to be associated with BPR adoption (Newell et al. 1998) and with successful implementation of BPR projects (Agrawal and Haleem 2003; Ahadi 2004; Martinsons, Davison and Martinsons 2009; Neghab, Sardari and Imani 2009). Organizational culture is a complex concept which may be reflected in multiple facets such as power distance, uncertainty avoidance, individualism and masculinity (Agrawal and Haleem 2003; Hofstede 1991; Martinsons et al. 2009; Nasierowski 2000). Cooperation, coordination, and empowerment of employees are the standard characteristics of an innovative organizational environment (Rogers 2003). Aspects of organizational culture, such as shared organizational vision and information, open communication, strong leadership style, and employee participation in decision making, will affect implementation of a BPR project (Grover and Jeong 1995; Neghab et al. 2009).

- **Strategic Stimulus**

Strategy has been investigated in BPR project research from different aspects (Guha and Grover 1997; Maull, Tranfield and Maull 2003; Mitchell and Zmud 1995; Mitchell and Zmud 1999; Tallon, Kraemer and Gurbaxani 2000). Through

Tallon's classification of IT strategies (Tallon et al. 2000), Porter's distinction between operational effectiveness and strategic positioning can be translated directly into corresponding goals for BPR projects. Business strategy can be associated with BPR initiatives in order to develop a classification of organizations based on whether their BPR project goals emphasize operational effectiveness, strategic positioning, or both. Consequently, three groups of BPR project strategies can be identified:

(1) Operational-focus BPR projects focus on cost reduction, improving quality and speed, and enhancing overall firm effectiveness. This is from the perspective of internal forces.

(2) Market-focus (or strategic-focus) BPR projects focus on extending market reach and changing industry and market practices, from the perspective of external competition.

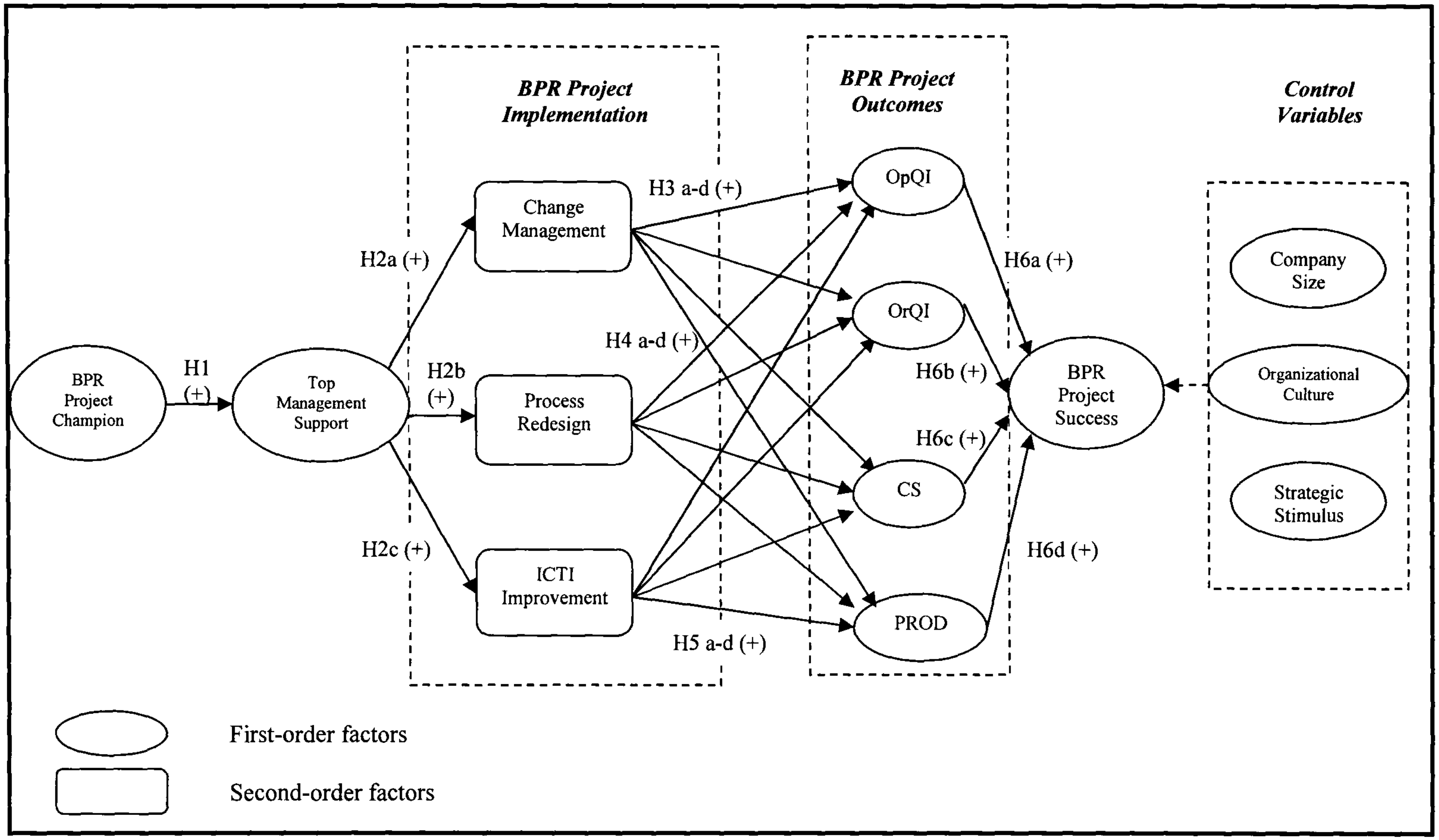
(3) Dual-focus BPR projects focus on a combination of both operational and market goals, i.e., both internal and external (Porter 1985; Porter 1996; Tallon et al. 2000).

In Guha and Grover's (1997) antecedent model of BPR project implementation, strategic initiatives include a "stimuli" construct, which can be either proactive or reactive. A proactive initiative is a push to leverage potential opportunities, while a reactive initiative is a reaction to a need (customer needs or market needs). These two initiatives in fact correspond to the operational focus and strategic focus discussed above.

3.3.6 The Proposed Model

The review and discussion above can be summarized in our proposed research model (shown in Figure 3-3). This model includes the three most critical components (change management, process redesign, and ICTI improvement) for BPR project implementation, which are thought of as antecedents of successful BPR project outcomes. BPR project champion and top management support are deemed as strong enablers for successful BPR projects. BPR project success is viewed from four perspectives (operational quality improvement, organizational quality improvement, cost savings, and productivity). Company size, organizational culture, and strategic stimulus are included as control variables.

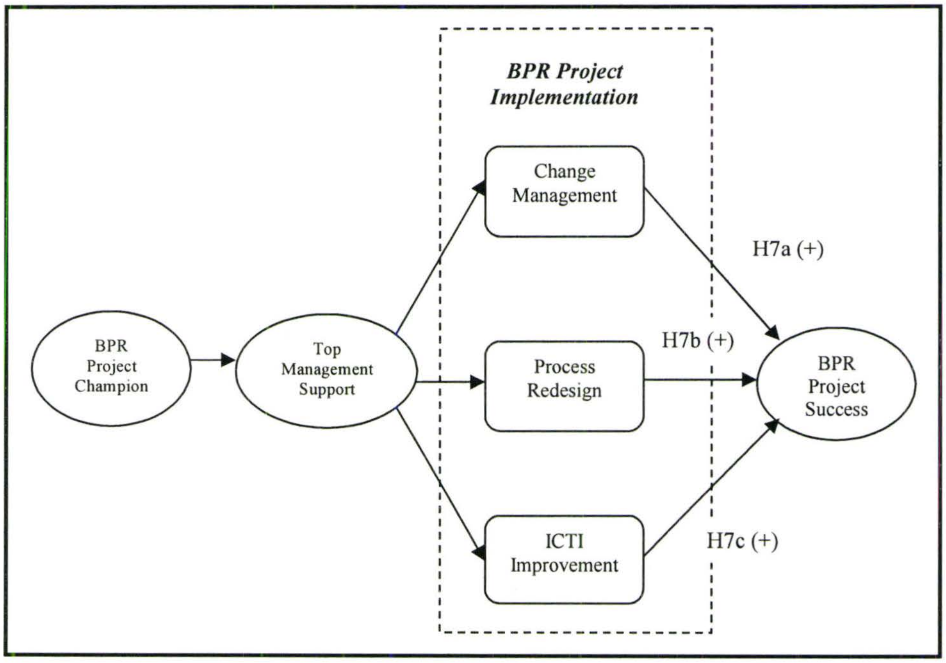
Figure 3-3: The Proposed Research Model



Notes: OpQI: Operational Quality Improvement
OrQI: Organizational Quality Improvement
CS: Cost Savings
PROD: Productivity

Testing hypotheses 3, 4 and 5 will help to determine how each of the components of BPR project implementation (i.e., change management, process redesign, and ICTI improvement) affects each of the facets of BPR project outcomes (i.e., operational quality improvement, organizational quality improvement, cost savings, and productivity). However, it is interesting to know how each of the components of BPR project implementation directly affects overall BPR project success. Therefore, the four facets of BPR project outcomes were removed from the model to get the "Direct Impact" model (Figure 3-4) through which the direct relationships of BPR project implementation components on BPR project overall success can be examined. It is worthwhile to do so because this test will help infer the priorities of the impacts of the BPR project implementation components on ultimate BPR project success.

Figure 3-4: The "Direct Impact" Research Model



Hence, another set of hypotheses was developed:

H7a. More comprehensive change management will result in a higher level of overall BPR project success.

H7b. More comprehensive business process redesign will result in a higher level of overall BPR project success.

H7c. A higher level of ICTI improvement will result in a higher level of overall BPR project success.

Chapter 4: Research Design

Generally there are four key elements of a research project: research questions, prior work, research design, and contribution to literature (Creswell 2003; Edmondson and McManus 2007; Rogelberg 2002). Research questions and prior work have been discussed in previous chapters. This chapter focuses on research design - how this study gets from the initial set of research questions to a logical and valid set of conclusions (Yin 2003); more specifically, the methods and tools for data collection and analysis that were used in this study.

4.1 Research Methodology

4.1.1 Philosophical Perspectives

Generally, the philosophical underpinnings of IS research can be classified into three main categories: the positivist, interpretive, and critical traditions (Chua 1986; Myers and Avison 2002; Orlikowski and Baroudi 1991).

Positivist approaches assume that reality is objectively given and can be described by measurable properties that are independent of the observer (researcher) and his/her instruments. Positivist studies are premised on the existence of a priori fixed relationships within phenomena which are typically investigated with structured instrumentation (i.e. surveys) (Chua 1986; Orlikowski and Baroudi 1991).

Interpretivist approaches assume that "people create and associate their own subjective and inter-subjective meanings as they interact with the world around them" (Chua 1986; Orlikowski and Baroudi 1991). The criterion for classifying research as interpretive is evidence of a nondeterministic perspective where the intent of the research is to increase understanding of the phenomenon within cultural and contextual situations (Orlikowski and Baroudi 1991).

Critical studies aim to critique the status quo, through the exposure of what are believed to be deep-seated and structural contradictions within social systems, and thereby to transform these alienating and restrictive social conditions (Orlikowski and Baroudi 1991). Critical research assumes that social reality is historically constituted by people and that people can change their social and economic circumstances, but only to a limited extent due to social, cultural and political constraints (Myers and Avison 2002).

Based on these classification and their corresponding assumptions, the philosophical underpinning of this study is positivist, because the emphasis is to be placed on the testing of relationships between phenomena. Basically, the positivist tradition concentrates on theory testing in order to increase the predictive understanding of variables or phenomena.

4.1.2 Research Type and Method

This is an exploratory study which defines possible relationships between constructs based on prior studies and utilizes multivariate techniques to estimate such relationships. This study used quantitative research methods to test the research model. It was implemented as a field study that employed statistical survey methods.

When gathering a batch of research evidence, one is always trying to maximize three desirable criteria: i) generalizability of the evidence over the populations of actors; ii) precision of measurement of the behaviors that are being studied; and, iii) realism of the situation or context within which the evidence is gathered. However, these three criteria cannot all be maximized at the same time (McGrath 1994). Quantitative research is designed to ensure objectivity, generalizability and reliability (Babbie c2004). The strengths of the quantitative paradigm are that its methods produce quantifiable, reliable data that are usually generalizable to some larger population; the weaknesses of the quantitative approach are that it decontextualizes human behavior in a way that removes the event from its real world setting and ignores the effects of variables that have not been included in the model (Babbie c2004).

4.2 Data Collection

In order to collect data for testing the proposed hypotheses, this research employed a statistically-grounded survey method. A survey is "not just an instrument for gathering information. It is a comprehensive system for collecting information to describe, compare or explain knowledge, attitudes and behavior" (Pfleeger and Kitchenham 2001, p.16). Activities involved in a survey are: i) identification of a target population; ii) design and, if necessary, pretest an instrument to establish its validity and reliability; iii) decide on appropriate data analysis techniques; iv) calculate sample size requirements and select a valid sample; v) predict an acceptable response rate; and, vi) develop data collection procedures (Pfleeger and Kitchenham 2001).

4.2.1 Construct Operationalization

A "complete" explanatory model would include an unmanageable number of variables (Grover 1993). The variables selected for this research attempt to build on some of the general consensus in the literature on both conceptual and empirical work on the success of BPR projects.

A survey instrument was developed by both identifying appropriate measurements from a comprehensive literature review, and proposing new constructs based on their conceptual domains identified in the existing literature. Some modifications were made to existing scales to make them more suitable to this study. The instrument in this study involves both reflective and formative constructs.

4.2.1.1 Formative versus Reflective Indicators

The assumption in using reflective indicators is that the variance in the scores on measures of a construct is a function of the true score plus error and leads to a causal direction - the underlying latent construct causes the observed variation in the measures (Bollen and Lennox 1991). This kind of causality is conceptually appropriate in many cases, but not all - “in many cases, indicators could be viewed as causing rather than being caused by the latent variable measured by the indicators" (MacCallum and Browne 1993, p533). It has been recognized that it makes more sense conceptually to view causality flowing from the measures to the construct, i.e., a formative indicator measurement model (Bagozzi 1981; Fornell and Bookstein 1982; Jarvis, Mackenzie, Podsakoff, Mick and Bearden 2003). In a formative indicator measurement model, changes in the measures are hypothesized to cause changes in the underlying construct. Indicators, as a group, then jointly determine the conceptual and empirical meaning of the construct.

Unfortunately, formative constructs are often incorrectly modeled as reflective constructs, which can affect the conclusions about the theoretical relationships among the constructs, because measurement model misspecification of even one formatively measured construct within a typical structural equation model can cause serious bias (Diamantopoulos, Riefler and Roth 2008; Jarvis et al. 2003). The almost automatic acceptance of reflective indicators has been criticized by some researchers (Diamantopoulos and Winklhofer 2001). Bollen (1989, p65) pointed out that "most researchers in the social sciences assume that indicators are effect indicators. Cause indicators are neglected despite their appropriateness in many instances". A review by Jarvis et al. (2003) found that 29 percent of the latent constructs with multiple measures found in the top-four marketing journals during the precious 24 years were incorrectly modeled; whereas Petter et al. (2007) found that there was a 30 percent level of misspecification in the IS literature. This problematic situation also exists in other research areas. For example, Podsakoff et al. (2006) revealed inappropriate modeling for 62% of constructs published in three major strategic management journals (*Academy of Management Journal, Administrative Science Quarterly, Strategic Management Journal*); while Podsakoff et al. (2003) reported a misspecification rate of 47% for leadership research (including publications in

The Leadership Quarterly, Journal of Applied Psychology, and again the *Academy of Management Journal*).

Researchers (e.g., Diamantopoulos et al. 2008; Jarvis et al. 2003; Petter et al. 2007) advocate examining constructs carefully before classifying them into reflective or formative categories. Jarvis et al. (2003) proposed a set of criteria (see Table 4-1) on how to determine if a construct should be modeled as formative or reflective.

Table 4-1: Criteria for Judging a Construct as a Formative Indicator Measurement Model, and the Analysis of Three Constructs in This Study (Based on Jarvis et al. 2003)

Criteria	Process Redesign	Change Management	ICTI Improvement
(a) The indicators are viewed as defining characteristics of the construct.	√	√	√
(b) Changes in the indicators are expected to cause changes in the construct.	√	√	√
(c) Changes in the construct are not expected to cause changes in the indicators.	√	√	√
(d) The indicators do not necessarily share a common theme.	√	√	√
(e) Eliminating an indicator may alter the conceptual domain of the construct.	√	√	√
(f) A change in the value of one of the indicators is not necessarily expected to be associated with a change in all of the other indicators.	√	√	√
(g) The indicators are not expected to have the same antecedents and consequences.	√	√	√

Based on the work of Jarvis et al. (2003), Petter et al. (2007) illustrated these criteria in detail as four decision rules to guide researchers when they are considering modeling formative constructs:

(1) Consider the theoretical direction of causality between each construct and its measures. If causality is directed from the items to the construct, the construct is formative.

(2) Examine the interchangeability of the measures. Good reflective measures should be unidimensional and reflect this common theme; while formative measures may not be interchangeable and will often employ different themes.

(3) Check if the measures covary with one another. Internal consistency (reliability) is important in reflective measures; while formative measures do not need to covary.

(4) Check if the measures of the construct have the same antecedents and consequences. Since formative constructs are made up of measures that may be very different, it is not necessary for the measures to have the same antecedents and consequences.

Three of the constructs in this study were classified as formative scales according to Jarvis et al.'s (2003) criteria and Petter et al.'s (2007) decision rules. The three constructs are: Change Management, Process Redesign, and ICTI improvement. Recall the discussion in Chapter 2 that each of the three constructs includes several dimensions. The reasons (see Table 4-1) that the three constructs were judged as formative are as follows:

(1) Their dimensions are viewed as defining characteristics of the constructs. For example[2], change management conceptually involves three dimensions: change management at the organizational level,

[2] Change management is used as an example to illustrate these criteria. Please refer to section 4.2.1.3 for details about the three formative constructs.

change management at the employee level, and change management at the stakeholder level. These dimensions are viewed as defining the whole concept of change management.

(2) Changes in any one of the dimensions are expected to cause changes in the construct, but changes in the construct are not expected to cause changes in all indicators. For example, changes in any level of change management are expected to cause changes in construct of change management, but changes in the change management construct do not necessarily mean changes in all the three levels.

(3) The dimensions do not necessarily share a common theme. For example, change management at the employee level does not share a common theme with change management at the stakeholder level.

(4) Eliminating an indicator may alter the conceptual domain of the construct. For example, eliminating any one level of change management will make the domain of change management incomplete.

(5) The dimensions are not expected to have the same antecedents and consequences.

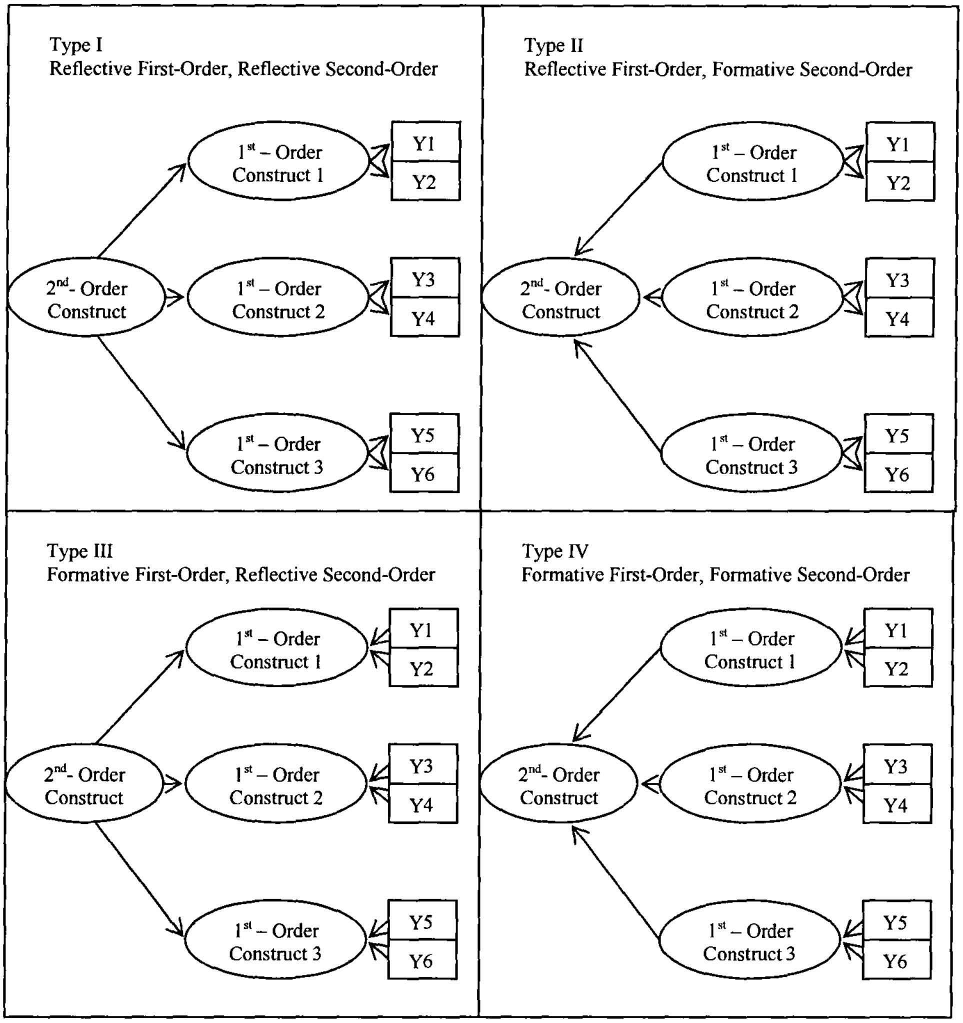
(6) A change in the value of one of the dimensions is not necessarily expected to be associated with a change in all of the other dimensions. For example, changes in change management at the organizational level do not necessarily affect the changes in change management at the employee level.

4.2.1.2 Introduction of Second-Order Constructs

Latent variables are phenomena of theoretical interest which cannot be directly observed and have to be assessed by manifest measures which are observable (Diamantopoulos et al. 2008). Conceptual definitions of constructs are often specified at a more abstract level, which sometimes includes multiple formative and/or reflective first-order dimensions (Jarvis et al. 2003; Rindskopf and Rose 1988). Constructs are often conceptualized and subsequently operationalized as multidimensional entities (Diamantopoulos et al. 2008). Multidimensional constructs are "constructs with more than one dimension, and each dimension can be measured using either reflective or formative indicators" (Petter et al. 2007, p627). A construct is conceptually multidimensional "when it consists of a number of interrelated attributes or dimensions and exists in multidimensional domains. In contrast to a set of interrelated unidimensional constructs, the dimensions of a multidimensional construct can be conceptualized under an overall abstraction, and it is theoretically meaningful and parsimonious to use this overall abstraction as a representation of the dimensions" (Law, Chi-Sum and Mobley 1998, p.741).

When dealing with multidimensional constructs, it is necessary to distinguish among levels of analysis. The first level relates Manifest Variables (MVs) to first-order dimensions; and the second-level relates the individual dimensions to the second-order latent constructs, etc. (Diamantopoulos et al. 2008). This study involves two-level constructs. Jarvis et al. (2003) illustrated four possible combinations in second-order factor models since for each level both formative and reflective specifications are applicable. They refer to these four combinations as Type I to Type IV, as shown in Figure 4-1.

Figure 4-1: Four Types of Second-Order Factor Models (adapted from Jarvis et al. 2003)[3]



Note: Y1 – Y5 are indicators.

Type I and Type III models have first-order factors as reflective indicators. Specifically, a Type I model is reflective second-order and reflective first-order; a Type III model is reflective second-order and formative

[3] Models are briefed for clear presentation.

first-order. Both Type II and Type IV models have first-order factors as formative indicators. Specifically, Type II is formative second-order and reflective first-order; Type IV is formative second-order and formative first-order. In other words, first-order constructs in Type I and Type II have reflective indicators; while first-order constructs in Type III and Type IV have formative indicators.

4.2.1.3 Modeling Formative Constructs

The existing literature was reviewed as a basis for developing construct measures. Three constructs (Change Management, Process Redesign and IT Infrastructure) in the model have several dimensions according to the literature. Therefore, each of the constructs was operationalized as a second-order construct and each of their dimensions was operationalized as a latent variable (first-order). Specifically, the conceptual dimensions of the three constructs were first identified; and then the dimensions were used as a guide to construct the multidimensional scales, i.e., higher order constructs. As for the causal direction, the three constructs were identified as formative second-order and reflective first order constructs (i.e., Type II as discussed in section 4.2.1.1), as discussed next.

Change Management

A new measure was developed for change management that aimed to assess the extent to which a BPR project utilizes change management practices. Besides considering change through a process-centered approach, it was found that there was a need to consider the impact of the change on the organization and resources, the systems and control, and finally the behaviours of the actors in the changed organization. Change management involves effectively balancing forces in favor of a change over forces of resistance. The value of change management is to manage resistance to change (Grover and Jeong 1995). Such forces of resistance can come from organizations, groups, individuals (Guha and Grover 1997; Markus 1983). Psychologically, the frequently researched sources of problems in change are participation, management, training, rewards, and communication among participants (Rizzuto and Reeves 2007).

As suggested by the literature (Al-Mashari et al. 2001; Grover and Jeong 1995; Teng et al. 1996), change management contains three dimensions:

(1) Change management at the ***organizational level***, aiming at assessing the extent of change management on organizational culture change and human resources system change (Al-Mashari and Zairi 1999; Bee Wah and Kok Wei 2006; Grover and Jeong 1995). Four items were drawn from Al-Mashari and Zairi's study (Al-Mashari et al. 2001; Al-Mashari and Zairi 1999).

(2) Change management at the ***employee level***, aiming at assessing the extent of change management on employee resistance such as empowerment, communication and training (Al-Mashari and Zairi 1999; Grover and Jeong 1995). Three items were used for this dimension.

(3) Change management at the ***stakeholder level***, aiming at assessing the extent of change management on stakeholder resistance and

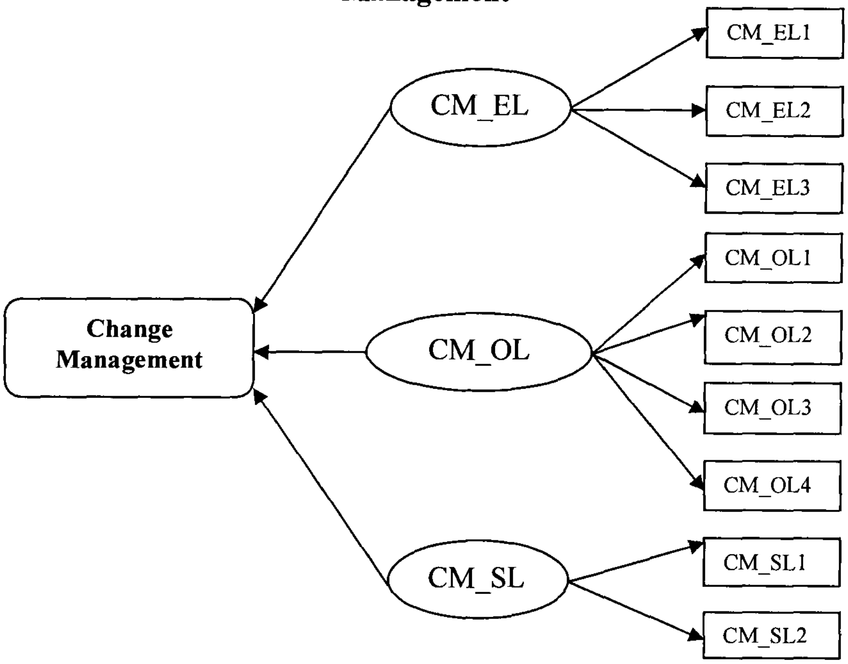
commitment (Kettinger and Teng 1997; Nwabueze 2000; Paper and Chang 2005; Teng et al. 1996). Two items were used to measure this dimension.

All the indicators of change management are listed in Table 4-2. The hypothesized formative construct of change management is shown in Figure 4-2.

Table 4-2: Indicators of Change Management

Scale items. 7-item Likert scale (strongly disagree/strongly agree) Change Management: assess the extent to which a BPR project utilizes change management practices.	
Change Management at Organizational Level (*CM_OL*)	
Source(s): (Al-Mashari et al. 2001; Al-Mashari and Zairi 1999)	
CM_OL1	The BPR project properly reviewed and revised reward/motivation and compensation systems.
CM_OL2	The BPR project management made necessary changes in human resource policies as a result of the BPR project.
CM_OL3	The BPR project stimulated the organization's receptivity to change.
CM_OL4	The BPR project created an effective culture for organizational change.
Change Management at Employee Level (*CM_EL*)	
Source(s): (Al-Mashari and Zairi 1999; Grover and Jeong 1995)	
CM_EL1	The BPR project management effectively communicated the reasons for change to management and employees.
CM_EL2	The BPR project management properly empowered relevant employees.
CM_EL3	The BPR project management provided adequate training for personnel affected by the redesigned processes.
Change Management at Stakeholder Level (*CM_SL*)	
Source(s): (Kettinger and Teng 1997; Nwabueze 2000; Paper and Chang 2005; Teng et al. 1996)	
CM_SL1	The vision of the BPR project was communicated well to all the stakeholders.
CM_SL2	All the stakeholders were solicited for feedback on the project.

Figure 4-2: Hypothesized Second-Order Construct of Change Management



Process Redesign

The construct of process redesign is intended to assess the existence of utilizing process redesign practices in a BPR project. Many BPR projects have demonstrated best practices for redesigning business processes. A conceptual framework that synthesizes 29 best practices (Reijers and Mansar 2005), was identified from the perspective of process mechanics. Another study (Mansar and Reijers 2005), conducted by the same authors, tested these best practices in real cases and obtained ten most frequently utilized process redesign techniques: task elimination, technology use, task composition, parallelism, specialization, resequencing, integration, empowerment, minimize units, and order assignment. These process redesign best practices are useful for capturing the characteristics of process redesign in BPR projects. Since the other 19 practices are rarely used, only these ten are considered in this study.

One of these ten best practices focuses on utilizing Information Technology. This practice is thought of as part of the ICTI improvement, so this practice will not be considered in this construct.

The two dimensional view for process redesign was adopted: technical redesign and social redesign (Attaran 2003). Again, technical redesign is process-based, during which process linkages are reexamined, tasks are reassigned, and controls are relocated; social redesign is people-based, which focuses on the human aspects and involves employees who will affect corporate changes. In a straightforward manner, technical redesign is used to redesign the allocation of the process workload; while social redesign is used to redesign the allocation of the workload of people. The indicators of Process Redesign and the hypothesized formative relationship are shown in Table 4-3 and Figure 4-3, respectively.

Figure 4-3: Hypothesized Second-Order Construct of Process Redesign

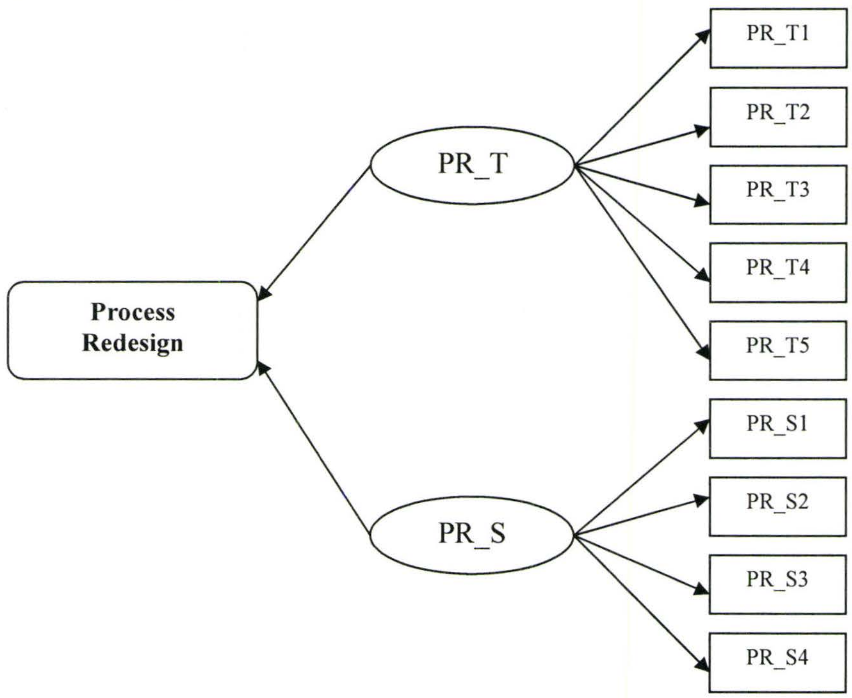


Table 4-3: Indicators of Process Redesign

Scale items. 7-item Likert scale (strongly disagree/strongly agree) Process Redesign: the existence of utilizing process redesign practices in a BPR project.	
Source(s): (Attaran 2003; Mansar and Reijers 2005; Reijers and Mansar 2005)	
Process-Based Process Redesign (*PR_T*)	
PR_T1	The BPR project involved eliminating unnecessary tasks from business processes.
PR_T2	The BPR project involved combining small tasks into composite tasks or dividing large tasks into workable smaller tasks.
PR_T3	The BPR project involved moving and re-sequencing tasks to more appropriate places in the processes.
PR_T4	The BPR project involved arranging tasks to be executed in parallel.
PR_T5	The BPR project involved integration of business processes with those of customers or suppliers.
Organization-Based Process Redesign (*PR_S*)	
PR_S1	The BPR project involved empowering workers with more decision-making authority.
PR_S2	The BPR project involved assigning workers to perform as many steps as possible for single orders.
PR_S3	The BPR project involved making human resources more specialized or more generalized.
PR_S4	The BPR project involved minimizing the number of departments, groups, and persons involved in business processes.

ICTI Improvement

The construct of ICTI improvement in this study was used to assess the extent to which a company's ICTI capabilities have been improved through a BPR project. This construct estimates whether the attention to ICTI is adequate and if the IT investment is effective in a BPR project.

As discussed in chapter 2, ICTI improvement consists of several dimensions. The four dimensions of ICTI improvement (network communications, data integration, facilities and management, and, training) and their corresponding items as proposed by Law and Ngai (2007b) were adopted. The measures of the four dimensions were drawn from different sources. Two items for network communications and three items for data integration were from (Bhatt 2000b; Bhatt 2001a); items for facilities and management (including hardware and software, and IT management) were combined from (Allen and Boynton 1991; Sambamurthy and Zmud 1999; Weill and Broadbent 1999, etc); items for training were from (Sakaguchi and Dibrell 1998). This set of dimensions for ICTI improvement has been also used by a recent study (Sobol and Klein 2009).

All the indicators, modified in order to fit the needs of this study, are shown in Table 4-4. According to the conceptual definition of ICTI improvement and the characteristics of formative constructs, the four dimensions were hypothesized as four causal factors that form the ICTI improvement construct, as shown in Figure 4-4.

Figure 4-4: Hypothesized Second-Order Construct of ICTI Improvement

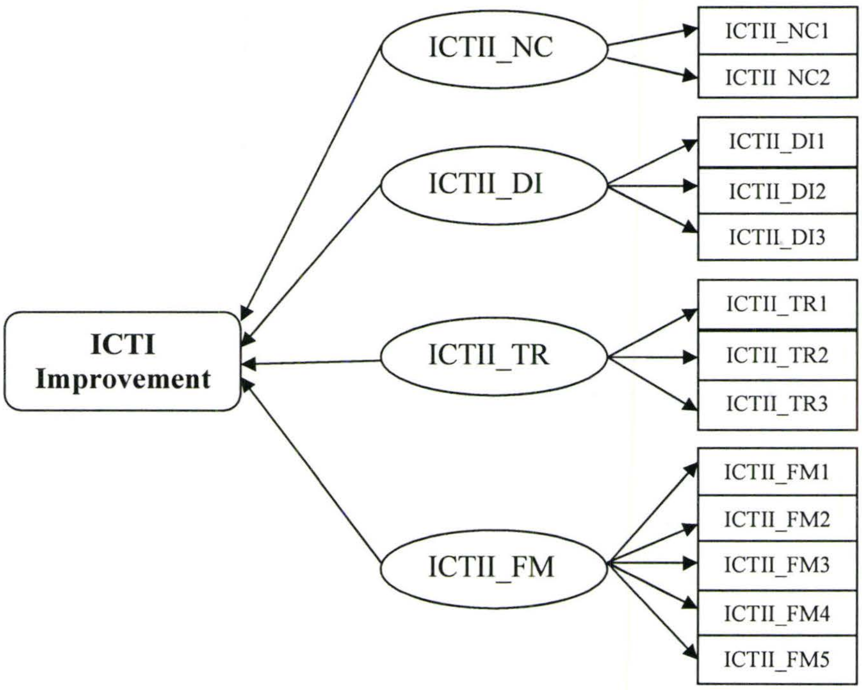


Table 4-4: Indicators of ICTI Improvement

Scale items. 7-item Likert scale (strongly disagree/strongly agree) ICTI improvement: assess the extent to which a BPR project improves its company's ICTI capabilities.	
Network Communications (*ICTII_NC*)	
Source(s): (Bhatt 2000b; Bhatt 2001a)	
ICTII_NC1	Networks which link the company and its main suppliers were improved as a result of the BPR project.
ICTII_NC2	Networks which link the company and its main customers were improved as a result of the BPR project.
Data Integration (*ICTII_DI*)	
Source(s): (Bhatt 2000b; Bhatt 2001a)	
ICTII_DI1	Information and data sharing across the company was improved as a result of the BPR project.
ICTII_DI2	Duplication of data was reduced or eliminated as a result of the BPR project.
ICTII_DI3	The standardization of data element definitions across the company was improved as a result of the BPR project.
IT Facilities and Management (*ICTII_FM*)	
Source(s): (Allen and Boynton 1991; Sambamurthy and Zmud 1999; Weill and Broadbent 1999)	
ICTII_FM1	Company servers were increased in capacity as a result of the BPR project.
ICTII_FM2	Regular preventive maintenance down time was reduced as a result of the BPR project.
ICTII_FM3	The company had increased expertise to manage its IT facilities after the BPR project.
ICTII_FM4	Users were more satisfied with IT services as a result of the BPR project.
ICTII_FM5	IT administration standards and procedures were improved as a result of the BPR project.
Training (*ICTII_TR*)	
Source(s): (Sakaguchi and Dibrell 1998)	
ICTII_TR1	The company improved its IT training programs through the BPR project.
ICTII_TR2	Training of users was adequate through the BPR project.
ICTII_TR3	Training of IT personnel was adequate through the BPR project.

As a double check, the measures of the dimensions for these three constructs were examined against Petter's four decision rules[4] (Petter et al. 2007). All the rules were met for the three constructs, which confirm that they should be modeled as formative instead of reflective.

4.2.1.4 Modeling Reflective Constructs

The remaining constructs: BPR project champion, top management support, operational quality improvement, organizational quality improvement, cost savings, productivity and BPR project overall success, were modeled as reflective constructs.

BPR Project Champion

Measurements in the literature for BPR project champions focus on measuring the existence and commitment of the champion. Three items for BPR project champions were based on relevant research in the MIS adoption literature (Brown et al. 2004; Fui-Hoon Nah et al. 2003; Grover 1993; Lai and Mahapatra 2004). The measurement scale for BPR project champion is summarized in Table 4-5.

Table 4-5: Indicators of BPR Project Champion

Scale items. 7-item Likert scale (strongly disagree/strongly agree) BPR Project Champion: assess the existence and commitment of a champion through the BPR project.	
BPR Project Champion (*CHAM*)	
Sources: (Brown et al. 2004; Grover 1993)	
CHAM1	The BPR project had an identifiable project champion.
CHAM2	The commitment of the champion(s) was strong.
CHAM3	The champion(s) enthusiastically championed the BPR project.

[4] Petter's four decision rules were discussed in section 4.2.1.1.

Top Management Support

The construct of Top Management Support was used to assess the extent of support and commitment of top management to the BPR project, including top management understanding and support of BPR initiative, as well as funding and communication support (Grover and Jeong 1995; McAdam and Donaghy 1999). The items measuring top management support were adapted from the relevant research in MIS (Grover 1993; McAdam and Donaghy 1999; Premkumar and Michael 1995; Wang, Klein and Jiang 2006). Five items were chosen and minor modifications were made to fit them in the context of BPR projects. The measurement scale for top management support is shown in Table 4-6.

Table 4-6: Indicators of Top Management Support

Scale items. 7-item Likert scale (strongly disagree/strongly agree) Top Management Support: assess extent of top management support to the BPR project.	
Top Management Support (*TMS*)	
Sources: (Grover 1993; McAdam and Donaghy 1999; Premkumar and Michael 1995; Wang et al. 2006)	
TS1	Top management was favorable in the implementation of the BPR project.
TS2	Top management was able to understand the concepts of the BPR project.
TS3	Top management considered the BPR project to be important to the company.
TS4	Top management effectively communicated its support for the BPR project
TS5	Top management provided adequate funding for the project.

Measurements of BPR Project Outcomes

Recall that BPR project success can be measured from two perspectives as discussed in chapter 2, i.e., overall perception of success and goal-specific perceptions. A two-item scale measuring the "perceived level of success" was used to evaluate overall BPR project success. This perspective has been indicated as the most widely used measure of MIS success (DeLone and McLean 1992; Grover and Jeong 1995). The measures of overall BPR project success are listed in Table 4-7.

As for the goal-specific perception, BPR project outcomes were measured on four dimensions, adopted from Raymond et al.'s study (Raymond et al. 1998). Some other relevant studies (Caccia-Bava et al. 2005; Guimaraes and Bond 1996) were also examined in developing the items for measuring BPR project success used in this study. The measures of goal-specific BPR project success are listed from Table 4-8 to Table 4-11.

Table 4-7: Indicators of Overall BPR Project Success

Scale items. 7-item Likert scale (strongly disagree/strongly agree) BPR Project Success: assesses the overall successfulness of a BPR project.	
BPR Project Success (*SS*)	
Sources: (Grover and Jeong 1995)	
SS1	Overall, this BPR project was successful.
SS2	Overall, this BPR project achieved favourable outcomes.

Table 4-8: Indicators of Operational Quality Improvement

Scale items. 7-item Likert scale (strongly disagree/strongly agree) Operational quality improvement: assesses improved quality in goods and services.	
Operational Quality Improvement (*OpQI*)	
Sources: (Raymond et al. 1998)	
OpQI1	The BPR project achieved product quality improvement.
OpQI2	The BPR project achieved customer services improvement.
OpQI3	The BPR project achieved customer satisfaction improvement.

Table 4-9: Indicators of Organizational Quality Improvement

Scale items. 7-item Likert scale (strongly disagree/strongly agree) Organizational quality improvement: assesses improved quality of organizational coordination and communication.	
Organizational Quality Improvement (*OrQI*)	
Sources: (Raymond et al. 1998)	
OrQI1	The BPR project resulted in less managerial hierarchy.
OrQI2	The BPR project reduced bureaucracy.
OrQI3	The BPR project improved internal users' satisfaction.
OrQI4	The BPR project improved communication within the company.

Table 4-10: Indicators of Cost Savings

Scale items. 7-item Likert scale (strongly disagree/strongly agree) Cost Savings: assesses administrative and production cost savings.	
Cost Savings (*CS*)	
Sources: (Raymond et al. 1998)	
CS1	The BPR project achieved a good return on investment.
CS2	The BPR project improved company profits.
CS3	The BPR project saved on operational costs.
CS4	The BPR project saved on personnel costs.

Table 4-11: Indicators of Productivity

Scale items. 7-item Likert scale (strongly disagree/strongly agree) Productivity: assesses increased productivity from workers and managers.	
Productivity (*PROD*)	
Sources: (Raymond et al. 1998)	
PROD1	The BPR project achieved more units produced or more customers served per unit time.
PROD2	The BPR project achieved fewer delays in production and/or services.
PROD3	The BPR project achieved shortened cycle time in production and/or customer services.
PROD4	The BPR project achieved lower error rates in production and/or customer services.

4.2.1.5 Control Variables

(1) Company Size

The literature has shown the influence of company size to BPR projects as discussed in section 3.2.6. To help provide a better explanation for the effects of the predictors to BPR project success, the confounding effects of company size was controlled. Another consideration is that the concept of business processes may be formally defined in large and medium organizations. It is likely that small companies do not need to define explicit business processes because their business operations tend to be simple (Davenport 1993). For those small companies where business processes have been defined, they are usually not as complex and difficult as they are in larger organizations to redesign and implement. Therefore, only large and medium sized companies (i.e., companies with 100 and more employees) were investigated in this study.

(2) Organizational Culture

Organizational culture is a system of common assumptions, values or norms among the members of an organization which is the basement of their behavior (Neghab et al. 2009). Due to the complexity of the nature of organizational culture and also that organizational culture is not the focus in our research model, it is assumed in this study that organizations in the same country have similar cultures, although this may in fact vary among organizations and among different regions within one country. Besides, the location of companies investigated was limited to Canada and US where organizational culture is likely to be relatively uniform. Therefore, we only differentiated organizational culture for companies in US from that in Canada.

(3) Strategic Stimulus

The concept of BPR project strategic stimulus adopted from Guha's study (Guha and Grover 1997) was included as a control variable in our study. In Guha's antecedent model of BPR project success (Guha and Grover 1997), strategic initiatives include a "stimuli" construct, which can be either proactive or reactive as discussed previously. Sometimes proactive and reactive initiatives may concurrently stimulate companies to carry out BPR projects.

4.2.2 Study Participants

The refined instrument, in the form of a self-administered questionnaire (Appendix B), was used to collect data through the means of an Internet panel survey.

4.2.2.1 Survey Format

Simsek and Veiga (2001) have summarized advantages of Web-based surveys, including lower cost, fast data collection, and media richness. An Internet panel that utilized a Web-based survey was used rather than a paper-based survey in this study because of the following advantages. *First*, it reduced expenses, such as postage, paper print, envelops, etc. *Second*, it allowed researchers to receive complete questionnaires immediately after a respondent submitted a form, thus reducing waiting time. *Third*, data recording is automatic and recording errors were avoided. *Fourth*, the completion of an online form is more convenient for participants in this study since computers and the Internet have become common necessities for work.

Certainly, there are disadvantages in using Web-based surveys. For example, it is possible for the same person to fill in the survey more than once, introducing survey bias. However, the possibility for this event can be avoided through the survey design and the online survey systems which are able to automatically prevent participants from completing the survey twice.

4.2.2.2 Respondent Selection and Data Collection Methods

A sample unit in this study is a BPR project completed by a medium or large sized company located in United Stated or Canada within the past three years. A BPR project is carefully defined, at the beginning of the questionnaire, as "a deliberate (planned) change, typically enabled by information technologies (IT) in an attempt to redesign and implement a business process to achieve performance breakthroughs in quality, speed, customer service, cost, etc" (DeLone and McLean 1992; Grover and Jeong 1995). This helps to avoid misunderstanding the meaning of the term BPR project. Respondents were those who had participated in at least one such BPR project during the past three years. Therefore, the requirements for respondents were those who:

(1) participated in at least one BPR project in the past three years;

(2) were working at a medium-to-large sized company (with 100 or more employees) when the BPR project was carried out by the company.

Difficulty in finding respondents that met these criteria and persuading them to participate in our research survey was expected, because:

(1) it is very difficult to locate people who have participated in BPR projects by searching Internet company information;

(2) because recent data that would be remembered better by participants was desired, the requirement for BPR projects undertaken within the past three years tends to reduce the target population size;

(3) most of the people who participate in BPR projects belong to the management team (top or middle management) and they may be too busy to spend the time filling out the questionnaire.

Therefore, two solutions for collecting data were prepared. The first solution was to look for medium/large sized companies by randomly searching Internet company information and sending invitation letters (Appendix C – Part I) to the managers, other employees and administrative staff of these companies through e-mail. These messages explained the research purpose and invited the potential participants to fill out the survey. Managers and other employees who were potential respondents were directed to our Web-based survey; administrative staff was requested to forward the invitation letter to those employees who might be interested in completing the survey.

The second solution was to use an Internet panel survey managed by a commercial survey agency. Note that the undertaking of the second solution depended on the results of the first solution.

Several methods were considered in order to increase the response rate of the first data collection solution:

- Use of monetary incentives has been found to yield consistent positive results in both consumer and organizational surveys (Jobber, Saunders and Mitchell 2004). It was not planned to utilize this method because it is believed that potential participants like top and middle management will not be attracted by the low level of incentives we could provide. The more likely reason to participate in the study would be that those people might feel the research itself is worth spending time on, because they are interested in the research topic. Instead, respondents were offered as an incentive a report that summarized the study's results.
- The length of a questionnaire has a substantial effect on response rate. A shorter questionnaire delivers a higher response rate than a longer one (Dillman 2007). The questionnaire for this study is not short (the number of statements participants need to respond to is 77). Efforts have been put to make it as short as possible, but it had to include enough statements to cover properly all aspects of the study.
- Make the study instruments attractive and easy to handle by the participants (Edwards, Roberts, Clarke, DiGuiseppi, Pratap, Wentz and Kwan 2002). People tend to reply to surveys if they believe their answers may contribute to an important research field, and we tried to get this point across to our participants.
- Response rate can also be improved through lowering and/or eliminating participation risks. One relevant source of participation risk is insufficient confidentiality and anonymity. Participants were advised upfront that neither their personal information nor their

company's identity would be revealed in any way through any research results arising from this study.

- Administrative procedures, such as verification of respondents' addresses and multiple follow-ups, are techniques of improving response rate (Rogelberg 2002). In this study, follow-up reminders (Appendix C – Part II) were to be sent through e-mail to respondents after two-week and one-month intervals.

The first data collection solution failed to meet our sample size requirement (discussed later), forcing us to resort to the second solution.

4.3 Data Analysis Method

This section discusses the statistical tools and methods used in this study.

Instrument validation is very important, as pointed out by Boudreau et al. (2001) “within the positivist, quantitative arena of research, the very scientific basis of the profession depends on solid validation of the instruments that are used to gather the data upon which findings and interpretations are based”. In order to secure validity of the instrument in this study, the content validity, construct validity (convergent and discriminant validity), reliability, and common method bias were examined. This section is organized into two subsections according to the analysis phases to which the validation activity belongs: the initial data assessment and the PLS assessment.

The PLS assessment is further divided into two parts: measurement model analysis and structural model analysis. "The reason for drawing a distinction between the measurement model and the structural model is that proper specification of the measurement model is necessary before meaning can be assigned to the analysis of the structural model" (Bagozzi 1981, p376).

4.3.1 Initial Data Assessment

"The relevancy or validity of any instrument must be assured before relationships between measures of independent and dependent variables can be assessed" (Jarvenpaa, Dickson and DeSanctis 1985, p.143). Partial Least Squares analysis was used in this study to assess construct reliability and validity through the measurement model (to be discussed in section 4.3.2). But before that, several validation techniques were used to examine the data.

The first step was to examine Cronbach's alpha measure of reliability of the multi-item scales, so that construct reliability could be assessed. Cronbach's alpha measure of reliability was evaluated for *comparison purposes* instead of as a final judgement of construct reliability (Jarvenpaa, Shaw and Staples 2004).

The second step was to carry out a principal components analysis of the data with the purpose of reducing and summarizing the data and to ensure that the constructs were designed correctly (Bontis 1998). The results indicate the associations between the variables and their factors. Items that do not load on their expected factors at levels of at least 0.5 or greater or that cross-load on several factors should be dropped from the analysis (Bontis 1998).

Another important issue is common method bias which can be checked through factor analysis. As with all self-reported data, there is a potential for common method bias resulting from multiple sources such as consistency motif and social desirability (Podsakoff et al. 2003). The first approach to test common method bias is the Harmon one-factor test (Podsakoff and Organ 1986). This approach performs a factor analysis on all the conceptually crucial variables in the research model. If a single factor emerges from the factor analysis or a "general" factor accounts for the largest part of the covariance in the independent and dependent variables, common method bias is present in the measurement (Podsakoff and Organ 1986). In addition, if the one-factor test presents unsatisfied results, a *partial correlation procedure* can be conducted to check for possible common method bias. This step consists of partialling out the first unrotated factor, which is assumed to be a general factor on which all variables load, and testing again for possible meaningful correlation between the remaining independent and dependent variables (Podsakoff and Organ 1986).

4.3.2 Partial Least Squares (PLS) Method

4.3.2.1 Appropriateness of Using PLS

Structural Equation Modeling (SEM) has a substantial advantage over the first generation data analysis techniques, such as multiple regression analysis, discriminant analysis, logistic regression, and analysis of variance, because SEM enables researchers to answer a set of interrelated research questions in a single, systematic, and comprehensive analysis by modeling the relationships among multiple independent and dependent constructs simultaneously (Gerbing and Anderson 1988). This capability for simultaneous analysis differs greatly from most first generation regression models which can analyze only one layer of linkages between independent and dependent variables at a time (Gefen, Straub and Boudreau 2000). Due to the complexity of the research model in this study, first generation data analysis techniques were not used because of their limited capabilities (Gefen et al. 2000). Instead, structural equation modeling (SEM) techniques were used.

There are two main SEM approaches (Gefen et al. 2000). One approach uses covariance-based methods; examples of tools using this approach include AMOS, EQS, and LISREL. The second approach is component-based methods for estimating structural models, which places minimal demands on sample size and data normality, unlike the other approach. Examples of this approach include PLS (Partial Least Squares), which was popularized by Wold (1981, 1985). Comparisons between LISREL and PLS are presented in Table 4-12, partially adapted from (Gefen et al. 2000), shows comparisons between covariance-based SEM methods, such as LISREL, and component-based SEM, hereafter, referred to as PLS.

PLS is especially suitable for exploratory research focusing on explaining variance (Chin 1998a; Gefen et al. 2000). Although PLS can be used for theory confirmation, it can also be used to suggest where relationships might or might not exist and to suggest propositions for testing later (Chin 1998b). PLS is useful when a research model is posited in a domain where theory and/or data are weak (Wold 1985). That is to say, PLS is more applicable to studies where a theoretical model, or parts of it, has not been previously validated.

Table 4-12: Comparative Analysis Between LISREL and PLS

Issue	LISREL	PLS
Objective of Overall Analysis	To show that the null hypothesis of the entire proposed model is plausible, while rejecting path-specific null hypotheses of no effect.	To reject a set of path specific null hypotheses of no effect.
Method *	Covariance-based: maximizing the likelihood between the sample covariance and those predicted by the theoretical model.	Variance-based (Component-based): minimizing the variance of all dependent variables.
Objective of variance analysis	Overall model fit	Variance explanation (high R^2)
Required Theory Base	Requires sound theory base. Supports confirmatory research.	Does not necessarily require sound theory base. Supports both exploratory and confirmatory research.
Assumed Distribution	Multivariate normal	Relatively robust to deviations from a multivariate distribution.
Required Minimal Sample Size	At least 100-150 cases	At least 10 times the number of items in the most complex construct
Ability to work with smaller sample size	Relatively low	Relatively high
Ability to work with large models with a large number of indicators *	Limited capability	High capability
Number of indicators per construct	At least three indicators to identify a construct and four indicators for statistical analysis	No restrictions
Type of Constructs	Supports reflective constructs only	Supports both reflective and formative constructs

* Refer to (Chin 1998b) and (Haenlein and Kaplan 2004).

For this study in particular, PLS was used essentially for four reasons:

(1) This study is an exploratory study and PLS is more suitable as discussed in Table 4-12.

(2) Given the study's small sample size, the PLS approach seemed to be the most suitable approach (Barclay, Thompson and Higgins 1995 ; Chin 1998b; Fornell and Bookstein 1982).

(3) PLS supports modeling both reflective and formative constructs. The instrument in this study includes both reflective and formative constructs as discussed previously.

(4) PLS does not restrict the numbers of indicators per construct. In the proposed research model, the numbers of indicators varies from 2 to 5. Thus, PLS was more suitable for testing this model

Essentially, PLS recognizes two components of a causal model - the measurement model and the structural model (Chin 1998a; Gefen et al. 2000). Following the recommended two-stage analytical procedures (Bontis 1998; Gee-Woo, Zmud, Young-Gul and Jae-Nam 2005; Jarvenpaa et al. 2004), confirmatory factor analysis was first conducted to assess the measurement model; the structural relationships were then examined:

1) the measurement model, which assesses the loadings of observed items on their expected latent variables and,
2) the structural model, which assesses the assumed causation among a set of dependent and independent constructs (Chin 1998a; Haenlein and Kaplan 2004).

Formal Specification of PLS Models

From the perspective of formal specification of PLS models, Chin (1998) pointed out that all latent variable path models in PLS consist of three sets of relationships: (a) the outer model, which specifies the relationships between latent variables (LVs) and their associated observed or manifest variables (MVs), (b) the inner model, which specifies the relationships between LVs, and (c) the weight relations, upon which the case values for the LVs can be estimated.

Measurement Model. The measurement model (also known as outer model or outer relations) defines how each block of indicators relates to its latent variable (Chin 1998b). The manifest variables (MVs) are partitioned into non overlapping blocks. For those blocks with reflective indicators, the relationships can be defined as (Chin 1998b):

$$\begin{aligned} x &= \Lambda_x \xi + \varepsilon_x \\ y &= \Lambda_y \eta + \varepsilon_y \end{aligned} \qquad (4\text{-}1)$$

where x and y are the MVs for the independent and dependent latent variables (LVs) ξ and η, respectively. Λ_x and Λ_y are the loading matrices representing simple regression coefficients connecting the LV and their measures. ε_x and ε_y are the residuals that can be interpreted as measurement errors.

For those blocks in a formative mode, the relationship is defined as:

$$\begin{aligned} \xi &= \Pi_\xi x + \delta_\xi \\ \eta &= \Pi_\eta y + \delta_\eta \end{aligned} \qquad (4\text{-}2)$$

where Π_x and Π_y are the multiple regression coefficients for the LV on its block of indicators, and δ_x and δ_y are the corresponding residuals from the regressions. The other terms are the same as those used in Equation 4-1.

Structural Model. The structural model (also know as inner model or inner relations) depicts the relationship among latent variables based on substantive theory (Chin 1998b). The formal specification is defined as:

$$\eta = \beta_0 + \beta\eta + \Gamma\xi + \zeta \qquad (4\text{-}3)$$

where, η represents the vector of endogenous (i.e., dependent) latent variables, ξ is a vector of the exogenous latent variables, and ζ is the vector of residual variables (i.e., unexplained variance). The purpose of the structural model is to represent the structural interrelationships of all latent variables. Structural interrelationships are linkages (i.e., paths) between research constructs (or LVs), which usually reflect a study's hypotheses.

Weight Relations. Case values for each latent variable can be estimated upon weight relations in PLS. The LV estimates are linear aggregates of their observed indicators who weights are obtained via the PLS estimation procedure (Chin 1998b).

4.3.2.2 Assessing and Analyzing Reflective Measurement Models

4.3.2.2.1 Content Validity

Content validity is the degree to which items in an instrument reflect the content universe to which the instrument will be generalized. The essential question posed by this validity is, "does the instrumentation (e.g., questionnaire items) pull in a representative manner from all of the ways that could be used to measure the content of a given construct" (Cronbach 1971). This is usually established by ensuring consistency between the measurement items and the extant literature. Therefore one common technique for ensuring content validity is carefully reviewing the literature. Beyond a literature review, other methods to ensure content validity include expert panels, pre-testing and Q-sorting (Boudreau et al. 2001; Straub, Boudreau and Gefen 2004).

The questionnaire was examined by one academic researcher and two industrial experts for its content validity. The questionnaire was improved according to the experts' opinions. A pre-test was conducted to assess the content validity of the instrument (Boudreau et al. 2001; Straub et al. 2004).

4.3.2.2.2 Construct Validity

The measurement model consists of relationships among the conceptual factors of interest (the observed items or variables) and the measures underlying each construct. Statistically, PLS estimates item loadings and residual covariance, and AVE (Average Variance Extracted) of each of the latent constructs at the measurement model level. The data were evaluated through confirmatory factor analysis using a measurement model in which the first-order latent constructs were specified as correlated variables with no causal paths (Gee-Woo et al. 2005; Yi and Davis 2003).

The measurement model demonstrates the *construct validity and reliability* of the research instrument (how well the instrument measures what it purports to measure). Construct validity asks whether the measures chosen are true constructs describing the event or merely artifacts of the methodology itself (Campbell and Fiske 1959; Cronbach 1971). Convergent validity, discriminant validity and nomological validity are all considered to be components of construct validity (Straub et al. 2004). In this study only the first two types of validity were examined because the third one was not applicable[5]. Construct validity determines whether the instrumentation has truly captured operations that will result in constructs that are not subject to common method bias and other forms of bias.

As discussed above, PLS supports the assessment of *convergent validity* and *discriminant validity* through Confirmatory Factor Analysis (CFA). However, arguments against purifying measures and treating an instrument more holistically have been made (MacCallum and Austin 2000; Straub et al. 2004). Therefore, this study used Exploratory Factor Analysis (EFA) first on the reflective constructs to purify the measures. Gerbing and Anderson also pointed out that exploratory factor analysis can be a useful preliminary technique for scale construction (Gerbing and Anderson 1988). Data reduction can be achieved through EFA, since items that do not load properly are dropped.

Following the preliminary exploratory factor analysis on the constructs, construct validity (convergent validity and discriminant validity in this study) and reliability were examined through the PLS results as discussed next.

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[5] Nomological validity is the degree to which a construct behaves as it should within a system of related constructs called a nomological network. It is established through comparison with previous nomological networks or comparison between different methods for measuring constructs (Cronbach 1971; Cronbach and Meehl 1955; Straub et al. 2004).

(a) Convergent Validity

Convergent validity is the degree to which an item is similar to or converges on other items that theoretically should also be similar (Straub et al. 2004).

With partial least squares (PLS), the researcher specifies the items that are expected to load onto a set of latent constructs. Convergent validity is shown when each of the measurement items loads with a significant t-value on its latent construct (Gefen and Straub 2005). To prove convergent validity, the test is twofold:

1. Are the loadings significant? PLS generates t-statistics for loadings by running a bootstrap test (preferred) or jackknife test on the raw data. Typically, the p-value of this t-value should be significant to at least the 0.05 level, and;
2. Are the loadings greater than 0.7 to show that over half the variance is captured by the latent construct (Chin 1998b; Hair, Anderson, Tatham and Black 1998; Thompson, Barclay and Higgins 1995).

(b) Discriminant Validity

Discriminant validity is shown when two things happen:

1. The correlation of the latent variable scores with the measurement items needs to show an appropriate pattern of loadings, one in which the measurement items load highly on their theoretically assigned factor and not highly on other factors (Gefen and Straub 2005). One of the thresholds is that standardized item loadings should be at least 0.7, and items should load more highly on constructs they are intended to

measure than on other constructs (Barclay et al. 1995 ; Chin 1998b; Fornell and Bookstein 1982).

2. An appropriate AVE (Average Variance Extracted) analysis should be made to test discriminant validity. The threshold is that the square root of the AVE by a construct from its indicators should be at least 0.7 (i.e., AVE > 0.50) and should exceed that construct's correlations with other constructs (Barclay et al. 1995 ; Chin 1998b; Fornell and Bookstein 1982).

AVE is a measure of the amount of variance captured by a construct from its indicators relative to the amount due to measurement error (Fornell and Larcker 1981). PLS offers AVE calculation through the bootstrap technique based on the following equation:

$$AVE = \frac{\sum \lambda_i^2}{\sum \lambda_i^2 + \sum (1-\lambda_i^2)} \tag{4-4}$$

where λ_i is the loading of each measurement item on its corresponding construct.

4.3.2.2.3 Construct Reliability

While construct validity is an issue of measurement between constructs, reliability is an issue of measurement within a construct. Cronbach (1951) pointed out that reliability is a statement about measurement accuracy, i.e., "the extent to which the respondent can answer the same questions or close approximations the same way each time" (Cronbach 1951). Internal consistency (e.g., the standard coefficient of internal consistency

Cronbach's α) and inter-rater reliability are examples of techniques used to assess reliability.

Composite reliability coefficients (analogous to internal consistency) as assessed through statistical packages such as SPSS and SAS, are also available in SEM. Values of these coefficients (similar to Cronbach's alpha) of 0.70 or higher are considered adequate (Barclay et al. 1995 ; Chin 1998b). The composite reliability coefficient is considered a more appropriate measure of reliability in SEM than Cronbach's alpha because the latter assumes that all items contribute equally to reliability, while the former (i.e., composite reliability) draws on the standardized loadings and measurement error for each item (Shook, Ketchen Jr, Hult and Kacmar 2004). Therefore, "alpha tends to be a lower bound estimate of reliability, where composite reliability coefficient is a closer approximation under the assumption that the parameter estimates are accurate" (Chin 1998b, p. 320).

4.3.2.3 Assessing and Analyzing Formative Measurement Models

As compared to reflective indicators, formative indicators have certain characteristics such as:

(1) Reflective indicators are essentially interchangeable, while omitting a formative indicator is omitting a part of the construct;

(2) Correlations among formative indicators are not explained by the measurement model;

(3) There is no reason that a specific pattern of signs (i.e., positive versus negative) or magnitude (i.e., high versus moderate versus low) should characterized the correlations among formative indicators;

(4) Formative indicators do not have error terms; error variance is represented by a disturbance term (Bollen and Lennox 1991; Diamantopoulos and Winklhofer 2001).

Diamantopoulos and Winklhofer (2001) concluded, from these characteristics, that "conventional procedures used to assess the validity and reliability of scales composed of reflective indicators (e.g., factor analysis and assessment of internal consistency), are not appropriate for composite variables (i.e., indexes) with formative indicators". Therefore, alternative approaches must be followed to evaluate the quality of measures that are based on formative indicators (Chin 1998b; Jarvis et al. 2003). However, given the lack of attention to formative constructs in the literature, researchers do not seem to have a common opinion on validating and analyzing formative constructs (Diamantopoulos et al. 2008; Petter et al. 2007). The methods that fit best to this study were utilized to validate and analyze the three formative constructs.

4.3.2.3.1 Approximation of Second-Order Constructs in PLS

Three constructs (i.e., Change Management, Process Redesign, ICTI Improvement) were modeled as Type II second-order constructs according to their theoretical implication as discussed in section 4.2.3.

One way to approximate Type I and Type II (refer to section 4.2.1.1) second-order constructs, whose first-order constructs have reflective indicators, in PLS is the approach of repeated indicators (Wold 1982). This is to directly measure the high-order constructs with the measurement items of the first-order factors (Chin, Marcolin and Newsted 2003). However, a second-order construct that has first-order LVs (Latent Variables) as its formative indicators (Type II and Type IV) cannot be modeled by using repeated indicators when it is an endogenous variable. This is because its variance is explained by its indicators (i.e., all the "cause" indicators including the first-order indicators and the repeated ones from the first order constructs) and then "the specification of an additional source of variation (i.e., an antecedent construct) is conceptually questionable" (Diamantopoulos et al. 2008).

An alternative approach to approximate Type II second-order constructs in PLS is to use factor scores from the first-order constructs (Chin et al. 2003). This approach has been used in many studies (Gee-Woo et al. 2005; Pavlou and Sawy 2006). In this approach, high level constructs are degraded into low level ones.

4.3.2.3.2 Validity and Reliability of Formative Constructs

As formative measurement models have been discussed only recently in the literature, the methodological literature provides relatively few guidelines on how to assess the reliability and validity of formative constructs. Different methods have been proposed, but this is still an open issue for researchers.

Only the most recent literature provides empirical guidelines, and this study will follow the guidelines given by Petter and Straub et al. (2007) and Diamantopoulos and Riefler et al. (2008), as outlined below.

(a) Phase I: Prior to Data Collection

✓ Step 1.1: Identify Formative Constructs

This step has been discussed in section 4.2.1.3. Both Jarvis et al.'s criteria (Jarvis et al. 2003) and Petter et al.'s decision rules (Petter et al. 2007) were referenced for identifying the three formative constructs.

✓ Step 1.2: Assess Content Validity

Recall that carefully reviewing the literature is one common technique for ensuring content validity. Beyond a literature review, other methods to ensure content validity include expert panels and Q-sorting (Boudreau et al. 2001; Straub et al. 2004). For the formative constructs, both literature review and Q-sorting were utilized in this study. Since all the items of the formative constructs and their dimensions were drawn from the literature, the goal of Q-sorting was to verify the dimensions or categories of the items, in order to further ensure the content validity for the formative constructs. Therefore, a one-round Q-Sort was sufficient for this purpose. Five participants (knowledgeable in IS area, but with no prior knowledge of this study) were asked to examine a series of descriptive items that would be used for each of the constructs and to place each of them into one of several categories (comprised of the formative constructs). The measures and constructs theoretically identified by the researchers matched the results of the Q-sort sufficiently, although there was one unmatched category (social-based process redesign). This was due to a misunderstanding; and the ambiguity was cleared up after this clarification. It can be therefore concluded that the content validity of the formative constructs was achieved (Petter et al. 2007).

✓ Step 1.3: Assess The Structural Model

This step assesses whether the structural model will have problems with identification, if covariance-based SEM is used in the study. A benefit of using components-based SEM (PLS) with formative models is that there is no need for statistical identification (Chin 1998b; Petter et al. 2007). Hence, this is not a problem for this study.

(b) Phase II: After Data Collection

The analysis results after data collection are discussed in chapter 5.

✓ Step 2.1: Assess Formative Construct Validity

(1) Principal components analysis, rather than common factor analysis, should be used to examine the item weightings for measures (not items loadings as in reflective measure) (Petter et al. 2007). After the weightings are obtained, there are two opinions on how to deal with the non-significant items, if any. One opinion suggests that if any of the item weightings for formative measures are non-significant, it may be appropriate to remove non-significant indicators (one at a time) until all paths are significant and a good fit is obtained (Diamantopoulos et al. 2008; Diamantopoulos and Winklhofer 2001). Another opinion suggests retaining non-significant indicators to maintain content validity (Bollen and Lennox 1991). When a decision

is made to remove measures for suitable theoretical reasons, it is important to ensure that the construct is still measuring the entire domain and that content validity is preserved.

(2) MacKenzie et al. (2005) suggested that standard procedures for assessing discriminant validity are equally applicable to formative indexes, which include testing (a) whether the focal construct less than perfectly correlates with related constructs, and/or (b) whether it shares less than half of its variance with some other construct. That is, is the construct inter-correlation less than 0.7?

✓ Step 2.2: Evaluate Reliability

(1) It is necessary to ensure that multicollinearity does not exist for formative measures. A particular issue for formative constructs is multicollinearity because the formative measurement model is based on a multiple regression (Diamantopoulos and Winklhofer 2001). Excessive collinearity among indicators makes it difficult to separate the distinct influence of the individual indicators on the latent variable. The VIF (variance inflation factor) statistic is used to determine if formative measures are too highly correlated. Traditionally, general statistical theory suggests that multicollinearity is a concern if the VIF is higher than 10; however, with formative measures, multicollinearity poses more of a problem. Hence, a more strict cut-off of the VIF statistic for formative measures is 3.3 (Diamantopoulos and Siguaw 2006; Petter et al. 2007).

(2) Some researchers (Chin 1998a; MacKenzie, Podsakoff and Jarvis 2005) suggest examining the correlations among the formative indicators for reliability. As the correlations between formative indicators may be positive, negative or zero, reliability as an internal consistency measure is not meaningful for formative indicators (Diamantopoulos et al. 2008). High correlations among the formative indicators suggests that the formative indicators may belong to the same set, even if formative constructs need not be correlated (Chin 1998a; Tanaka and Huba 1984).

✓ Step 2.3: Assess The Model

The guideline given by Petter, Straub and et al (Petter et al. 2007, p643) is that "overall evaluation of formative models is essentially the same as evaluating reflective models in components-based SEM; the R^2 for each endogenous variable in the structural model should be examined in a manner similar to the procedures used in regression." This is discussed in the next section.

4.3.2.4 Structural Model

The second component in a causal model is the structural model. A structural model is a regression-based technique that is rooted in path analysis. The structural model consists of the unobservable constructs and the theoretical relationships among them (the paths). It evaluates the explanatory power of the model, and the significance of paths in the structural model which represent hypotheses to be tested.

PLS provides the squared multiple correlations for each endogenous construct in the model and for the path coefficients. It does not generate a single goodness-of-fit metric for the entire model, unlike covariance-based SEM (e.g., LISREL), but the path coefficients and the squared multiple correlations (R^2) are sufficient for analysis purposes (Chin 1998a).

Therefore, the structural model in PLS examines two values:

(1) path coefficients, which represent the effect of "predicting" variables on endogenous variables and are assessed for statistical significance by using bootstrap analysis (Chin 1998b);

(2) squared multiple correlation (R^2) for a construct, which shows the prediction of that construct explained by its antecedents (Chin 1998b). High squared multiple correlations and significant relationships between constructs indicate a good model (Chin et al. 2003; Fornell and Bookstein 1982).

4.3.2.5 Sample Size

PLS is able to work well with smaller sample sizes. The most frequently used rule for minimum sample size in PLS was proposed by Chin (1998b, p.311): "one simply has to look at the arrow scheme and find the largest of two possibilities: (a) the block with the largest number of formative indicators (i.e., largest measurement equation); or (b) the dependent LV with the largest number of independent LVs impacting it (i.e. largest structural equation)...the sample size requirement would be 10 times either (a) or (b), whichever is the greater."

The research model in this study involves three formative constructs: Change Management, Process Redesign, and ICTI improvement, which have 3, 2, and 4 formative indicators, respectively. As for the structural equation, the dependent LV with the largest number of independent LVs impacting it is Overall Success, which has 4 paths leading into it. Therefore, the minimum sample size requirement for this study is 10*4, which equals 40.

Another rule that should be considered for sample size is that there is a need for doing a principal components factor analysis on the indicators for all the constructs. Everitt (1975) recommended that the proper case-to-indicator ratio range for PCA should be at least 10. The largest construct is considered, i.e., ICTI improvement, which has 13 indicators, although they are divided into four dimensions. Therefore, according to this rule, the minimum sample size requirement is 13*10, or 130.

A data set with 130 cases is believed to be more than sufficient for the PLS analysis of the model, since 40 is the minimum requirement for running PLS analysis on the model.

Chapter 5: Data Analysis and Results

5.1 Data Collection

5.1.1 Solution 1 for Collecting Data

As discussed in section 4.2.2, two potential solutions for data collection were considered since a low response rate was expected. The first solution (to contact the companies obtained through online company database searching) was attempted first. The Canadian company database "Canadian Federal Corporations & Directors database" was used to test the response rate. Companies with more than 100 employees were contacted through an e-mail invitation letter where the basic information of our research survey was introduced. Managers and other employees as potential respondents were directed to our Web-based survey; administrative staffs were requested to forward the invitation letter to those employees who might be interested in completing the survey questionnaire. In total, 501 invitation letters were sent out, but only 6 agreed to complete the questionnaire, and one of the 6 cases was invalid. This gave a very low response rate of only 1 percent. Multiple follow-up reminders did not improve the response rate. Since the required sample size was 130, at least 13,000 persons would be required to get 130 completed (and hopefully valid) questionnaires.

5.1.2 Solution 2 for Collecting Data

Due to the extremely low response rate, a decision was made to ask for the service of a commercial survey agency that used Internet surveys of an existing client database matching our participant requirements. A pre-test request through this agency returned 10 completed questionnaires. These 10 cases were compared with the 5 cases previously obtained, through both t-tests (i.e., early and late respondents test) and MANOVA discriminant tests and there was no significant difference in these two groups of cases. The results for both of the tests are presented in Appendix E. In summary, a) in the t-test, the significance levels of all the F values for all the constructs were above 0.05, so there was no significant difference between the two groups; b) in the MANOVA discriminant test, the Wilks' Lambda[6] values for all the constructs ranged from 0.878 to 0.999, and all the significance levels for these values were above 0.05, also indicating that there was no significant difference between the two groups. These two groups of cases were therefore pooled to do the pre-test.

5.1.3 Pre-Test

The purpose of the pre-test was to test the instruments for comprehension, clarity, ambiguity, and any difficulties in participant response; the results were used to revise the questionnaire as required, so it could be formally validated.

A total of 15 valid cases (as discussed previously) were used to do the pre-test. Cronbach's Alpha was calculated for each of the constructs and the results are shown in Table 5-1. Most of the values of Cronbach's Alpha were above 0.70; and only four (shaded in the table) among the sixteen constructs

[6] Wilks' lambda is a test statistic used in multivariate analysis of variance (MANOVA) to test whether there are differences between the means of identified groups of subjects on a combination of dependent variables. Because lambda (ranging between 0 and 1) is a kind of inverse measure, values of lambda which are near zero denote high discrimination between groups.

had values is less than 0.70. It is possible that some of the constructs presented unstable Cronbach's Alpha values due to the small sample size. These preliminary pre-test results generated confidence in construct reliability, which were formally tested after the completed dataset was obtained. Minor revisions were made to the questionnaire based on feedback from the pre-test. For example, the questions regarding respondents' BPR project experiences were brought ahead to let those unqualified respondents exit the survey sooner.

Table 5-1: Cronbach's Alpha for Constructs in the Pre-Test

Constructs	Cronbach's Alpha
CHAM	0.879
TMS	0.767
CM_EL	0.512
CM_OL	0.720
CM_SL	0.919
PR_T	0.677
PR_S	0.738
ICTII_NC	0.920
ICTII_DI	0.609
ICTII_FM	0.896
ICTII_TR	0.486
OpQI	0.700
OrQI	0.832
CS	0.778
Productivity	0.778
Success	1.000

5.1.4 Final Data Set

After the pre-test was completed, the commercial survey agency proceeded to collect the remaining participant data. Recall that there are two requirements for participants: 1) participants must have participated in one

BPR project within the past three years; 2) the company in which the BPR project was carried out must be a medium to large sized company. Twenty-one percent (313 out of 1481) of the targeted business professionals qualified under the first requirement; for the second requirement, 95% of the professionals who had participated in at least one BPR project within the past three years worked at a medium to large sized company. Among the 294 qualified business professionals, 140 professionals answered the questionnaire. As a result, 140 completed questionnaires were returned to us, in addition to the 10 from the pre-test questionnaires. Roughly speaking, the response rate through the survey agency was 9.5% if the screening rate for the two requirements is considered; it is 47.6% if the screening rate is not considered.

A "Don't Know" option was available for the scale questions in the questionnaire (see Appendix B), participants could choose this option when they were unable to answer a particular question. This option was treated as missing data. Ten of the 140 subjects in this dataset failed to complete a number of the scales related to the variables. A t-test was used to compare these 10 cases with the other 130 cases for business type, company size, department, and job title and there was no significant difference ($p>0.05$). Hence, these ten cases were dropped from the remaining statistical analyses.

For missing data in the remaining 130 cases, Little's MCAR test (Little and Rubin 2002) was performed and found that these values were missing completely at random (Little's MCAR test: Chi-Square = 7.358, Sig. = .393). This suggests that the missing values were not based on a hidden systematic pattern and any suitable imputation method could be applied to replace them

(Hair et al. 1998). An approach of replacing with series means was used to replace the missing data.

The MANOVA discriminant test described in Section 5.1.2 was used to test if there were any differences between these 130 valid cases and the previous 15 test cases. There was no significant difference between the group of 130 cases and the group of 15 cases (Wilks' Lambda = 0.910, and significance level = 0.690). Therefore, these were pooled for further analysis. This set of 145 cases was our final data set.

5.2 Participant Demographics

The study participants came from various industries. Table 5-2 presents the types of business in the sample. The majority of the respondents were from the financial industry (15.8%), healthcare and pharmaceutical (11.7%) manufacturing (11.0%), and government (10.3%). IT and telecommunication each accounted for 6.9 percent of the sample; the remaining respondents represented less than 5 percent of the sample and came from education, transportation, retail, etc. The profile of industries showed that the sample was a good representation of industry in general.

Table 5-2: Profile of Companies – Industry Distribution

Industry	N	%
Financial	23	15.8
Healthcare & Pharmaceutical	17	11.7
Manufacturing	16	11.0
Government	15	10.3
Entertainment and others	12	8.3
IT	10	6.9
Telecommunication	10	6.9
Retail & Wholesale	7	4.8
Education	6	4.1
Transportation	6	4.1
Food	5	3.4
Consulting	4	2.8
Tourism	3	2.1
Automotive	2	1.4
Legal	2	1.4
Utilities	2	1.4
Media	2	1.4
Real Estate	2	1.4
Construction	1	0.7
Total	145	1.00

Other descriptive data about companies including company size, position in industry, and location, is shown in Table 5-3. All the companies were medium to large sized: 71% had 500 or more employees, and 29% had more than 100 but less than 499 employees.

Table 5-3: Profile of Companies – Other Descriptive Data

		N	%
Company Size	500 or more employees	103	71
	100-499 employees	42	29
Location	US	66	45.5
	Canada	79	54.5

The demographics of the respondents are presented in Table 5-4. As the data indicate, the respondents were mostly senior managers, middle level managers, and front-line supervisor and project leaders. The majority had been working in their companies for more than five years. The respondents came from various departments: the IT/IS department accounted for almost 30 percent of the sample; others were scattered in the departments of sales/marketing, production/manufacturing, customer services, finance, etc. Regarding their roles in the BPR project, a large percent (43.4%) of the sample were BPR project team members; 18.6 percent were top management who supported and guided the whole BPR project; 15.2 percent were team leaders who guided the BPR project; 14.5 percent were champions who pushed the BPR project to be initiated and implemented; 7.6 percent were process managers who were familiar with the redesigned business processes; and there was one end user participant.

Table 5-4: Demographic Information of Respondents

Job Title		Frequency	%
Chief Executive Officer (CEO)		5	3.4
Senior management (e.g., CIO, CFO, CTO...)		30	20.7
Middle management		73	50.3
Front-line supervisor or Project leader		32	22.1
Other		5	3.4
	Total	145	100
Years in the Company		**Frequency**	**Percent**
Less than 5 years		33	22.8
Between 5 and 10 years (including 5)		49	33.8
Between 10 and 20 years (including 10)		44	30.3
Between 20 and 30 years (including 20)		12	8.3
Equal or greater than 30 years		7	4.8
	Total	145	100
Department		**Frequency**	**Percent**
Human Resources		7	4.8
Information Technology/Information Systems		42	29.0
Sales and/or Marketing		24	16.6
Production and/or Manufacturing		19	13.1
Customer Services		20	13.8
Finance		14	9.7
Management		9	6.2
Other		10	6.9
	Total	145	100
Role in the BPR Project		**Frequency**	**Percent**
• As a champion who pushed the BPR project to be initiated and implemented.		21	14.5
• As top management who supported and guided the whole BPR project.		27	18.6
• As a team leader who guided the BPR project.		22	15.2
• As a team member who participated in the BPR project.		63	43.4
• As a process manager who was familiar with the redesigned business processes.		11	7.6
• Other (End User)		1	0.7
	Total	145	100

5.3 Initial Data Analysis Steps

Before actually testing the measurement model produced by PLS, Exploratory Factor Analysis (EFA) was first used to examine whether the items that measure one underlying reflective construct were actually measuring it, or were possibly measuring more than one latent construct. This was carried out through a Principal Component Analysis (PCA) with varimax rotation supported by SPSS 15.0. This step mainly calculated the Cronbach alpha reliability coefficients for all scales. All the Cronbach alpha coefficients for the reflective constructs calculated were above the 0.7 level (0.805-0.961 for group1, as shown in the first column of Table 5-5; 0.7-0.874 for group2, as shown in the last column of Table 5-6), and hence considered acceptable for further data analysis, so no items were removed and no changes made to the constructs at this initial step.

The next step was to check for common method bias. Harman's one-factor test was applied to all the items from the ten crucial constructs involved in the research model. Results from this test (Appendix D) showed that eleven factors are present and that the highest covariance explained by one factor is 35.3%, indicating that common method bias is not a likely contaminant of this study.

5.4 Measurement Model Analysis Results

5.4.1 Convergent Validity for Reflective Constructs

There are two groups of reflective constructs. The first group includes BPR project champion, top management support, operational quality improvement, organizational quality improvement, cost savings, productivity, and overall success. The second group includes the reflective first-order constructs belonging to the three second-order formative constructs. They are CM_EL, CM_OL, CM_SL for Change Management; PR_T and PR_S for Process Redesign; ICTII_DI, ICTII_NC, ICTII_TR and ICTII_FM for ICTI improvement.

For the first group of reflective constructs, the analysis was performed globally with SmartPLS 2.0[7] (Ringle, Wende and Will 2005). Through the measurement model, convergent validity, discriminant validity, and reliability were examined.

The second group of reflective constructs was tested through the reliability analysis tool in SPSS 15.0. Since the second-order constructs were degraded into first-order constructs by approximations from the factor scores of their first-order constructs (discussed in section 4.3.2.3), the first-order constructs were not represented in the PLS analysis model. Therefore, before the approximation was used, the validity and reliability of this group of reflective constructs was examined.

For group 1 of the reflective constructs, recall that convergent validity for reflective constructs is assumed when the loadings of their items are above 0.7 and are significant at the 0.05 level.

[7] SmartPLS 2.0 and PLS-Graph 3.0 will produce the same results (Temme and Kreis 2005).

Table 5-5: Item Loadings for Reflective Constructs - Group 1

Construct (a) (b) (c)	Indicator	Mean	SD	Loadings	T-Value	P-Value
CHAM (0.973) (0.923) (0.958)	CHAM1	6.15	1.20	0.946	57.02	***
	CHAM2	6.09	1.31	0.972	123.21	***
	CHAM3	6.04	1.31	0.964	102.19	***
TMS (0.917) (0.688) (0.886)	TMS1	6.24	1.03	0.851	20.44	***
	TMS2	5.90	1.31	0.836	19.89	***
	TMS3	6.20	1.14	0.825	15.15	***
	TMS4	5.69	1.44	0.868	42.82	***
	TMS5	5.64	1.39	0.763	16.72	***
OpQI (0.885) (0.724) (0.798)	OpQI1†	5.28	1.69	0.668	7.13	***
	OpQI2	5.43	1.61	0.976	154.64	***
	OpQI3	5.34	1.57	0.972	105.45	***
OrQI (0.887) (0.663) (0.833)	OrQI1	4.38	1.81	0.754	15.10	***
	OrQI2	4.58	1.69	0.811	21.20	***
	OrQI3	5.34	1.39	0.851	30.94	***
	OrQI4	5.27	1.48	0.836	26.74	***
CS (0.872) (0.634) (0.805)	CS1	5.50	1.44	0.883	41.39	***
	CS2	4.54	1.85	0.777	17.92	***
	CS3	5.37	1.37	0.898	42.56	***
	CS4†	4.70	1.69	0.655	8.80	***
PROD (0.893) (0.676) (0.840)	PROD1	4.49	1.96	0.754	14.01	***
	PROD2	4.89	1.71	0.841	22.45	***
	PROD3	5.01	1.72	0.870	33.64	***
	PROD4	5.06	1.68	0.820	20.70	***
Sucess (0.981) (0.963) (0.961)	Success1	5.75	1.32	0.981	124.40	***
	Success2	5.77	1.27	0.982	160.43	***

Notes: 1. (a) (b) (c) - (Composite Reliability) (AVE) (Cronbach's Alpha)
2. *p<0.05; **p<0.01; ***p<0.001
3. † Removed from further analysis
4. CHAM – BPR project Champion; TMS – Top Management Support; OpQI – Operational Quality Improvement; OrQI – Organizational Quality Improvement; CS – Cost Savings; PROD – Productivity; Success – BPR Project Success.

In Table 5-5 all the item loadings are above 0.7 except for two items: OpQI1 (0.668) and CS4 (0.655). These two items were removed from further analysis and PLS was rerun (note that all the data shown in Table 5-5 were updated after the PLS was rerun, except those for OpQI1 and CS4). Now the item loadings were all above 0.7 and significant at the 0.001 level. This supports the conclusion of convergent validity for the reflective constructs in group 1.

Examining the results for the Group 2 reflective constructs in Table 5-6, all the item loadings are above 0.7 and the Cronbach's alpha coefficients for all the constructs are above 0.7. Therefore, the reflective constructs in this group meet acceptable requirements for validity and reliability.

Table 5-6: Item Loadings for Reflective Constructs - Group 2

Construct	Indicator	Mean	SD	Loadings	Cronbach's Alpha
CM_EL	CM_EL1	5.57	1.36	0.872	0.805
	CM_EL 2	5.56	1.33	0.883	
	CM_EL 3	5.18	1.68	0.789	
CM_OL	CM_OL1	4.22	1.85	0.72	0.791
	CM_OL2	4.42	1.93	0.72	
	CM_OL3	4.94	1.51	0.86	
	CM_OL4	4.90	1.56	0.84	
CM_SL	CM_SL1	5.30	1.53	0.935	0.857
	CM_SL2	5.01	1.64	0.935	
PR_T	PR_T1	5.61	1.50	0.584	0.747
	PR_T2	5.00	1.71	0.713	
	PR_T3	5.20	1.60	0.761	
	PR_T4	4.88	1.78	0.803	
	PR_T5	4.88	1.89	0.659	
PR_S	PR_S1	4.68	1.82	0.731	0.700
	PR_S2	4.09	1.94	0.737	
	PR_S3	3.91	1.98	0.753	
	PR_S4	4.61	1.90	0.678	
ICTII_NC	ICTI_NC1	4.19	1.99	0.942	0.874
	ICTI_NC2	4.50	1.90	0.942	
ICTII_DI	ICTI_DI1	5.71	1.38	0.802	0.781
	ICTI_DI2	5.45	1.60	0.862	
	ICTI_DI3	5.52	1.52	0.838	
ICTII_TR	ICTI_TR1	4.44	1.69	0.756	0.758
	ICTI_TR2	5.14	1.38	0.825	
	ICTI_TR3	4.95	1.43	0.880	
ICTII_FM	ICTI_FM1	4.73	1.88	0.764	0.837
	ICTI_FM2	4.06	1.68	0.775	
	ICTI_FM3	4.35	1.80	0.835	
	ICTI_FM4	4.90	1.53	0.682	
	ICTI_FM5	4.79	1.64	0.832	

5.4.2 Discriminant Validity for Reflective Constructs

Two criteria should be met for discriminant validity as discussed in section 4.3.2.2: a) item loadings should be at least 0.7, and items should load more highly on constructs they are intended to measure than on other constructs; and, b) the square root of the AVE calculated for a construct from its indicators should be at least 0.7 (i.e., AVE > 0.50) and should exceed that construct's correlations with other constructs.

Under criteria a) above, the values of the item loadings and cross-loadings were examined (see Table 5-7). The table shows that all the item loadings on the constructs they are intended to measure (values in Bold) are above 0.7; and they load less on the other constructs.

Table 5-7: Item Loadings and Cross-Loadings

	CHAM	TMS	OpQI	OrQI	CS	PROD	Success	CM	PR	ITI
CHAM1	0.946	0.663	0.399	0.449	0.418	0.341	0.508	0.555	0.291	0.408
CHAM2	0.972	0.670	0.375	0.396	0.469	0.333	0.522	0.551	0.334	0.392
CHAM3	0.964	0.659	0.429	0.434	0.535	0.390	0.565	0.591	0.349	0.402
TS1	0.634	0.851	0.397	0.300	0.394	0.245	0.464	0.487	0.293	0.339
TS2	0.572	0.836	0.491	0.481	0.527	0.394	0.633	0.570	0.359	0.387
TS3	0.580	0.825	0.319	0.263	0.373	0.229	0.406	0.455	0.298	0.345
TS4	0.591	0.868	0.514	0.451	0.526	0.442	0.594	0.634	0.424	0.452
TS5	0.487	0.763	0.379	0.324	0.364	0.297	0.460	0.560	0.244	0.433
OpQI2	0.395	0.471	0.976	0.453	0.586	0.621	0.632	0.540	0.398	0.554
OpQI3	0.356	0.466	0.972	0.426	0.601	0.612	0.573	0.517	0.357	0.531
OrQI1	0.259	0.273	0.311	0.754	0.448	0.379	0.365	0.347	0.485	0.405
OrQI2	0.254	0.281	0.324	0.811	0.495	0.473	0.437	0.451	0.552	0.468
OrQI3	0.443	0.449	0.469	0.851	0.652	0.540	0.717	0.583	0.409	0.546
OrQI4	0.438	0.403	0.458	0.836	0.520	0.518	0.575	0.640	0.382	0.589
CS1	0.448	0.503	0.554	0.585	0.883	0.545	0.753	0.573	0.456	0.528
CS2	0.289	0.368	0.491	0.434	0.777	0.442	0.492	0.453	0.407	0.388
CS3	0.514	0.504	0.557	0.589	0.898	0.574	0.742	0.609	0.486	0.522
PROD1	0.230	0.234	0.601	0.319	0.513	0.754	0.407	0.340	0.446	0.382
PROD2	0.326	0.322	0.531	0.487	0.499	0.841	0.518	0.442	0.476	0.459
PROD3	0.303	0.344	0.598	0.497	0.565	0.870	0.511	0.457	0.464	0.503
PROD4	0.343	0.379	0.447	0.618	0.564	0.820	0.572	0.530	0.516	0.465
Success1	0.524	0.5935	0.642	0.643	0.7359	0.585	0.981	0.699	0.431	0.580
Success2	0.562	0.6286	0.668	0.665	0.7546	0.623	0.982	0.730	0.462	0.657
CM_EL	0.573	0.659	0.548	0.584	0.614	0.510	0.707	0.957	0.406	0.634
CM_OL	0.389	0.416	0.501	0.557	0.539	0.422	0.525	0.773	0.430	0.591
CM_SL	0.536	0.578	0.466	0.550	0.552	0.486	0.637	0.858	0.406	0.579
PR_T	0.395	0.405	0.482	0.521	0.530	0.565	0.479	0.462	0.937	0.555
PR_S	0.205	0.308	0.398	0.478	0.528	0.518	0.379	0.417	0.843	0.514
ICTII_NC	0.184	0.248	0.502	0.311	0.354	0.429	0.340	0.372	0.401	0.661
ICTII_DI	0.347	0.393	0.401	0.564	0.492	0.426	0.568	0.522	0.480	0.813
ICTII_TR	0.398	0.424	0.424	0.528	0.483	0.423	0.510	0.647	0.407	0.814
ICTII_FM	0.248	0.317	0.286	0.481	0.347	0.448	0.302	0.356	0.603	0.678

To check criterion b) above, the values in Table 5-8 were examined. The square roots of the AVE for all the constructs from their indicators are above 0.7 (note that AVE is not applicable for the formative constructs CM, PR, and ICTII), and exceed that construct's correlations with other constructs. Hence, the constructs have been shown to have adequate discriminant validity.

Table 5-8: Correlations among Constructs

	CHAM	TMS	OpQI	OrQI	CS	PROD	Success	CM	PR	ICTII
CHAM	0.961									
TMS	0.691***	0. 829								
OpQI	0.417***	0.512***	0. 851							
OrQI	0.443***	0.444***	0.491	0. 814						
CS	0.493***	0.531***	0.632	0.659	0. 796					
PROD	0.369***	0.394***	0.654	0.596	0.652	0. 822				
Success	0.553***	0.622***	0.667**	0.666***	0.759***	0.616	0. 981			
CM	0.588***	0.656***	0.577**	0.638***	0.651***	0.544*	0.628***	n/a		
PR	0.356**	0.408***	0.499	0.560*	0.588***	0.607***	0.489***	0.494	n/a	
ICTII	0.417***	0.473***	0.567*	0.626*	0.585	0.553	0.630*	0.683	0.599	n/a

*p<0.05; **p<0.01; ***p<0.001

Note: 1, The shaded numbers in the diagonal row are square roots of the average variance extracted.
2, CHAM – BPR Project Champion; TMS – Top Management Support; OpQI – Operational Quality Improvement; OrQI – Organizational Quality Improvement; CS – Cost Savings; PROD – Productivity; Success – BPR Project Success; CM – Change Management; PR- Process Redesign; ICTII – ICTI Improvement.

5.4.3 Reliability for Reflective Constructs

Recall the discussion in section 4.3.2.2.3 that the composite reliability coefficient is considered a more appropriate measure of reliability in SEM than Cronbach's alpha. The composite reliability coefficients for all the reflective constructs in the PLS model are above 0.7 (Table 5-5). Hence, they pass the reliability criterion.

5.4.4 Validity for Formative Constructs

The first step to establish validity for the formative constructs is to use principal component analysis to examine item weightings for formative measures. If any of these item weightings are non-significant, it may be appropriate to remove non-significant indicators, or to keep non-significant items to preserve content validity. All the item weights (shown in Table 5-9), except for ICTII_FM, are significant, so the problem here is in ICTII_FM.

Table 5-9: Weights of the Indicator Variables for Formative Constructs

Construct	Items	Weights	T-Value	P-Value
CM	CM_EL	0.592	4.548	***
	CM_OL	0.236	2.235	*
	CM_SL	0.329	2.863	**
PR	PR_T	0.673	5.754	***
	PR_S	0.439	3.420	***
ICTI Improvement	ICTII_NC	0.361	3.125	**
	ICTII_DI	0.466	4.340	***
	ICTII_TR	0.473	5.143	***
	ICTII_FM	0.005	0.0397	NS

*p<0.05; **p<0.01; ***p<0.001

There are two options: either remove this indicator or leave it for further analysis. The literature regarding this dimension of ICTI improvement was re-examined. The authors in the study (Law and Ngai 2007b) built a multidimensional construct (i.e., ICTI improvement) from several resources. The first three dimensions (network communications, data integration, and, training) have clear reference support (Bhatt 2000a; Bhatt 2001b; Sakaguchi and Dibrell 1998); while the last dimension of facility management (FM) was unclear and it was combined from several resources (as discussed in section 4.2.1.3). Although Law and Ngai (2007b) claimed that ICTI improvement was a multidimensional concept, they treated the four dimensions separately and did not test the validity of combining them into a multidimensional high-order construct. However, the results from our empirical test on this construct showed that this dimension is not significant to the construct IT Infrastructure. Therefore, considering that a) the last dimension is unclear from its origin; and, b) the data results showed it was insignificant, it was decided to remove ICTII_FM from the multidimensional construct ICTI improvement. PLS was rerun at this point and all the results shown in the tables and figures were updated. After removing this dimension, all the formative indicators were significant.

The second step was to examine discriminant validity. All the formative constructs share less than half of their variances with other constructs (construct inter-correlation is less than 0.7 as shown in Table 5-8); also, their items have higher loadings on their intended constructs than on other constructs. Hence, discriminant validity of the formative constructs has been achieved.

5.4.5 Reliability for Formative Constructs

Multicollinearity was checked for the measures of the formative constructs through SPSS 15.0. The VIF values for all the formative indicators ranged from 1.408 to 3.119 (Table 5-10), which meets the strict cut-off threshold 3.3. Therefore, multicollinearity is not a problem for the three formative constructs.

Table 5-10: Multicollinearity Examination

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	5.752	.076		75.905	.000		
	IT_NC	.041	.090	.031	.456	.649	.710	1.408
	IT_DI	.273	.100	.207	2.726	.007	.577	1.733
	IT_TR	-.084	.106	-.063	-.790	.431	.516	1.940
	CM_EL	.618	.134	.468	4.601	.000	.321	3.119
	CM_OL	.005	.111	.004	.044	.965	.470	2.129
	CM_SL	.187	.114	.141	1.643	.103	.448	2.233
	PR_S	.014	.103	.011	.136	.892	.540	1.851
	PR_T	.136	.109	.103	1.249	.214	.490	2.041

Correlations among the formative indicators were then examined for reliability. As shown in Figure 5-1, Figure 5-2 and Figure 5-3, correlations between the formative indicators of ICTII were 0.314, 0.325, 0.480 ($p<0.01$ in each case); those for CM were 0.548, 0.712, 0.674 ($p<0.01$ in each case); and for PR it was 0.587 ($p<0.01$). As discussed previously, the results suggest that the three sets of formative indicators may belong to the same set respectively, even if formative constructs need not be correlated. Note that, because a reflective model would tend to generate extremely high correlations (often above 0.80), a formative model seems more likely (Pavlou and Sawy 2006).

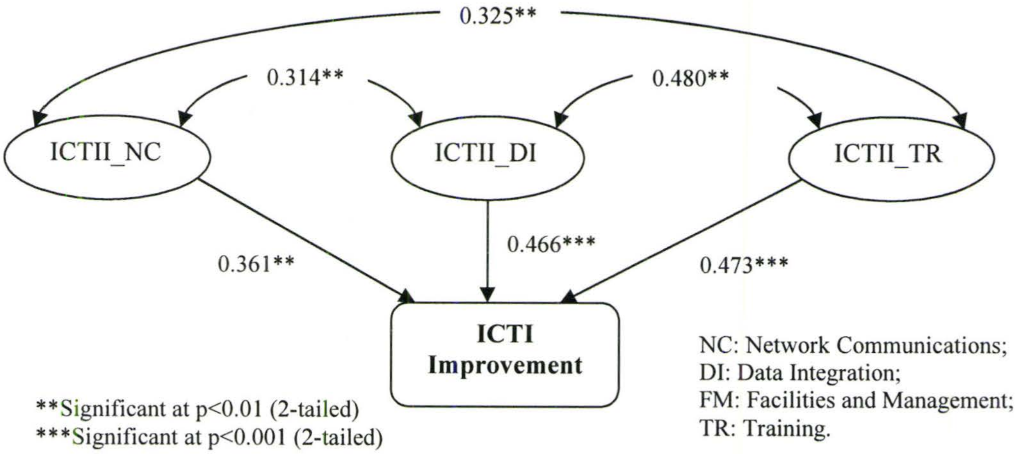


Figure 5-1: Correlations between Formative Indicators of ICTI Improvement

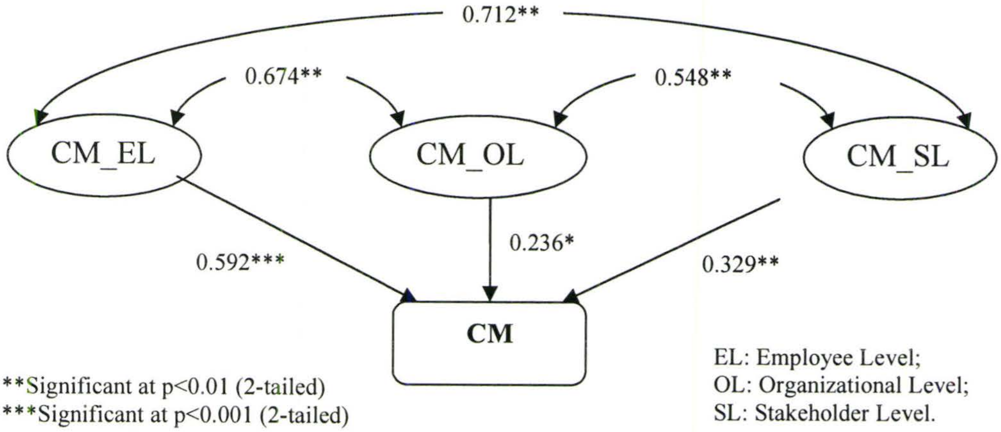
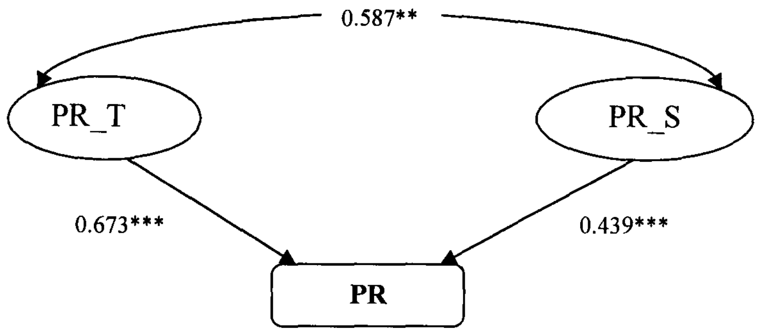


Figure 5-2: Correlations between Formative Indicators of CM



**Significant at p<0.01 (2-tailed)
***Significant at p<0.001 (2-tailed)

PR_T: Technical dimension
PR_S: Social dimension

Figure 5-3: Correlations between Formative Indicators of PR

5.5 Structural Model Analysis Results

The structural model evaluates two types of relationships among the constructs: path coefficients and squared multiple correlations R^2. High squared multiple correlations and significant relationships between constructs indicate a good model (Chin 1998b; Petter et al. 2007).

5.5.1 The Overall Model

The results of the hypothesized path significance tests are shown in Table 5-11 and the PLS results for the overall structural model are shown in Figure 5-4.

According to the results of the evaluation, most of the paths hypothesized in the theoretical model are supported. As expected,

(1) BPR project champion has a significantly strong influence on top management support, supporting H1;

(2) Top management support significantly affects the three BPR project implementation components (change management, process redesign, and ICTI improvement), supporting H2a, H2b, and H2c, respectively;

(3) Change management has significant impacts on all of the four facets of BPR project outcomes (operational quality improvement, organizational quality improvement, cost savings, and productivity), thus supporting H3a, H3b, H3c and H3d, respectively;

(4) Process redesign has significant impacts on organizational quality improvement, cost savings, and productivity, supporting H4b, H4c, and H4d, respectively;

(5) ICTI improvement has significant impacts on operational quality improvement and organizational quality improvement, supporting H5a and H5b; 6) Three among the four facets of BPR project outcomes, i.e., operational quality improvement, organizational quality improvement, cost savings, contribute significantly to the overall BPR project success, supporting H6a, H6b, and H6c, respectively.

However, four hypotheses were not supported by the structural model: a) Process redesign did not have a significant impact on OpQI, rejecting H4a; b) ICTI improvement did not have a significant impact on CS and PROD, rejecting H5c and H6d; and c) Productivity did not significantly contribute to overall BPR project success, rejecting H6d.

The impacts of the three BPR project implementation components on the facets of BPR project outcomes show that change management is the most important component of BPR project implementation, since it affects all facets of the outcomes significantly. Redesigning processes does not improve operational quality, such as customer service quality, but it does significantly improve cost savings and productivity, as well as organizational quality (e.g., bureaucracy reduction and internal user satisfaction). This shows that ICTI improvement significantly affected operational quality and organizational quality, rather than cost savings and productivity.

It is evident from Figure 5-4 that the model demonstrated moderately to high explanatory power. The R^2 value for the overall BPR project success construct was 0.697, which means it explained 69.7% of the variance in BPR project success. The R^2 values for seven of the other endogenous constructs ranged from 0.224 to 0.511. The lowest R^2 value in this model is that for process redesign (0.166), but it is still acceptable.

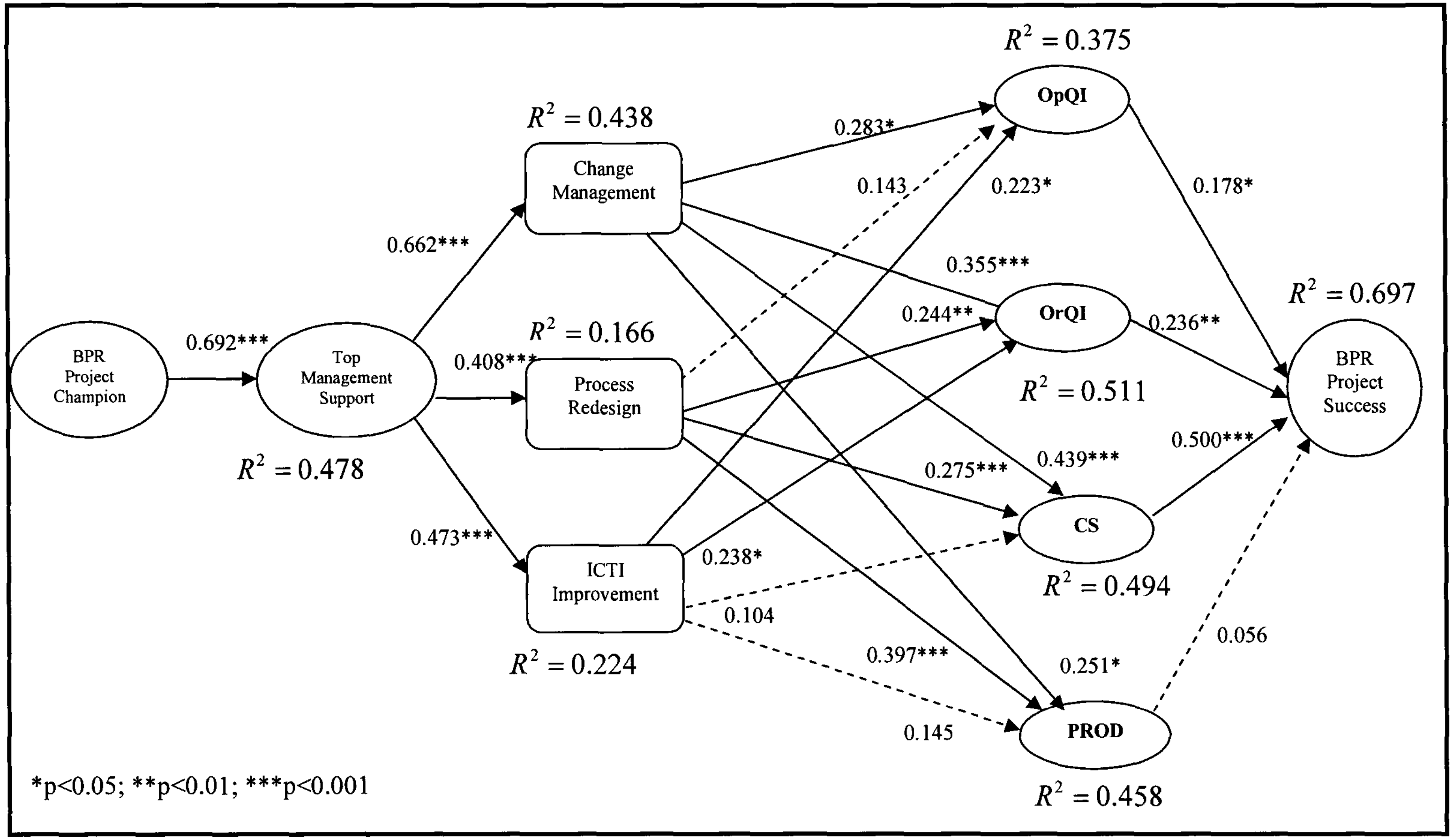
Overall, despite the rejection of four hypotheses, the proposed model appears to provide an adequate explanation for BPR project success. This is clarified in the detailed discussion of the simplified model in the next section.

Table 5-11: Path Significance Tests

Path	Path coefficient	Standard error	t-value	Significance level	Test result
H1: CHAM→ TMS	0.692	0.081	8.552	***	S
H2a: TMS→CM	0.662	0.068	9.767	***	S
H2b: TMS→PR	0.408	0.098	4.149	***	S
H2c: TMS→ICTII	0.473	0.096	4.923	***	S
H3a: CM→OpQI	0.283	0.124	2.263	*	S
H3b: CM→OrQI	0.355	0.091	3.907	***	S
H3c: CM→CS	0.439	0.095	4.606	***	S
H3d: CM→PROD	0.251	0.114	2.209	*	S
H4a: PR→ OpQI	0.143	0.110	1.295	NS	R
H4b: PR→ OrQI	0.244	0.092	2.665	**	S
H4c: PR→ CS	0.275	0.077	3.565	***	S
H4d: PR→ PROD	0.397	0.085	4.677	***	S
H5a: ICTII→ OpQI	0.223	0.126	2.247	*	S
H5b: ICTII→ OrQI	0.238	0.111	2.149	*	S
H5c: ICTII→ CS	0.104	0.104	0.995	NS	R
H5d: ICTII→ PROD	0.145	0.115	1.263	NS	R
H6a: OpQI →Success	0.178	0.079	2.243	*	S
H6b: OrQI →Success	0.236	0.073	3.218	**	S
H6c: CS →Success	0.500	0.078	6.373	***	S
H6d: PROD →Success	0.056	0.064	0.866	NS	R

Notes: *$p<0.05$; **$p<0.01$; ***$p<0.001$; NS: Not Significant
S: Supported; R: Rejected.

Figure 5-4: PLS Analysis Results (The Model with Outcome Facets)



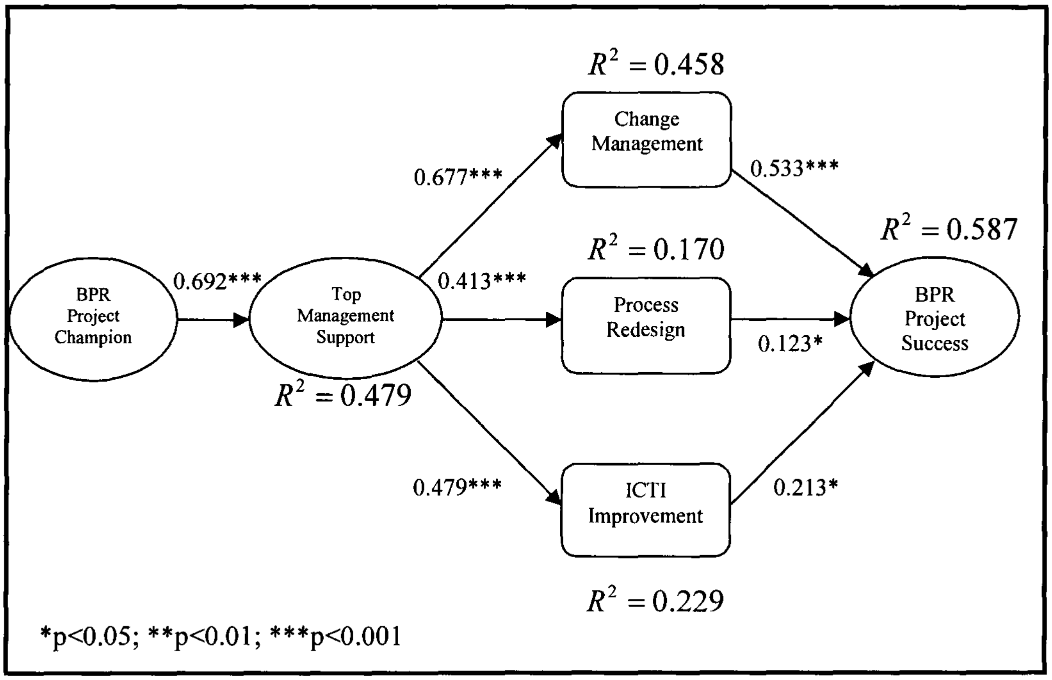
Notes: OpQI: Operational Quality Improvement
OrQI: Organizational Quality Improvement
CS: Cost Savings
PROD: Productivity

5.5.2 The "Direct Impact" Model

The overall model in Figure 5-4 displays the values and significance of the relationships between the three BPR project implementation components (change management, process redesign, and ICTI improvement) and the different facets of BPR project outcomes (operational quality improvement, organizational quality improvement, cost savings, and productivity); as well as the relationships between the four facets of BPR project outcomes and ultimate BPR project success. It is useful to examine the direct relationships between the three BPR project implementation components and ultimate BPR project success in order to see their relative impacts on BPR project success. Therefore, the facets of BPR project outcomes were eliminated from the original model to get the "Direct Impact" model (shown in Figure 5-5), where the BPR project implementation components are directly linked to overall BPR project success. Differentiating between the simplified model and the overall model is not intended to test the mediation of the eliminated constructs; rather, it is to examine the model from two different perspectives: excluding the facets of BPR project outcomes or including them in the model, respectively.

The results shown in Figure 5-5 clearly indicate that all of the three BPR project implementation components have significant impacts on overall BPR project success. Change management (CM) has the most significant impact on BPR project success (Beta=0.533, $p<0.001$), supporting H7a; the impact of Process Redesign (PR) and that of ICTI improvement on BPR project success are at the same significance level (Beta=0.123, p<0.05; Beta=0.213, p<0.05, respectively), supporting H7b and H7c.

Figure 5-5: PLS Analysis Results (The "Direct Impact" Model)



5.5.3 Detailed Examination of Hypothesis Tests

- **Hypothesis H1**

Hypothesis *H1* states that stronger BPR project champions will obtain stronger top management support (TMS). The R^2 for TMS was about 48%, which indicated that Champion explained almost half of the variance in TMS; and the path coefficient was 0.692 at a significance level of p<0.001 (H1 was supported). Only one variable (champion) was examined as a predictor of TMS, but there are other possible factors that can help explain the remaining variance in TMS. These may include: BPR knowledge that top management has, readiness of organizations to carry out BPR projects, strategies, pressures from internal need or external competition, etc.

- **Hypotheses H2a to H2c**

The series of hypotheses *H2* states that stronger top management support will result in more comprehensive change management (CM), more comprehensive process redesign (PR), and a higher level of ICTI improvement. The variance of CM explained by TMS was 44%, that of PR was 17%, and that of ICTI improvement was 23%; and their path coefficients from TMS were 0.66, 0.41, and 0.47, all at a significance level of $p<0.001$ (H2a, H2b and H2c were supported). These results indicate that top management support was significantly associated with all the three BPR project implementation components; however, top management support explained much more of the variance in change management (44%) than it did for process redesign (17%) and ICTI improvement (23%). This implies that top management support may be an important predictor for change management, but less so for process redesign and ICTI improvement. Other important predictors for process redesign and ICTI improvement need to be investigated in further research.

- **Hypotheses H3, H4, and H5**

The series of hypotheses *H3* states that a more comprehensive change management program will result in higher level of operational quality improvement (OpQI), higher level of organizational quality improvement (OrQI), higher level of cost savings (CS) and higher level of productivity (PROD). The path coefficients for the paths from change management to OpQI, OrQI, CS, and PROD were 0.283 ($p<0.05$), 0.355 ($p<0.001$), 0.439 ($p<0.001$), and 0.251 ($p<0.05$), respectively. This set of results confirmed the support of H3a to H3d.

The series of hypotheses *H4* states that a greater extent of process redesign will result in higher levels of operational quality improvement, organizational quality improvement, cost savings, and productivity, respectively. The coefficients for the relevant paths from process redesign to OpQI, OrQI, CS and PROD were 0.143 (not significant), 0.244 ($p<0.01$), 0.275 ($p<0.001$), and 0.397 ($p<0.001$), respectively.

The series of hypotheses *H5* states that higher levels of ICTI improvement will result in higher levels of operational quality improvement, organizational quality improvement, cost savings, and productivity, respectively. The coefficients for the relevant paths from ICTI improvement to OpQI, OrQI, CS and PROD were 0.223 ($p<0.05$), 0.238 ($p<0.05$), 0.104 (not significant), and 0.145 (not significant), respectively.

The three BPR project implementation components together explained 37.5% of the variance of OpQI; 51.1% of the variance of OrQI; 49.4% of the variance of CS; and 45.8% of the variance of PROD. These results indicate that the three components of BPR project implementation account for a substantial amount of the variance of the four facets of BPR project outcomes; however, there remains unexplained variance of BPR project outcomes that may be explained by other aspects of BPR project implementation that were not considered in the current study.

- **Hypotheses H6**

The series of hypotheses *H6* states that a higher level of operational quality improvement (organizational quality improvement / cost savings / productivity) will result in higher levels of BPR project overall success. The path coefficients for the paths from the four BPR project outcomes (OpQI, OrQI, CS, PROD) to overall success were 0.178 ($p<0.05$), 0.236 ($p<0.01$), 0.500 ($p<0.001$), and 0.056 (not significant). The variance of BPR project overall success explained by the four facets of BPR project outcomes was 69.7%, which explains an acceptable amount of the variance in overall BPR project success. Other aspects of outcomes that were not considered but which may contribute to overall BPR project success include BPR project planning, project management, etc.

- **Hypotheses H7**

The series of hypotheses *H7* states that a more comprehensive change management program (a greater extent of process redesign / a higher level of ICTI improvement) will result in a higher level of BPR project success. The path coefficients for the paths from change management, process redesign, and ICTI improvement to BPR project success were 0.533 ($p<0.001$), 0.123 ($p<0.05$), and

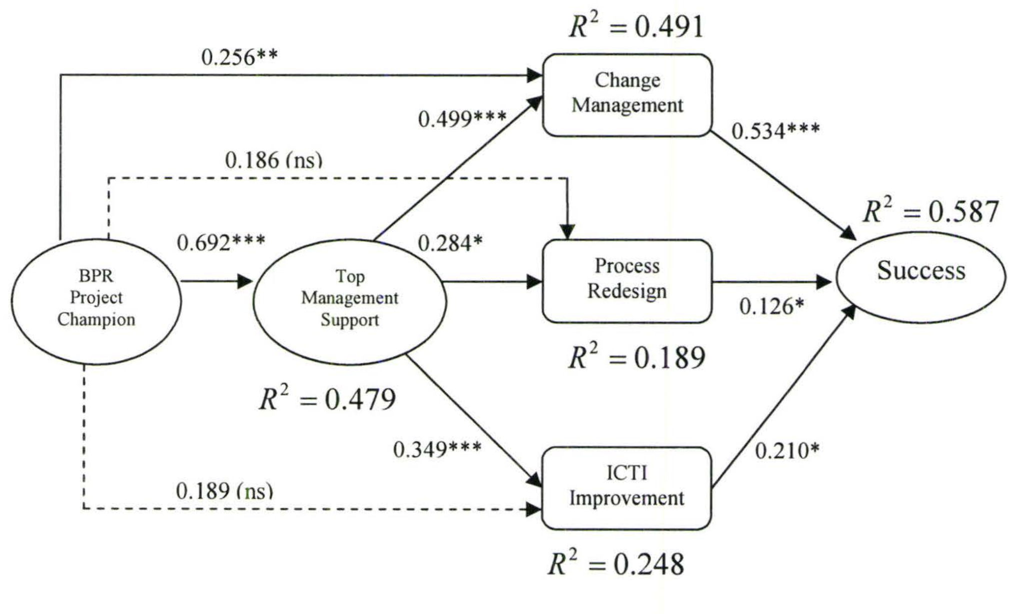
0.213 ($p<0.05$), respectively. The variance of BPR project success explained through the three implementation components was 58.7%. The meaning of this percentage is different from that in the test of H6 (69.7%). R^2 (0.587) in the test of H7 indicates the percentage (58.7%) of the BPR project success achieved by the activities carried out in the BPR project. R^2 (0.697) in the test of H6 indicates the percentage (69.7%) of BPR project success explained by the BPR project outcomes. Unexplained variances in both these measures are due to other BPR project implementation activities not taken into account in the current study, such as strategy alignment.

5.5.4 The Mediating Role of Top Management Support

In order to test the hypothesized mediating role of top management support between BPR project champion and the three BPR project implementation components, two tests were done on the model. These tests were done on both the complex and the simplified model, but only the "direct impact" model was used to illustrate the results since both of them produced essentially the same results.

In the first test, we removed the top management support construct from the model and added three direct links from BPR project champion to CM (change management), PR (Process Redesign), and ICTII (ICTI improvement). This tested whether the BPR project champion construct itself is significantly related to the three BPR project implementation components. PLS analysis results showed that BPR project champion was significantly related to all of the three constructs at a significance level of 0.001, as shown in the "Direct Influence" part of Table 5-12. In the second test, we added back the link to top management support (TMS) and the links between CHAM (BPR project champion) and TMS, as well as the links between TMS and CM/PR/ICTII, leaving the links between CHAM and CM/PR/ICTII in the model at the same time. Then another PLS analysis was conducted and the results are shown in Table 5-12 (in the part labeled "Mediated by TMS") and Figure 5-6.

Figure 5-6: The Mediating Role of Top Management Support



*p<0.05; **p<0.01; ***p<0.001; ns: not significant

Table 5-12: The Direct Relationships between Champion and the Three Implementation Components

		Path Coefficients	t-value	significance
Direct Influence	CHAM→CM	0.601	7.915	***
	CHAM→PR	0.389	3.938	***
	CHAM→ICTII	0.431	4.901	***
Mediated by TMS	CHAM→CM	0.256	3.256	**
	CHAM→PR	0.186	1.456	NS
	CHAM→ICTII	0.189	1.921	NS

Notes: *p<0.05; **p<0.01; ***p<0.001; NS: Not Significant

The results provide clear evidence that TMS mediated the relationship between CHAM and PR because the direct link between CHAM and PR was found to be not significant; but the link between CHAM and TMS and that between TMS and PR were significant. By the same reasoning, it can be concluded that TMS also mediated the relationship between BPR project champion and ICTI improvement.

The results are not as evident for the mediating role of TMS between CHAM and CM as those between CHAM and PR/ICTII because the link between CHAM and CM is still significant after TMS was added between CHAM and CM. However, the results showed that the influence between CHAM and CM was decreased a great deal as a result of including the direct link (from Beta = 0.601 at the level of 0.001 to Beta = 0. 256 at the level of 0.01). Therefore, the mediating role of TMS between CHAM and CM still holds although its mediating effect is not as strong as it was for the other two.

5.5.5 Effect Size

Potential changes in R^2 can be explored through an inclusion analysis to determine if the impact of a particular independent variable on a dependent variable has substantive impact (Chin 1998b). The effect size f^2 can be used to evaluate the predictive power of independent variables, which is calculated as:

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}} \tag{5-1}$$

Where f^2 is the effect size of an independent variable; $R^2_{included}$ is the R^2 value of a dependent variable when the tested independent variable is included in the model; and $R^2_{excluded}$ is the R^2 value of a dependent construct when the tested independent variable is excluded from the model. The effect size values of 0.02, 0.15, and 0.35 may be viewed as a gauge of whether a predictor has a small, medium, or large effect at the structural level (Chin 1998b; Cohen 1988).

We are interested in the effect size of six sets of independent variables: (i) effect sizes of the three BPR project implementation components that contribute to operational quality improvement; (ii) effect sizes of the three BPR project implementation components that contribute to organizational quality improvement; (iii) effect sizes of the three BPR project implementation components that contribute to cost savings; (iv) effect sizes of the three BPR project implementation components that contribute to productivity; (v) effect sizes of the four facets of BPR project outcomes that contribute to the overall

BPR project success; and (vi) effect size of the three BPR project implementation components that are related to the BPR project success.

The first four sets were tested from the complex model where, for each set, one of the links between BPR project implementation components and one of the outcome facets was removed at a time, and R^2 values were recorded.

It is shown in Table 5-13 that the effects of change management, process redesign and ICTI improvement on operational quality improvement (OpQI) all fell into the small effect category.

Table 5-13: The Effect Size of BPR Project Implementation Components on OpQI (Operational Quality Improvement)

$R^2_{included}$=0.375	CM	PR	ICTII
$R^2_{excluded}$	0.333	0.362	0.339
f^2	0.067	0.021	0.058
Effect	Small	Small	Small

It is shown in Table 5-14 that the effects of change management, process redesign and ICTI improvement on organizational quality improvement (OrQI) also fell into the small effect category, the same level of effect as on OpQI .

Table 5-14: The Effect Size of BPR Project Implementation Components on OrQI (Organizational Quality Improvement)

$R^2_{included}$ =0.511	CM	PR	ICTII
$R^2_{excluded}$	0.444	0.479	0.486
f^2	0.137	0.065	0.051
Effect	Small	Small	Small

It is shown in Table 5-15 that the effect of change management on cost savings belongs to the medium category; the effect of process redesign on cost savings was small; and ICTI improvement had no significant effect on cost savings.

Table 5-15: The Effect Size of BPR Project Implementation Components on CS (Cost Savings)

$R^2_{included}$ =0.494	CM	PR	ICTII
$R^2_{excluded}$	0.392	0.447	0.489
f^2	0.202	0.093	0.010
Effect	Medium	Small	NS

Table 5-16 shows that the effect of process redesign on productivity belongs to the medium category; the effect of change management on productivity was small; while ICTI improvement had no significant effect on productivity.

Table 5-16: The Effect Size of BPR Project Implementation Components on Productivity

$R^2_{included}$ =0.458	CM	PR	ICTII
$R^2_{excluded}$	0.425	0.359	0.449
f^2	0.061	0.183	0.017
Effect	Small	Medium	NS

The fifth set was tested with the overall model, where one of the links between OpQI, OrQI, CS, or PROD and BPR project success was removed at a time. The relevant R^2 values are shown in Table 5-17. The sixth set was tested with the "Direct Impact" model, where one of the links between CM, PR, or ICTI improvement and BPR project success was removed at a time. The R^2 values are recorded in Table 5-18.

The results show that CS has a large impact on BPR project success and OpQI and OrQI have a small impact on BPR project success. Productivity did not have a substantive impact on BPR project success; Change Management had a large impact on BPR project success; and Process Redesign and ICTI improvement both have relatively small impacts on BPR project success. These results are consistent with the path coefficient values discussed previously.

Table 5-17: The Effect Size of Facets of BPR Project Outcomes on BPR Project Success

$R^2_{included}$ =0.697	OpQI	OrQI	CS	PROD
$R^2_{excluded}$	0.681	0.668	0.584	0.696
f^2	0.053	0.096	0.373	0.003
Effect	small	small	large	NS

Table 5-18: The Effect Size of BPR Project Implementation Components on BPR Project Success

$R^2_{included}$ =0.587	CM	PR	ICTII
$R^2_{excluded}$	0.433	0.577	0.566
f^2	0.373	0.024	0.051
Effect	large	small	small

5.5.6 Influence of Control Variables

The impacts of the control variables were analyzed through the model by adding the three control variables into the model simultaneously since our sample size is large enough to do so[8]. Their influence was then detected by (1) comparing the R^2 values for all the endogenous constructs with the values corresponding to the uncontrolled model; and (2) analyzing path coefficients and their significance. Both the overall model and the "Direct Impact" model were used to test the

[8] After adding the three control variable, the dependent LV (Latent Variable) with the largest number of independent LVs impacting it is Overall Success, which has 7 paths leading into it. This structure requires the sample size to be at least 7*10=70. Our sample size is 145, which is large enough.

control variables, but the results from these two models were essentially the same. Therefore, the results are explained through the "Direct Impact" model for clarity.

Company Size. Only large and medium sized companies were investigated in this study. Among them, companies with more than 500 employees were differentiated from those with less than 500 but more than 100 employees. This differentiation allows us to test for company size impact on BPR project implementation and success.

Organizational Culture. This variable was controlled by limiting the location of companies to Canada and US, because companies in these two countries were assumed to have similar cultures. However, for completeness we did test for differences in the impact on BPR project implementation and success between these two country groupings.

Strategic Stimulus. Guha's antecedent "stimuli" was adopted as strategic initiatives (Guha and Grover 1997) and respondents were asked to indicate if their BPR projects were proactive, reactive, both, or not strategy aligned. This allows a test of whether BPR project strategic stimulus will influence BPR project success significantly.

The resulting changes in the R^2 values of the endogenous constructs are captured in Table 5-19. This table shows that company size, culture, and strategy stimulus had virtually no influence on dependencies in the model, since all the corresponding R^2 values increased only slightly.

The results for path coefficients between the three control variables and the endogenous constructs are presented in Table 5-20, showing that no significant path coefficients emerged after adding the control variables to the model.

Table 5-19: Variances Explained in the Uncontrolled and Controlled Model

Control Variable	TMS	CM	PR	ICTII	Success
Uncontrolled Model	0.479	0.458	0.170	0.229	0.587
Company Size	0.491	0.460	0.170	0.231	0.590
Culture	0.481	0.461	0.172	0.233	0.588
Strategy Stimulus	0.480	0.467	0.177	0.231	0.594

Table 5-20: Path Coefficients between Control Variables and the Endogenous Constructs

Control Variable		TMS	CM	PR	ICTII	Success
Company Size	Path Coefficient	-0.107	0.045	-0.011	-0.048	0.056
	t-value	1.600	0.618	0.128	0.638	1.100
	significance	*ns*	*ns*	*ns*	*ns*	*ns*
Culture	Path Coefficient	-0.030	0.051	0.042	0.066	-0.047
	t-value	0.451	0.812	0.471	0.789	0.801
	significance	*ns*	*ns*	*ns*	*ns*	*ns*
Strategy	Path Coefficient	0.042	0.101	0.082	0.036	-0.086
	t-value	0.634	1.510	1.039	0.437	1.509
	significance	*ns*	*ns*	*ns*	*ns*	*ns*

Chapter 6: Discussion and Conclusions

6.1 Introduction

This exploratory study applied Social-Technical Theory in the context of BPR project implementation to explain the impact of success factors on BPR project success. The proposed conceptual research model includes the following factors: BPR project champion, top management support, change management, process redesign, and Information and Communication Technology Infrastructure (ICTI) improvement. The model considers critical factors from both the social and technical aspects of BPR project practice and the relationships among them. Facets of BPR project outcomes, including operational quality improvement, organizational quality improvement, cost savings, and productivity, were also examined.

A survey of 145 managers and executives from medium and large-sized companies was used to validate the model. The results show that a BPR project champion is a critical success factor for BPR project success, mediated through top management support, and that top management support must be emphasized through the whole BPR project implementation procedure. More specifically, change management has a better likelihood of success if it is strongly supported by top management, while other factors play an important role in helping to encourage process redesign and ICTI improvements.

This study also shows that three BPR project implementation components: change management, process redesign, and information and communications technology infrastructure (ICTI) improvement, are all critical to BPR project success. However, change management occupies the most important position because it impacts significantly the success of all four facets of BPR project outcomes (operational quality improvement, organizational quality improvement, cost savings, and productivity). Among these outcomes, the study showed that productivity is no longer the top focus of companies; instead, operational quality and organizational quality have become more important.

The key learnings of previous chapters were that the quantitative research methodology and techniques, as well as the theory (socio-technical theory) and the instruments designed for this study could be successfully applied to empirical investigations of BPR project implementation.

The goals of this last chapter are three-fold. The first is to answer the research questions posed in Chapter 3. The second is to reflect on the methodology, theory and practice discussed in the thesis. The third is to outline the limitations of this study and suggest directions for future research.

6.2 Answers to Research Questions

The research questions proposed in this study are essential to advance BPR project research. Two major characteristics of this research area in the past have been a focus on reporting success factors from single BPR projects and a lack of suitable theoretical explanations. This results in limited generalizability in the existing literature. In addition BPR project implementation, as the most important stage of any BPR project, has not been examined regarding its effect on project outcomes. This study aimed to make BPR project research more generalizable and to determine the most important implementation activities that affect BPR project success most.

Answers to the research questions posed at the beginning of this document are discussed below by: (i) identifying the most critical BPR project implementation components, based on socio-technical theory; (ii) examining the relationships between implementation components and project outcomes, which has rarely been accomplished in previous research; (iii) examining relationships between the important enablers (project champion and top management support) and project implementation components.

6.2.1 BPR Project Implementation Components

To investigate BPR project implementation, it is necessary to examine the question "What are the major implementation components in order to successfully implement a BPR project". Based on social-technical theory, all the social and technical dimensions and their interactions were considered in developing the BPR project implementation research model. Three important components of BPR project implementation were involved: change management, process redesign, and ICTI (Information and Communications Technology Infrastructure) improvement. Change management is the social aspect of the change since it solves people-side problems within organizations such as employee resistance and structural adjustments (Al-Mashari et al. 2001; Grover and Jeong 1995; Teng et al. 1996). Process redesign deals with technical changes, such as eliminating unnecessary tasks or resequencing tasks (Attaran 2003; Mansar and Reijers 2005; Reijers and Mansar 2005). ICTI improvement is the technology foundation dealing with IT capabilities upon which processes and humans rely for transforming inputs to outputs (Bhatt 2000b; Law and Ngai 2007b). Redesigned processes are the final assets, through which the effects of ICTI improvement and change management are realized.

The above three fundamental components were identified from the existing literature and explained, based on socio-technical theory. In the previous literature there has been no focus on studying success factors in BPR project implementation – all the success factors were just reported from separate BPR project cases and then pooled together. It is hard to generalize those results. A single success story that companies try to emulate in their own BPR projects is unlikely to lead to project success. A clear guide to the major processes and activities involved in successful BPR project implementation is needed. Answering this research question offered a set of solid footprints for practitioners to follow when they implement their BPR projects.

6.2.2 The Important Enablers

The two important enablers identified in this study are BPR project champion and top management support. Regarding these two enablers, this study examined the following questions: i) “what is the influence of a BPR project champion on top management support”; ii) “what is the influence of top management support on BPR project implementation components”; and iii) “does top management support mediate the relationships between the BPR project champion and the components of a BPR project implementation”?

This study examined the impact of the presence of a BPR project champion on top management support and confirmed that indeed a champion does influence top management support for BPR projects. In fact, this effect explained almost half of the variance measured in the top management support construct. The result is consistent with what has been implied in the literature (Grover 1993; Lai and Mahapatra 2004). The strong influence of a BPR project champion results from the nature of a champion. This is especially true in the situation when BPR projects initiate innovative change. This study confirmed the necessary role of a BPR project champion.

The results from this study have shown that top management support has a very significant influence on all three BPR project implementation components (change management, process redesign, and ICTI improvement), and that a BPR project champion is a critical success facilitator for BPR project implementation, mediated through top management support.

Previous studies identified top management support as a success factor in BPR projects (Grover and Jeong 1995; McAdam and Donaghy 1999). A recent study (Žabjek and Štemberger 2009) also confirmed the positive impact of top management support on successful ERP implementation. However, these studies did not examine the specific effect of top management support on each of the BPR project implementation components. This study has tested and validated one of the best practices noted in the literature - that top management support should be strong and effective throughout the entire project (Al-Mashari and Zairi 1999; Huq et al. 2006). Specifically, change management is supported through top management, because top management support explained almost half of the variance measured in the change management construct; on the other hand, other project facilitators also need to take a role in successfully implementing process redesign and ICTI improvement.

6.2.3 The Impact of BPR Project Implementation Components

This study also tried to answer the research question "how do the components of BPR project implementation affect BPR project outcomes". The resulting answers are as follows.

6.2.3.1 The Impact of Change Management

This study showed that change management significantly affected all the four facets of BPR project outcomes (operational quality improvement, organizational quality improvement, cost savings, and productivity). Similar results have been implied in previous studies (Grover 1999; Grover and Jeong 1995; Teng et al. 1996) and hence it is within our expectation that successful BPR projects require a great deal of attention to change management. This conclusion is especially useful for the companies who realize BPR projects through the implementation of ERP systems. Many ERP implementers find themselves having to re-engineer their existing processes to fit the software they are implementing. At the same time, because of the major impact of change management on BPR project success, they should avoid overlooking change management issues while implementing specific systems if they wish to achieve truly successful change (Huq et al. 2006).

Previous studies (Martin and Huq 2007; Žabjek and Štemberger 2009) emphasized the important role of change management on BPR project success. However, they did not test the specific impact of change management on each of the outcome facets. This study provides conclusive evidence that change management has a significant influence on all the aspects identified (i.e., operational quality improvement, organizational quality improvement, cost savings, and productivity). This means that, no matter which of these goals are set by managers of a BPR project, change management is a significant determinant in achieving these goals.

6.2.3.2 The Impact of Process Redesign

The empirical results indicate that process redesign has a significant impact on organizational quality improvement, cost savings, and productivity, but not on operational quality improvement. In addition, the impact of process redesign was greater on productivity than on the other three outcome facets (operational quality improvement, organizational quality improvement, and cost savings). Process redesign covers both technical redesign and social redesign, as discussed in Chapter 4. The most frequently utilized best practices for technical redesign include task elimination, task composition, parallelism, etc. (Mansar and Reijers 2007), which will tend to improve productivity and cost savings. Social redesign, which may include empowering workers, assigning more steps of work to one employee, minimizing the number of departments, etc., is potentially beneficial to organizational quality improvement.

The reason why process redesign did not affect operational quality improvement significantly in this study can be explained as follows. Operational quality emphasizes product quality and/or customer service quality, while process redesign practices aim to shorten business processes through task elimination or combination, or downsizing through removing unnecessary people, groups, or departments from business processes. Although process redesign can, to some extent, improve the quality of customer service or products (for example, quicker response to customers if processes are shorter), its major advantages lie in improving productivity, cost savings, and organizational quality.

6.2.3.3 The Impact of Information Communications Technology Infrastructure Improvement

This study showed that ICTI improvement was significantly associated with operational and organizational quality improvements. This is easily explained. Basically, ICTI improvement builds a convenient and fast communication bridge among employees, and between companies and customers. It results in improved customer satisfaction and better cooperation among employees (Bhatt 2000b; Law and Ngai 2007b).

However, this study showed that ICTI improvement did not increase company productivity through BPR projects. Possible reasons are: a) customer satisfaction has become the goal of most companies, becoming more important than productivity (Grover 1999; Terziovski et al. 2003); or b) manufacturing companies may emphasize productivity more than others (Terziovski et al. 2003), but most of the respondents in this study came from service industries.

The non-significant influence of ICTI improvement on productivity is within the author's expectations. Another study conducted by Terziovski and Fitzpatrick et al. (2003) also found that there was no significant relationship between the increased use of information technology and process cycle time reduction. One implication from this result is that managers must reengineer their core processes from a customer perspective (Terziovski et al. 2003). Another two implications can be derived from this study. First, emphasizing productivity improvement through IT did not appear to be the focus of BPR projects; instead, IT development has switched to a focus on improving organizational quality and operational quality within organizations and with customers. Second, it may be that most companies have started to improve company performance by improving organizational and operational quality, instead of merely through improving productivity.

This study also showed that ICTI improvement did not improve company cost savings. This can be explained in the same way as the lack of impact on productivity. It may be that companies are willing to spend money on ICTI for improving quality of customer service and quality of employee working life, but not necessarily for reducing costs.

In summary, ICTI improvement does help companies to achieve higher quality of customer service and higher quality of company internal and external communications, but not necessarily to help with productivity and cost savings.

6.2.4 The Facets of BPR Project Outcomes

This study also examined the research question "how do the four facets of BPR project outcomes contribute to the overall success of BPR projects". The results can help explain the relative importance of the four facets of outcomes regarding overall BPR project success. Cost savings was the most important determinant to overall success (path coefficient of 0.500, $p<0.001$); organizational quality improvement was second in importance, with a path coefficient of 0.236, $p<0.01$); operational quality improvement also showed a small effect on overall success (path coefficient 0.178, $p<0.05$); but productivity did not have a significant influence on overall success.

The issue of cost savings through BPR projects has long been the focus in most company undertakings (Davenport 1993; Grover and Jeong 1995). Hence, it was within our expectation that cost savings was the most important determinant of overall BPR project success. However, it was quite unexpected to find in our study that productivity[9] was not a significant contributor to overall BPR project success. Nevertheless, this result can be understood in that it implies that more recent BPR projects have switched their focus from productivity to organizational and operational quality improvement.

6.2.5 Implementation Components and Project Success

The last research question this study answered is "how the components of a BPR project implementation directly affect the overall BPR project success". The results indicated that all of the three BPR project implementation components are significantly associated with BPR project success. Specifically, change management occupied the most important position since its effect is largest (path coefficient 0.533, $p<0.001$). Both process redesign and ICTI improvement had a small impact on BPR project success (path coefficient = 0.123, $p<0.05$; path coefficient = 0.213, $p<0.05$, respectively). This is consistent with the results discussed previously, that change management significantly impacts all of the

[9] Because respondents who filled the questionnaire were asked to evaluate BPR projects that were completed within the past three years, it is assumed that increased productivity could be observed at the time of filling the questionnaire.

four facets of BPR project outcomes, and ultimately has a corresponding large effect on overall BPR project success.

6.3 Contributions

6.3.1 Contributions to Methodology

A major contribution to methodology in this study is building formative constructs and the utilization of a second-order construct structure. As discussed in section 4.2.1.1, formative indicators are often neglected despite their appropriateness in many instances, and a high percentage of latent constructs have been found to be incorrectly modeled in many research areas (e.g., marketing, management information systems, organizational behavior, etc.). Formative constructs have not drawn serious attention from researchers until recently (Diamantopoulos et al. 2008; Jarvis et al. 2003; Petter et al. 2007).

This exploratory study built and validated three formative constructs for BPR project implementation components (i.e., change management, process redesign, ICTI improvement), following the existing guidelines of formative construct development strictly.

A second-order structural model was also utilized for the three formative constructs because each consists of multiple dimensions. The approximation method for the second-order constructs in this study was to approximate them through factor scores from the first-order constructs. Although the disadvantage of this method is that part of the information implied in the second-order structure is lost, it appeared to be the only feasible way to proceed in the development of our model as discussed earlier. The calculations resulted in estimates of both the validity and reliability of these constructs.

6.3.2 Contributions to Theoretical Knowledge

6.3.2.1 Methodological Approach to BPR Project Implementation Research

This study contributed to the demonstration of a methodologically grounded approach to BPR project implementation research. The literature offers theories and models to explore the phenomenon of BPR project success. However, prior research focused only on collecting success factors, and lacks a thorough examination of why the collected success factors are critical to the fate of BPR projects.

This study attempts to bridge that gap by demonstrating a methodologically sound approach to the examination of BPR project success. It shows that existing theories may be confirmed and advanced by the employment of methodologies from reference disciplines. Socio-Technical Theory was applied to examine the following relationships:

(1) BPR project champion relationship to top management support;

(2) Top management support relationships to success factors in implementation such as change management, process redesign, and ICTI improvement;

(3) BPR project implementation relationships to outcomes; and

(4) Facets of outcomes and their relationships to overall success.

Through these relationships, the following was learned:

a) the presence of a champion is critical to BPR project implementation, mediated by top management support;

b) top management support is much more important to change management than the other two implementation components (process redesign and ICTI improvement);

c) all of the three BPR project implementation components (change management, process redesign, and ICTI improvement) are critical to BPR project success;

d) change management is by far the most important component of BPR project implementation;

e) the outcome facet of cost savings is the focus of companies for their BPR projects; operational and organizational quality are also important;

f) productivity no longer appears to be the main focus of BPR projects.

It appears likely that all the relationships that were tested in this study are more valuable to both researchers and BPR practitioners than the many existing lists of success factors in the literature. This will be dicussed in the following subsections.

6.3.2.2 BPR Project Implementation Components and Facets of Outcomes

The most important contribution from this study lies in the examination of how different BPR project implementation components affect different facets of BPR project outcomes and ultimate success. This is possible because this is the first study which has focused on building and validating constructs for BPR project implementation components (i.e., change management, process redesign, and ICTI improvement). Although a number of studies have examined success factors in BPR projects (Al-Mashari and Zairi 1999; Grover 1999; Huq et al. 2006; Klein 1994; Worren et al. 1999), most have employed a qualitative case study approach, and hence have limited generalizability. Even for those studies using quantitative methods, the constructs tended to differ from one study to the next, making it difficult to arrive at consistent overall judgments from their combined knowledge. This feature made it impossible to model BPR project implementation factors by using traditional reflective constructs. This is the first study that has modeled activities related to BPR project implementation as formative constructs.

Therefore, a major achievement from this study is its contribution to modeling BPR project implementation components were based on various dimensions that have been identified from existing literature, and the development and validation of sound constructs that could be used in SEM (Structural Equation Modeling) methodologies. By achieving this, progress in BPR project research has advanced significantly in the utilization of quantitative methodologies to validate appropriate research models in this field.

Furthermore, to the author's knowledge, this is the first study to examine how different BPR project implementation components would impact different facets of BPR project outcomes. Previous studies have only tested how success factors would affect overall BPR project success. However, different BPR projects may aim to achieve different outcomes. It is not enough to have only a rough idea of success factors that might affect BPR project success. It is also very important to know more about how the detailed aspects of outcomes will be determined by different implementation components. For example, companies may decide to put major resources into change management if they want to improve quality of customer service and customer satisfaction, reduce managerial hierarchy and bureaucracy, or improve communication within the company; meanwhile, simultaneous process redesign and improvements in ICTI are required to achieve these goals.

6.3.2.2 STT Validity

Last but not least, socio-technical theory was validated in the BPR project implementation research context. The results of analyzing the proposed research model showed that much of the variance in BPR project measures of success (69.7%) was explained through the factors based on socio-technical theory. It can be concluded that STT may be successfully utilized in future BPR project research.

6.3.3 Contributions to Applied Knowledge

The results obtained from this study can provide useful guidelines to BPR practitioners because the validated model and instrument that were developed can be used to better understand what needs to be done to successfully implement a BPR project.

Both BPR project champion and top management support were confirmed to be critical to the fate of BPR projects. The presence of a champion has been emphasized previously for the adoption and realization of innovations (Rogers 2003). Although BPR has become a familiar concept for managers, the role of a strong and dedicated champion in initiating a BPR project and pushing its realization is clearly critical to the project's success. On the other hand, the effect of a champion is greatly enhanced through strong top management support in all the relevant BPR projects such as the allotment of time, funding, human resources, etc.

Though all three BPR project implementation components (change management, process redesign, and ICTI improvement) are significantly related to BPR project success, change management stands in the most important position.

This study presents BPR practitioners with relationships between each of the BPR project implementation components and each of the outcome facets. This is useful in directing attention to the most important implementation activities while paying less attention to the less important ones. Especially for goal-driven BPR projects, managers can link their performance goals to the necessary implementation activities and put more effort on the relevant activities. This study appears to be the first attempt at categorizing goal-oriented BPR projects, supporting outcomes such as improved productivity, increased customer satisfaction, transformed organizational culture or structure, etc. However, a single BPR project cannot achieve all these outcomes. Companies often have specific requirements to meet through a BPR project. The four categories of BPR project goals in our model include: operational quality improvement, organizational quality improvement, cost savings, and productivity. Starting from whichever of these goals is selected; organizations can decide which implementation components are most critical to their specific goals.

In summary, the following recommendations to BPR practitioners can be drawn from the results of this study:

(a) A committed BPR project champion is critical to project success, and the role of such a champion should not be limited to initiating a BPR project; instead, a champion should stay involved until the project is completed.

(b) The effectiveness of BPR project champion depends on top management support. A BPR project champion will be more successful if he/she gains strong support from top management.

(c) Change management should be seriously considered and comprehensively carried out in order to achieve BPR project success. Change management involves three dimensions: organizational level, employee level, and stakeholder level. At the organizational level of change management, human resource policies, reward and compensation systems should be properly reviewed and revised. Effective culture for organizational change should be created. With respect to the employee level of change management, the essential is to avoid employee resistance whether the reason for resisting is from ineffective communication, lack of empowerment, or inadequate training. The stakeholder level of change management requires adequate communication to stakeholders for their opinions on BPR projects.

(d) Managers need to carefully define BPR project goals: does this project aim at cost savings, productivity, or others? Starting from their defined project goal, the implementation components can then be assigned appropriate priorities. This is especially important in planning the utilization of limited project resources.

6.4 Limitations and Future Research

6.4.1 Sampling Procedure

A first limitation of this study is related to its sampling procedure. The author had to turn to a commercial survey agency because of the extremely low response rate from the first data collection solution (i.e., searching company information from company database). The advantage of using a commercial survey agency is that the data were all collected rapidly. The disadvantage is that the author could not get involved in the actual data collection process and had to give up control over how the data were collected. Nevertheless, the data collected showed high quality in terms of response and demographics, and the sample size was satisfactory. The data were used to great advantage to validate the model.

6.4.2 Self-Report Survey

The second limitation is the self-report survey format that was adopted. Self-report is by far the most frequently used type of measure in behavioral and social science(McGrath 1994). It, however, has its disadvantages. Self-reported measures can always induce bias (Wu and Wang 2005) and common method variance (Igbaria, Iivari and Maragahh 1995). "Respondents are potentially reactive, since the participants are aware that their behavior is being done for the researcher's, not the respondent's, purpose….such knowledge may influence how they respond…participants may try to make a good impression, to give socially desirable answers, to help the researcher get the results being sought (or, alternatively, to hinder that quest)" (McGrath 1994, p166). Fortunately, this did not become a problem of this study because common method variance was found to be at an acceptable level. As presented in section 5.3, the results of Harman's one-factor test showed that eleven factors are present and that the highest covariance explained by one factor is 35.3%, indicating that common method bias is not a likely contaminant of this study.

6.4.3 Cross Evaluation

The survey was initially designed as a cross-evaluation for one BPR project. In that design, multiple participants in one BPR project were asked to complete the questionnaire and their answers were compared and synthesized as one case in the sample (i.e., one case for each project). The reason for doing so is that people playing different roles in a BPR project may respond differently to the same questions. For example, people who are in charge of a BPR project may tend to evaluate its performance higher than others (e.g., process managers versus end users) do. Data collected through cross evaluation may be more objective and reliable. However, this approach requires a significant sample size increase and a great deal of coordination in selecting participants, making data collection for the requisite end sample much more difficult if not impossible.

6.4.4 Generalizability

Caution is advised regarding the generalizability of the results of the study, from two aspects.

The first is related to company size. The sample in this study was drawn from medium and large sized companies. Small organizations have their own distinct features such as strong flexibility, ability to reorient themselves quickly, capacity for rapid decision-making, proximity to their market, etc. (Raymond et al. 1998; Smart, Maull, Childe and Radnor 2004). The study conducted by Smart et al. (2004) found that small and medium sized (SME) companies used uncoordinated change management practices which move from one implementation issue to the next without appropriate strategic planning and monitoring practices. Therefore, company size needs to be considered in the explanation of such a study.

The second is related to culture. Since change management has appeared to be the most important aspect of BPR projects, and culture is closely associated with change management, more studies regarding relationships between culture and BPR projects need to be carried out. This study controlled the culture variable by limiting respondents to Canada and US companies. Although companies in US were still distinguished from those in Canada, the results showed that there was no significant difference between these two groups in terms of BPR project implementations. However, it would be very interesting to investigate BPR project implementations in other countries where the culture is likely to be different (Martinsons et al. 2009).

For example, if this study were conducted in China, there could be different results because Chinese companies have quite different organizational cultures from those in Canada and US (Martinsons and Hempel 1998; Noronha 2002). Distinct characteristics of Chinese culture, which may affect change management at the employee level, are reflected in abasement, adaptiveness, harmony with the universe, respect for authority, etc. (Noronha 2002). Distinct characteristics of Chinese organizational culture, which may affect change management at both the employee and organizational level, involve high power distance, low individualism, tolerated uncertainty, implicit communications, top-down directives and bottom-up reporting, etc. (Martinsons and Hempel 1998). Nevertheless, Chinese organizational culture may have changed during recent years; in any event, more studies would need to be done in different cultural societies to confirm or disconfirm the influence of culture on BPR projects.

6.4.5 Formative Constructs of ICTI Improvement

This study is the first BPR project implementation study to use formative constructs to measure factors. Although the author searched the literature diligently and screened feasible methods to build and validate the three formative constructs, more studies are needed in order to improve these constructs. For example, the construct of ICTI improvement may be improved. Law's study (Law and Ngai 2007b) added the dimension of facilities and management (as defined in section 4.2.1.3) into ICTI improvement, but this study showed this dimension of facilities and management was not an important contributor to ICTI improvement. Hence, this dimension of ICTI improvement (i.e., facilities and management) should be retested in future studies, so that the domain specification for ICTI improvement can be improved. Relevant studies in defining and validating dimensions of ICTI improvement have been found recently (Fink and Neumann 2009; Sobol and Klein 2009), which provide a better foundation for further building this multidimensional construct.

6.5 Conclusion

This study makes a significant contribution to both theory and practice. The establishment of a BPR project implementation model, based on socio-technical theory, including the development of new instruments for change management and process redesign, provides a foundation for future BPR project research. This study also offers better generalizability of BPR project research over the existing literature, firstly because the quantitative approach was used for a reasonably large number of cases, rather than qualitative case studies on a small number of cases often used for such research, and secondly because it resulted in a validated model that includes the most important aspects of BPR projects.

With respect to practice, the specification of the three BPR project implementation components presents managers with clear guidance regarding BPR project implementation. The validated model will help practitioners to understand in advance what major obstacles they may face (change management, process redesign, or information technology) and how they should implement BPR projects in a way that will achieve their expected goals.

As such, this study represents a significant advance over the existing literature in the development of a valid model to explain the relationships between success factors, goals, and outcomes within the BPR project context.

References

Abdolvand, N., A. Albadvi, et al. (2008). "Assessing readiness for business process reengineering." Business Process Management Journal 14(4): 497-511.

Agrawal, V. K. and A. Haleem (2003). "Culture, Environmental Pressures, and the Factors for Successful Implementation of Business Process Engineering and Computer-Based Information Systems." Global Journal of Flexible Systems Management 4(1/2): 27-47.

Ahadi, H. R. (2004). "An examination of the role of organizational enablers in business reengineering and the impact of information technology." Information Resources Management Journal 17(4): 1-19.

Al-Mashari, M., Z. Irani, et al. (2001). "Business process reengineering: a survey of international experience." Business Process Management Journal 7(5): 437-455.

Al-Mashari, M. and M. Zairi (1999). "BPR implementation process: an analysis of key success and failure factors." Business Process Management Journal 5(1): 87-112

Al-Mashari, M. and M. Zairi (2000). "Revisiting BPR: a holistic review of practice and development." Business Process Management Journal 6(1): 10-42

Al-Mudimigh, A., M. Zairi, et al. (2001). "ERP software implementation: An integrative framework " European Journal of Information Systems 10(4): 216-226.

Al-Mudimigh, A. S. (2007). "The role and impact of business process management in enterprise systems implementation." Business Process Management Journal 13 (6): 866-874

Aladwani, A. M. (2001). "Change management strategies for successful ERP implementation " Business Process Management Journal 7(3): 266-275.

Albizu, E., M. Olazaran, et al. (2004). "BPR and change management: a case study of a large Spanish electricity company." International Journal of Innovation Management 8(4): 355-379.

Allen, B. R. and A. C. Boynton (1991). "Information Architecture: In Search of Efficient Flexibility." MIS Quarterly 15(4): 435-445.

Archer, N. (2003). Selecting a Methodology for Change Management: Review and Critique. McMaster World Congress on the Management of E-Business.

Archer, N. P. (2005). "An overview of the change management process in eGovernment." International Journal of Electronic Business 3(1): 1-1.

Ascari, A., M. Rock, et al. (1995). "Reengineering and organizational change: Lessons from a comparative analysis of company experiences." European Management Journal 13(1): 1-30.

Attaran, M. (2000). "Why does reengineering fail? A practical guide for successful implementation." The Journal of Management Development 19(9/10): 794-801.

Attaran, M. (2003). "Information technology and business-process redesign." Business Process Management Journal 9(4): 440-458.

Attaran, M. and G. G. Wood (1999). "How to succeed at reengineering." Management Decision 37(10): 752-757.

Babbie, E. (c2004). The practice of social research. Belmont, CA, Thomson/Wadsworth.

Bagozzi, R. P. (1981). "Evaluating Structural Equation Models With Unobservable Variables and Measurement Error: A Comment." Journal of Marketing Research (JMR) 18(3): 375-381.

Barclay, D., R. Thompson, et al. (1995). "The partial least squares approach to causal modeling: personal computer adoption and use as an illustration." Technology Studies: Special Issue on Research Methodology 2(2): 285-324.

Barua, A., C. H. S. Lee, et al. (1996). "The Calculus of Reengineering." Information Systems Research 7(4): 409-428.

Bashein, B. J. and M. L. Markus (1994). "Preconditions for BPR success. (Cover story)." Information Systems Management 11(2): 7-13.

Beath, C. M. (1991). "Supporting the Information Technology Champion." MIS Quarterly 15(3): 355-372.

Bee Wah, Y. and K. Kok Wei (2006). "Examining the effects of customer service management (CSM) on perceived business performance via structural equation modelling." Applied Stochastic Models in Business & Industry 22(5/6): 587-605.

Bhatt, G. D. (2000a). "Exploring the relationship between information technology, infrastructure and business process re-engineering." Business Process Management Journal 6(2): 139 - 163.

Bhatt, G. D. (2000b). "Exploring the relationship between information technology, infrastructure and business process re-engineering." Business Process Management Journal 6(2): 139-163.

Bhatt, G. D. (2001a). "Business process improvement through electronic data interchange (EDI) systems: an empirical study." Supply Chain Management: An International Journal 6(2): 60-74.

Bhatt, G. D. (2001b). "Business process improvement through electronic data interchange (EDI) systems: an empirical study." Supply Chain Management: An International Journal 6(2): 60 - 74.

Bhatt, G. D. and R. L. Stump (2001). "An empirically derived model of the role of IS networks in business process improvement initiatives." Omega 29: 29-48.

Bollen, K. (1989). Structural equations with latent variables. New York, Wiley.

Bollen, K. and R. Lennox (1991). "Conventional Wisdom on Measurement: A Structural Equation Perspective." Psychological Bulletin 110(2): 305-314.

Bontis, N. (1998). "Intellectual capital: An exploratory study that develops measures and models." Management Decision 36(2): 63-76.

Bostrom, R. P. and J. S. Heinen (1977a). "MIS Problems and Failures: A Socio-Technical Perspective. Part I: The Causes." MIS Quarterly 1(3): 17-32.

Bostrom, R. P. and J. S. Heinen (1977b). "MIS Problems and Failures: A Socio-Technical Perspective. Part II: The Application of Socio-Technical Theory." MIS Quarterly 1(4): 11-28.

Boudreau, M.-C., D. Gefen, et al. (2001). "Validation in information systems research: A state-of-the-art assessment." MIS Quarterly 25(1): 1-16.

Bradley, J. (2008). "Management based critical success factors in the implementation of Enterprise Resource Planning systems." International Journal of Accounting Information Systems 9(3): 175-200.

Broadbent, M., P. Weill, et al. (1999). "The Implications of Information Technology Infrastructure for Business Process Redesign." MIS Quarterly 23(2): 159-182.

Brown, D. A., P. Booth, et al. (2004). "Technological and organizational influences on the adoption of activity-based costing in Australia." Accounting & Finance 44(3): 329-356.

Buonanno, G., P. Faverio, et al. (2005). "Factors affecting ERP system adoption: A comparative analysis between SMEs and large companies." Journal of Enterprise Information Management 18(4): 384-426.

Burgelman, R. A. (1983). "Corporate Enterpreneurship and Strategic Management: Insights from a Process Study." Management Science 29(12): 1349-1364.

Caccia-Bava, M. d. C., V. C. K. Guimaraes, et al. (2005). "Empirically testing determinants of hospital BPR success." International Journal of Health Care Quality Assurance 18(6/7): 552.

Callon, M. (1986). The Sociology of an Actor-Network: The Case of the Electric Vehicle. Mapping the Dynamics of Science and Technology. M. Callon, J. Law and A. Rip. London, Macmillan Press: 19-34.

Callon, M. and B. Latour (1981). Unscrewing the big leviathan: How actors macro-structure reality and how sociologists help them to do so. Advances in Social Theory and Methodology: Towards an Integration of Micro and Macro-Sociologies. K. D. Knorr-Cetina and A. V. Cicourel. London, Routledge and Kegan Paul: 277–303.

Campbell, D. T. and D. W. Fiske (1959). "Convergent and discriminant validation by the multitrait-multimethod matrix." Psychological Bulletin 56(2): 81-105.

Chang, L.-J. and P. Powell (1998). "Towards a framework for business process re-engineering in small and medium-sized enterprises." Information Systems Journal 8(3): 199-215.

Chen, C. C., C. C. H. Law, et al. (2009). "Managing ERP Implementation Failure: A Project Management Perspective." IEEE Transactions on Engineering Management 56(1): 157-170.

Chin, W. W. (1998a). "Commentary: Issues and Opinion on Structural Equation Modeling." MIS Quarterly 22(1): vii-xvi.

Chin, W. W. (1998b). The partial least squares approach to structural equation modeling. Modern methods for business research. G. A. Marcoulides. Mahwah, N.J., Lawrence Erlbaum: 295-336.

Chin, W. W., B. L. Marcolin, et al. (2003). "A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and an Electronic-Mail Emotion/Adoption Study." Information Systems Research 14(2): 189-217.

Chrusciel, D. and D. W. Field (2006). "Success factors in dealing with significant change in an organization." Business Process Management Journal 12(4): 503-516.

Chua, W. F. (1986). "Radical Developments in Accounting Thought." Accounting Review 61(4): 601-632.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2ed.). Hillsdale, NJ, Lawrence Erlbaum Associates.

Covey, S. (1996). "Making change count." Incentive 170(12): 21.

Creswell, J. W. (2003). Research design : qualitative, quantitative, and mixed methods approaches. Thousand Oaks, Calif. , Sage Publications.

Cronbach, L. J. (1951). "Coefficient alpha and the internal structure of tests." Psychometrika 16(3 / September): 297-334.

Cronbach, L. J. (1971). Test validation. Educational measurement R. L. Thorndike. Washington, DC, American Council on Education: 443-507.

Cronbach, L. J. and P. E. Meehl (1955). "Construct validity in psychological tests." Psychological Bulletin 52(4): 281-302.

Davenport, T. H. (1993). Process Innovation: Reengineering Work Through Information Technology. Boston, MA, Harvard Business School Press.

Davenport, T. H., M. Hammer, et al. (1989). "How Executives Can Shape Their Company's Information Systems." Harvard Business Review 67(2): 130-134.

Davenport, T. H. and J. E. Short (1990). "The new industrial engineering: Information technology and business process redesign." Sloan Management Review 31(4): 11-27.

DeLone, W. H. and E. R. McLean (1992). "Information Systems Success: The Quest for the Dependent Variable." Information Systems Research 3(1): 60-95.

Diamantopoulos, A., P. Riefler, et al. (2008). "Advancing formative measurement models." Journal of Business Research 61(12): 1203–1218.

Diamantopoulos, A. and J. A. Siguaw (2006). "Formative Versus Reflective Indicators in Organizational Measure Development: A Comparison and Empirical Illustration." British Journal of Management 17(4): 263-282.

Diamantopoulos, A. and H. M. Winklhofer (2001). "Index Construction with Formative Indicators: An Alternative to Scale Development." Journal of Marketing Research (JMR) 38(2): 269-277.

Dillman, D. A. (2007). Mail and internet surveys : the tailored design method : with new internet, visual, and mixed-mode guide. Hoboken, N.J. , Wiley.

Earl, M. and B. Khan (1994). "How new is business process redesign?" European Management Journal 12(1): 20-30.

Edmondson, A. C. and S. E. McManus (2007). "Methodological Fit in Management Field Research " Academy of Management Review 32(4): 1155-1179.

Edwards, P., I. Roberts, et al. (2002). "Increasing response rates to postal questionnaires: systematic review." British Medical Journal 324(7347): 1183-1191.

Ehie, I. C. and M. Madsen (2005). "Identifying critical issues in enterprise resource planning (ERP) implementation." Computers in Industry 56(6): 545-557.

Ein-Dor, P. and E. Segev (1978). "Organizational Context and the Success of Management Information Systems." Management Science 24(10): 1064-1077.

Everitt, B. S. (1975). Multivariate Analysis: the Need for Data, and other Problems. 126: 237-240.

Fenelon, M. J., III (2002). Success factors for reengineering projects at medium-sized firms. Management Systems. West Haven, Connecticut, US, University of New Haven. Ph.D. Thesis.

Fink, L. and S. Neumann (2009). "Exploring the perceived business value of the flexibility enabled by information technology infrastructure." Information & Management 46 (2): 90-99

Fornell, C. and F. L. Bookstein (1982). "Two Structural Equation Models: LISREL and PLS Applied to Consumer Exit-Voice Theory." Journal of Marketing Research (JMR) 19(4): 440-452.

Fornell, C. and D. F. Larcker (1981). "Structural Equation Models With Unobservable Variables and Measurement Error: Algebra and Statistics." Journal of Marketing Research (JMR) 18(3): 382-388.

Frohlich, M. T. and J. R. Dixon (1999). "Information systems adaptation and the successful implementation of advanced manufacturing technologies." Decision Sciences 30(4): 921-957.

Fui-Hoon Nah, F., K. M. Zuckweiler, et al. (2003). "ERP Implementation: Chief Information Officers' Perceptions of Critical Success Factors." International Journal of Human-Computer Interaction 16(1): 5-22.

Galliers, R. D. and B. S. H. Baker (1995). "An Approach to Business Process Reengineering: the Contribution of Socio-Technical and Soft or Cncepts." INFOR 33(4): 263-278.

Gattiker, T. F. and D. L. Goodhue (2002). "Software-driven changes to business processes: an empirical study of impacts of Enterprise Resource Planning (ERP) systems at the local level." International Journal of Production Research 40(18): 4799-4814.

Gee-Woo, B., R. W. Zmud, et al. (2005). "Behavioral Intention Formation in Knowledges Sharing: Examining the Roles of Extrinsic Motivators, Social-Psychological Forces, and Organizational Climate." MIS Quarterly 29(1): 87-111.

Gefen, D. and D. Straub (2005). "A practical guide to factorial validity using PLS-Graph: tutorial and annoated example." Communications of AIS 16(109): 91-109.

Gefen, D., D. W. Straub, et al. (2000). "Structural equation modeling and regression: guidelines for research practice." Communications of AIS 4(7): 1-76.

George, V. and G. Michalis (1999). "Critical review of existing BPR methodologies: The need for a holistic approach." Business Process Management Journal 5(1): 65 - 86.

Gerbing, D. W. and J. C. Anderson (1988). "An Updated Paradigm for Scale Development Incorporating Unidimensionality and Its Assessment." Journal of Marketing Research (JMR) 25(2): 186-192.

Goodhue, D. L. and R. L. Thompson (1995). "Task-technology fit and individual performance." MIS Quarterly 19(2): 213-236.

Grady, M. S. and W. E. Hammer (1996). People-friendly re-engineering: management's role in successful business process change. International Industrial Engineering Conference (IIE), Minnesota, USA.

Grant, D. (2002). "A wider view of business process reengineering." Communications of the ACM 45(2): 84-90.

Grover, V. (1993). "An Empirically Derived Model for the Adoption of Customer-based Interorganizational Systems." Decision Sciences 24(3): 603-640.

Grover, V. (1999). "From business reengineering to business process change management: A longitudinal study of trends and practices." IEEE Transactions on Engineering Management 46(1): 36-46.

Grover, V. and S. R. Jeong (1995). "The implementation of business process reengineering." Journal of Management Information Systems 12(1): 109-144.

Grover, V. and M. K. Malhotra (1997). "Business process reengineering: A tutorial on the concept, evolution, method, technolgoy and application." Journal of Operations Management 15(3): 193-213.

Grover, V., J. Teng, et al. (1998). "The influence of information technology diffusion and business process change on perceived productivity: The IS executive's perspective." Information & Management 34(3): 141-159.

Guha, S. and V. Grover (1997). "Business process change and organizational performance: Exploring an antecedent model." Journal of Management Information Systems 14(1): 119-154.

Guimaraes, T. and W. Bond (1996). "Empirically assessing the impact of BPR on manufacturing firms." International Journal of Operations & Production Management 16(8): 5-28.

Haenlein, M. and A. M. Kaplan (2004). "A Beginner's Guide to Partial Least Squares Analysis." Understanding Statistics 3(4): 283-297.

Hair, J. F., R. E. Anderson, et al. (1998). Multivariate data analysis with readings. Englewood Cliffs, NJ, Prentice Hall.

Hall, G., J. Rosenthal, et al. (1993). "How to Make Reengineering Really Work." Harvard Business Review 71(6): 119-131.

Hamilton, S. and N. L. Chervany (1981). "Evaluating Information System Effectiveness -- Part I: Comparing Evaluation Approaches." MIS Quarterly 5(3): 55-69.

Hammer, M. (1990). "Reengineering work: Don't automate, obliterate." Harvard Business Review 68(4): 104-112.

Hammer, M. (2007). "The Process Audit." Harvard Business Review 85(4): 111-123.

Hammer, M. and J. Champy (1993). Reengineering the corporation: a manifesto for business revolution, New York: Harper Business Editions.

Hammer, M. and S. A. Stanton (1995). The Reengineering Revolution. NY, Harper Business.

Harkness, W. L., A. H. Segars, et al. (1996). "Sustaining Process Improvement and Innovation in the Information Services Function: Lessons Learned at the Bose Corporation." MIS Quarterly 20(3): 349-368.

Hassan, N. R. (2009). "Using Social Network Analysis to Measure IT-Enabled Business Process Performance." Information Systems Management 26(1): 61-76.

Herzog, N. V., S. Tonchia, et al. (2009). "Linkages between manufacturing strategy, benchmarking, performance measurement and business process reengineering." Computers & Industrial Engineering 57 (3): 963-975.

Hiatt, J. (2003). Change Management: the people side of change. Loveland, CO., Learning Center Publications.

Hofstede, G. H. (1991). Cultures and organizations: software of the mind. London, McGraw-Hill.

Holland, D. and S. Kumar (1995). "Getting past the obstacles to successful reengineering." Business Horizons 38(3): 79-85.

Hong, K.-K. and Y.-G. Kim (2002). "The critical success factors for ERP implementation: an organizational fit perspective." Information & Management 40(1): 25-40.

Huq, Z., F. Huq, et al. (2006). "BPR through ERP: Avoiding change management pitfalls." Journal of Change Management 6(1): 67-85.

Ifenedo, P. (2007). "Interactions Between Organizational Size, Culture, and Structure and Some IT Factors in the Context of ERP Success Assessment: An Exploratory Investigation." Journal of Computer Information Systems 47(4): 28-44.

Ifinedo, P. and N. Nahar (2009). "Interactions between contingency, organizational IT factors, and ERP success." Industrial Management & Data Systems 109(1): 118-137.

Igbaria, M., J. Iivari, et al. (1995). "Why do individuals use computer technology? A Finnish case study." Information & Management 29(5): 227-238.

Iivari, J. and R. Hirschheim (1996). "Analyzing information systems development: A comparison and analysis of eight IS development approaches." Information Systems 21(7): 551-575.

Jarvenpaa, S. L., G. W. Dickson, et al. (1985). "Methodological Issues in Experimental IS Research: Experiences and Recommendations." MIS Quarterly 9(2): 141-156.

Jarvenpaa, S. L., T. R. Shaw, et al. (2004). "Toward Contextualized Theories of Trust: The Role of Trust in Global Virtual Teams." Information Systems Research 15(3): 250-264.

Jarvenpaa, S. L. and D. B. Stoddard (1998). "Business process redesign: Radical and evolutionary change." Journal of Business Research 41(1): 15-27.

Jarvis, C. B., S. B. Mackenzie, et al. (2003). "A Critical Review of Construct Indicators and Measurement Model Misspecification in Marketing and Consumer Research." Journal of Consumer Research 30(2): 199-218.

Jobber, D., J. Saunders, et al. (2004). "Prepaid monetary incentive effects on mail survey response." Journal of Business Research 57(1): 21-25.

Karimi, J., T. M. Somers, et al. (2007). "The Role of Information Systems Resources in ERP Capability Building and Business Process Outcomes." Journal of Management Information Systems 24(2): 221-260.

Kettinger, W. J. and V. Grover (1995). "Special Section: Toward a Theory of Business Process Change Management." Journal of Management Information Systems 12(1): 9-30.

Kettinger, W. J. and J. T. C. Teng (1997). "Business Process Change: A Study of Methodologies, Techniques, and Tools." MIS Quarterly 21(1): 55-98.

Kettinger, W. J. and J. T. C. Teng (1998). "Aligning BPR to strategy: a framework for analysis." Long Range Planning 31(1): 93-107.

Klein, M. M. (1994). "The most fatal reengineering mistakes." Information Strategy: The Executive's Journal 10(4): 21-28.

Kock, N., A. Danesh, et al. (2008). "A discussion and test of a communication flow optimization approach for business process redesign." Knowledge & Process Management 15(1): 72-85.

Kock, N., J. Verville, et al. (2009). "Communication flow orientation in business process modeling and its effect on redesign success: Results from a field study " Decision Support Systems 46 (2): 562-575.

Kotter, J. P. (1995). "Leading Change: Why Transformation Efforts Fail. (Cover story)." Harvard Business Review 73(2): 59-67.

Lai, V. S.-k. and R. K. Mahapatra (2004). "Correlating business process re-engineering with the information systems department." International Journal of Production Research 42(12): 2357-2382.

Land, F. F. (1987). Social Aspects of Information Systems. Management Information Systems: The Technological Challenge. N. Piercy. Beckenham, Croom-Helm: 11-57.

Lashway, L. (2006). Leadership Styles and Strategies. School Leadership: Handbook for Excellence in Student Learning. S. C. Smith, P. K. Piele and J. Murphy, Corwin Press.

Laukkanen, S., S. Sarpola, et al. (2005). ERP system adoption — Does the size matter? Proceedings of the 38th. Hawaii International Conference on System Sciences, Hawaii, USA.

Law, C. C. H. and E. W. T. Ngai (2007a). "An investigation of the relationships between organizational factors, business process improvement, and ERP success." Benchmarking: An International Journal 14(3): 387-406.

Law, C. C. H. and E. W. T. Ngai (2007b). "IT Infrastructure Capabilities and Business Process Improvements: Association with IT Governance Characteristics." Information Resources Management Journal 20(4): 25-47.

Law, K. S., W. Chi-Sum, et al. (1998). "Toward a taxonomy of multidimensional constructs." Academy of Management Review 23(4): 741-755.

Lee, S. and H. Ahn (2008). "Assessment of process improvement from organizational change." Information & Management 45 (5): 270-280.

Lindsey, D. and P. H. Cheney (1990). "TELCOT: An Application of Information Technology for Competitive Advantage in the Cotton Industry." MIS Quarterly 14(4): 347-357.

Little, R. J. A. and D. B. Rubin (2002). Statistical Analysis With Missing Data, Hoboken, N.J. : Wiley.

Loonam, J. A. and J. McDonagh (2005). "Exploring Top Management Support for the Introduction of Enterprise Information Systems: A Literature Review." Irish Journal of Management 26(1): 163-178.

Lucas Jr, H. C. (1978). "Empirical Evidence For a Descriptive Model of Implementation." MIS Quarterly 2(2): 27-42.

Luna-Reyes, L. F., J. Zhang, et al. (2005). "Information systems development as emergent socio-technical change: a practice approach." European Journal of Information Systems 14 (1): 93-105.

Mabert, V. A., A. Soni, et al. (2003). "The impact of organizational size on enterprise resource planning (ERP) implementation in the US manufacturing sector." Omega 31(3): 235-246.

MacCallum, R. C. and J. T. Austin (2000). "Applications of structural equation modeling in psychological research." Annual Review of Psychology 51(1): 201-226.

MacCallum, R. C. and M. W. Browne (1993). "The use of causal indicators in covariance structure models: Some practical issues." Psychological Bulletin 114(3): 533-541.

MacKenzie, S. B., P. M. Podsakoff, et al. (2005). "The Problem of Measurement Model Misspecification in Behavioral and Organizational Research and Some Recommended Solutions." Journal of Applied Psychology 90(4): 710-730.

Mansar, S. L. and H. A. Reijers (2005). "Best practices in business process redesign: Validation of a redesign framework." Computers in Industry 56(5): 457-471.

Mansar, S. L. and H. A. Reijers (2007). "Best practices in business process redesign: use and impact." Business Process Management Journal 13(2): 193 - 213.

Markus, M. L. (1983). "Power, Politics, and MIS Implementation." Communications of the ACM 26(6): 430-444.

Martin, T. N. and Z. Huq (2007). "Realigning Top Management's Strategic Change Actions for ERP Implementation: How Specializing on Just Cultural and Environmental Contextual Factors Could Improve Success." Journal of Change Management 7(2): 121-142.

Martinsons, M. G., R. Davison, et al. (2009). "How Culture Influences IT-enabled Organizational Change and Information Systems." Communications of the ACM 52(4): 118-123.

Martinsons, M. G. and P. S. Hempel (1998). "Chinese Business Process Re-engineering." International Journal of Information Management 18(6): 393-407.

Maull, R. S., D. R. Tranfield, et al. (2003). "Factors characterising the maturity of BPR programmes." International Journal of Operations & Production Management 23(6): 596-624.

McAdam, R. and J. Donaghy (1999). "Business process re-engineering in the public sector: A study of staff perceptions and critical success factors." Business Process Management Journal 5(1): 33-52.

McGrath, J. E. (1994). Methodology Matters: Doing Research in the Behavioral and Social Sciences. Readings in Human-Computer Interaction: An Interdisciplinary Approach. R. Baecker and W. A. S. Buxton. San Mateo, CA: Morgan Kaufman Publishers: 152-169.

McKay, D. T. a. B., D.W. (1989). "Building I/T infrastructure for the 1990s." Stage by Stage (Nolan Norton and Company) 9(3): 1-11.

Mitchell, V. and R. Zmud (1995). Strategy congruence and BPR rollout. Business Process Change: Reengineering Concepts, Methods and Technologies. V. Grover and W. Kettinger. London, Idea Group Publishing: 428-52.

Mitchell, V. and R. Zmud (1999). "The effects of coupling IT and work process strategies in redesign projects." Organization Science 10 (3): 424-438.

Mitchell, V. L. and R. W. Zmud (2006). "Endogenous Adaptation: The Effects of Technology Position and Planning Mode on IT-Enabled Change." Decision Sciences 37(3): 325-355.

Motwani, J. (2003). "A business process change framework for examining lean manufacturing: a case study." Industrial Management & Data Systems 103(5): 339-346.

Motwani, J., A. Kumar, et al. (1998). "Business process reengineering: A theoretical framework and an integrated model." International Journal of Operations & Production Management 18(9/10): 964 - 977.

Motwani, J., R. Subramanian, et al. (2005). "Critical factors for successful ERP implementation: Exploratory findings from four case studies." Computers in Industry 56(6): 529-544.

Mumford, E. and G. J. Beckma (1994). Tools for Change and Progress: A Socio-Technical Approach to Business Process Re-engineering. UK, Cheshire, CG Publications.

Myers, M. D. and D. E. Avison (2002). Qualitative research in information systems: a reader. London, UK, Sage Publications.

Nah, F. F.-H. and S. Delgado (2006). "Critical Success Factors for Enterprise Resource Planning Implementation and Upgrade." Journal of Computer Information Systems 47: 99-113.

Nasierowski, W. (2000). "Technology and quality improvements in Mexican companies: some international comparisons." Journal of Quality Management 5(1): 119-137.

Neghab, A. E. P., N. Sardari, et al. (2009). "A Model to Evaluate Organization Capability for Business Process Reengineering with respect to Organizational Culture." International Journal of Business Research 9(2): 87-93.

Newell, S., J. Swan, et al. (1998). "A cross-national comparison of the adoption of business process reengineering: fashion-setting networks?" The Journal of Strategic Information Systems 7(4): 299-317.

Newell, S., J. A. Swan, et al. (2000). "A knowledge-focused perspective on the diffusion and adoption of complex information technologies: the BPR example." Information Systems Journal 10(3): 239-259.

Newman, M. and R. Sabherwal (1996). "Determinants of Commitment to Information Systems Development: A Longitudinal Investigation." MIS Quarterly 20(1): 23-54.

Ngai, E. W. T., C. C. H. Law, et al. (2008). "Examining the critical success factors in the adoption of enterprise resource planning." Computers in Industry 59(6): 548-564.

Nokes, S. and S. Kelly (2008). The Definitive Guide to Project Management: The fast track to getting the job done on time and on budget. London, Financial Times / Prentice Hall.

Nord, W. R. T. and S. Tucker (1987). Implementing Routine and Radical Innovation. Lexington, MA, Lexington Books.

Noronha, C. (2002). "Chinese cultural values and total quality climate." Managing Service Quality 12(4): 210-223.

Nwabueze, U. (2000). "In and out of vogue: the case of BPR in the NHS " Managerial Auditing Journal 15(9): 459-463.

O'Mahoney, J. (2007). "The Diffusion of Management Innovations: The Possibilities and Limitations of Memetics." Journal of Management Studies 44(8): 1324-1348.

O'Neill, P. and A. S. Sohal (1999). "Business Process Reengineering A review of recent literature." Technovation 19(9): 571-581.

Oakland, J. S. and S. J. Tanner (2007). "Successful Change Management." Total Quality Management and Business Excellence 18(1-2): 1-19.

Orlikowski, W. J. and J. J. Baroudi (1991). "Studying Information Technology in Organizations: Research Approaches and Assumptions." Information Systems Research 2(1): 1-28.

Paper, D. and R.-D. Chang (2005). "The state of business process reengineering: A search for success factors." Total Quality Management 16(1): 121-133.

Pavlou, P. A. and O. A. E. Sawy (2006). "From IT Leveraging Competence to Competitive Advantage in Turbulent Environments: The Case of New Product Development." Information Systems Research 17(3): 198-227.

Petter, S., D. Straub, et al. (2007). "Specifying formative constructs in information systems research." MIS Quarterly 31(4): 623-656.

Pfleeger, S. L. and B. A. Kitchenham (2001). "Principles of survey research: part 1: turning lemons into lemonade." ACM SIGSOFT Software Engineering Notes 26 (6): 16-18.

Podsakoff, N. P., W. Shen, et al. (2006). The Role of Formative Measurement Models in Strategic Management Research: Review, Critique, and Implications for Future Research. Research Methodology in Strategy and Management, No longer published by Elsevier. Volume 3: 197-252.

Podsakoff, P. M., S. B. MacKenzie, et al. (2003). "The mismeasure of man(agement) and its implications for leadership research." The Leadership Quarterly 14(6): 615-656.

Podsakoff, P. M. and D. W. Organ (1986). "Self-reports in Organizational Research: Problems and Perspectives." Journal of Management 12(4): 531-544.

Porter, M. E. (1985). Competitive Advantage. New York, Free Press.

Porter, M. E. (1996). "What Is Strategy?" Harvard Business Review 74(6): 61-78.

Premkumar, G. and P. Michael (1995). Adoption of computer aided software engineering (CASE) technology: an innovation adoption perspective, Association for Computing Machinery (ACM). 26: 105-124.

Prosci. (2005). "Best practices in business process reengineering and process design." Retrieved November 18, 2005, from http://www.prosci.com/bpr-benchmarking.htm.

Raymond, L., F. Bergeron, et al. (1998). "Determinants of business process reengineering success in small and large enterprises: An." Journal of Small Business Management 36(1): 72-85.

Reijers, H. A. and S. L. Mansar (2005). "Best practices in business process redesign: An overview and qualitative evaluation of successful redesign heuristics." Omega 33(4): 283-306.

Ribbler, J. (1996). "Delivering solutions for the knowledge economy." Online 20(5): 12-19.

Rindskopf, D. and T. Rose (1988). "Some Theory and Applications of Confirmatory Second-Order Factor Analysis." Multivariate Behavioral Research 23(1): 51-67.

Ringle, C. M., S. Wende, et al. (2005). SmartPLS 2.0 (M3) Beta, http://www.smartpls.de. Hamburg.

Rizzuto, T. E. and J. Reeves (2007). "A multidisciplinary meta-analysis of human barriers to technology implementation." Consulting Psychology Journal: Practice and Research 59(3): 226-240.

Roberts, N. (1984). Transforming Leadership: Sources, Process, Consequences. Academy of Management Conference. Boston.

Rogelberg, S. G. (2002). Handbook of research methods in industrial and organizational psychology. Malden, Mass, Blackwell Publishers.

Rogers, E. M. (2003). Diffusion of innovations (5th ed). New York, Free Press.

Roure, L. (2001). "Research note Product champion characteristics in France and Germany." Human Relations 54(5): 663-682.

Sakaguchi, T. and C. C. Dibrell (1998). "Measurement of the intensity of global information technology usage: quantitizing the value of a firm's information technology." Industrial Management & Data Systems 98(8): 380-394.

Sambamurthy, V. and R. W. Zmud (1999). "Arrangements for Information Technology Governance: A Theory of Multiple Contingencies." MIS Quarterly 23(2): 261-290.

Sarker, S. and A. Lee (2002). "Using a Positivist Case Research Methodology to Test Three Competing Theories-in-Use of Business Process Redesign." Journal of the Association for Information Systems 2(7).

Sarker, S., S. Sarker, et al. (2006). "Understanding Business Process Change Failure: An Actor-Network Perspective." Journal of Management Information Systems 23(1): 51-86.

Schon, D. A. (1963). "Champions for Radical New Inventions." Harvard Business Review 41(2): 77-86.

Shoaf, C., Genaidy, A. and Christenden, D. (1996). A new paradigm for solving human performance problems in the workplace. International Industrial Engineering Conference (IIEC) Proceedings, Minneapolis, USA.

Shook, C. L., D. J. Ketchen Jr, et al. (2004). "An assessment of the use of structural equation modeling in strategic management research." Strategic Management Journal 25(4): 397-404.

Simsek, Z. and J. F. Veiga (2001). "A Primer on Internet Organizational Surveys." Organizational Research Methods 4(3): 218-235.

Smart, P. A., R. S. Maull, et al. (2004). "Capitalizing on thematic initiatives: a framework for process-based change in SMEs." Production Planning & Control 15(1): 2-12.

Sobol, M. G. and G. Klein (2009). "Relation of CIO background, IT infrastructure, and economic performance." Information & Management 46(5): 271-278.

Somers, T. M. and K. G. Nelson (2004). "A taxonomy of players and activities across the ERP project life cycle." Information & Management 41(3): 257-278.

Stefanou, C. J. (1999). Supply Chain Management (SCM) and organizational key factors for successful implementation of Enterprise Resource Planning (ERP) systems. Proceedings of the Americas Conference on Information Systems, Milwaukee, WI.

Straub, D., M.-C. Boudreau, et al. (2004). "Validation guidelines for IS positivist research." Communications of AIS 2004(13): 380-427.

Strebel, P. (1992). Breakpoints : how managers exploit radical business change. Boston, Mass, Harvard Business School Press.

Sumner, M. (1999). Critical success factors in enterprise wide information management systems projects. Proceedings of the 1999 ACMSIGCPR Conference on Computer Personnel Research.

Sun, A. Y. T., A. Yazdani, et al. (2005). "Achievement assessment for enterprise resource planning (ERP) system implementations based on critical success factors (CSFs)." International Journal of Production Economics 98(2): 189-203.

Tallon, P. P., K. L. Kraemer, et al. (2000). "Executives' Perceptions of the Business Value of Information Technology: A Process-Oriented Approach." Journal of Management Information Systems 16(4): 145-173.

Tanaka, J. S. and G. J. Huba (1984). "Confirmatory hierarchical factor analyses of psychological distress measures." Journal of Personality and Social Psychology 46(3): 621-635.

Taylor, J. C. (1998). "Participative design: linking BPR and SAP with an STS approach." Journal of Organizational Change Management 11(3): 233-245.

Temme, D. and H. Kreis (2005). The PLS approach to structural equation modeling with latent variables: a software review. PLS and related methods - proceedings of the PLS'05 international symposium. T. Aluja, J. Casanovas, V. E. Vinzi, A. Morineau and M. Tenenhaus: 87-94.

Teng, J. T. C., V. Grover, et al. (1996). "Developing strategic perspectives on business process reengineering: From process reconfiguration to organizational change." Omega 24(3): 271-294.

Teng, J. T. C., S. R. Jeong, et al. (1998). "Profiling Successful Reengineering Projects." Communications of the ACM 41(6): 96-102.

Terziovski, M., P. Fitzpatrick, et al. (2003). "Successful predictors of business process reengineering (BPR) in financial services." International Journal of Production Economics 84(1): 35-50.

Thompson, R., D. W. Barclay, et al. (1995). "The Partial Least Squares Approach to Causal Modeling: Personal Computer Adoption and Use as an Illustration." Technology Studies: Special Issue on Research Methodology 2(2): 284-324.

Velcu, O. (2007). "Exploring the effects of ERP systems on organizational performance: Evidence from Finnish companies." Industrial Management & Data Systems 107(9): 1316-1334.

Walsham, G. (1997). Actor-Network Theory and IS research: Current status and future prospects. Information systems and qualitative research. A. S. Lee, J. Liebenau and J. I. DeGross. London, Chapman and Hall: 466-480.

Wang, E. T. G., G. Klein, et al. (2006). "ERP Misfit: Country of Origin and Organizational Factors." Journal of Management Information Systems 23(1): 263-292.

Weill, P. and M. Broadbent (1999). Four Views of IT Infrastructure: Implications for IT Investments. Beyond the IT productivity paradox. L. P. Willcocks and S. Lester. New York, John Wiley & Sons: 335-369.

Weill, P., M. Broadbent, et al. (1996). IT Value and the Role of IT Infrastructure Investments. Competing in the Information Age : Strategic Alignment in Practice. J. N. Luftman. New York, Oxford University Press: 361-384.

Wold, H. (1982). Soft Modeling: the basic design and some extensions. Systems under indirect observation: causality, structure and prediction. Part II. K. G. JÖRESKOG and H. WOLD. Netherlands, North-Holland Publishing company.

Wold, H. (1985). Partial Least Squares. Encyclopedia of Statistical Sciences. S. Kotz and N. L. Johnson. New York, Wiley: 581-591.

Worren, N. A. M., K. Ruddle, et al. (1999). "From Organizational Development to Change Management: The Emergence of a New Profession." The Journal of Applied Behavioral Science 35(3): 273-286.

Wu, J. H. and S. C. Wang (2005). "What drives mobile commerce?" Information & Management 42(5): 719-729.

Yi, M. Y. and F. D. Davis (2003). "Developing and Validating an Observational Learning Model of Computer Software Training and Skill Acquisition." Information Systems Research 14(2): 146-169.

Yi, S. P., T. Wang, et al. (2008). "Analysis and Empirical Study on the Impetus and Resistance of BPR Based on A Mechanical Dynamics Model." Journal of Advanced Manufacturing Systems 7(1): 137-140.

Yin, R. K. (2003). Case study research : design and methods, Thousand Oaks, Calif. : Sage Publications.

Young, R. and E. Jordan (2008). "Top management support: Mantra or necessity?" International Journal of Project Management 26(7): 713-725.

Žabjek, D. and M. I. Štemberger (2009). "The influence of business process management and some other CSFs on successful ERP implementation." Business Process Management Journal 15 (4): 588-608.

Appendix A: Glossary of Acronyms

Acronyms	Meaning
ANT	Actor Network Theory
AVE	Average Variance Extracted
BPC	Business Process Change
BPR	Business Process Redesign/Reengineering
CFA	Confirmatory Factor Analysis
CM	Change Management
CS	Cost Savings
DI	Data Integration
EFA	Exploratory Factor Analysis
ERP	Enterprise Resource Planning
FM	Facilities and Management
ICT	Information and Communication Technology
ICTI	Information and Communication Technology Infrastructure
ICTII	Information and Communication Technology Infrastructure Improvement
IS	Information Systems
LISREL	Linear Structural Relations
LV	Latent Variable
MIS	Management Information Systems
MANOVA	Multivariate Analysis of Variance
MV	Manifest Variable
OpQI	Operational Quality Improvement
OrQI	Organizational Quality Improvement
PCA	Principal Component Analysis
PR	Process Redesign

PROD	Productivity
PLS	Partial Least Squares
SEM	Structural Equation Modeling
SME	Small and Medium sized Enterprises
SS	Success
STS	Socio-Technical Systems
STT	Socio-Technical Theory
TMS	Top Management Support
TR	Training
VIF	Variance Inflation Factor

Appendix B: Consent Letter and Questionnaire

Research Study

Predictors of Success of Business Process Redesign Implementation

MeRC (McMaster eBusiness Research Centre),
DeGroote School of Business,
McMaster University

Investigators:
Principal Investigator: Norman P. Archer, Ph.D.
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Purpose of the Study
We understand your organization has completed one or more business process redesign (BPR) projects, and that you are familiar with at least one of these projects. We are developing a model that will assist in understanding the major factors that lead to BPR success, and how to achieve successful outcomes to such projects. Your experience would be valuable to us in deriving a model that will contribute to that understanding. This study is for academic research purposes only.

Questionnaire Information
Your answers to this questionnaire will be maintained in strictest confidence and only the researchers named above will have access to the data. Neither you nor your company's identity will be revealed in any way through any research results arising from this study.

You may decline to answer any or all questions, and you may personally withdraw from the study at any time, without consequences.

From this study, companies will develop a better understanding of how they could achieve BPR success, so that they can avoid unnecessary financial and human resource investments. A general analysis of the results will be available at a future date on the Web site http://merc.mcmaster.ca/workingpapers.html .

This is an academic study that has been reviewed and approved by the McMaster University Research Ethics Board. If you have concerns or questions about your rights as a participant or about the way the study is conducted, you may contact:

McMaster Research Ethics Board Secretariat
Telephone: (905) 525-9140 ext. 23142
c/o Office of Research Services
E-mail: ethicsoffice@mcmaster.ca

Knowing the above information and then answering the following questionnaire implies that you understand the terms outlined above and consent to participate in the study. It should take about 20 minutes to complete the questionnaire.

Thank you for your help with this important study!

Section I

Before you fill out this survey, please answer the following question.
1. Have you participated in any BPR projects within the past 3 years?
   (1) Yes → continue the survey.
   (2) No → show the message: "For this survey we are seeking the opinions of people in a different target group than your own." and exit.

Please provide some basic information about the company that performed the BPR project.
2. How many people does the company employ worldwide?
   (1) 500 or more employees → continue the survey.
   (2) 100-499 employees → continue the survey.
   (3) Fewer than 100 employees → show the message: "For this survey we are seeking the opinions of people in a different target group than your own." and exit.

3. Year the company was established: _______
4. Industry: ______

5. Is the company's industry very changeable, or is it relatively stable?
   (1) Yes, the company's industry is very changeable.
   (2) No, the company's industry is relatively stable

6. What is the position of the company in the industry?
   (1) Local leader
   (2) Small national player
   (3) Medium national player
   (4) World player

Please recall ONE of the BPR projects in your company that you have participated in, and answer all of the following questions based on your perceptions of this BPR project. There is no right or wrong answer to any of these questions.

1. The main location in which the BPR project was undertaken was in:
   (1) United States
   (2) Canada

2. What was your job title in the company?
   (1) Chief Executive Officer (CEO)
   (2) Senior management (e.g., CIO, CFO, CTO...)

(3) Middle management
(4) Front-line supervisor or Project leader
(5) Other (Please specify):

3. Which department were you in at the time the BPR project was undertaken?
(1) Human Resources
(2) Information Technology/Information Systems
(3) Sales and/or Marketing
(4) Production and/or Manufacturing
(5) Customer Services
(6) Finance
(7) Management
(8) Other (Please specify):

4. How many years were you with the company? ______

5. What was your role in the specific BPR project in which you participated?
(1) As a champion who pushed the BPR project to be initiated and implemented.
(2) As top management who supported and guided the whole BPR project.
(3) As a team leader who guided the BPR project.
(4) As a team member who participated in the BPR project.
(5) As a process manager who was familiar with the redesigned business processes.
(6) Other (Please specify):______

Section II

Please answer the following questions. Each section has two types of questions.

1. For the statement questions, your response to each of the statements is on a seven point scale, ranging from 1 (strongly disagree) to 4 (neutral) to 7 (strongly agree). If the statement is not applicable in your case, please select N/A. If you don't know, please select DK.
2. For the open ended questions at the end of each section, please provide any additional comments you might have, based on your perceptions of this BPR project. We appreciate any additional insights you might have, but please note that these additional open ended comments are optional.

BPR Champion

A champion is "a charismatic individual who throws his or her weight behind an innovation, thus overcoming indifference or resistance that the new idea may provoke in an organization". The role of a champion is to encourage the adoption and implementation of an innovative idea. Note that champions could be but are not necessarily top management members.

1.1 How would you evaluate the existence and extent of the champion in the BPR project? (7-item Likert-type scale: from strongly disagree to strongly agree)

a) The BPR project had an identifiable project champion.
b) The commitment of the champion(s) was strong.
c) The champion(s) enthusiastically championed the BPR project.

1.2 Which department did the champion(s) come from (for example, IT, Sales and Marketing, Human Resources, or top management, etc.)? Please Specify:______

1.3 Do you have any other information that applies to champions in your BPR project? Please Specify:______

BPR Strategic Initiatives

2.1 What was the strategy initiative for your BPR project?

(1) The BPR initiative came from potential internal opportunities (for example, cost reduction, improving quality and speed, or enhancing overall firm effectiveness).
(2) The BPR initiative was a reaction to an external need (for example, customer needs or market needs).
(3) The BPR initiative was stimulated by both internal and external needs.
(4) The BPR was not strategy aligned.

Top Management Support

3.1 How would you evaluate top management support for the BPR project? (7-item Likert-type scale: from strongly disagree to strongly agree)
a) Top management was favorable in the implementation of the BPR project.
b) Top management was able to understand the concepts of the BPR project.
c) Top management considered the BPR project to be important to the company.
d) 'Top management effectively communicated its support for the BPR project.
e) Top management provided adequate funding for the project.

3.2 How was top management involved in this project? (For example, by attending meetings, reviewing reports, interacting with project leaders, etc.) Please specify if any:______

3.3 When the BPR project required more resources, were they provided by top management?

3.4 Do you have any other comments about top management support in your BPR project? Please specify if any:______

Change Management

4.1 How would you evaluate the following change management items regarding your BPR project? (7-item Likert-type scale: from strongly disagree to strongly agree)
a) The BPR project properly reviewed and revised reward/motivation and compensation systems.
b) The BPR project management made necessary changes in human resource policies as a result of the BPR implementation.
c) The BPR project stimulated the organization's receptivity to change.
d) The BPR project created an effective culture for organizational change.
e) The BPR project management effectively communicated the reasons for change to management and employees.
f) The BPR project management properly empowered relevant employees.
g) The BPR project management provided adequate training for personnel affected by the redesigned processes.
h) The vision of the BPR project was communicated well to all the stakeholders.
i) All the stakeholders were solicited for feedback on the project.
j) BPR Strategic Initiatives

4.2 Could you please state any observations you might have about how the BPR project stimulated the organization's receptivity to change?

4.3 Could you please state any observations you might have about how the BPR project created an effective culture for organizational change?

4.4 Do you have any other comments about change management in your BPR project? Please specify if any:______

Process Redesign

5.1 Were the following operational process redesigns involved in your BPR project? (7-item Likert-type scale: from strongly disagree to strongly agree)

a) The BPR project involved eliminating unnecessary tasks from business processes.
b) The BPR project involved combining small tasks into composite tasks or dividing large tasks into workable smaller tasks.
c) The BPR project involved moving and resequencing tasks to more appropriate places in the processes.
d) The BPR project involved arranging tasks to be executed in parallel.
e) The BPR project involved integration of business processes with those of customers or suppliers.
f) The BPR project involved empowering workers with more decision-making authority.
g) The BPR project involved assigning workers to perform as many steps as possible for single orders.
h) The BPR project involved making human resources more specialized or more generalized.
i) The BPR project involved minimizing the number of departments, groups, and persons involved in business processes.

5.2 In addition to the previously specified ten best practices of process change, did your company utilize any other major best practices in your BPR project? Please specify if any:______

ICTI Improvement

6.1 How would you evaluate the improvement of the ICT (Information and Communication Technology) infrastructure capabilities in your company as a result of the BPR project? (7-item Likert-type scale: from strongly disagree to strongly agree)

a) Networks which link the company and its main suppliers were improved as a result of the BPR project.
b) Networks which link the company and its main customers were improved as a result of the BPR project.

c) Information and data sharing across the company was improved as a result of the BPR project.
d) Duplication of data was reduced or eliminated as a result of the BPR project.
e) The standardization of data element definitions across the company was improved as a result of the BPR project.
f) The company improved its IT training programs through the BPR project.
g) Training of users was adequate through the BPR project.
h) Training of IT personnel was adequate through the BPR project.
i) Company servers were increased in capacity as a result of the BPR project.
j) Regular preventive maintenance down time was reduced as a result of the BPR project.
k) The company had increased expertise to manage its IT facilities after the BPR project.
l) Users were more satisfied with IT services as a result of the BPR project.
m) IT administration standards and procedures were improved as a result of the BPR project.

6.2 Do you have any other comments about the IT infrastructure changes resulting from the BPR project? Please specify if any:______

BPR Outcomes

7.1 How would you evaluate the extent of achieved outcomes of the BPR project for your company? (7-item Likert-type scale: from strongly disagree to strongly agree)

<u>OpQI</u>

a) The BPR project achieved product quality improvement.
b) The BPR project achieved customer services improvement.
c) The BPR project achieved customer satisfaction improvement.

<u>OrQI</u>

a) The BPR project resulted in less managerial hierarchy.
b) The BPR project reduced bureaucracy.
c) The BPR project improved internal users' satisfaction.
d) The BPR project improved communication within the company.

<u>Cost Savings</u>

a) The BPR project achieved a good return on investment.
b) The BPR project improved company profits.
c) The BPR project saved on operational costs.
d) The BPR project saved on personnel costs.

Productivity

a) The BPR project achieved more units produced or more customers served per unit time.
b) The BPR project achieved fewer delays in production and/or services.
c) The BPR project achieved shortened cycle time in production and/or customer services.
d) The BPR project achieved lower error rates in production and/or customer services.

Project Management

a) The BPR project was completed on time.
b) The BPR project was completed on or under budget.
c) The BPR project's deliverables were as specified in the project planning phase.

Overall Success

a) Overall, this BPR project was successful.
b) Overall, this BPR project achieved favourable outcomes.

7.2 Do you have any other comments about the extent of achieved outcomes, of your BPR project? Please specify if any:______

Thank you for your participation in our survey.

Appendix C: Invitation Letter and Reminding Letter (through Email)

Part I: Invitation Letter

Email Title: Research Invitation from McMaster University

Dear (First Name & Last Name),

The DeGroote School of Business at McMaster University is doing a study of business process redesign (BPR) (sometimes called process workflow redesign or business process change) and how it improves business performance. The objective of the research is to develop a better understanding of how companies can achieve BPR success and related performance improvement.

The principal investigator is Dr. Norm Archer, and he can be reached at 905-525-9140 ext 23944 or archer@mcmaster.ca. I am a Ph.D. candidate and a student investigator in this research.

Our research requires the collection of data from people in industry who have had real experience through involvement in some way with a BPR project. An example of a BPR project in your company might have been carried out if and when your company implemented an Enterprise Resource Planning (ERP) system. BPR is a type of project that often is undertaken in conjunction with ERP installation.

If you have had such experience it would be valuable to us in deriving a model that will contribute to an understanding of how organizations can do a better job of BPR. We trust that you would be willing to take about 20 minutes to fill out an online questionnaire for us (click or copy the Web address below to your Internet browser to enter the survey). http://buscom.mcmaster.ca/limesurvey/index.php?sid=48294&token=2009&lang=en

As a potential participant, if you do not have such experience or the time to complete the survey, we would appreciate it if you would forward this message to someone you know who has been involved with a BPR project, or, if you would reply to us by email with the email addresses of any potential participants. The following are typical roles of people who participate in such projects:

* As champions who encouraged BPR project initiation.
* As executives who supported BPR projects.
* As team leaders who guided BPR projects (e.g., CIO - Chief Information Officer, or manager of IT department).
* As team members who participated in BPR projects.
* As process managers who were familiar with the redesigned business processes.

The survey is anonymous and confidential. Neither participants nor their organizations will be identified in any reports or publications derived from survey results.

This is an academic study that has been reviewed and approved by the McMaster University Research Ethics Board. You may communicate any concerns or questions to the Board by calling 905-525-9140 Ext. 23142 or by e-mailing ethicsoffice@mcmaster.ca

The McMaster eBusiness Research Centre (MeRC) Web site (http://www.merc-mcmaster.ca/) will publish the results of the study as a working paper in about eight months.

Thank you for your help with this important study! We greatly appreciate your assistance.

Very sincerely,
Junlian Xiang
Ph.D Candidate in Information Systems
DeGroote School of Business, McMaster University
Tel: 905 525 9140 ext. 26184
Fax: 905 528 0556
E-Mail: xiangj@mcmaster.ca

Part II: Reminder

Email title: Reminder: Research Survey from McMaster University

Dear (First Name & Last Name),

Recently we invited you to participate in a survey taken at McMaster University.

This is a gentle reminder that the survey is still available should you wish to take part. We look forward to hearing from you and your opinion is very valuable for our study.

The survey is titled:
"Predictors of Success of Business Process Redesign Implementation"

To participate, please click on the link below.
http://buscom.mcmaster.ca/limesurvey/index.php?sid=48294&token=2009&lang=en

Sincerely,

Junlian Xiang (xiangj@mcmaster.ca)

Appendix D: Test Results for Common Method Bias

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	19.782	35.325	35.325	19.782	35.325	35.325
2	4.487	8.012	43.337	4.487	8.012	43.337
3	2.597	4.638	47.975	2.597	4.638	47.975
4	2.433	4.345	52.320	2.433	4.345	52.320
5	2.251	4.019	56.339	2.251	4.019	56.339
6	1.898	3.390	59.729	1.898	3.390	59.729
7	1.535	2.741	62.470	1.535	2.741	62.470
8	1.337	2.388	64.858	1.337	2.388	64.858
9	1.209	2.158	67.016	1.209	2.158	67.016
10	1.169	2.087	69.103	1.169	2.087	69.103
11	1.079	1.928	71.031	1.079	1.928	71.031
12	.995	1.777	72.808			
13	.979	1.749	74.557			
14	.935	1.670	76.228			
15	.854	1.524	77.752			
16	.795	1.419	79.171			
17	.743	1.327	80.499			
18	.683	1.220	81.719			
19	.677	1.209	82.928			
20	.614	1.097	84.025			
21	.584	1.043	85.068			
22	.571	1.019	86.087			
23	.540	.964	87.051			
24	.509	.909	87.960			
25	.472	.843	88.803			
26	.426	.760	89.563			
27	.407	.726	90.289			
……	……	……	……			
56	.031	.056	100.000			

Extraction Method: Principal Component Analysis.

Appendix E: Group Difference Tests for Pilot Study Data

Part I: t-test Results

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)
	Lower	Upper	Lower	Upper	Lower
Construct_CHAM	.042	.841	.187	13	.855
			.173	6.740	.867
Construct_TMS	.013	.911	1.290	13	.220
			1.265	7.713	.243
Construct_CM_EL	.096	.762	1.342	13	.202
			1.331	7.923	.220
Construct_CM_OL	2.345	.150	.119	13	.907
			.157	12.354	.878
Construct_CM_SL	.125	.730	1.152	13	.270
			1.324	11.582	.211
Construct_PR_T	.003	.955	.675	13	.512
			.658	7.602	.530
Construct_PR_S	.840	.376	.225	13	.825
			.208	6.642	.842
Construct_ICTI_NC	.648	.435	.000	13	1.000
			.000	8.556	1.000
Construct_ICTI_DI	.025	.878	.595	13	.562
			.617	8.923	.553

Continued...

Construct_ICTI_FM	1.841	.198	-1.244	13	.236
			-.987	4.959	.369
Construct_ICTI_TR	.546	.473	-.753	13	.465
			-.640	5.600	.548
Construct_OpQI	.360	.559	.272	13	.790
			.306	11.059	.765
Construct_OrQI	.146	.708	.525	13	.609
			.507	7.418	.627
Construct_CS	4.594	.052	-.486	13	.635
			-.640	12.462	.534
Construct_PROD	3.880	.071	1.036	13	.319
			1.298	12.997	.217
Construct_SS	.474	.503	1.227	13	.242
			1.552	12.990	.145

Part II: MANOVA Test Results

Tests of Equality of Group Means

	Wilks' Lambda	F	df1	df2	Sig.
Construct_CHAM	.997	.035	1	13	.855
Construct_TMS	.887	1.663	1	13	.220
Construct_CM_EL	.878	1.802	1	13	.202
Construct_CM_OL	.999	.014	1	13	.907
Construct_CM_SL	.907	1.328	1	13	.270
Construct_PR_T	.966	.455	1	13	.512
Construct_PR_S	.996	.051	1	13	.825
Construct_ICTI_NC	1.000	.000	1	13	1.000
Construct_ICTI_DI	.974	.353	1	13	.562
Construct_ICTI_FM	.894	1.546	1	13	.236
Construct_ICTI_TR	.958	.566	1	13	.465
Construct_OpQI	.994	.074	1	13	.790
Construct_OrQI	.979	.275	1	13	.609
Construct_CS	.982	.236	1	13	.635
Construct_PROD	.924	1.074	1	13	.319
Construct_SS	.896	1.506	1	13	.242

Appendix F: Summary of the Finalized Constructs

Construct	Definition	Key References	Items*
BPR Champion † (CHAM)	The existence and extent of champion in the BPR project.	(Grover 1993; Fui-Hoon Nah, Zuckweiler et al. 2003; Brown, Booth et al. 2004; Lai and Mahapatra 2004)	3 (3)
Top Management Support (TMS)	The existence and extent of top management support in the BPR project.	(Grover 1993; Grover and Jeong 1995; Premkumar and Michael 1995)	5 (5)
Change Management (CM)	The existence and extent of change management techniques utilized in the BPR project, including three dimensions: organization level, employee level, and stakeholder level.	(Bee Wah and Kok Wei 2006; Grover and Jeong 1995)	7 (9)
Process Redesign (PR)	The existence and extent of operational best practices utilized in the BPR project, including two dimensions: technical based and social based.	(Mansar and Reijers 2005; Reijers and Mansar 2005)	9 (10)
ICTI Improvement (ICTII)	*Inter-Firm Communication (IFC)*: the extent of the improvement in inter-firm communication during the BPR project.	(Law and Ngai 2007)	2 (2)
	Data Integration (DI): the extent of data integration across a company during the BPR project.	(Law and Ngai 2007)	3 (3)
	Training (TR): the extent of IT training during the BPR project.	(Law and Ngai 2007)	3 (3)
Operational Quality Improvements (OpQI)	The extent of achieved outcomes of the BPR project in the aspect of operational quality.	(Grover 1999; Grover and Jeong 1995; Raymond et al. 1998)	2 (3)

Continued…

Construct	Definition	Key References	Items*
Organizational Quality Improvements (OrQI)	The extent of achieved outcomes of the BPR project in the aspect of organizational quality.	(Grover 1999; Grover and Jeong 1995; Raymond et al. 1998)	4 (4)
Cost Savings (CS)	The extent of achieved outcomes of the BPR project in the aspect of cost savings.	(Grover 1999; Grover and Jeong 1995; Raymond et al. 1998)	3 (4)
Productivity (PROD)	The extent of achieved outcomes of the BPR project in the aspect of productivity.	(Grover 1999; Grover and Jeong 1995; Raymond et al. 1998)	4 (4)
Overall Success (SS)	The overall extent of achieved outcomes of the BPR project	(Grover 1999; Grover and Jeong 1995; Raymond et al. 1998)	2 (2)

† A champion is "a charismatic individual who throws his or her weight behind an innovation, thus overcoming indifference or resistance that the new idea may provoke in an organization" (Rogers 2003).
* Final item numbers (Initial item numbers)