**A study of the strategic value, uses and effects of
Corporate Performance Management (CPM)
Systems from a dynamic capability perspective**

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Abstract

This thesis focuses on the strategic value, use and impacts of Corporate Performance Management (CPM) systems within organizations. CPM systems are a new class of information system that firms are adopting in order to improve performance and to become more competitive. CPM systems and the capabilities they engender are examined through the lens of the dynamic capability perspective. Dynamic capability may be an appropriate approach with which to study CPM systems because we believe that such systems impact performance by altering the resource base of the firm. A multi-part CPM performance model is presented in this paper that positions a successful implementation outcome as being reliant on three underlying capability constructs; IT infrastructure, Human Capital and Strategic Leadership. We propose firms that successfully implement and integrate CPM systems can consciously and deliberately develop a dynamic capability (*CPM specific capability*) that manifests itself as changes to business processes that reconfigure the core capability portfolio of the firm. We believe that such changes over time should lead to superior organizational performance. A total of 165 respondents filled out our survey designed to assess the impact of CPM systems on their firms and how these systems may have contributed to improved organizational performance. Interviews were conducted with twelve senior managers to explore our research themes and to add context and depth to the quantitative findings. We believe that CPM systems, although ubiquitous, generate information rich outputs and services that become deeply integrated within business processes in unanticipated ways, creating heterogeneities and economic differentials between firms. The introduction of CPM systems normally accompanies enterprise wide performance management initiatives making this research important as the implementation of these systems carries the potential for significant organizational change.

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I dedicate this work to the memory of my Dad who had great respect for education, taught us to love to learn and to believe that anything was possible.

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1 Introduction and Research Objective

Industrial theories of competition have tended to discount the importance of resource heterogeneity and the emphasis of idiosyncratic attributes on a firm's competitive position (Barney, 1991). Firms have been thought of as being identical in terms of their strategically relevant resources that they control and the strategies they can pursue (Porter, 1981; Rumelt, 1984; Scherer, 1980; Nelson, 1991). Variances in firm performance due to resource heterogeneity has been assumed to be short lived as the human resources used to implement value creating strategies are thought to be highly mobile and easily bought on factor markets (Barney, 1986; Hirshleifer, 1980). This thesis argues that resource heterogeneity and the ability to reconfigure a firm's capabilities is critical for a firm seeking to improve its performance and long-term competitive position. We propose that the use of a Corporate Performance Management (CPM) system provides firms with the capability to create such heterogeneity by allowing it to create, modify and re-configure its resource base. CPM systems are a class of organizational-wide Decision Support System (DSS) (Power, 2002) that integrate Business Intelligence (BI), Scorecarding & Dashboards (S&D) and Enterprise Planning (EP) activities within a unified software platform enabling firms to conduct performance measurement and management activities. These terms and concepts will be discussed in detail in Chapter 2.

Our position is supported by the Resource Based View (RBV) of strategy (Penrose, 1959; Wernerfelt, 1984; Rumelt, 1984; Barney, 1986, 1991; Dierickx & Cool, 1989; Grant,

1991; Amit & Schoemaker, 1993; Peteraf, 1993), a perspective that suggests that firms are defined by the useful assets and resources they control and can press into service, and are unique entities defined in time, space and competitive readiness by the evolutionary paths they have travelled. We further build upon the precepts of the RBV by employing arguments made by proponents of the Dynamic Capability View (DCV) of strategy (Teece & Pisano, 1994; Teece et al., 1997; Eisenhardt & Martin, 2000; Winter, 2003; Teece, 2007; Helfat et al., 2007 etc.). The DCV is a modern theory of management that derives intellectually from the RBV and suggests that it is the special capabilities that firms develop to dynamically change their resource bases that determine competitive position and likelihood of enjoying Sustained Competitive Advantage (SCA). Dynamic capabilities permit firms to adjust and reconfigure their resource bases so that they can deal effectively with external and internal challenges. The literature largely supports the notion that dynamic capabilities are valuable (Teece, 2007; Ambrosini & Bowman, 2009; Helfat & Peteraf, 2009) and academics have called for more empirical research to understand how dynamic capabilities can be practically developed and used in firms (Pablo et al. 2007; Power, 2008).

The RBV has been critiqued for not adequately explaining how resources are developed, integrated and released¹ (Wade, 2008). It has been criticized for being tautological, static and lacking rigor and formalization (Priem & Butler, 2001a, 2001b). It has been queried for lacking in balance between conceptual development and empirical verification (Williamson, 1999) and in need of a mechanism to operationalize it in practice (Dosi et al., 2000). Similarly, DCV has been criticized for lacking empirical support and having

unclear practical implications (Arend & Bromiley, 2009). The literature is also equivocal regarding the definition, action mechanism, form and nature of dynamic capabilities (Nelson & Winter, 1982; Winter, 2003; Dosi et al., 2000; Easterby-Smith et al., 2009).

We found that the literature on dynamic capabilities does not sufficiently address practical methods through which such capabilities can be deliberately developed and enhanced in firms. In this research paper, we build on theory and propose an argument that the deliberate development of such dynamic capabilities, that we collectively refer to as “*CPM specific capabilities*” based on the successful implementation, integration and usage of a CPM system may indeed be a plausible strategy that might be used to create variance in economic performance between firms.

The ability to make good decisions is central to effective strategic management (Simon, 1986) and information systems that support decision-making are believed to be critical for this purpose (Gorry & Scott-Morton, 1971; Sprague, 1980). Simon (1947, 1991) proposed that managers make calculated “*bets*” based on the limited information that they have available at their disposal and incorrect or inadequate information has an impact on decision-making. The success of transaction based Enterprise Resource Planning (ERP) systems has inundated the modern manager with mountains of data that has to be analyzed for decision-making. A 2007 study by Accenture of 1000 managers found that 47% of respondents did not have any confidence in their corporate information². Further, this study found that 42% of managers use wrong information at least once a week and 59% missed information they should have used.

This research is concerned with how CPM systems impact organizations and examines the mechanisms through which these systems are successfully implemented and used. CPM specific capabilities develop post-implementation as managers and users develop skills and experience in the use of these systems and apply their outputs to conduct the day to day business of the firm. But before such capabilities develop, these systems need to be implemented and integrated successfully. CPM systems are major IT/IS investments so there is an urgent need to better understand the conditions under which they are successfully implemented and integrated. We propose three antecedent capabilities (*IT Infrastructure, Human Capital and Strategic Leadership*) that firms should possess in order to enjoy a successful implementation outcome. We develop these capability constructs further in Chapter 3.

The term CPM was coined by Gartner Research in 2001 to describe the combination of processes, tools and techniques firms use to measure and manage organizational performance. CPM links the long term strategic goals and objectives of the organization with the daily operations through measurement and monitoring of day to day activities and then presents this information in an easy to digest form to key decision makers in the organization. CPM system outputs are used for decision-making, the logical premise being that better information leads to better decisions. CPM thus serves as a confluence point where the strategic goals of the organization are juxtaposed beside the tactical steps taken towards achieving them.

In this paper, we examine this recent IS phenomenon through the lens of the dynamic capability perspective. A key question is whether firms can deliberately develop dynamic capabilities. We study how CPM specific capabilities impact existing firm capabilities that may be considered central to an organization's performance. We suggest that firms can change their core capabilities by changing their business processes through adopting a CPM-centric approach. For example, DCV suggests that a firm can enjoy sustained superior performance in a rapidly changing industry through continuous proactive and reactive change by building up its sensing and sense-making capabilities (Teece, 2007; Harreld et al., 2007). CPM specific capabilities can enhance such alerting mechanisms and help managers to make sense of the information that a firm is receiving from the external and internal environment. We believe that the skillful use of CPM systems by managers and end users may over time, bind the outputs and services that these systems produce into business processes in ways that are unanticipated and unplanned. By doing so, they might create causal ambiguity (Demsetz, 1973; Dierickx & Cool, 1989; Kogut & Zander, 1992) within a firm's processes that are not easily replicated by competitors. The unique evolutionary paths (Nelson & Winter, 1982; Teece et al., 1997; Eisenhardt & Martin, 2000) taken by the firm also provide unique environmental conditions that enhance the effect of such changes and make it difficult for these advantages to be duplicated through movement of employees to a competitor. We believe that these CPM specific capabilities are a valuable dynamic capability and possess an obsequious quality that allows them to become woven into a firm's business processes causing them to become more efficient and effective for that particular firm's

business. By changing underlying processes, the firm's capability portfolio is altered and we believe that this might lead to superior firm performance.

Field observations and discussions with professional CPM consultants have suggested that for a variety of reasons, technical and otherwise, CPM systems are not always implemented successfully and are not enjoying the enterprise wide effects that they are potentially capable of. CPM systems need to be implemented and integrated successfully to positively impact firm performance. Worthen (2002) noted that information systems are often deployed primarily for solving pressing functional and technical problems without regard for overall strategic considerations. Markus & Benjamin (1997) noted that managers often consider the introduction of new IT as a panacea that is supposed to promote positive organizational changes by virtue of their presence alone. Consequently, many organizations fail to comprehend or acknowledge the broader implications for organizational change that implementing these systems engenders (Worthen, 2002). The interviews we conducted with senior managers informed us that the implementation of a CPM system is too often regarded as a "*spot-fix*" to provide a firm with instant reporting or analytic capability without adequate consideration being given to its wider enterprise altering potential. We propose and test a conceptual model that frames a successful implementation outcome resulting from the development and maturity of three underlying capability constructs. Further to a successful implementation, we study its impact on core organizational capabilities and firm performance.

We believe that CPM specific capabilities are a valuable dynamic capability that may be beneficial to the firm in the long run. Dynamic capabilities are believed to be important for firms seeking to attain and maintain competitive advantage. Competitive advantage is a difficult concept to define but there appears to be general consensus among scholars that value creation based on effective use of combinations of resources is fundamental (Lippman & Rumelt, 2003). We looked at other management theories related to competitive advantage before settling on a choice through which to study this IS phenomenon. Positioning theory in strategic management (Porter, 1980) deals with industry structure and a firm's position within its environment. The Resource Based View (RBV) combines the external (*industry structure*) and internal (*core competencies*) views of strategy and defines firms in terms of the valuable resource bundles it controls and can put into service with the definition of value subject to various tests and conditions (Collis & Montgomery, 1995). Managers are advised to develop core competencies and capabilities (Prahalad & Hamel, 1990) and to focus on the activities that the firm does best. Although, we feel our argument resonates with other perspectives, DCV is the most appropriate as we believe that through the effective usage of CPM systems firms develop a dynamic capability that permits them to affect resource positions, business processes and evolutionary paths (Teece et al., 1997). The DCV is concerned with change and the ability to respond to challenges posed by change, both internal and external to the firm.

We propose that CPM specific capabilities provide firms with additional insights in decision-making and process execution within high-velocity, volatile and flexible

environments. We believe that these capabilities develop through continued experience and exposure to CPM systems. Such experiences impact individuals and define their personal capabilities and these impacts taken collectively define a firm level capability. Our survey asked respondents to reflect on both individual and firm level impacts of these systems. Therefore, this research might be considered at both the individual capability and the firm level. Our survey data, supplemented by personal interviews with senior managers helped us to understand whether CPM specific capabilities added value to existing processes, empowered workers and provided strategic advantage to the organization. Such assertions have been routinely made by CPM software vendors but there has been limited empirical research on CPM systems to validate and test such claims (Neely, 2005; Busi & Bititci, 2006).

We are interested in understanding how CPM specific capabilities and their supported processes create value in organizations. This is increasingly relevant in an age where mergers and acquisition is the norm and multi-business organizations struggle to create value greater than the sum of their parts (Collis & Montgomery, 1998). IT and IS enabled processes are known to create cost and differentiation advantages and may increase firm value (Porter, 1980; Dehning et al., 2005). The use of information systems is said to create efficiencies in production that translate into economies of scale thereby creating an effective entry barrier against competitors (Porter, 1980; Barney, 1991). The notion of CPM specific capabilities is consistent with these strategic perspectives since they give organizations timely access to information from all available assets to allow

them to operate more efficiently, detect problems proactively and utilize firm resources more effectively.

Previously, business improvement approaches, such as six sigma (Pande & Holpp, 2004), lean enterprise (Womack & Jones, 2003) and theory of constraints (Dettmer, 1997) have indicated the need for using performance measures to drive and sustain business improvement. Performance measurement related publications (Hoque & James, 2000; Davis & Albright, 2004 etc.) suggest that businesses perform better if they are managed using formalized, balanced and integrated performance measures. For example, the balanced scorecard (Kaplan & Norton, 1992, 2004) is a widely used performance measurement framework. However, there appears to be a lack of consensus that performance management actually improves organizational performance. It has been suggested that the use of performance measurement systems, such as the balanced scorecard, does not make any difference to business performance as it lacks theoretical grounding and focuses too heavily on empirical measures of success (Neely et al., 2004; Ittner et al., 2003). Others have suggested that the impact of performance measurement is largely contingent upon the way it is used (Braam & Nijssen, 2004).

The primary goals of this research are to understand the strategic relevance, usage and impacts of CPM systems and their CPM specific capabilities in an organization trying to improve its performance. First, we need to understand how CPM systems are implemented successfully and what underlying capabilities need to be developed to make this happen. Second, we want to see if successfully implemented systems result in CPM

specific capabilities forming that may eventually impact core firm capabilities. Third, we want to see if these enhanced capabilities translate into actual performance improvements. In addition, this paper will examine the motivations behind the decision to implement a CPM system and the expectations that firms have when they make this choice and whether these expectations have been met. At this time, there is not much academic literature on CPM and as is often the case in the field of information systems practitioners appear to be defining the field ahead of academics. The lack of empirical research may be due to the newness and immaturity of the field of performance management in general (Thorpe & Beasley, 2004; Neely, 2005; Busi & Bititci, 2006). More conceptual and empirical study is required to fully understand this phenomenon and hopefully this paper will address this shortage in some way.

This paper is concerned with the following three research questions.

1. What are the capabilities firms should focus on to enjoy a successful CPM system implementation outcome?
2. Does the successful implementation outcome of a CPM system result in improvements in core firm capabilities?
3. Does improvement in core firm capabilities resulting from successful CPM system implementation outcome impact firm performance?

This paper is written from an information systems perspective but briefly bridges into the organizational behaviour and psychology literature to explore how CPM specific capabilities might have other impacts in areas such as human creativity, attention and mindfulness. While we recognize that organizational culture may be an important element in determining the success of CPM systems we have not explicitly included it in our analysis as we desired to keep the model parsimonious and manageable. The culture

of the organization may be especially germane since CPM systems bring business and IT users together in integrated teams and business users are expected to evolve from dormant to proactive consumers of information. Exploring the impacts of culture and CPM systems may possibly be a future direction for this research and this is discussed further in Chapter 8.

This research is based on a sample of 165 respondents from organizations that have implemented CPM systems within the past five to ten years. Quantitative data was collected through an online survey. The survey was completed by individuals that use CPM systems as part of their day-to-day jobs. In addition to the quantitative data collected in the survey, interviews were conducted with senior managers from twelve firms belonging to the sample population. By combining interviews with a quantitative approach, we believe that a richer perspective was obtained.

Why is this research required? Benbasat & Zmud (1999) identified five reasons why information systems research lacks relevance and made a total of nine recommendations for IS researchers to follow. Two of these recommendations were that IS research should focus on the future interests of key stakeholders and identify relevant topics from IS practice. This paper answers that call and looks at a topic that has not been extensively or specifically covered within the IS body of literature. The business of CPM appears to be highly relevant to the modern firm with the market expected to surpass \$ 10 billion USD by the end of 2010 according to Gartner Research³. This research is timely due to the interest that currently exists in CPM systems. Performance Management is an important

IS growth area and has been identified as a top CIO priority in a study conducted by Gartner Research in January 2009. CPM and its related activities (*business intelligence, analytics etc.*) are consistently identified as the top spending priority for CIO's⁴. There is also a growing sentiment that firms are simply not getting the value out of their CPM investments that was originally anticipated. With all of this interest around these systems, it is important to understand how to improve implementation success and to better understand the mechanisms through which they act and to develop strategies around their usage so that competitive disparity and heterogeneity may be created in the firm.

However, CPM is not an end in itself. Companies are looking to improve performance and profitability and challenging economic conditions further push firms to seek efficiencies in operations. A 2006 Gartner study found that most companies are wasting money doing IT implementation and 80% of IT dollars is not being directed to advancing business competitive position. This "*dead money*" does not directly impact business growth or boost competitive advantage and thus is "*ultimately expendable*". Approximately 80 percent of IT spending is allocated to keeping the existing infrastructure running or "*just keeping the lights on*". This number should be closer to 60% with the additional funds being diverted to integration efforts, change management, corporate performance management, risk management, governance and architecture (Gartner Research, 2006). We propose that CPM specific capabilities will alter firm processes changing other firm capabilities and end up making organizations more efficient and productive.

This paper makes the following contributions. First, we try to provide a better understanding of a recent IS phenomenon while seeking to gain insight into how these systems and their specific capabilities impact an organization. Performance management is an important strategy that firms are using to create competitive differences in their industries. By adopting a capability based orientation and deliberately developing the tools to alter existing capability portfolios, firms may attain stronger positions to address the challenges posed by change within their respective industries. We believe that a fundamental mindset change is required for managers whereby CPM implementing firms broaden the scope of their expectations and open their minds further to the process altering potential of these information systems. Examining these performance management systems through the lens of dynamic capability is novel and has not been done by other researchers to the best of our knowledge. Positioning CPM deployment as a capability building process is a key contribution of this paper as most firms implement these systems to solve a specific problem. We exhort managers to fully utilize the capacities of these systems and conduct audits of existing processes to see if they can be improved by using CPM outputs. We know that based on personal experience that the process of implementing such systems presents challenges that affect the eventual level of integration within the firm, thereby curtailing usefulness and this paper proposes a practical framework that may enhance the success of such IS implementations in the future. The literature has called for more empirical research using dynamic capability (Pablo, 2007; Ambrosini & Bowman, 2009; Helfat & Peteraf, 2009). We found little academic research in the IS literature dealing specifically with CPM systems and their impacts on core firm capabilities. Most of the literature is practitioner-based and there is

a need for more academic study and independent research. This is an independent academic research that has examined vendor notions relating to CPM systems and may be useful to firms that have implemented CPM or are considering such an implementation in the future.

The rest of the thesis will proceed as follows:

Chapter Two is a literature review that examines the state of research in the field. Since this is a relatively new area, the literature on Decision Support Systems (DSS) was reviewed to identify critical issues and to set theoretical context. The literature review also examines theories of competitive advantage, and in particular the dynamic capability perspective which is the focus of this paper.

Chapter Three presents a conceptual model that frames the implementation outcome of a CPM system in terms of three capability constructs with a successful implementation outcome leading to impacts on organizational performance through the firm's capability portfolio. The research questions are posed and hypotheses are presented in this chapter.

Chapter Four discusses the methodology that was used in this research. The design of the quantitative survey as well as the method of supplementary user interviews that was used to collect data is presented.

Chapter Five covers the quantitative data analysis. The survey data was analyzed using SPSS/AMOS and various statistical methods including Exploratory Factor Analysis (EFA), Multiple Linear Regressions (MLR) and Structural Equation Modeling (SEM) were applied to the dataset to study the relationships between the model constructs and to test our hypotheses and propositions.

Chapter Six reviews the supplementary information that was obtained from the twelve interviews with senior managers who were involved with CPM system implementations. A total of eight CPM themes were explored during these interviews. The information gained from these interviews was used to reflect on the quantitative findings and to further inform the development of our conceptual model.

Chapter Seven consists of a discussion of the key findings of this research and discusses the theoretical and practical implications of this study for the industry and researchers. A conceptual model for CPM is presented and discussed in this section.

Chapter Eight concludes the study, discusses its limitations, areas for improvement and suggests additional research directions to further extend and improve its findings.

2 Literature Review

The literature review is made up of four sections. Section 1 provides a review of the Decision Support System (DSS) literature to understand the historical origins for our subject and to establish theoretical context. Section 2 introduces the topic of performance management and provides background material on CPM systems. Section 3 begins with a brief discussion of the IT productivity question and the relationship between information systems and performance. We review the academic literature related to the RBV and DCV and explore why DCV is an appropriate lens through which to examine the strategic value, uses and effects of these systems. Section 4 discusses how CPM specific capabilities might be considered as a dynamic capability and how CPM systems are used within the modern firm. We conclude with a discussion on how ubiquitous technology might be used to differentiate a firm from its competitors and the effects such usage has on human creativity.

2.1 What can we learn from DSS research?

References to the use of ancillary, scientific methods to support better decision making can be found in papers appearing as early as the 1950's. The earliest paper we found on DSS was written by Henderson & Schlaifer (1954) examining the use of mathematical techniques such as linear programming to support better decision making by executives. The decision to use mathematical techniques was a fundamentally new way of managing a business and that the notion of analyzing data to support planning and decision making was every bit as revolutionary as double entry book-keeping was to accounting (Henderson & Schlaifer, 1954). Using DSS was a fundamentally new way of looking at

an issue. Early use of DSS focused on obtaining cost and profit information, efficient resource allocation and investment planning.

Gorry & Scott Morton (1971) defined “*management decision systems*” as interactive computer based systems that helped decision makers utilize data and models to solve unstructured problems. They originally proposed the concept of Decision Support Systems that Power (2002, p. 149) defined as “...*an interactive computer-based system or subsystem intended to help decision makers use communications technologies, data, documents, knowledge, and/or models to identify and solve problems, complete decision process tasks, and make decisions...*”. Today, DSS is a well established research area within the field of information systems (Benbasat & Nault, 1990; Alavi & Joachimsthaler, 1992).

Although vendors do not explicitly present it in this way, we argue that CPM systems are a form of organizational wide DSS with unique characteristics. Using the various DSS taxonomies, we believe that they may actually be a hybrid form of decision support system that might be considered a passive DSS according to the classification scheme proposed by Haettenschwiler (1999) (*which is based on the user’s relationship with the DSS*) because they assist in the process of decision making but are generally not used to make decisions automatically. They might also be considered as a database-driven DSS according to Holsapple & Whinston’s (1996) classification scheme (*which is based on the architectural framework*). Alter’s (1976) taxonomy of six DSS types is based on the degree of problem solving support offered ranging from simple retrieval of information

all the way up to proposing and making decisions. We would argue that CPM systems are performing 4 of those 6 tasks already and starting to enter the realm of decision proposal. Power (2002) has classified DSS (*based on the mode of assistance provided*) into five types. Power's (2002, 2008) classification might see CPM systems being considered as a data driven DSS as they are largely used to manipulate and process data that is both internal and external to the company and as an enterprise wide DSS (*instead of a desktop DSS*). We consider this last definition as the one that most closely matches our view of CPM systems in terms of capacity to provide support for decision making. We view CPM systems as a form of "*DSS for the masses*", a distributed method to increase the "*collective IQ*" of the firm in a process that Englebart (1962) termed "*bootstrapping*". Whereas originally DSS was conceptualized as a highly specialized activity available only to a small group of actors, the CPM system approach may be viewed as a "*distilled down DSS*" that puts such decision-making power into the hands of a much broader user community. We believe that this is a fundamental shift in perspective and opens up tremendous research possibilities.

In our review of the DSS literature, we note that the definition of what exactly constitutes a DSS has become more and more general (Sol, 1987; Vahidov & Kersten, 2004; Arnott et al., 2005). DSS was originally envisioned as a specialized computer system that was supposed to provide answers to difficult, unstructured problems through an analysis of data using complex mathematical techniques. Today, the notion of DSS has become so generalized and includes almost any information system that helps management to make decisions. DSS straddles the realm of expert systems, AI, BI and KM and has evolved to

include databases, networked models and Internet technologies and is a critical component of modern management design (Arnott et al. 2005). Data-driven decision support is used for a variety of purposes including operational and strategic business intelligence queries, static and real-time performance monitoring, and customer relationship management (Power, 2002). Data management for decision support has moved through three generations, with the latest being real-time data warehousing (Watson et al., 2006). This shift in terminology provides research continuity back to Gorry & Scott-Morton's (1971) article that originally introduced the concept of a decision support system (Power, 2008). CPM software is evolving and starting to embrace its strong DSS roots with an increased focus on predictive analytics based on sophisticated statistical techniques⁵. Such approaches aimed at a wider non-technical user community might well define the next generation of CPM/DSS activity.

Sprague (1980) identified three alternative viewpoints when DSS first emerged in the 1970's. Even then as now, there appears to have been a healthy skepticism over these supposedly new IS manifestations - was DSS a natural evolution of Management Information Systems (*MIS*) which evolved from earlier Electronic Data Processing (*EDP*) systems or was it a subset of MIS or more cynically was DSS something really new and could it deliver anywhere near what the vendors promised? Academics questioned the ability of DSS to alter organizational performance (Ackoff, 1967). We believe that the same level of inquiry and scrutiny needs to be applied for CPM as well and we should continue to ask such questions. A review of the information systems literature from 2000-09 revealed that around 90 % of papers including the keyword "*decision support*"

appear in scholarly journals compared to around 40% that include the keyword “*performance management*”. Recently there has been an explosion of interest in CPM but mainly seems to be within the practitioner press (eg. *Ventana Research; Infotech etc.*). There is a gap in the academic IS literature regarding CPM and we feel that not enough academic attention has been paid to how CPM systems act, how they contribute to better decision-making and potentially alter user behavior. More academic attention to this topic and empirical study is required.

Due to the nature of how DSS was positioned and deployed, its use was inherently privileged to the senior managers within the firm. This is a fundamental difference between DSS and CPM. Due to advances in networking technology, databases, servers and Graphical User Interface (*GUI*) software, CPM is deployable to a much larger audience. Whereas DSS systems were considered “*special*” and restricted to a few, CPM systems potentially place the power of DSS into the hands of every user in the firm. Users may develop greater insight into the business processes they affect and are affected by and this broadening of the DSS community within the firm is a fundamental shift. The following table lists some key characteristics of DSS, its relevance to CPM and key authors.

TABLE 2.1 – Characteristics of DSS and relevance to CPM		
Characteristics of DSS	Relevance to CPM	Authors
Aimed at the less well structured, underspecified problems that upper level managers typically face	Planning and analytical aspects of CPM systems allow managers to create scenarios and to detect trends within their businesses.	Simon, 1947 Gorry & Scott Morton, 1971 Alter, 1980 Keen (1981a, 1981b)
Attempt to combine the use of models or analytic techniques with traditional data access and retrieval functions	Strong support for traditional data access and retrieval functions. Users access the system using metadata models that are controlled by a centralized IT group.	Alter, 1980 Keen (1981a, 1981b)
Specifically focus on features which make them easy to use by non computer people in an interactive mode.	Uses template oriented approaches and multi-dimensionally modeled structures that mimic real-world conceptualizations of objects. Heavy use of graphical interfaces and wizards.	Alter, 1980 Keen (1981a, 1981b) Codd et al., 1993
Emphasis on flexibility and adaptability to accommodate changes in the environment and the decision making approach of the user.	Additional data sources can be easily introduced. Some support for multi-source comparison is available. Ad-hoc analysis is supported including data export to other application (e.g. SPSS)	Alter, 1980 Keen (1981a, 1981b) Codd et al., 1993 Power, 2008
View pre-defined data displays for operational and strategic performance monitoring.	Provides the ability to create Scorecards and Dashboards for these purposes.	Power, 2008

Poon & Wagner (2000) as well as Arnott & Dodson (2008) have identified a number of “critical success factors” (CSF) for DSS implementations. They found that all of the CSF’s should be executed properly by firms for DSS implementations to be successful and that firms either “get it all right” or “get it completely wrong” when trying to implement DSS. They found that firms that only got some of the CSF’s right enjoyed mediocre returns from their investment in DSS whereas those firms that got it all right achieved above normal returns. Many failures have occurred when implementing DSS and EIS, with failure rates estimated to be as high as 70% (Burkan, 1991; McBride,

1997). Rainer & Watson (1995a, 1995b) found that the DSS implementation process and integration with the firm's existing technology and processes turned out to be far more difficult than anticipated and technological, organizational, psychological and educational issues all contributed to making the implementation of such systems difficult. From our personal experience, we have observed that many CPM initiatives have either failed or have enjoyed mediocre success. What should firms do to ensure CPM systems are implemented and integrated properly? How will the effects of these systems be manifested? We address and develop these issues further in this paper.

ERP systems are important from a transactional and record-keeping perspective. Davenport (1998) suggested that the need to make sound and timely business decisions is a key reason why organizations implement ERP systems. Holsapple & Sena (2005) studied the linkage between ERP systems and DSS capabilities and found that ERP systems have a strong ability to impact DSS capability because they are the underlying data sources DSS uses to provide insight into the business function. The relationship between ERP, DSS and CPM is evident in the fact that ERP systems such as SAP and Oracle form the basis of primary data that is manipulated through Extract Transform and Load (*ETL*) processes into data warehouses that can be utilized by CPM tools to support decision making by management. ERP systems must continue to generate business intelligence that really matters so that they continue to be relevant in the future (Li, 1999). ERP systems, in addition to their fundamental function of collecting, capturing and storing transactional data also provide tools for data communication, data access, data analysis and presentation, synthesizing data from other sources and assessing

completeness of data (Bingi et al., 1999). ERP systems may in fact be the foundation for effective decision making in the firm.

Holsapple & Sena (2005) found a strong relationship between successfully implemented ERP systems and decision support benefits. They found that firms that have implemented ERP successfully should be more successful in implementing a DSS project. Such improvements were attributed to the experience the firm has gained in implementing a large and complex information system. ERP experiences might also be helpful in implementing CPM successfully. Also, the more experience the firm has with ERP, the more likely are they to understand what information is available for use within CPM. Stedman (1999) has noted that the return on ERP investment depends much more on the plan an organization has for using the system than on the technology itself and CPM usage should be part of the initial ERP plan. ERP planning practices may have a substantial impact on decision support. Poor planning has been cited as a major reason why ERP and DSS implementations have failed (Meador et al., 1986; Umble et al. 2003). Sponsors of ERP projects need to understand that return on ERP investment has both quantifiable aspects (*e.g., cost savings, revenue gains*) and intangible aspects such as improved customer service (Shang & Seddon, 2002).

The adoption of DSS was hampered to some degree by the intangible nature and value associated with better decision making. CPM systems, especially through their Online Analytic Processing (*OLAP*) capabilities give managers the ability to analyze their own data without having to order individual reports from IT staff. The time frames to make

decisions and to plan have also been reduced. The savings in time afforded through its self-service model is indeed a tangible value that CPM systems bring to the firm (Hackathorn, 2003).

Brown & Grant (2005) have argued that DSS and EIS have failed to fulfill its promise due to their cumbersomeness, sole focus on executive information, lack of strategic alignment and reliance on an immature infrastructure. Sprague (1980) cautioned early adopters and vendors to avoid hyperbole and lofty expectations with regard to the implementation of DSS and that DSS should be considered as only one of several important technology sub-systems geared towards improving organizational performance. CPM vendors would do well to heed this warning and not set unrealistic expectations for their products. Given this, what then are realistic expectations for CPM?

After reviewing the DSS literature we conclude that the questions and concerns raised about DSS are relevant and applicable for today's CPM systems. Even though research on DSS has been conducted for the past four decades, there is still much that is still to be done (Power, 2002, 2008). The link between the use of DSS and organizational performance in finite terms is still unclear (Sprague, 1980; Power, 2008). The changes in impact from highly specialized single user DSS models to the networked data-driven DSS that matches our notion of CPM system has not been adequately explored to see if better decision making has resulted in tangible and measureable improvements in organizational performance. Many DSS implementations have failed and what are the lessons learned from these failures that can be used to increase the likelihood of CPM

systems being successfully implemented (Meador et al., 1986; Umble et al. 2003). Just as the success of DSS to achieve its objective was uncertain, so it is with CPM. The lessons learned from the experience with DSS should be used to increase the likelihood of CPM projects succeeding.

2.2 *Corporate Performance Management and CPM Systems*

Corporate Performance Management (CPM) is a management discipline designed to accomplish the strategic goals and objectives of the organization by measuring and monitoring tactical indicators using a technology platform known as a “*CPM System*”. CPM systems produce outputs that are supposed to alert managers to variations from expected performance and to provide early warning of problems allowing them to take corrective action proactively. These systems rely heavily on data produced within the business and are capable of producing information rich outputs that are supposed to improve decision making. The discipline of CPM is a set of management and analytic processes, supported by the technology system enabling businesses to define strategic goals and to then measure and manage their performance against those goals. Core CPM processes include financial and operational planning, consolidation and reporting, business modeling, analysis and monitoring of key performance indicators linked to strategy (Axson, 2007).

Richards (2009) provides the following definitions associated with CPM.

- Performance Measurement: a process for assessing indicators of success.
- Performance Measurement Framework: a structured methodology for defining key performance measures.
- Performance Management: the use of performance measurement to guide and support the improvement of the business.
- Corporate Performance Management: a structured methodology that includes processes and technologies for applying performance measurement in a manner that considers the outputs of all functional areas in an organization and how these outputs contribute to the accomplishment of strategic objectives.

IBM conceptualizes a CPM system as consisting of three sub-components - Business Intelligence (BI), Scorecarding & Dashboarding (S&D) and Enterprise Planning (EP).

The following diagram illustrates the temporal nature of these components.

Each of the components is supposed to answer a fundamental business question.

- **How** is the organization performing at this current point in time? (*present – S&D*)
- **Why** are we performing at this level? (*past - BI*)
- **What** should we be doing? (*future - EP*)

The CPM system is an information system that provides a unified platform to address the requirements of each of these perspectives. S&D is used to get immediate feedback about how the organization is performing and provides visual indicators to see if the business is currently on track towards meeting its strategic goals. BI consists of reporting and OLAP analytics and looks back in time to understand why the organization is performing at its current level. EP looks to the future to set direction allowing an organization to set goals and targets and determines the criteria upon which the performance of the organization will be measured. A symbiotic relationship exists between all of the CPM components whereby the output of each serves as an input into the other components. The outputs of the BI and S&D systems feed into the EP system to facilitate future planning and goal setting. Similarly, the outputs of EP determine what is measured in S&D and reported in BI. Through the interaction of these three components, CPM systems allow managers access to near real time, reliable and accurate data and provide a direct link to corporate strategy. A model depicting these CPM inter-relationships is presented in Chapter 7.

There is a shortage of academic research on CPM within the IS literature. Brown & Grant (2005) have noted that the IS academic literature remains essentially void of articles addressing the systems side of business performance management. The lack of

academic literature related to emerging IS trends are an ongoing problem as IS research tends to typically lag IS field practices (Robey & Markus, 1998; Senn, 1998; Arnott & Dodson, 2008). This is why we turned to the rich academic literature on DSS to get a better understanding of the key issues and to set theoretical context. CPM systems have been adopted by the market more readily than traditional DSS³. We presume this is because they have been exposed to the entire organization and the technology for effective deployment is now readily available within the firm. We discuss the reasons why these systems appear to have caught on where DSS has struggled in more detail in Chapter 7.

2.2.1 Business Intelligence (BI)

Business Intelligence (BI) is increasing in strategic importance to organizations (Paladino, 2008). BI is the rational application of the principles of intelligence services to business and includes the collection, analysis and application of strategic information to facilitate business decisions (Marren, 2004). BI generally refers to the processes of Online Analytical Processing (OLAP) and reporting. BI allows managers to find trends in data and is used to explain past performance. OLAP is fast and can provide the data and information that gives managers the opportunity to develop new insights into business operations. OLAP uses static data that is refreshed periodically. Reporting is based on meta-data models that access vast enterprise data warehouses. Reports tend to be operational in nature and drawn from enterprise systems (*e.g. SAP, PeopleSoft etc.*) outputs. “*Mashups*” are a new BI trend where disparate sources of information internal and external to the firm are used to provide new frameworks for decision-making.

Morrison (2006) observed that visual BI solutions can be effectively used to support and improve the decision making process of business managers in sales, marketing or operations. One of the most effective methods of analyzing data is through mapping data geographically, as it allows users to analyze not only the data they have but also to identify new opportunities through identification of “*gaps*” since visual tools are able to highlight such things as where you do not have customers, something that is difficult to do with traditional database querying. The city of New York has used BI effectively to help reduce crime and to increase tourism revenue. The police department combined geographic information with street level intelligence such as broken window incidents and other minor violations to target scarce resources towards potential crime hotspots. Such systems allow police to react proactively to dangerous situations, often before they even occur⁶. Using new systems effectively requires a change in mindset and a willingness to try new approaches (Morrison, 2006). Pentland & Feldman (2008) have noted that artifact centered assumptions inhibit the design of effective organizational routines and procedures. Morrison (2006) found that the prevalent practice of using spreadsheet data instead of visual data in communications was more due to habit than function and this is a mindset that needs to be overcome to facilitate better decision-making.

A key goal of BI is to promote decision making based on low-latency information. Currently, there is a time gap between when data is collected to when it is transformed into information that can be used in decision making. With faster hardware and streamlined processes, the cycle time between data collection and presentation has come

down. This has resulted in the notion of “*real-time business intelligence*”. Watson et al. (2006) found that real-time BI can increase revenues and decrease costs dramatically.

2.2.2 Enterprise Planning (EP)

Enterprise Planning is a strategic activity concerned with planning, budgeting and allocating resources to various organizational activities and projects (Axson, 2007). EP software allows an organization to continuously plan a budget on a monthly, weekly and even on a daily basis. EP provides organizations with the power and flexibility to support strategy with up to date plans, budgets, and forecasts. EP is a finance-managed solution that provides real-time visibility into resource requirements and future business results and is the cornerstone of enterprise-wide performance management.

EP allows managers to create, compare, and evaluate business scenarios, conditions, drivers, rates, and assumptions. Managers can take the actual ‘*what is*’ data and simulate “*what-if*” scenarios critical to forecast future performance. The result is supposed to be improved predictability and greater accountability across the enterprise. The key driver behind the adoption of EP software is the uncertainty and unpredictability of the business world (Axson, 2007). Business leaders have criticized traditional budgeting and planning processes as being a waste of time and corporate energy. Axson & Hackett (2005) quote a senior IBM executive stating that “...*the planning processes as most of us have known it is a complicated pain in the neck, largely ineffective, and mostly irrelevant. Companies need a new approach to planning that offers simple methods for setting performance targets and for developing action steps to move the business ahead...*”. Planning processes are typically driven from the bottom of the organization. New EP approaches

include action from the top and involves setting baseline plans based on recent actual performance. Managers can implement scenario based plans such as looking at effects of a 5% increase in sales or a 10% increase in fuel costs to assess impact on other areas of the business. These new approaches stress an emphasis on tactics rather than on budgeting and planning becomes a continuous process unfettered by a calendar or any other artificial constraint. (Axson & Hackett, 2005).

2.2.3 Scorecarding and Dashboards (S&D)

Scorecards are a performance management system used for strategic purposes to manage and align the organization with its strategic goals whereas dashboards are a performance measurement system used for tactical purposes and are used for measuring and understanding daily operations⁷. Daft & Lengel (1986) have noted the need to use the richest media forms to convey information in ambiguous contexts. S&D consist of easy to understand visual interfaces that provide executives with rich information at a highly summarized level. They support the ability to drill-through to lower levels of detail and can bring up operational-style BI reports with relevant transactional details. Viaene & Willems (2007) have noted that though S&D concepts are typically associated with automated support for performance management, CPM should not be reduced to such early warning systems alone. S&D operates by comparing present state variables to expected outcomes. The business decides what is important for measurement and creates key performance indicators (*KPI's*) that are supposed to provide guidance to managers as to how the business is performing. KPI measurements are often complex derived calculations such as profitability, sales margin, customer satisfaction scores that are based on a number of underlying variables.

In Chapter 3, we shall discuss the concept of mindfulness and the importance of focusing organizational attention. S&D may be particularly germane to this discussion as it is the primary method through which managers understand what is happening within their businesses.

2.3 *IT and organizational performance*

Sam Walton, the legendary founder of Wal-Mart credited the major part of the retail giant's success to its large investment in IT. The following quote made by him is inscribed in the lobby of Wal-Mart's corporate headquarters in Bentonville, Arkansas.

"...There is no question about it – one of the main reasons we've been able to roll this company out nationally was the pressure put on me to invest so heavily in information technology. I am convinced that computers were essential to managing growth and keeping our cost structure down..."

The link between IT investments and organizational performance has been a hotbed of academic debate in the past two decades since Robert Solow, famously stated in a 1987 New York Review article that "...*You can see the computer age everywhere but in the productivity statistics...*"⁸ This sparked a debate on the usefulness of investment in computer technology known as the "*productivity paradox*", a state where increased investment in IT did not create commensurate increases in output and productivity (Brynjolfsson, 1993). Roach (1991) argued that IT is an effectively used substitute for labor in most manufacturing industries, but has paradoxically been associated with bloating white-collar employment in services, especially in the area of finance (Brynjolfsson, 1993). More recent evidence indicates that IT investment does indeed increase productive output (Soh & Markus, 1995) but not necessarily an increase in

business value as measured by return on asset or return on equity (Hitt & Brynjolffson, 1994). Kauffman & Weill (1989), among others, failed to find a convincing body of evidence that IT investment is always associated with superior performance. Soh & Markus (1995) move past whether or not IT confers any extraordinary value and instead considers how value is created and the reasons why this does not happen at times. They propose a process view of IT business value that emphasizes the necessary but not sufficient role that IT investment plays in achieving extraordinary value for the organization.

The implementation and use of CPM systems promise benefits yet to be realized by the organization. Whether or not these benefits materialize depends on many things. Weill (1992) found that the ability to convert an IT investment into business value depends on the firm's "*IT conversion effectiveness*". Multiple researchers (Clemons & Row, 1991; Lucas, 1993; Grabowski & Lee, 1993; Sambamurthy & Zmud, 1999; Ross et al., 1996) have found that IT creates the necessary but insufficient conditions for improved organizational performance. Grant (2003) noted that IT investment alone is insufficient and alignment of business strategies with IT strategies is an essential yet difficult to attain condition capable of causing widespread organizational change (Luftman & Kempaiah, 2007). Keen (1981c) has noted the inherent inclination of people and organizations to resist changes and describes "*counter-implementation*" activities that users employ to resist change.

Ray et al. (2007) found that competing firms implementing processes based on similar IT resources are sometimes able to gain radically differing returns on their investments. IT spending was not found to be directly and positively associated with relative process performance. They concluded that IT plays less of a role than originally thought and their findings suggest that tacit, socially complex, firm-specific resources explain the variation in process performance across firms. They found that a shared understanding between IT and business users is a key IT capability that affects performance and moderates the impacts of explicit IT resources such as the generic information technologies used in the process. Ray et al. (2007) recommend changes to hiring practices so that business users have IT knowledge and vice versa.

Information systems have to be used in order to have any impact on performance (Trice & Treacy, 1986). Markus & Keil (1994) explored why some IS solutions never get used and have attributed this to two factors they called “*software-usability*” and “*implementation*”. Lucas (1993) found that well-designed information systems lead to appropriate use. If information systems are used appropriately and other variables are in alignment, superior organizational performance should result. However, even if the system is well-designed, it is entirely possible that it is not used appropriately thereby losing any value of the IT investment (Markus & Keil, 1994). Grabowski & Lee (1993) consider fit between the application portfolio, strategic type, and cost structure to be a necessary, but not sufficient, condition for favorable organizational performance, because competitors may easily imitate the IS applications and remove the advantage. Markus & Soh (1993) found that IT investments will be impacted by IT management processes as

they evolve into what they call “*IT Assets*”. Some of the value of the investment may be wasted in this evolution due to poor management processes. If the resultant IT assets have value, then this might possibly lead to improved firm performance.

We believe that the effective usage of CPM systems and the deliberate development of CPM specific capabilities can lead to improvements in organizational performance and we explore this in greater detail in a later section of the literature review. In the next section, we look at the concept of competitive advantage and how dynamic capability perspective might be used to examine the development, usage and impacts of CPM systems within organizations.

2.3.1 Information Systems and Competitive Advantage

The field of strategic management is principally concerned with how firms generate and sustain competitive advantage (Ambrosini & Bowman, 2009). Understanding the nature and drivers of competitive advantage has become a major research area in strategic management (Porter, 1985; Porter & Millar, 1985; Rumelt, 1984). The dominant view in strategic management has been that firms acquire competitive advantage by exploiting their internal strengths, responding to opportunities while neutralizing threats and reducing internal weaknesses (Andrews, 1987; Barney, 1991). The basic idea in this theory is to match the firm’s strengths and weaknesses to threats and opportunities that exist within the environment (Barney, 1991). A firm seeking competitive advantage in its market requires mastery of both these perspectives and should try to establish a position where all four of these factors can be managed effectively as singly or collectively they may affect competitive position.

A firm is in a position of competitive advantage over others if it is able to implement a value creating strategy that is not being followed by any of its current or potential competitors (Barney, 1986, 1991). Firms that are able to create more economic value (*defined as the difference between the perceived benefits to the purchaser and the economic cost to the producer*) than the marginal competitor in its product market is said to be in a position of competitive advantage (Peteraf & Barney, 2003). In economic terms, firms that are in positive rent-earning positions over their competitors are in a position of competitive advantage. An economic rent represents the difference between what is earned by a resource (*income*) versus the cost of the resource itself (Peteraf & Barney, 2003). Since resources may be put to multiple uses, it is rational that the resource will be used for the purpose that results in the largest rent generation. The income that might have been gained had the resource been put to its second-best use represents an opportunity cost. Rents are created by a firm being more efficient in its production processes. For example, if Firm A has a positive economic rent over Firm B, and the perceived benefit of their products on the market is identical (*meaning the customer willingness to buy is the same*) then Firm A is in a better position because it is more efficient in production. Peteraf & Barney (2003) discuss these points in detail in their paper in terms of perceived benefits, consumer surplus, producer surplus and residual value.

Competitive advantage can be short lived or persist indefinitely over time. When competitive advantage is enduring, it becomes Sustained Competitive Advantage (SCA) and is a highly desired state. SCA is not just competitive advantage that lasts for a

relatively long time but one that endures after all attempts to duplicate it have ceased (Lippman & Rumelt, 1982; Rumelt, 1984). SCA ensues from a firm being able to create and manage certain resources effectively. Barney (1991) and Barney & Hesterly (2006) have proposed that firm resources should possess VRIO (*Valuable, Rare, Inimitability/non-substitutability and Organization appropriability*) in order to attain SCA. SCA is a condition of stable equilibrium (Barney, 1991) and is very difficult to attain. Sustained competitive advantage does not follow a calendar. Changes to an industry structure may nullify sustained competitive advantage under new environmental conditions. These industrial shocks may redefine what assets of the firm are considered as resources. Often the latest technologies are quickly rendered obsolete due to environmental shifts. Firms create wealth by putting themselves in a position of advantage over current and future competitors for a protracted period of time (Teece et al., 1997).

Rumelt (1991) has noted that intra (*within*) industry differences in profits of firms are greater than inter (*between*) industry differences and this supports the idea that firm-specific differences may be important in establishing and retaining a competitive position. In fact, the notion of heterogeneous difference is a pervasive theme in the IS strategy literature as distinctiveness is seen as the key to competitive advantage. Managers are inundated by strategic management theories exhorting them to develop distinctive competencies (Selznick, 1957; Learned et al. 1969; Andrews, 1987; Prahalad & Hamel, 1990), establish impregnable positions within their industries guarded by forces difficult for competitors to overcome (Porter, 1980), develop resource bases, asset

stocks, strategic assets (Penrose, 1959; Wernerfelt, 1984, Dierickx & Cool, 1989; Barney, 1991; Amit & Schoemaker, 1993) and to develop valuable dynamic capabilities (Teece & Pisano, 1994; Teece et al., 1997; Eisenhardt & Martin, 2000; Helfat et al., 2007). We observe that all of these theories share a common theme, namely that of difference and firms that are able to set themselves apart should be more successful than their competitors. Firms cannot expect to obtain sustained competitive advantage when strategic resources are evenly distributed across all competing firms and are highly mobile. The source of sustainable competitive advantage is therefore tied into the conditions of heterogeneity and immobility. The development of firm specific capabilities is thus central to the notion of competitive advantage.

There are several theories of competitive advantage in the strategy management literature. We cannot focus on all of them in this paper. Our thesis is firms possess certain IS resources that enable them to develop certain special capabilities that can alter their resource base eventually leading to superior organizational performance. Therefore, we shall only review two strategic literatures, namely that of the RBV and DCV, two related theoretical perspectives that we use to make our argument.

2.3.2 Resource Based View (RBV) of the firm

The resource-based view of the firm is a perspective of strategic management that has its intellectual roots in the work of Penrose (1959) and has been developed by several others such as (Wernerfelt, 1984; Rumelt, 1984; Barney, 1986, 1991; Dierickx & Cool, 1989; Grant, 1991; Peteraf, 1993; Amit & Schoemaker, 1993). The RBV was developed to understand the conditions under which firms are able to gain and sustain a competitive

advantage (Barney 1986, 1991; Amit & Schoemaker, 1993). It has also been used to understand and explain process differences between competing firms. The RBV attempts to explain variance in firm performance in terms of the resources that the firm has at its disposal or can effectively control. In its focus on self determination, self-reliance and seeking of internal efficiencies, the RBV is reminiscent of Gandhian philosophy where one is urged to find internal solutions first to deal with challenges internal and external.

Penrose (1959) theorized that the difference between economic activity within a firm and in the market is that economic activity within a firm is carried out and inherently constrained by its management (*aka Penrose effect*). A firm is a collection of productive resources, where the choice of different uses of these resources over time is determined by management (Mahoney, 2004). Resources of the firm are categorized into physical, human and organizational capital and are valuable insofar as the productive potential services they are capable of rendering. Physical resources entail such things as plant equipment and geographic location. Human capital includes experience, training, judgment, intelligence, insights, ideas and relationships of the firm's managers and workers. Organizational capital includes a firm's formal reporting structure, controlling and coordinating systems as well as informal relationships among groups within a firm and between a firm and its environment (Barney, 1991).

Firm resources are strategic assets that the business has control of through use of which it can implement "*value creating*" strategies. Since not all resources of a firm are strategic, only those attributes of a firm that allow it to conceive and implement strategies that

improve its efficiency and effectiveness are considered as resources (Wernerfelt, 1984). Resources allow firms to serve their customers in unique and distinctive ways that may ultimately lead to competitive advantage. Efficient allocation of resources among different uses in a firm is therefore central to this theory.

What exactly constitutes a firm resource has been a source of debate and confusion among theorists (Wade & Hulland, 2004). They have been variously called competences (Prahalad & Hamel, 1990), skills (Grant, 1991), strategic assets (Amit & Schoemaker, 1993) and asset stocks (Dierickx & Cool, 1989). This lack of agreement in terminology itself has led to a considerable amount of confusion (Priem and Butler, 2001a, 2001b). Resources are assets and capabilities that are available and useful to the firm in detecting and responding to market opportunities and threats. Assets can be inputs to or outputs of a process. Capabilities transform assets into outputs of greater worth (Amit & Schoemaker, 1993). Leonard-Barton (1992) noted that resources once considered valuable assets may eventually become liabilities over time and resources at some points in time have negative value and may have to be shed from the firm. Resources that can contribute to competitive advantage should possess the VRIO attributes (Barney, 1991; Barney & Hesterly, 2006). Resources may be considered valuable when they permit the firm to make their processes more effective and efficient than their competitors who do not have access to the same resources. However, just investing in a valuable resource is not going to add a great deal to the firm's competitive position unless this resource also happens to satisfy all of the VRIO attributes.

RBV recognizes the important role of knowledge in firms that achieve a competitive advantage. Mahoney (2004, p 172) writes that “...*Penrose (1959) argues that knowledge can be formally taught, and it can be achieved via learning by-doing in the form of personal experience...experience produces increased knowledge and contributes to objective knowledge insofar as its results can be transmitted to others...but experience itself can never be transmitted; experience produces a change—frequently a subtle change—in individuals and cannot be separated from them. Increasing experience shows itself in two ways—changes in knowledge acquired and changes in the ability to use knowledge. There is no sharp distinction between these two forms because to a considerable extent the ability to use old knowledge is dependent on the acquisition of new knowledge...*” Knowledge is embedded and carried through multiple entities including organizational culture and identity, policies, routines, documents, systems and employees (Di Tullio, 2006).

A resource is an observable entity (*not necessarily tangible*) that can be valued or traded, such as a patent, land, machine, or a brand (Makadok, 2001). We propose that the CPM system as far as being an off-the-shelf software application is only an asset of the firm and maybe even a resource but even this merely scratches the surface to its potential within the firm. Capabilities, although part of the resource base of the firm, are not observable (*they are intangible*) and cannot be easily valued and may only be transferred or traded as part of a merger or acquisition (Makadok, 2001). After the system gets implemented and integrated into the business processes of the firm, we believe it takes on a life of its own and will become ingrained into the way the firm does its business. As managers gain experience with using its information outputs, the firm should start to

develop a unique set of CPM specific skills and capabilities that are not easily transferable or replicable by competitors. In the next section, we shall discuss the dynamic capability perspective which will help us to understand how firms can develop capabilities that allow them to alter their resource bases and the role that CPM systems might play in the process.

2.3.3 Dynamic Capabilities View (DCV)

This section reviews the state of the IS literature on dynamic capabilities and breaks down the review along a number of dimensions. We provide a summary of definitions, characteristics, action mechanism and role played in knowledge management, routine development, acquisition and development, value and identification.

Definitions

Teece et al. (1990) originally proposed Dynamic Capabilities (DC) perspective as an extension of the RBV by observing that “...*our view of the firm is somewhat richer than the standard resource-based view ... it is not only the bundle of resources that matter, but the mechanisms by which firms learn and accumulate new skills and capabilities, and the forces that limit the rate and direction of this process...*” Teece et al. (1990, p.11) and then later (Teece et al., 1997, p. 516) defined DC’s as “...*the firm’s ability to integrate, build, renew and reconfigure internal and external competencies to address rapidly changing environments so as to achieve congruence with the changing business environment by adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competencies...*’. Dynamic capabilities have also been described as the firm’s processes that use resources — specifically the

processes to integrate, reconfigure, gain and release resources. Dynamic capabilities have also been described as “...*the organizational and strategic routines by which firms achieve new resource configurations...to match and create market change...*” (Eisenhardt & Martin, 2000, p. 1107). More recently, Helfat et al. (2007, p. 3) have defined dynamic capabilities as “...*the capacity of an organization to purposefully create, extend or modify its resource base...*” By altering the organization’s resource base, the firm opens up new strategic alternatives or “*paths*” for itself (Helfat, 1997).

Since the resource base of the firm include resources as well as capabilities (*both functional and dynamic*), dynamic capabilities are sometimes described as capabilities that can change capabilities (Helfat et al., 2007). The insights of Teece et al. (1990, 1997) extended the thinking of Nelson & Winter (1982) that addressed the importance of path dependencies, evolutionary history and the role of organizational routines and how they shape and constrain firm growth and the ability to manage change.

Nature and characteristics of Dynamic Capabilities

Dynamic capabilities are built rather than bought in the market (Makadok, 2001), are path dependent (Zollo & Winter, 2002) and are embedded in processes of the firm (Eisenhardt & Martin 2000). Dynamic capabilities are not ad hoc problem solving events or spontaneous reactions. They should be deliberate and contain a pattern of activity that can be repeated and exercised at will (Winter, 2003). Zollo & Winter (2002) note that reacting in a creative but disorganized way is not an example of a dynamic capability. The element of luck also has nothing to do with the way these capabilities are used

(Zahra et al. 2006; Helfat et al., 2007). Dynamic capability view is sometimes referred to as “*best practice*” – a best way to organize resources and processes to achieve a desired outcome. Eisenhardt & Martin (2000, p.1105) state that “...*Dynamic capabilities are a set of specific and identifiable processes that are neither vague nor tautological...they are idiosyncratic in their details and path dependent in their emergence but have significant commonalities across firms and often tend to take the form of best practice...*”.

Dynamic capabilities have been described as falling into a hierarchy. Collis (1994) rationalizes this problem of “*infinite regress*” by stating that all capabilities are connected to each other with each capability rolling up to a higher level capability and we will never find the ultimate source of SCA. Building on Helfat et al. (2007) definition of DC’s, Ambrosini & Bowman (2009) describe three levels of dynamic capabilities – incremental (*used to fine tune the resource base*), renewing (*used to refresh the resource base*) and regenerative (*used to refresh the dynamic capability base of the firm*). Higher order dynamic capabilities include the ability to learn and to build up strategic assets within the firm. New strategic assets such as technology, knowledge and customer feedback need to be incorporated rapidly into the strategy of the firm and also, firms need to leverage existing assets through transformative processes. Winter (2003) classifies capabilities in terms of strategic relevance including ordinary or zero-level capabilities that enable companies to earn a living. In his view, dynamic capabilities are those that operate to extend, modify or create ordinary capabilities.

Dynamic capabilities tend to be contextually dependent – the degree to which they need to be evolved will vary between firms due to each firm’s context. Helfat et al. (2007) noted that dynamic capabilities need to satisfy the notion of “*fitness*”. They should possess evolutionary as well as technical fitness. Evolutionary fitness of a dynamic capability refers to how well the dynamic capability is capable of creating, extending or modifying the resource base. Technical fitness is a measure of rationality imposed on the dynamic capability to assess the quality versus cost of acquisition/utilization of the capability. The level of technical fitness should be appropriate and contextually relevant for the firm. Quality and cost do not always have a one to one relationship as they can move in opposing directions with low cost sometimes accompanying high quality – e.g. Toyota’s Just-In-Time capability allows the company to deliver high quality product at a lower cost than their competitors (Helfat et al. 2007).

Action mechanism of Dynamic Capabilities

Bowman & Ambrosini (2003) identified four classes of dynamic capabilities - reconfiguration, leveraging, learning and integration. Understanding the nature and characteristics of dynamic capabilities and recognizing the forms in which they manifest themselves in firms is critical if managers hope to deliberately develop specific dynamic capabilities. We feel that this idea of deliberate action is important because RBV research has been criticized for not elaborating how firms should go about building new capabilities (Cavusgil et al., 2007). Dynamic capabilities allow firms to develop the VRIO resources described by Barney (1991) that are used by the firm to generate rents. Having such resources is important but simple possession does not confer competitive

advantage. The firm should also possess valuable and difficult to replicate dynamic capabilities that can be harnessed to continuously create, extend, upgrade, protect and keep relevant the enterprise's unique asset base (Teece & Pisano, 1994; Teece et al., 1997).

“The concept of dynamic capabilities arose from a key shortcoming of the resource-based view of the firm where it is criticized for ignoring factors surrounding resources, assuming that they simply “exist” within the firm. Considerations such as how resources are developed, how they are integrated within the firm and how they are released have been under-explored in the literature. Dynamic capabilities attempt to bridge these gaps by adopting a process approach: by acting as a buffer between firm resources and the changing business environment, dynamic capabilities help a firm adjust its resource mix and thereby maintain the sustainability of the firm's competitive advantage, which otherwise might be quickly eroded. So, while the RBV emphasizes resource choice or the selecting of appropriate resources, dynamic capabilities emphasize resource development and renewal”² (Wade, 2008)

The dynamic capability perspective extends the resource-based view by addressing how VRIO resources are created and how the current stock of valuable resources can be refreshed in changing environments (Ambrosini & Bowman, 2009). Dynamic capabilities thus reflect an organization's ability to achieve new and innovative forms of competitive advantage given path dependencies and market positions and may help firms to avoid developing core rigidities that inhibit development, generate inertia and stifle innovation (Leonard-Barton, 1992). Core rigidities are resources that were once valuable but are now obsolete and inhibit the further development of the firm. They are resources that have not been appropriately adapted, upgraded or restructured through the action mechanism of dynamic capabilities (Ambrosini & Bowman, 2009).

The RBV stresses the need for firms to maximize its use of internal resources. In general, internal resources are often more accessible and less expensive to utilize than external resources. A dynamic capability should possess the ability to transform existing resources to meet the challenges of change. The ability to fine tune the firm's response to change is a very important dynamic capability. If dealing with the change is going to be very costly and the pay-off resulting from the asset reconfiguration low, then it may not be worth making the change. The ability to make changes effectively depends on a firm's success in scanning the environment for opportunity or threats and then preparing the firm by changing itself to embrace the opportunity or to face the threat ahead of its competitors.

Dynamic Capability as Routine

Organizational routines are a major source of the reliability and speed of organizational performance. Without routines, organizations would lose efficiency as structures for collective action (Cohen & Bacdayan, 1994). Specialized knowledge and routines may be one of the few, if only, sources of SCA, according to the RBV and knowledge-based view of the firm (Collis, 1994; Grant, 1996; Levitt & March, 1988). Organizational routines have been described as “...a *coordinated, repetitive set of organizational activities...*” Miner (1991, p. 773) and as the skills of the organization (Dosi et al., 2002) analogous to an individual's skills. The notion of repetition and deliberate action is consistently associated with the literature on organizational routines (Nelson & Winter, 1982; Levitt & March, 1988; Cohen et al., 1996; Feldman, 2000). Routines need to be “*routinized*” and performed without too much thinking (Cohen, 1991; Cohen &

Bacdayan, 1994; Nelson & Winter, 1982; Stinchcombe, 1990). Routines may simply emerge, but a great many routines are the product of explicit attempts to design efficient, effective work practices (Pentland & Feldman, 2008). We still know little about how, in practice, routines actually work and, more importantly, what makes them work well (Grant, 1996). Organizational routines are still widely misunderstood as rigid, mundane and mindless (Cohen, 2007; Feldman & Pentland, 2003). Routines are behavior that is learned, highly patterned, repetitious in nature and based on explicated knowledge. When routines get codified, they become well understood and less ambiguous. Pentland & Feldman (2008) have argued that IS design is too often centered on artifacts (*checklists, procedures etc.*) when it should focus more on the patterns of actions between human actors. They write that “...*artifact-centered design is valuable, of course, but when applied to organizational routines, we believe it leaves a critical gap. Thus, ontological questions about material versus social determinism are not just esoteric matters for social theory. They have practical implications for anyone who wants to create or change a work process...*” (Pentland & Feldman, 2008, p. 236).

In the biological sciences, the evolutionary process for desirable characteristics depends on variation, selection and retention (Eldridge & Gould, 1972). This metaphor can be neatly applied to how firms select and retain organizational routines. Eisenhardt & Martin (2000) noted that the nature of dynamic capabilities is to a large extent dictated by the dynamism of the markets in which the firms operate. In high velocity environments, dynamic capabilities tend to be fluid, simple and experiential in nature with unpredictable outcomes and an evolutionary emphasis based on selection (Eisenhardt & Martin, 2000).

In slower paced environments, they resemble structured routines and evolutionary emphasis is on variation with more predictability in their outcomes (Eisenhardt & Martin, 2000). Like organizational capabilities, patterning of activity and the development of routines are also important for dynamic capabilities and substantial involvement and investment is required to support such patterning activity (Winter, 2003). Dynamic capabilities can be looked at as high level routines that when taken together with other inputs, gives the management of the firm a set of decision options that can be applied to solve certain types of problems the firm may encounter. Thus a dynamic capability may provide options in choice to the firm to deal with change. The more developed the capability, the greater and richer the choice of options. Even in the most frenetic environments, there is some routine in how problems are solved. Managers tend to rely on their own personal experiences and judgment and these approaches tend to follow familiar patterns.

Dynamic Capabilities and the Role of Knowledge

Zollo & Winter (2002) have focused on organizational learning as a source of dynamic capability and explored how learning supports the evolutionary mechanism within organizations. In their view, dynamic capabilities are distinct from ordinary organizational capabilities in that they are used by the firm to modify existing routines in pursuit of improved effectiveness. Kogut & Zander (1992) discuss the concepts of individual and firm-specific skills and how technology systems are used to embed knowledge within the firm. They propose that firms learn how to use the technology to recombine existing capabilities based on unique social conditions that exist within the

firm into new forms that cannot be easily imitated by others. Ciborra & Andreu (2001) proposed a “*learning ladder*” to describe the main learning processes in an economic organization and how knowledge is developed and shared between firms across boundaries. Their model suggests that IS resources might be used in ways unique to the firm and when overlaid on the firm’s distinctive history can create capabilities that may lead to competitive advantage. Itami & Roehl (1987) focused on the role of “*invisible assets*” in the development of dynamic capabilities. They emphasize the vital contribution of accumulated experience and information and state that intangible assets, such as a particular technology and accumulated information and experience may be the only real source of SCA. Knowledge is derived from information and wisdom comes from knowledge. Information is at the heart of both these invisible resources and includes not only the stock of accumulated information in the firm but also the channels that handle the flow of information of importance to the firm. Internal information originates and terminates within the firm, again affecting the invisible asset stock. This category of information flow includes management capabilities as well as the firm’s ability to manage information and the employees’ ability to transmit and use the information in decision making. Successful accumulation of these invisible resources comes down to control of the information flow (Mahoney, 2004).

Acquisition and Development of Dynamic Capabilities

Acquisition of dynamic capabilities can be expensive. Developing dynamic capabilities typically involves long-term commitments to specialized resources. The more pervasive and detailed the patterning of the activity involved, the higher the costs of the

commitments tend to be (Winter, 2003). Knowing what the basket of capabilities the firm needs to hold and in what measure is a delicate balancing act for just as it is expensive to acquire the capability, it is equally costly to hold on to an under-used capability even if it is valuable. In Winter's view, it is a mistake to aggressively seek out reasons to use a dormant capability as this might cause disruption, outweighing the benefit of its use. Therefore, the level of use of the capability becomes central. If a firm is going to use a capability only once, then it may not be worth it to build up an expensive infrastructure to support the one time execution of a valuable capability. The need to formally acquire and manage capabilities depends very much on the use that the capability will be put to in the future apart from the immediate, pressing problem that it may solve. Winter (2003) feels that capabilities suffer from "*rustiness*" and may get stale if they are not exercised frequently. Potentially useful capabilities that end up with a negative net value can actually become sources of rigidity and might prevent an organization from exploiting future opportunities.

Solving repeated problems causes a pool of knowledge to accumulate that can become a source of learning to tackle repeating problems of a similar vein in the future. This generated organizational knowledge constitutes routines that represent successful solutions for commonly repeating problems. For instance, the creation of a BICC within a large firm to provide expertise into BI project deployment and to facilitate the spread of best practices is an example of this type of active learning from experience and translation into action. Similarly, the ability to acquire strategic assets through indigenous creation or through acquisition and assimilation is another high order dynamic

capability. Firms need to constantly evolve in the face of change and should learn to integrate these new technological developments. For instance, the ability to take customer experience, collected through a Customer Relationship Management (CRM) system and linking this to firm decisions to determine future product offerings and engineering design is an example of the exercise of a dynamic capability.

Dynamic capabilities possess a temporal quality, evolving and changing over time (Helfat & Peteraf, 2003; Wernerfelt, 1984). Helfat & Peteraf (2003) described a “*capability lifecycle*” that sees capabilities go through the stages of growth, maturity and decline. During the lifecycle, capabilities mature and get “*grooved*” into the character of the organization. For instance, all firms possess a large number of capabilities some of which might be considered as dynamic in nature. Capabilities can be general (*e.g., bookkeeping*), industry specific (*e.g. airline seat yield management*) or firm specific (*e.g. satellite based transportation logistics*). Capabilities need to be looked at holistically as they may exhibit a complementary quality with dependencies on each other. Knowing which capabilities to develop is not a simple task. In a dynamic environment, managers often do not have all the information they need and cannot process all the alternatives and consequences and make “*boundedly rational bets*” based on what they do know (Simon, 1947, 1991). We believe that such decisions are highly contextual in nature and depend on the firm and the unique environmental conditions that it faces.

Value of Dynamic Capabilities

The literature largely supports the notion that dynamic capabilities are useful and valuable (Teece, 2007; Ambrosini & Bowman, 2009; Helfat & Peteraf, 2009) but there are differing views among academics regarding their worth and existence. Dynamic capabilities have been viewed as the key to competitive advantage (Teece et al., 1997) whereas “...other strategy scholars remain skeptical about the value of the concept of dynamic capabilities...and doubt that there actually are such things while others believe that they exist, but suspect that they are born not made – i.e., they doubt that deliberate efforts to strengthen such capabilities are a genuine option for managers - and some believe that while they are a genuine option, they are not necessarily something that confers competitive advantage...” (Winter, 2003, p. 991). Arend & Bromiley (2009) in particular have been critical of the DC perspective in terms of value addition over existing concepts, unclear theoretical foundations, weak empirical support and unclear practical implications. Helfat & Peteraf (2009) provided a vigorous defense noting that the field of dynamic capability is still in its infancy and is attempting to explain the most complex and difficult problems in the strategy domain and criticism is premature and unwarranted.

Identifying Dynamic Capabilities

It may appear difficult to identify dynamic capabilities due to their somewhat intangible nature. Eisenhardt & Martin (2000) noted that dynamic capabilities are identifiable routines and processes through which a firm develops products or accumulates technology assets. This opens the door towards operationalizing the concept and allows

one to study the factors and behaviors that can develop or encourage the creation of such valuable capabilities. It also helps us to understand the role management might play in facilitating the process. A review of the literature suggests that dynamic capabilities may encompass such things as an excellence in orchestration (Teece, 2007), an ability to develop other capabilities (Collis, 1994; Winter, 2003; Helfat et al., 2007; Ambrosini & Bowman, 2009), specific processes such as product development, strategic decision making and alliancing (Eisenhardt & Martin, 2000) or mechanisms that enable knowledge to be shared between IT and business users (Ray et al. 2007).

Winter (2003) argues that all organizations possess zero-level capabilities - those that are needed “*to just keep the lights on*”. Collis (1994) describes a continuum of capabilities that grow increasingly abstract at higher levels. Dynamic capabilities are the most precious of these as they permit the firm to deal with the challenge of change. The capability to use CPM systems effectively and to integrate it within existing processes and the ability to use new insights it provides may be a crucial dynamic capability and have the potential to alter the firm’s resource base thereby impacting organizational performance.

Based on our literature review, the following table provides some examples of typical firm level dynamic capabilities.

TABLE 2.2 - Examples of dynamic capabilities from the IS literature	
Dynamic Capability	Literature Reference
Ability to alter business through acquisitions, internal growth and strategic alliances	Helfat et al. (2007) Eisenhardt & Martin (2000)
Ability to create new products and production processes	Helfat et al. (2007) Eisenhardt & Martin (2000)
Resource allocation	Eisenhardt & Martin (2000)
Knowledge transfer and replication	Eisenhardt & Martin (2000)
Organizational Learning	Zollo & Winter (2002)
Ability to identify the nature of changing market environment and to sense opportunity	Teece, Pierce & Boerner (2002) Denrell, Fang & Winter (2003)
Managerial capability to sense opportunity	Teece, Pierce & Boerner (2002)
Management Leadership	Rosenbloom (2000)
Ability to build, integrate or re-configure operational capabilities	Teece et al. (1997)
Ability to alter other dynamic capabilities such as innovation, acquisition and alliance	Helfat & Peteraf (2003) Helfat et al. (2007)
Post-acquisition integration for Mergers & Acquisition	Zollo (1998) Capron & Mitchell (1998)
Just-in-time manufacturing	Helfat et al. 2007
Logistics and supply chain management	Helfat & Peteraf (2003)
Recombination of capabilities	Kogut & Zander (1992)
Project Management	Eisenhardt & Martin (2000)
Research & Development	Helfat & Peteraf (2003)
New product development	Eisenhardt & Martin (2000)

In the next section, we look at the role CPM systems might play in developing dynamic capabilities and in particular a set of capabilities that is specific to the firm's built up expertise in the use of the CPM system. We refer to this dynamic capability that is created as "*CPM specific capabilities*".

2.4 *CPM and Dynamic Capabilities*

Can the implementation of a CPM system improve organizational performance and ultimately lead to competitive advantage? Vendors boldly make such claims with slogans such as "*the key to competitive advantage*", "*one version of the truth*", "*intelligence unleashed*", "*the power of one*", "*making better decisions every day*" and "*the next step in performance*" etc. Are such claims justifiable or is this a marketing strategy from vendors trying to sell their products?

Soh & Markus (1995) found that mere investment in IT was not enough to improve organizational performance and that investment in IT provided the “*necessary but not sufficient*” conditions to improve organizational performance and competitive advantage (Clemons & Row, 1991). Often, inefficient management processes were found to squander away any advantages that IT may have added to the organization. We do not believe that mere implementation of a CPM system automatically leads to new dynamic capability, improved organizational performance and competitive advantage. Much work needs to be done post-implementation for CPM systems to yield any of these benefits. Wade & Hulland (2004) have noted that IS resources, such as CPM systems, might serve as a dynamic capability by helping firms to develop, add, integrate and release other key resources over time and thus may be particularly useful to firms operating in rapidly changing environments. Information technologies have been found to play an important role in developing knowledge resources within a firm by synthesizing, enhancing and expediting large-scale intra and inter-firm knowledge management (Alavi et al., 2006). Even if IS resources do not directly lead the firm to a position of superior SCA, they may nonetheless be critical to the firm’s longer-term competitiveness in unstable environments if they help it to develop, add, integrate and release other key resources over time (Teece et al., 1997; Eisenhardt & Martin, 2000).

2.4.1 CPM specific capabilities

Does the successful implementation of a CPM system lead to the creation of a dynamic capability in a firm? We need to be clear about what the dynamic capability is - is it the IT resource (*the CPM system*), the processes that the resource supports or is it the mastery the firm develops in using the resource? Although the CPM system may be inherently

valuable and is capable of productive services, we believe it is only a standard software asset that can be easily purchased by a competitor. We argue that when a firm implements a CPM system successfully, it sets the stage for the creation of a dynamic capability. We refer to this artifact that emerges as CPM-specific capabilities and believe that these capabilities develop and get heightened as a result of exposure and focused usage of the information system over a period of time. CPM specific capabilities are not directly observable but are likely expressed through the actions of managers who actively use CPM system outputs in their decision making as they create, modify and eliminate business processes. Value is created when the CPM specific capability gets integrated within an existing business process and the firm develops mastery of this changed process. For example, depending on the skill of the one who wields it, a hammer can be used to build a grand palace or to smash one's thumb. We propose that the dynamic capability potential of CPM systems is articulated through the processes it supports and the skills and abilities of the firm in integrating the CPM system outputs into these processes. These modified processes result in changes to the firm's capability portfolio which then impacts organizational performance.

Developing capabilities requires deliberation, intention and clarity of purpose. Dosi et al. (2002, p.2) have stated that “...*to be capable of something is to have a generally reliable capacity to bring that thing about as a result of intended action...capabilities fill the gap between intention and action and they fill it in such a way that the outcome bears a definite resemblance to what was intended*”. The development of CPM specific capability must therefore be deliberate and intentional. In our view, CPM specific

capabilities are the skills and expertise organizations develop in the application of performance management techniques using a CPM system. These capabilities are expressed by the firm's ability to successfully integrate the outputs of these systems into their daily activities and business processes. We believe that CPM specific capabilities are not homogeneous and will develop organically in firms based on the unique circumstances and evolutionary paths of each organization and that these capabilities allow managers to change existing business processes in creative and productive ways. Ray et al. (2007) noted that a shared understanding is required between IT and business users to determine what information can be captured, stored and processed in organizational processes, and how emerging technologies such as a CPM system, might be used to transform these business processes to enable new strategies. The information outputs of CPM systems allow managers to assess how firm strategies are being implemented. Effective CPM specific capabilities permit the manager to interpret these outputs, to plan for the future and to develop appropriate metrics that can be measured and analyzed allowing them to track progress towards meeting their objectives.

We believe that CPM system capabilities manifest themselves primarily in terms of decision-making, either on deciding courses of action or in terms of decisions that deliberately alter business process. Simon (1947) has written that *"...the process of decision-making is of profound importance to individuals and organizations...making the right decisions at the right time can fundamentally alter the course of human events...work that steers the course of society and its economic and governmental organizations...is largely work of making decisions and solving problems..."* Managers

need to remain open minded to the wider possibilities that CPM systems offer. Keen (1981c) found that social inertia is a reason that innovative IS projects often get ignored or abandoned as formalized information systems are sometimes seen as threats by managers who are comfortable with their decision making processes and view the new system as an unwelcome intruder and actively work against it. Mintzberg (1973) and Stewart (1967) found that that under pressure, managers often end up discarding information, ignoring technology and generally avoid exploring new alternatives. The processes used in decision-making do not remotely approximate the rational ideal and the gap between the descriptive and prescriptive is a main cause for inertia (Keen, 1981c).

Michel (2007) found that in order to be effective, formal decision making processes have to be spread out to the periphery of the organization. These formal approaches cultivate a culture of good judgment and ability to read signals effectively from the market place, knowing which ones to react to and which ones to discard. Teece (2007) has also noted the importance of sensing and sense-making capability and how heightened ability in these areas can lead to better decisions and improved firm performance. We suggest that developing CPM specific capabilities requires managers to consciously try to increase the information potential of business processes by looking to their CPM systems for useful information that might enrich and enhance such processes.

How are decisions made in an organization? Simon (1986, 1991) observed that people are not rational actors when faced with economic decisions and in times of stress and uncertainty lean towards stereotypical, familiar decisions even when such approaches

may be inappropriate (Weick & Sutcliffe, 2006). Kahneman & Tversky (1979) evaluated decision value along a utility function and found that people exhibit loss aversion and overreact to small probability events (*losses*) and under react to higher probability events (*gains*). Chittka & Spaethe (2006) found that accuracy of decision and time available to make the decision was strongly influenced by visual cues and that these two dimensions are tightly linked and decisions tend to be either “*fact based*” or “*gut-based*”. Fact based decisions use data from internal and external sources and rely less on the manager’s personal intuition and experience whereas gut based decisions are based on individual experience, knowledge and intuition. Nelson & Winter (1982) have observed that decision-making failures occur not because the intelligence system failed to acquire warning signals but because the intelligence system failed to process, relate, and interpret those signals into a message relevant to available choices. Intelligence analysts and decision makers have only a limited amount of time and limited assistance in the task of organizing, analyzing and thinking about the available information. Sometimes, highly obvious and emphatic signals get lost in the noise as a result of such limitations (Winter, 2003).

We propose that CPM specific capabilities influence decision making and this is one of the main reasons these systems need to be successfully implemented and integrated. In high velocity environments, the time to make a decision is dramatically reduced. CPM specific capabilities may add value in such environments when vast quantities of information need to be analyzed quickly and presented visually to assist in decision-making. The ability of CPM systems to “*analyze-then-query*” by starting with a

summarized analytic view and allowing the ability to “*drill-down*” to lower levels of detail in the form of operational reports could be of tremendous value.

When looking at CPM specific capability through the dynamic capability lens, we follow Zollo & Winter’s (2002) definition that a dynamic capability is something that allows a firm to deal with change through its ability to affect other operational capabilities, including organizational learning. This is congruent with Helfat et al.’s (2007) position that focuses on the capacity of the dynamic capability to alter the resource base of the firm as changes to the resource base of the firm impact the firm’s ability to derive rents and impacts performance (Barney, 1991).

2.4.2 Maturity of CPM specific capabilities

The notion of maturity cycles is a familiar theme in the IT and IS literature. As Helfat & Peteraf (2003) have suggested for ordinary capabilities, we believe that the development of CPM specific capabilities also follows a maturity cycle that includes the stages of birth, familiarity, awareness, mastery and death. The Data Warehousing Institute (*TDWI*) has proposed a maturity life cycle where organizations are supposed to progress through six stages of growth after implementing a CPM system. CPM systems are said to impact usage, data standards, business value and insight into operations. They provide “*strategic insights*” through the EP and S&D components and “*tactical insights*” through the BI and S&D components. We note that most of the benefits of CPM manifest during the latter stages of maturity. Our interviews with senior managers confirmed that many firms stay in an “*adolescent*” stage after implementing CPM and never reap the full benefits of their

investments. We believe that it is through the conscious and deliberate development of CPM specific capabilities that organizations might progress up the maturity curve. We believe that firms will over time improve in the development and usage of such capabilities provided managers continue to remain open minded about the need to change processes and to the enterprise wide potential of these systems.

The introduction of the CPM system acts as the foundation stage of a dynamic capability (Helfat & Peteraf, 2003) and over its lifecycle, this capability is expected to grow and mature impacting other firm capabilities along the way. CPM specific capabilities might qualify as a dynamic capability if we can show that they change the firm's resource base. We argue that they do exactly this. By providing deeper insights into business processes, we believe that they may actually change the process itself and cause the firm to do things differently as a result. Since CPM systems are able to integrate external and internal sources of information, CPM specific capabilities may help a firm achieve congruence within a changing business environment. They may change or extend the resource base of the firm through the creation of information assets that were not available prior to their implementation. By providing information reliably and quickly, activities can be coordinated between groups and allows the firm to make better use of its existing resources. In this way knowledge can be captured and better shared among all of the firm's workers.

2.4.3 Competing on the basis of ubiquity

Davenport (1998) noted that homogeneous best practice in a single industry might lead to a lessening of the value of innovation. Dierickx & Cool (1989) argue that purchasable

assets cannot be sources of sustained competitive advantage, just because they can be purchased. After all, if any firm can go out and purchase a CPM system then what unique advantages could that possibly bring to the firm? Taking an economic perspective, Peteraf (1993) states that the price of the resource will increase to the point that it equals the future above-average return, or other competitors will purchase the resource as well and use it in a value-increasing strategy that diminishes possible rents to zero. Carr (2003) has argued that IT is no longer a strategic activity and should be standardized and commoditized and has likened IT to the “*plumbing*” of the firm and that it should by necessity become boring and unworthy of serious strategic attention. The basis of his argument is – since one of the fundamental premises of competitive advantage is the notion of “*scarcity*” then how can “*ubiquity*” possibly lead to competitive advantage?

The above paragraph might lead one to conclude that any advantages afforded by a CPM system will be short lived and/or immediately imitated by competitors. We, along with other authors, strongly disagree with this notion. Glossing over the key role information and information systems play in organizations and characterizing everything under an umbrella of IT is an over-simplification. Others (Seely-Brown & Hagel, 2003; Grant, 2004; Hackathorn, 2003) have all noted that Carr failed to mention the complex procedures and processes behind business activities that IT supports as well as enterprise level data, the lifeblood of corporate IT. Ray et al. (2007) have also noted that Carr’s definition of IT is too broad and should only be confined to physical infrastructure. IT/IS procedures tend to evolve over years, are path-dependent and are often woven into the

organizational fabric and are not easily observable or replicated by competitors. These procedures are an asset that cannot be easily bought on factor markets (Barney, 1991). The “*easy replicability*” argument of IT that Carr offers is at odds with reality if one observes the high failure rate of IT projects (Saarinen, 1990, 1996) and the well known failures in implementing enterprise wide systems (Umble et al., 2003).

Interpretation, expertise in deploying and using these systems and integration of these capabilities into the business processes is path-dependent, contextual and may be causally ambiguous due to complex social factors that are difficult to replicate (Demsetz, 1973; Dierickx & Cool, 1989; Kogut & Zander, 1992; Ray et al. 2007). Causal ambiguity exists when the link between the resources controlled by the firm and the advantages they provide are understood imperfectly. The lack of understanding needs to be from the outside-in as well as from the inside-out to be a source of advantage. Because the holding firm itself does not fully understand the relationship, it is difficult for it to be imitated by competitors. If the holding firm understands the relationship perfectly then it is possible for key personnel to be acquired by other competitor firms causing the advantage to be copied. Social complexity is also an important element to protect such advantages. Complex relationships develop between individuals and managers forming a network that is not easily discernible, penetrated or understood by competitors. Organizational culture is a key example of this type of protective barrier.

Organizations become better and more efficient as they gain greater experience in the use of systems and create synergies and unexpected complementarities with other functions.

This is an important point - CPM systems may be easily procured but to successfully implement and use them requires mastery of other factors. Eisenhardt & Martin (2000) have noted that the development of dynamic capabilities share significant commonalities across firms in what they referred to as “*best practice*”. It may be the creation, use and refinement of these best practices that may ultimately create differences in organizational performance.

Two such CPM best practices include Business Intelligence Competency Centre (BICC) and Adaptive Analytic (AA) applications. BICC’s improve the business value of CPM investments through creation of re-usable business processes (Dziekan, 2006). The goal is to reduce implementation costs and to increase the likelihood of success by capitalizing on lessons learned from previous projects. The BICC is the response to a growing need for standardization of proven BI practices in an organization by drawing together diverse teams of individuals representing IT and BI to promote expertise jointly within the organization (Krause, 2006). Setting up and running a BICC can be quite expensive (Dziekan, 2006). Winter (2003) has argued that possessing an expensive but unexercised capability is wasteful and can end up being a corporate liability and the firm is better off relying on ad-hoc problem solving instead. A Gartner study⁹ in 2009 predicted that current trends in BI indicate growth in a decentralized BI model making a standards-based BICC approach all the more relevant.

Adaptive Analytic (AA) applications are packaged software programs that work with the well-known ERP systems to impose best practices and processes on common

organizational functions such as human resources and finance. Transaction based ERP systems pose formidable challenges to analyze due to their structural complexity that is beyond the scope of most organizations to analyze indigenously. AA applications place a “*ring fence*” around these “*oceans of data*” and convert them into manageable “*islands of information*” that can be interpreted and analyzed for decision-making. These pre-built packages allow customers to analyze segments of their ERP application data in areas such as workforce, sales, recruiting and finance. AA applications work with the major ERP packages to create standardized reports that give firms the ability to analyze and use transactional data. These applications produce standardized outputs that are applicable to common organizational functions such as human resources, finance and sales – the idea being that 90% of what goes on in any corporate function is predictable and standardized and the remaining is customizable. From experience, we have observed that getting the additional 10 % done can be a challenging and costly proposition because the software is often difficult to change; processes are heavily automated or hidden from access to programmers and other technical staff.

Although it is technically possible to get all of the answers provided by such “*canned report*” applications directly from the data sources without using any CPM product, the reality is that managers often do not know the right questions to ask and they are unaware that such information is even available to them. A typical response from an end user to the question “*what data do you need to do your job?*” is to reply “*all of it*”. This creates a “*defensive BI strategy*” where the IT department provides more data than is really required to do the job, often resulting in confusion. AA software opens a door for

managers and enables them to think analytically about their businesses, often for the first time.

2.4.4 Other impacts of CPM specific capabilities

Capabilities derived from the use of information processing tools, such as a CPM system, help to focus organizational attention on the processes that really matter (Weick & Sutcliffe, 2006) and to ensure firm survival and growth. We believe that CPM specific capabilities help managers to focus attention on key business issues. The outputs may provide new perspectives and fresh insights into issues that may have been thought to be previously well understood. From our personal experience, a client who had recently implemented a CPM system used it to analyze the fees that they were charging clients for a certain service. Their analysis revealed a pattern of activity where clients had been “*gaming*” the system to their benefit. Such information was not available prior to the firm developing its CPM-specific capabilities and any impacts resulting from this insight was directly attributable to the presence of the new system and its related capabilities. In Chapter 6, we discuss other examples where such CPM-specific capabilities have modified business processes.

The effective usage of CPM systems will tend to augment existing business processes through the introduction of efficiencies in data processing and analysis and through the infusion of intelligence in everyday business processes. By having better and more reliable access to the most relevant information, firms should in theory be able to make better and faster decisions. Of particular relevance to researchers might be the importance placed on information processing capabilities that may enable the firm to

identify the nature of the changing market environment and the ability to sense opportunities (Teece, Pierce & Boerner, 2002; Teece, 2007). The ability to identify strategic opportunities in a changing environment provides a potential continuing source of competitive advantage (Denrell, Fang & Winter, 2003). Both of these are areas that CPM specific capabilities may address very well.

The knowledge gained through the use of these systems can help to refine existing business processes and it is in the organizational learning that results after a successful implementation where we feel that value may be created. When value is created from intangible assets like knowledge, it is a lot more difficult to measure because the impact such intangibles have on the bottom line may occur through complex chains of cause and effect relationships.

The introduction of the CPM system serves as an intervention mechanism that punctuates the stable equilibrium of the firm triggering changes in firm processes and capabilities. It is a disruptive intervention that shakes up existing processes and forces them to change. Under normal course of events, firms continuously evolve with changes to process occurring at a gradual rate (Gersick, 1991). A biological metaphor can be made with Darwinian evolutionary theory where organisms changed due to miniscule random variations that were successfully encoded into successive generations through natural selection based on reproductive success through a process called speciation. Eldridge & Gould (1972) in their study of evolution noted that humankind evolved in slow, pondering steps with relatively stable stages of equilibrium being punctuated by

significant changes akin to a revolution. Management scholars such as Gersick (1991) and Romanelli & Tushman (1994) have skillfully used this biological metaphor to describe organizational behavior. As biological changes get codified at a cellular and genetic level organizational changes are apt to get recorded within the knowledge networks and information systems of the company (Zollo & Winter, 2002). This corporate memory becomes incredibly important as it dictates and influences the actions of the firm's workers in the future. This is where CPM systems may be very useful and may be viewed as part of the "*corporate DNA*" of the firm.

The dynamic capability perspective stresses that it is the ability to learn from experience and to integrate this knowledge into future efforts that creates process and firm heterogeneity. It further suggests that firms cannot gain advantage through mere possession of resources and capabilities but rather through the ability to deploy and re-configure resources to take advantage of opportunities in a dynamic environment. By providing capabilities such as being able to analyze data quickly and reliably and to retrieve information from vast archives, CPM systems are able to provide critical information to improve business processes making them more efficient and effective and to highlight relevant information for decision-making.

2.4.5 CPM system usage and Human Creativity

Developing and honing CPM specific capabilities requires the continuous use and application of CPM system outputs in the daily operations of the firm's business. Although these systems provide a great deal of ad-hoc flexibility many CPM outputs are standardized and merely consumed passively by end users. This raises the concern of whether the usage of such systems may actually stifle human creativity and critical thinking. This is a critical point as creativity has been defined as the ability to discern new relationships, examine subjects from new perspectives and to form new concepts from existing notions (Couger, 1995; Evans, 1990) and has been described as the cornerstone of organizational change, the foundation of innovation, and a key to organizational effectiveness (Amabile, 1996; Woodman et al., 1993). Creativity usually results in a new product being created from some process. Forgionne & Newman (2006) noted that creativity often relies less on genius than simply providing an idea-nurturing work environment. Providing tools and templates can enhance creativity by making them available to decision makers and such availability may actually enhance the decision-making process (Forgionne & Newman, 2006). Could the use of CPM systems and the use of templates snuff out the spark of human creativity needed for innovation that creates competitive differentials between firms? We do not believe that this will happen. Gilson et al. (2005) found that creativity and standardized procedures are complementary forces and not necessarily in opposition to each other and that the use of templates often reduced task variance and improved overall performance. We would argue that by providing templates for thought patterns, creativity may actually be enhanced by focusing the attention and energy of the individual on the specific problem without worrying about

overhead and having to define the landscape each and every time (Goldenberg & Mazursky, 2002).

In this chapter, we have presented the subject of CPM and described what our vision for these kinds of information systems covers. We have discussed the concept of competitive advantage and reviewed the RBV, DC and DSS literature in some detail and attempted to position CPM within the DSS framework. We have described how the successful deployment of CPM systems and the specific capabilities that firms develop in its usage might possibly lead to a position of competitive advantage. The interplay of the system and the capabilities it creates has been examined through the lens of dynamic capability theory. We have discussed relationships between CPM and the dynamic capabilities that are needed for an organization to survive and thrive in a competitive environment. In the next chapter, we will define a conceptual model that will look at how CPM systems may be successfully implemented and how such successful implementations might impact organizational performance by changing the resource base of the organization.

3 Research Questions and Hypotheses

This paper is concerned with the following three research questions:

1. What are the capabilities firms should focus on to enjoy a successful CPM system implementation outcome?
2. Does the successful implementation outcome of a CPM system result in improvements in core firm capabilities?
3. Does improvement in core firm capabilities resulting from successful CPM system implementation outcome impact firm performance?

These questions directly link the ideas that CPM specific capabilities (*we view these as capabilities specifically attributed to the presence of the CPM system*) are related to improved organizational performance. It addresses the notion proposed by vendors that the implementation of CPM systems improves organizational performance and therefore competitive advantage.

In this research we are primarily interested in two issues. The first is how to implement CPM systems successfully and second, to understand the mechanisms through which these information systems might impact organizational performance? Since implementing a CPM system is not a trivial undertaking we are also interested in ancillary topics such as the motivations for a firm to commit to a large investment that carries potential for change? Based on our literature review and discussions with professionals who work in the field, we believe that the decision to implement CPM systems may be driven by a number of factors that may include some or all of the following:

- Reaction to environmental pressures
- Recognition that the firm is generating information from its operational systems that are currently not being effectively used
- Desire to establish technology leadership within industry
- Pressure to stay in line or ahead of competitors
- Buying in to marketing strategies of vendors

3.1 *Conceptual Model Development*

In this section, a CPM performance model is proposed. This is a multi part model with three endogenous variables, CPM system implementation outcome, the firm's overall capability portfolio and organizational performance. We propose that successful implementation outcome is followed by the conscious and deliberate development of a dynamic capability (*CPM specific capabilities*) that alters the capability portfolio of firms thereby impacting organizational performance.

To establish the viability of our model, we need an approach to assess organizational performance. Measuring organizational effectiveness and establishing causality towards any single factor is virtually impossible for any organization of substantive size as there are just too many exogenous variables to consider. Handy (1993) identified 60 or more factors, individual and environmental that may impact performance. Since our research is not based on hard financial measures such as firm revenue or stock price, we based performance improvements on the subjective determinations of individual users as to the influence and impacts that CPM has had on them as individuals and within the firm in general. These effects may be personal, group level or organizational in nature. Taken collectively, these individual effects should translate into a firm level effect. We

patterned our approach on the well known IS success model proposed by DeLone & McLean (1992, 2003).

Based on the “*communications research*” work of Shannon & Weaver (1949) and the “*information influence*” theory of Mason (1978) (cf. DeLone & McLean, 2003), DeLone & McLean (1992, 2003) proposed the well known D&M IS success model (*original 1992 model is pictured below*). Technical success (*system quality*), coupled with semantic success (*information quality*) and effectiveness (*use, user satisfaction, individual and organizational impact*) are thought to result in IS success. Increased usage (*mandated or voluntary*) caused individual impact that when taken collectively impacted organizational productivity and performance.

FIGURE 3.1 – DeLone & McLean IS Success Model (1992)

In their 2003 model, DeLone & McLean added an additional dimension called “*service quality*” that was also associated positively with their original four measures of effectiveness. In addition, individual and organizational impacts were rolled into one construct called “*Net Benefits*” which considered both the positive and negative impacts of IS success. For the most part, their original model has stayed unchanged in form and in purpose. The original D&M IS Model has been validated by over 285 refereed articles since it was originally proposed (*cf. DeLone & McLean (2003), p. 11*). The D&M IS success model influenced the conceptual model proposed in this paper. We believe that a successful CPM system implementation is articulated through user satisfaction and continued usage that results in an impact on individuals. These individual impacts, due to synergies and system effects might result in an overall organizational impact that may tend to exceed the sum of such individual impacts.

The D&M IS success model has been critiqued for being both a process and causal model. A purely temporal process model suggests inherent order and that construct A precedes construct B in time. A variance model suggests causal relationships between the constructs and that adjusting the magnitude of a predecessor construct proportionally causes an impact on a successor. The conceptual model we propose in this thesis has elements of both a process and a variance model.

Hartono et al (2007) researched a large body of field studies in attempting to determine the factors that contribute to the success of Management Support Systems (MSS). Older studies provided the antecedents that were necessary for success based on a variety of

measures. These researchers found that there were no common antecedent success factors that were widely applicable to all the measures. They suggest that management should focus on the desired outcome and then pay attention to the corresponding success antecedent to make it happen.

Tracing cause and effect is difficult when considering organizational performance. Attempting to attribute organizational success and performance to one factor, such as a newly introduced information system is difficult as there are many external and internal influences that can affect organizational performance (Handy, 1993; Deshpande et al. 1997; Ho, 2008). How tightly can we link organizational performance to the successful implementation and integration of a CPM system? We take the reasonable position that a successful implementation outcome should not negatively affect organizational performance whereas an unsuccessful implementation is likely to do so. From personal experience, we have observed that poorly implemented CPM systems often result in confusion among users reducing confidence in and use of the system. We propose that a successful CPM implementation results in higher quality of information availability which should result in higher usage and satisfaction yielding individual and organizational benefits.

In our CPM performance model (*depicted in Figure 3.2*), the first dependent variable (*successful implementation outcome*) is positioned as being dependent on three independent capability constructs - IT infrastructure, human capital and strategic leadership. The model suggests that a successful implementation outcome results if these

three capability constructs are well developed and aligned. After the system is successfully implemented, managers and users start to make use of the system and develop a distinct set of skills and capabilities. These capabilities will vary between users and collectively between firms. As these experiences increase and these capabilities mature, managers and users should find new and creative ways to use the outputs from the systems to impact the work they do and the business of the firm. We refer to this artifact that gets created post implementation as CPM specific capability.

FIGURE 3.2 – CPM performance model

The second dependent variable, Core Organizational Capabilities (COC), is affected by a successful implementation outcome through the exercise of the CPM specific capabilities that we propose are created after a successful implementation. The exercising of these newly created capabilities should be conscious and deliberate and managers need to remain open minded to the prospect of changing the way the firm conducts its business. We believe that a successful implementation results in new information becoming available to users and the creation of new information resources. We propose that these

information rich artifacts are used to transform processes that eventually change the firm's capability portfolio.

The third dependent variable is organizational performance. This is a complex outcome that is dependent on a large number of variables. In this research paper, we have chosen to focus only on a small basket of organizational capabilities that were identified in an earlier research by Chen (2004) as being important indicators of enterprise system success. Since CPM systems are a type of enterprise system, we believe these selected capabilities are general enough to be used as a proxy for the firm's overall capability portfolio. Thus, we have focused on organizational capabilities that are believed to have an impact on performance and then attempted to establish a linkage between CPM specific capabilities and these core organizational capabilities. Since the core capabilities constitute a part of the resource base of the firm (Helfat et al., 2007) any changes to the resource base should have an impact on the firm's ability to generate economic rents (Barney, 1991) and therefore impact on performance. Using transitive logic, we state that if CPM specific capabilities can be shown to impact the firm's resource base then we may reasonably conclude that it may also affect organizational performance.

Aligning operational activities to the business strategy is critical to improving organizational performance and we believe that CPM systems provide the platform upon which progress towards achieving the strategic objectives of the firm can be measured in a systematic and consistent fashion providing early warning of deviations from strategic goals, allowing managers the chance to adjust processes in time. CPM systems may also

provide deeper insight into operations and assist in creating efficiencies and unanticipated linkages.

We shall now look at each of the individual capability constructs that contribute towards a successful CPM system outcome.

3.1.1 IT Infrastructure Capability (ITC)

What is the importance of IT Infrastructure Capability (ITC) in implementing CPM systems successfully? Hirshleifer (1980) found that as long as the number of firms possessing the valuable resource is less than the number of firms required to generate perfect competition dynamics in an industry, then that resource has the potential to improve competitive position. Reflecting on the earlier discussion in Chapter 2, we might reasonably ask - is ITC something that a firm might use to improve its competitive position and performance? Weill (1992) found that certain types of IT investment (*transactional*) were consistently associated with strong firm performance whereas others (*strategic*) had neutral effects and any advantages evaporated after imitation by competitors. Weill et al. (2002) noted that under-investing (*or worse, implementing the wrong infrastructure*) can cause serious problems including delays and limited sharing of resources, information and expertise by business units.

The success of a CPM initiative depends on more than just the technology but having the right technology infrastructure to deploy the system on is critical. Researchers have found that IT infrastructure is an important resource contributing to outstanding firm performance (Ross et al., 1996; Bharadwaj, 2000). Santhanam & Hartono (2003) found

that firms with high IT infrastructure capability outperformed a control sample over a sustained period of time. Barton & Peters (1993) linked competitive advantage to the availability of a modular IT infrastructure. This positive view of ITC is not unanimous – Bhatt & Grover (2005) found that IT infrastructure is not significant but IT business expertise and relationship infrastructure is vital to competitive advantage and that knowing how to effectively leverage the IT infrastructure is a key source of differentiation between firms. We take the position that a solid, reliable IT infrastructure platform is required and well established IT governance policies should be in place for a CPM implementation to succeed. We do not believe that ITC is likely to provide competitive advantage and other empirical study has confirmed this (e.g. Mata et al. 1995; Bharadwaj, 2000). However, without ITC, we believe that the firm cannot even play the game so from that perspective we think it is vital. In general, unless there are extenuating factors, ITC is likely to only meet the first of the VRIO attributes proposed by Barney (1991). ITC may be valuable and important but is not likely to generate competitive advantage. The ITC needed for successful CPM system implementation consists of web and database servers, high speed networks and workstation browser software. These technologies are all readily available within most firms.

Wade & Hulland (2004) have noted that the resource-based view makes a key distinction between information technology and information systems. The former is asset-based, whereas the latter comprises a mixture of assets and capabilities formed around the productive use of information technology. The CPM specific capabilities that we believe emerge as a result of a successful implementation outcome is a good example of such a

distinction. Since every firm is different and has a unique evolutionary path, their readiness for CPM and consequently the uses they might make of any capabilities that result are likely to differ. Many of these integration points will be difficult to predict a priori. The RBV, through its focus on attributes and its recognition of the importance of resource complementarities, may suggest an enhanced role for such CPM specific capabilities in sustaining firm competitiveness.

Weill & Broadbent (2000) identified three major dimensions of IT infrastructure capability, including communication network and hardware, IT human resources, and application software. We adopted the first dimension and refer to it as IT infrastructure. We did not model IT human resources under ITC as we dealt with this under another separate construct called Human Capital Capability that will be discussed in the next section. The third dimension (*application software*) is not relevant for our purposes and was simply omitted. Weill (2004) identified IT governance as a key competitive differentiator and we used this as our second dimension for ITC. The first dimension of ITC covers such items as the firm's architecture plan, physical hardware, servers and networks. A robust CPM architecture needs to be agile, scalable, available, secure and maintainable. The IT architecture plan has to describe the role IT and information management will play in the business, both now and in the future (Ross, 1999). The physical hardware is very important as this is the vehicle on which the application will be deployed. Since most organizations are geographically dispersed, fast network connections and reduction of bottlenecks (*centralized databases, switches, firewalls etc.*) are essential to promote usage. Information flow should be fast and secure between

locations. The second dimension of ITC covers the firm's IT governance approach. IT governance policies need to be defined that protect the infrastructure from threats. Both physical and information security methodologies should be put in place. Policies that outline the nature of relationships between the organization and its suppliers, reporting and command structures should all be considered. This leads us to our first hypothesis. We propose that firms that have a strong ITC will have greater success in implementing CPM and are likely to be more successful than firms that do not have such capability.

Hypothesis 1 – Firms with a well developed IT infrastructure capability are more likely to have a successful CPM implementation outcome than counterpart firms that have not developed the capability to the same degree.

We are also interested in knowing what additional ITC factors might need to be in place for a CPM system to be successfully implemented. Holsapple & Sena (2005) found that prior implementations of ERP systems had an impact on the successful implementation of DSS projects and we believe that this is the same for CPM. We propose that the successful implementation of other enterprise systems endows the firm with valuable experiences that it might re-use to successfully implement CPM systems. This seems like a reasonable proposition because at the heart of the ERP system is an enterprise wide data source. Does the presence of all the enterprise data in one readily available repository bode well for the success of a CPM implementation? We believe it does. To investigate the relationship between existing enterprise systems and CPM systems, we offer the following proposition.

Proposition 1 – Firms that have successfully implemented enterprise systems in the past are more likely to have a successful CPM implementation outcome than counterpart firms with lower levels of enterprise system experience.

3.1.2 Human Capital Capability (HCC)

What is Human Capital Capability? There was a period in time when the concept of associating humans as capital resources would have been considered abhorrent (Schultz, 1961). Philosophers of the stature of J.S. Mill stated that humans should not be looked upon as wealth because wealth existed only for their sake (Schultz, 1961). Adam Smith provided the classical definition of human capital referring to the stock of skills and knowledge embodied in the worker allowing him to perform labor that produced economic value. Early theories of productivity treated human capital as a mere factor of production, that was fungible (*homogeneous and interchangeable*) in nature. These mindsets have changed - today, the potential embodied in its human capital is arguably the most important strategic asset possessed by the knowledge based firm (Drucker, 2002). Human capital is now viewed as a strategic asset, into which additional investment yields increased output (Becker, 1993). Among other human capital development investments, investment in human capital is typically done in the form of ongoing training and education of employees.

In this research, we view HCC as the totality of all the competencies and commitment of the people who work for an organisation. It is a collective term that represent their skills, experience, and capabilities that may be harnessed for the purpose of doing productive work. Human capital assets provide advantages that are not easily replicated by competitors. Hitt et al. (2006) found that service firms that do not have strong human capital resources and competencies are likely to be at a competitive disadvantage. In this research, we considered the staff of the organization as broken into two distinct groups,

IT staff and non-IT staff. We recognize that both these groups need to work closely together for a successful CPM system implementation. It may be essential for both of these groups to exhibit a high level of competence as successful implementation of information systems requires tight alignment, coordination and co-operation between the business and IT groups (Davenport, 1998; Grant, 2003) and these challenges are often exacerbated when the system is globally deployed (Grant, 2003). Professional and personal competence of these group members may be critical in ensuring that CPM systems are implemented successfully.

In recent times many organizations have moved to an outsourcing model where the value of IT staff has been questioned and IT departments have been drastically reduced or even eliminated. A Government of Canada report on IT spending for the years 2007-08 reported a drastic reduction of permanent full time equivalent (*FTE*) IT staff within federal and provincial government departments and overall decreases in internal IT staffing budgets. Carr (2003) has suggested that IT is no longer a strategic imperative and the success of global outsourcing models has resulted in firms having fewer full time internal IT staff available. The culture and attitudes of the firm towards internal IT staff and ongoing commitment to investing in their training and education may be relevant factors in determining the success of a CPM system implementation.

We considered HCC along 3 competence dimensions; personal, organizational and IT staff competence. Personal competence is defined in terms of the comfort level a user feels with the use of the CPM system. Users should be well trained and believe that the

organization has invested appropriately in their training. Organizational competence entails the user's conception of the firm's overall mission and strategy to accomplish its goals and should understand the purpose and objectives of the information system and how it fits in with these overarching objectives. IT staff competence covers within domain expertise and out of domain business knowledge. IT staff are required to have demonstrated high levels of IT competence through the successful deployment of past IT projects of similar complexity as experience with other information system initiatives in the past impacts the success of new IS implementation outcomes (Horner Reich, 2007). IT staff should possess a strong knowledge of the business so that an empathetic relationship may be built up between the business and IT groups, fueled by a shared understanding of the role of IT to meet the overall needs of the business (Ross et al., 1996; Bharadwaj, 2000; Ray et al., 2007). The knowledge, skills and competencies of the IT staff should be evident to the users when these two groups interact. Interactions are likely to take place in formal meetings or when technical support is required from the IT staff. Therefore, IT staff would likely require strong interpersonal skills and be able to communicate well with end users (Parr & Shanks, 2000; Byrd & Turner, 2001). IT staff competence is built up through on the job experience and investments in their training and career development. Continuous development of IT staff in the form of on the job and external training may be essential in this regard. It is important that IT staff receive special and customized training on the new technology directly from the vendor or other professional associations (Ross, 1999). We feel that in order for a successful implementation, IT and business groups may need to work together in an effective partnership whereby both sides have a vested interest in seeing the CPM system

implementation succeed. The presence of IT steering committees and effective project management capabilities may be critical in keeping both groups focused and on track.

We propose a second hypothesis as follows:

Hypothesis 2 – Firms that exhibit a high level of human capital capability are more likely to have a successful CPM implementation outcome than counterpart firms that have not developed the capability to the same degree.

3.1.3 Strategic Leadership Capability (SLC)

Strategic leadership is required to facilitate the successful outcome of a CPM system implementation. Ke & Wei (2008) established that strategic leadership was a key ingredient in determining the success of ERP system implementations. These researchers found that strong and clear leadership influenced the organizational culture along the dimensions of learning and development, participative decision making, power sharing, support and collaboration. Bingi et al. (1999) found that the action of implementing enterprise wide systems caused massive change that required concerted involvement of senior leaders and found that overt and unambiguous commitment from top leadership was vital to reap the benefits of such systems. Barton & Peters (1993) linked competitive advantage to IT management skills. Dehning et al. (2005) have shown that investments in IT, coupled with effective management can lead to discernible competitive advantage and organizational slack.

We believe that senior management attention is critical for a CPM system initiative to succeed. The ERP literature documents several cases of implementation failure due to

managers not being able to provide the proper level of leadership. A key factor cited behind the disastrous implementations of ERP systems at organizations such as Hershey, HP and Nestle was due to the lack of effective leadership with respect to planning, change management, implementation and training (Umble et al. 2003; Worthen, 2002).

Due to the relative newness of the CPM field, metrics around CPM successes and failures are not readily available (Busi & Bititci, 2006). However, the IS literature documents many cases of DSS and ERP failure. Arnott & Dodson (2008) have provided a synopsis of DSS failures with a list of critical success factors that should be established and noted the vital importance of leadership to reduce the failure rate of these projects. Also from the ERP literature, strategic leadership capability appears to be a recurring theme to avoid catastrophic costs and loss of productivity - a study by Deloitte (1999) found that the success rate of ERP implementation was less than 20% and the number of firms actually realizing potential benefits was even lower.

Senior leadership and line managers are expected to possess a clear and well developed vision for CPM in the organization and should communicate this vision to all the stakeholders (Markus & Tanis, 2000; Davenport, 2000). Top management should take CPM into consideration when developing future strategic initiatives. The CPM system implementation should be accompanied by a clear roadmap to guide the process with milestones and key achievements articulated (Broadbent & Weill, 1997; Markus & Tanis, 2000). The requirement to measure progress and development within a performance driven organization should also be clearly communicated by managers. In deploying

CPM within the organization, IT managers should focus on delivering intermediate CPM projects and score some early wins to build commitment, trust and involvement from the user community (Bhattacharjee, 2000). Senior management should stand solidly behind the CPM initiative and involve lower level management and the user community in decision making. Last, the organization should have the ability to finance the acquisition, deployment and long term maintenance of the CPM system.

Busi & Bititci (2006) found that organizational culture and management style seem to be interdependent throughout the lifecycle of a CPM system project. In particular, they found that management styles needed to evolve as the maturity of the CPM system and the organizational culture evolved. A successfully implemented CPM system, through cultural change, leads to a more participative and consultative management style (Busi & Bititci, 2006). The use of CPM systems supposedly encourages an achievement oriented culture to emerge. Busi & Bititci (2006) found that an authoritative management style was essential at the start but needs to change with the emerging culture. Because of these cultural impacts, it is anticipated that a strong commitment from management to the new CPM system is essential and we believe that CPM systems projects may fail if the management commitment is seen to be weak or lacking.

Since CPM systems carry a potential for organizational change, it is important for IT managers to be experienced in the process of change management (Grover et al., 1995). They should be prepared that the new CPM system will change existing business processes and create new processes as well. The organization should explicitly articulate

a change management plan and take steps to involve affected organizational members in dealing with CPM-enabled changes (Parr & Shanks, 2000). Employees should be advised as to how their existing jobs may change due to the new system and receive support to help them deal effectively with the changes. Similarly, incentive plans, bonus structures and compensation should be adjusted to ensure that employees stay committed to the changes and smooth the transition to the new systems (Ross, 1999; Nolan, 2001). The transition to the new system should follow a step-wise approach, instead of a big-bang approach, whereby CPM is gradually implemented in the organization to give users time to get accustomed to the change (Ross, 1999). Managers should clearly articulate how performance of the CPM system is to be measured. The measurement process has to be seen as unbiased and fair. The performance of the CPM system should be benchmarked against other best-in-class competitors.

We believe that the level of strategic leadership capability will have a direct impact on the successful implementation outcome of a CPM system. The following hypothesis is therefore proposed.

Hypothesis 3 – Firms with highly developed strategic leadership capability are more likely to have a successful CPM implementation outcome than counterpart firms that have not developed the capability to the same degree

3.1.4 Implementation Outcome (IO)

Markus & Tanis (2000) noted that the strategic outcome of enterprise systems is not necessarily a predictable consequence that comes with buying a software package. We

feel that this argument is appropriate for CPM systems as a firm making the investment is also not guaranteed a successful outcome. In spite of decades of research, information technology projects continue to fail (Wateridge, 1999). In fact, one out of 3 IT projects cannot be classified as a success and does not achieve its intended success mandate (Skaistis, 2007). Successful outcome is determined by a variety of interacting issues arising from system implementation and environmental context throughout the various phases of implementation (Soh & Markus, 1995; Markus & Tanis, 2000). In their study of CRM system implementations, Foss et al (2008) found that the scope, size, complexity and duration of the projects varied significantly across firms. This is true for CPM systems where implementation project timelines can span from a few weeks to years and user communities may range in size from 10 to 10,000+ licenses (*personal communication with sales representative from IBM Cognos, 2009*). Foss et al (2008) found that poor planning, lack of clear objectives and not recognizing the need for business change are key reasons for CRM failures. Do these apply to CPM systems as well?

If failure of an IT systems project implementation can be measured in terms of customer satisfaction, user perception and system usage (Wateridge, 1999) then these same indicators might also be used to assess system success. The successful implementation outcome of the CPM system can be assessed along these dimensions. The following are the types of questions one might ask post-project to determine if a CPM system implementation has truly been a success.

- Is the CPM system being appropriately used by the end users? (Venkatesh et al., 2003; Venkatesh & Davis, 2000; DeLone & McLean, 2003)
- What are the current user perceptions towards the CPM system (*usefulness, ease of use, opportunity or threat*)? (Davis, 1989; Gefen & Keil, 1998; DeLone & McLean, 2003). Have these perceptions changed over time?
- Has the CPM system added value to the organization? (Soh & Markus, 1995)
- Is the CPM system reliable and useful - does it personally impact the user in a positive way and helps them to perform their jobs more effectively? (DeLone & McLean, 2003)
- Was the CPM system project implemented on schedule and on budget? (Wateridge, 1999; Cooke-Davies, 2002)

Even if a CPM system implementation outcome is judged to be successful, it does not necessarily mean that this automatically translates into improved organizational performance. We believe that this is only the first step in a process. Once the system is in place and producing useful outputs, certain CPM specific capabilities are created and honed which allows managers to enhance their business processes. It is critical that these changes to processes be managed successfully as Soh & Markus (1995) argue that poor management processes and internal inefficiencies can squander any of the advantages created by information technology.

3.1.5 Impact on Core Organizational Capabilities (COC)

What impact does a successful CPM system implementation outcome have on the organization? As we proposed in Chapter 2, the successful implementation of a CPM system sets the stage for the creation of a new dynamic capability. We believe that the

degree and impact of this new capability increases in magnitude as users gain more experience with the CPM system and learn how to use its information outputs to execute various ordinary routines as they go about doing the daily business of the firm. This notion of ordinary routines being the genesis of powerful capability is a well developed theme in the IS literature. Eisenhardt & Martin (2000) and Feldman & Pentland (2003) depart from the traditionally held view of organizational routines as a source of inertia, inflexibility and mindlessness and believe that these ordinary routines may actually be a source of organizational flexibility (Pentland & Rueter, 1994) and organizational change (Miner, 1990; Feldman, 2000). Salvato (2009) in an extensive 15 year longitudinal study found that the performance of myriad ordinary activities may actually shape the evolution of powerful firm capabilities. There is other evidence in the literature to support our position that the exercise of ordinary routines can engender the creation of a more powerful dynamic capability (Nelson & Winter, 1982; Nelson, 1991; Collis, 1994). We believe that it is during the conduct of such ordinary activities that users discover new and innovative ways to use these information outputs to enhance their daily jobs and to change processes. This view is also in keeping with that of Englebart (1962) who wrote that new computer systems such as a DSS are supposed to make humans perform their jobs more effectively by augmenting but not entirely replacing human intelligence.

We shall illustrate the above with an example - let's say that a clerk's job is to participate in an account reconciliation process and the existing business process requires the user to check and approve values on a paper report. Now with the new CPM system, users are required to run the report themselves by providing a few simple parameters. The user

now has the ability to run multiple reports for different dates for comparative purposes, sort values, group customers etc. Depending on ability the user may be able to do additional analysis such as trend identification, group customers by sales volume to identify best and worst clients, credit risks and so on. The presence of the CPM system has created a new capability for the user who has been transformed from a “*passive recipient*” of information to an “*active participant*” in a business process. The ability of the user to adopt and adapt the information the CPM system provides and expertise in exercising this capability is an example of a “*CPM specific capability*”. We believe that such new insights may result in changes to the business process which might then impact the firm’s capability to provide a service or product. CPM systems are immensely powerful and can be used to generate various reports, dashboards, scorecards, alerts, multidimensional OLAP cubes, predictive analysis etc. Over time and provided the user receives appropriate training and has the aptitude, the possibilities are indeed myriad to change and inform business processes. These changes to capabilities may impact organizational performance but whether or not the performance is sustainable requires a longer term study that is out of scope of this research paper.

Humans are adept at invoking known routines to tackle familiar as well as unfamiliar problems in which resorting to such routines may be clearly inappropriate (Weick, 1998). Invoking routines can be a good thing as it allows focus and vigilance to be directed to tasks that need more attention. However, routine-based activity does not imply “*mindlessness*” as they can be an important storehouse of accumulated organizational experience (March, 1994; Nelson & Winter, 1982). Even though the mindful and less-

mindful perspectives have been treated as divergent perspectives in the literature, this may not be appropriate treatment as they share interdependencies and complementarities with each other (Levinthal & Rerup, 2006). Mindfulness and routines are in fact a dual process that depends on different mechanisms and can indeed operate simultaneously (Weick & Sutcliffe, 2006). Routines suffer from the problem of “*normalization*”, where events that should be singled out for special attention are normalized under acceptable categories due to the coarseness and inadequacy of the language used to describe such categories and events (Winter, 2003). Mindfulness is as much about the reversal of normalization as it is about encoding and matching situations with routines (Weick & Sutcliffe, 2006). The concept of “*mindfulness*” originated in the psychology literature at the individual level of analysis (Sternberg, 2000; Langer, 1997) and was concerned with automatic and non-automatic information processing. Mindfulness is described as a state of active awareness where the organization remains open to new information and a willingness to view contexts from multiple perspectives based on new information (Langer, 1989). The contrast to mindfulness is the “*less-mindful*” state that tends towards being routine oriented and follows fixed, stable patterns of activity.

We believe that CPM specific capabilities play a critical role in focusing organizational attention and creating an increased sense of awareness. Through providing valuable outputs and allowing users to manipulate and play with these outputs, fresh perspectives and insights may be obtained in processes that were previously thought to be well understood. CPM systems can support this notion of mindfulness by focusing managerial

attention on the organizational processes and routines that really matter (Weick & Sutcliffe, 2006).

Mindfulness, organizational attention and organizational learning may be important concepts to understand the impact of CPM specific capabilities on organizations as they provide the glue that binds the information processing capabilities of CPM systems with the existing routines and capabilities of the organization. The effectiveness of a mindful process and the improvisation potential it offers is often a function of the richness of the information tools that one has available (Weick, 1998). By transferring greater autonomy and providing access to formerly unavailable data, CPM systems might allow users to participate in the creative process that Ciborra (1996) described as “*bricolage*”, a play like approach characterized by a child like fascination with the endless possibilities of recombination and dynamic reconfiguration and “...*the quality of this tool set is in turn determined by the richness of the set of well-rehearsed routines available for the construction of novel re-combinations* (Levinthal & Rerup, 2006, p 504). It fosters an approach where users might be able to play with the system and “*throw out darts*” to try out and test new ideas without any possibility of causing damage. The user’s desktop computer thus becomes laboratory and sandbox where myriad ideas can be explored.

Mindfulness requires learning to switch modes of thinking and is concerned with the process of noticing new things and that involves seeing both similarities in things thought different and differences in things thought similar (Langer, 2005, p. 16). The availability of new information causes routines that have been executing “*less-mindfully*” to get

disrupted, creating a void where past experience no longer serves as a firm guide, and the disruption stirs the cognitive pot (Weick & Sutcliffe, 2006).

Firms have a large number of core capabilities and they tend to be contextual in nature depending on the industry the firm operates in and other factors. However, there are some important capabilities that all firms are expected to possess. These may be Winter's (2003) "*zero-level capabilities*" and we shall focus primarily on these in this research. The following table lists some likely candidate capabilities that may be influenced by a CPM system implementation.

TABLE 3.1 – Potential organizational capabilities impacted by CPM systems	
Capability	Literature References
Project Governance	Sambamurthy & Zmud, 1999; Biddick, 2009; Debrecekeny & Gray, 2009; Sharma et al., 2009; Henschen, 2008
Project Competence	Soderlund et al., 2008; Bardhan et al., 2007; Horner Reich, 2007
Business Process Re-Design	Hammer & Champy, 1993; Grover et al., 1995; Kettinger et al., 1997; Sarker & Lee, 2006; Guha et al., 1997; Zhuang & Lederer, 2004; Luftman & Kempaiah, 2007; Grant, 2003; Davenport, 1998; Davenport & Harris, 2007; Gerhart, 2004
Information sharing, communication and quality	Price et al., 2008; Daft & Lengel, 1986
Information and Knowledge management	Horner Reich, 2007; Grant, 1991; Cohen & Levinthal, 1990; Nonaka, 1991; Alavi et. Al., 2006; Nonaka & Takeuchi, 1996;

Let us now take a look at each of these capabilities to gain a better understanding.

Project Governance

An important aspect of project governance concerns Information Technology and is concerned with IT infrastructure, use and project management. IT governance is used to coordinate, direct and control these activities (Sambamurthy & Zmud, 1999). IT governance is not always dictated by the desire for effective and practical performance – often financial concerns tend to be the deciding factor (Biddick, 2009). The level of IT governance in firms also tends to vary. Debreceney & Gray (2009) in a research study based on Capability Maturity Model (CMM) process maturity models determined that the highest maturity levels for IT governance processes were attainable but sometimes the economic cost of attaining the highest levels was often not justifiable. These researchers found that firms tend to “*satisfice*” instead of always seeking optimum process maturity and were largely comfortable with a variable mix of process maturity levels as long as they were at the level or above those of peer firms.

A 2003 Rand Organization study found that some public sector organizations were able to use IT and IS more effectively than others despite having very similar resource endowments. Lack of effective IT and IS governance structures and business processes were believed to explain the variance. Studies such as this would suggest that there are other factors that firms need to master to effectively exploit their investments in such information technologies.

We believe that CPM specific capabilities may have the ability to alter the organization’s governance capabilities. Project governance although closely related to project

management is not the same thing. A firm may be strong in project management but yet be weak in project governance. Project governance is an umbrella capability to project management. Sharma et al. (2009) found that organizations should focus on project governance first to increase project delivery success in individual projects. The ability to provide insight on project performance and to track and disseminate project information through the firm is important. CPM systems through their ability to provide such shared information may be very useful in this regard.

The use of CPM best practices such as the implementation of a BICC may help project managers learn from others experience to benefit their own projects. Henschen (2008) notes that a 2008 study of 358 business professionals found that two thirds of the respondents who rated their BI deployments as "*very successful*" also said those deployments are "*mature*" or at least "*centralized*" in their approach. In contrast, three quarters of those who reported less success ranked their deployments as either "*just moving toward centralization*" or stuck in "*decentralized deployments with little or no coordination of practices and investments*".

The CPM project team should include members with a diverse experience of the business, including senior managers, IT staff, outside consultants and business end users. It is important for business process owners to take responsibility for CPM applications within their units. If the CPM project is not actively endorsed by important people in the organization, utility is much reduced therefore active champions are required to promote the initiative and to provide support when the projects encounter setbacks and delays.

Project Competence

Soderlund et al. (2008) found that the capability of generating and executing projects is critical for company performance and sustainability of firm-level competitiveness. These researchers found that three learning mechanisms of project competence, namely relating, reflecting and routinizing of processes contributed to greater project success. Bardhan et al. (2007) in a large cross sectional study found that the fit between enabling IT, such as a CPM system and the competence of the project team members had an impact on project performance in terms of cycle time, on-time completion, cost and quality. Project team competence and prior experience on similar projects was found to be a key risk area in IT projects (Horner Reich, 2007). Project teams need to exhibit high levels of competence and have a good track record of delivering large system projects effectively. We propose that CPM specific capabilities may have an impact on the overall project competence capability of the firm by providing information that can be shared between projects and may help to establish common standards. The project competence of the firm will be tested during the implementation of the CPM system. The team selected to implement the CPM system, including vendors, outside consultants etc, should have sufficient experience in implementing CPM systems in the past with success and be competent in the relevant technologies and processes.

Business Process Re-Design

BPR is defined as a “*rethinking and radical redesign of business processes*” to achieve dramatic increases in performance metrics such as cost and product quality (Hammer & Champy, 1993). Since we believe that CPM specific capabilities change business

process and alter the way things are done within a firm, could they also affect business process re-design/engineering (BPR) activities? Business Process Reengineering (BPR) literature maintains that the use of computer-based tools for tasks such as process modeling, simulation, and project management has a positive influence on business process redesign effectiveness (Grover et al., 1995; Kettinger et al., 1997). This view is not unanimously supported. Sarker & Lee (2006) found that the use of such tools sometimes had a negative impact on BPR activities – because their use caused distraction and lack of focus by the original re-designers from the business processes that they had originally envisioned. Guha et al. (1997) found that BPR initiatives were more successful when greater emphasis was placed on the change environment, process management, and change management and less successful projects exhibited inhibitors primarily in the area of cultural readiness and change management. Zhuang & Lederer (2004) found that BPR was not a relevant factor in predicting the success of e-commerce businesses whereas CEO commitment and planning was a far more important predictor of success.

The importance of aligning IT and business strategy has been a pervasive theme in the literature for a long time but it still remains a challenge (Luftman & Kempaiah, 2007; Grant, 2003). IT strategy needs to be properly aligned with the business strategy and organizations can only capitalize on IT investment if there is proper alignment between the IT strategy and the business requirements (Davenport, 1998; Grant, 2003). Business processes should reflect an appropriate mix of both business and IT strategies (Davenport, 1998; Davenport & Harris, 2007). We believe that the CPM system outputs

will be more effectively integrated if there is alignment between these two areas. Firms that exhibit strong BPR capability assign responsibilities for business processes to business process owners. If business processes change, as a result of such integration, executives and senior managers should be prepared for the changes and have an effective change management plan.

The effectiveness of a business process is normally assessed by establishing metrics that can be compared before and after the process is changed. If CPM specific capabilities affect business processes, new metrics may be required to measure such changes. The firm needs to be ready for changes that result when processes change. For example, a new way of dealing with customer product returns may result in more inquiries to the help desk. Management should be prepared for such changes and have a plan in place to support the integration of new processes to facilitate organizational adoption.

Ultimately, a business process will fail if humans do not embrace it. Such buy-in is usually accomplished through the use of appropriate incentives and rewards. When considering incentives as a means to boost individual performance, it is critical that the incentives be appropriately aligned with the organizational culture. Gerhart (2004) noted that Hewlett-Packard (HP)'s Pay for Performance (PFP) program found that the initiative failed as it did not fit into the HP culture. Humans need incentives to follow process and management needs to take this into account by providing appropriate financial and other incentives to encourage employee use of the new system.

Information sharing, communication and quality

Price et al. (2008) defined three levels of information quality, namely syntactic (*form*), semantic (*content*) and pragmatic (*usage*) and proposed objective measures to capture these dimensions. Daft & Lengel (1986) in their treatise on media richness theory stressed the need to use the richest media forms to convey information in ambiguous contexts. CPM systems make rich use of imagery, graphics, maps etc. and have great potential to impact organizations through improving capabilities at all three of these levels.

A common problem in organizations is that the data used for business is often redundant and unreliable. CPM systems are based on centralized data sources and provide a consistent and conformed data view so that everyone in the organization is supposed to see the same view of the data. Post implementation, we would be interested to find out user's perceptions of improved ability to communicate with each other and with external entities. CPM systems are capable of making use of multiple data sources and knitting them together seamlessly thereby allowing information to be analyzed across function and discipline. For example, if the monthly sales forecasts are stored in one system and the actual sales transactions are stored somewhere else this data can be integrated and compared across systems providing new insight and analysis that was just not possible before.

Information and Knowledge management

Horner Reich (2007, p. 8) defines “....*knowledge management as the application of principles and processes designed to make relevant knowledge available to all. Effective knowledge management facilitates the creation and integration of knowledge, minimizes knowledge losses and fills knowledge gaps...*” Knowledge has a long established role in theories designed to explain organizations and their performance. In the past, knowledge was viewed as residing within the individual members and the concept of firm wide knowledge was novel. CPM specific capabilities may be useful as a coordinating mechanism through which firms can integrate the specialist knowledge of its members causing firms to move from knowledge application to a knowledge creation mode (Grant, 1991; Cohen & Levinthal, 1990).

Organizational learning extends the theory of individual learning into a wider context. Organizational learning is concerned with how teams and groups learn and why some organizations perform it better than others. The field of organizational learning developed more significantly in the 1970's with the seminal writings of Argyris & Schon (1978) and March & Olsen (1975). Knowledge management, on the other hand, sought to explain how knowledge is acquired, transformed, and exploited (Cohen & Levinthal, 1990; Nonaka, 1991). Other researchers have focused on how information technology such as a DSS might support knowledge management (Alavi & Leidner, 2001). Organizations should develop competencies in the management of tacit and explicit knowledge, knowledge creation, individual and organizational knowledge, and communities of practice (Nonaka & Takeuchi, 1996). A key focus is on the tacit

knowledge that is embedded in individuals and the study of how this knowledge can be integrated with other knowledge, shared with other individuals, and eventually explicated so it can be aggregated and distributed widely within the firm (Cohen & Levinthal, 1990; Nonaka & Takeuchi, 1996). CPM specific capabilities may be able to create and foster such knowledge management activities. Supporting the internal knowledge management processes of the organization is an area where they may have a considerable impact. We believe that organizations that have formally defined and structured programs for researching, acquiring and diffusing information and knowledge will make better use of CPM systems.

In large organizations, effective methods to share CPM specific knowledge should be setup, either through the creation of newsgroup repositories on the corporate intranet to periodical publications that discuss various projects, successes and convey the latest developments regarding CPM initiatives in the organization to the end users. Sometimes when a customized application, such as a CPM system, is implemented, much of the knowledge leaves with the vendor. Successful CPM organizations will attempt to capture as much of this technical knowledge as possible so that it can be retained within the company. CPM vendors and practitioner organizations such as TDWI continue to generate best practices and methods based on field research and it is important for an ongoing relationship to be maintained between the organization and the CPM community at large to raise awareness of useful practices and to integrate them if appropriate.

Drawing a direct link between the introduction of a CPM system and organizational performance is difficult as there are many factors that can impact performance. Since organizational performance is ultimately driven by the resource base of the firm (Barney, 1991, Peteraf & Barney, 2003), if new technology systems cause the resource base to change, then a firm's performance is likely to be impacted. We believe that this happens when a firm uses its resources more effectively and efficiently as a result of the new system and is able to alter processes as a result. Since a well implemented CPM system is a valuable firm resource and any specific capabilities the firm develops in using it effectively may be a valuable dynamic capability, this leads us to propose the following hypothesis.

Hypothesis 4 – Firms with successfully implemented CPM systems will be successful in creating new capabilities or enhancing existing capabilities.

3.1.6 Organizational performance (OP)

A key idea of this research is that the successful implementation of a CPM system allows firms to develop CPM specific capabilities that alter core organizational capabilities and in doing so impact organizational performance. However, this impact does not always imply a positive improvement (Zahra et al., 2006). This position follows Helfat et al (2007) and Ambrosini & Bowman (2009) where the notion of dynamic capabilities automatically leading to improved organizational performance is decoupled. Using Barney's (1991) broad definition of resource to include activities, capabilities etc. which allow the firm to generate rents, we note that "...it is VRIO resources that generate rents and contribute to the firm's super-normal profit by being involved either in delivering product advantages perceived by customers or by conferring process advantages that

result in lower unit costs...” (Ambrosini et al., 2009, p. 19). It is the rent-generating resource base of the firm that ultimately determines organizational performance. In Chapter 2, we saw that dynamic capabilities must have the ability to impact the resource base so they are certainly capable of impacting organizational performance but this impact is not always guaranteed to be positive. If the changes to the resource base are not in synchronization with the environment, the firm’s survival and success may actually be threatened as a result (Zahra et al., 2006; Helfat et al., 2007). As an example - the ability to perform CRM activities should be a valuable capability that leads to improved organizational performance but according to a Gartner survey done in 2008, about 70 per cent of CRM projects have resulted in either losses or no bottom-line improvement in organizational performance. At present, there are no such similar studies for CPM.

Shannon & Weaver (1949) defined the success of communication systems along three dimensions; technical (*accuracy of information*), semantic (*meaning of information*) and effectiveness (*effect on receiver*). This framework is timeless and completely applicable to our research on CPM systems. As we stated in Chapter 2, we conceptualize CPM systems as a form of organizational wide DSS and ultimately its effects on organizational performance will be felt by its ability to impact decision making. The desire to improve decision-making capability is a principal motivation to implement CPM systems. This is of fundamental importance as good decision making is central to superior organizational performance. March (1994) stated that paying attention to all events and stimuli in the environment is central to decision making but found that practically, this is a very difficult thing to do since time and capabilities for attention are limited and not

everything can be attended to at once. With so many signals being received and so many items relevant to the decision, theories of decision making are often better described as theories of attention or search than as theory of choice and are more concerned with the way in which scarce attention is allocated (March, 1994). We believe that CPM systems improve decision making capability by providing decision-makers with a greater amount of the factual information required to make good decisions thereby allowing them to focus their attention on key issues.

Bharati & Chaudhary (2004) in their study of decision making found that the most important factors related to decision making satisfaction were information and system quality. DeLone & McLean (2003) also suggest this in their IS success model where IS quality determines usage that in turn determines individual and group impacts. We believe that usability needs to precede usefulness for systems to have value. This point is instructive for vendors as users will get turned off if a product is slow, difficult to use and produces wrong results.

To investigate the relationship between successfully implemented CPM systems and decision-making, we offer the following proposition.

Proposition 2 – Firms with successfully implemented CPM systems will experience an improvement in decision making.

Currently, there is little research on CPM specific benefits within the IS literature. Therefore, we look at studies that have been done on other enterprise systems to inform

us in this area. Shang & Seddon (2002) in an extensive study of ERP case surveys proposed five dimensions of IS benefits and related measurement criteria. The benefits are broken down along operational, managerial, strategic, IT infrastructure and organizational dimensions. Measurement of IT/IS benefits can be tricky as firms tend to use cost-benefit analysis to determine value and this may not be the best way to evaluate intangibles (Murphy & Simon, 2002). Since CPM systems may provide benefits that are sometimes intangible in nature, such as process complementarities, the ability to quantify such benefits in monetary terms is challenging.

In considering organizational performance outcomes, this study will deal with qualitative perceptions of the respondent as to whether organizational performance has improved or not. It is believed that improved performance will be manifested as individual level and organizational level effects as DeLone & McLean (1993, 2003) have suggested. A possible future study might consider a quantitative approach that uses hard measures such as sales, revenue and profitability and attempt to link such indicators to CPM specific capabilities but establishing such connections is difficult as they tend to rely on multiple variables and isolating cause and effect to any one exogenous factor is difficult. We believe that improvements in organizational performance are evidenced through the end user's belief that his or her job has improved to some degree and the organization has become more effective and efficient as a result of its investment in the new CPM system. After the CPM system has been implemented in the firm, it is felt that changes in organizational performance can be attributed to it if the users believe that some new benefits have been created that did not exist before it was put in place.

Following Shang & Seddon (2002), DeLone & McLean (1992, 2003), Mirani & Lederer (1998) and Velcu (2007), improvements in overall organizational performance can be attributed to positive changes in the following dimensions.

- Quantity and quality of information available to users
- Communication ability
- Knowledge sharing
- Flexibility and responsiveness to customers
- Ability to create new or modify existing business processes
- Competitive position and Financial performance
- Ability to develop process oriented skills
- Better and faster Decision making
- Ability to plan for the future
- Improved HR performance

We believe that organizational performance will improve if users believe that a greater quantity and quality of information is available to them than to do their work than they previously had available. If users have changed their methods of work and have become more process driven as a result of the new system then this is a noteworthy improvement. If users feel that the new CPM system has enabled them to share information better and to be able to communicate more effectively with their colleagues as well as with external stakeholders then this is also positive.

Even though it is difficult to attribute financial improvement in an organization's performance to any one factor, such as the implementation of a new CPM system, it is interesting to check users perception on whether they believe the financial performance of the organization has improved due to the CPM system being implemented. In theory,

financial information and individual performance information should become more readily available as CPM systems start to get integrated deeper into the firm processes. However, we believe that such effects will only be felt a few years after the CPM system has been put in place.

With regards to decision making, we believe that the ready availability of more and better information should lead to better and faster decisions being made and that the availability of such information will allow users to be better informed of the organization's strategy and direction. This should promote a uniform understanding of the business vision and lead to a feeling of inclusiveness, improved morale and attitude among employees. The human resource group can be a great champion in helping with the integration of CPM systems by promoting its virtues of universality, ready accessibility and information security to the user community.

In earlier chapters, we have acknowledged that moving from improved organizational performance to sustainable competitive advantage is difficult. As seen in the literature review, the attainment of sustainable competitive advantage is not easy as it requires competitors to completely cease efforts to replicate the advantages of the holding firm. Competitors will only do this if any further expenditure of labor and capital towards competing against a rival is judged to be futile and may be better used elsewhere. We believe that effective exercising of CPM specific capabilities may help firms bolster such advantages by creating desirable process complexity that may be difficult for competitors to replicate.

In the end, an organization's competitiveness may ultimately rest on its ability to have more options than its competitors. We believe that through more efficient utilization of resources, organizations gain a temporal edge over competitors that may allow them to develop new products or to refine existing strategies and plans. We propose that the effective use of CPM systems results in organizations gaining economic rents over their competitors, giving them the opportunity to pursue other creative options. The collective effects of such activities should result in improved organizational performance which might ostensibly result in improved competitive position.

The activity of individuals within the organization should work towards meeting common organizational goals. These individual activities taken in aggregate produce powerful synergies that are capable of producing superior organizational performance. Similar to how Kaizen philosophy has been successfully used to improve competitiveness in Japanese manufacturing (Masaaki, 1986), we believe the use of CPM systems can effectively endow ordinary employees in the firm with "*the ability to stop the production line*" and shine light on issues that may trigger changes to business processes and firm capabilities. We believe that human nature is such that intelligent individuals will continuously seek to improve processes and performance but often lack the information needed to make such changes. We believe that this is an essential hallmark of human intelligence. Intelligent people always look to make any process more efficient, faster or safer in some way. We believe that the key to process improvement lies in the availability of information and having sufficient time to apply it for some use. Even the most mundane tasks that are very well understood can benefit from new information – for

example, it is quite easy to slice half an onion perfectly but once one gets to the second half, there is diminishing onion to hold on to increasing the risk of cutting a finger with the knife. However, if one starts on the side that is not tightly held together by the fibrous bands at the base, the onion holds its shape intact longer leading to a better result. New information based on a simple observation has improved a process. The moral of this story is that the application of human intelligence, aided by technology, coupled to any task, mundane as in this case, or complex as in business, results in process improvements due to information availability and the luxury of time to process the intelligence effectively. CPM systems are very capable of providing such information and we believe that these systems and the buildup of CPM specific capabilities can unlock this latent human potential in firms and potentially lead to competitive advantage.

In this chapter, we have presented our conceptual model that outlines the key capabilities that firms need to develop to enjoy a successful CPM system implementation outcome. The selection of these factors has been grounded in the existing literature and three underlying capability constructs have been proposed. A successful CPM implementation is believed to generate the creation of a new dynamic CPM specific capability that may promote the creation of new or changes to existing capabilities. Efforts have been made to link a successful CPM system implementation to an alteration of the firm's capability portfolio as we believe that an altered capability portfolio should impact organizational performance. Four hypotheses and two propositions have been offered in support of and to test our ideas. In the next chapter, a research methodology will be developed and a framework to test the underlying research questions is proposed.

4 Research Design and Methodology

Even though IS research is traditionally dominated by a single methodological paradigm (Bazeley, 2009), a realist perspective encourages one to seek both process and variable-oriented data to detect regularities and to understand the mechanisms by which they occur (Maxwell, 2008). The value of using mixed methods for IS research is fairly well accepted (Mingers, 2001; Miles & Huberman, 1994; Orlikowski & Baroudi, 1991; Kaplan & Duchon, 1998; Lee, 1991).

Despite the benefits associated with a multi-method research study, practical constraints influence the decision to adopt an approach that can be effectively carried out in the research timeframe. In this research primary data was collected quantitatively through the distribution of a survey questionnaire hosted on an online service provider. Supplementary descriptive data was collected through targeted interviews with senior managers within organizations that are currently implementing or have already implemented a CPM system. Interview data was used to add richness to the quantitative data findings and to possibly reveal nuances that were missed in the quantitative survey. Such an approach would be considered a sequential mixed methods research strategy (Cresswell, 2009).

In the previous chapter, we framed the research questions and explored important considerations related to CPM system implementation. A conceptual model linking CPM system implementation outcome, capabilities and organizational performance was presented. The choice of the latent variables in the model were arrived at through a

review of the various literatures related to dynamic capabilities, IT, decision support and enterprise systems. Four hypotheses and two propositions were put forth to test the various relationships between CPM systems and the dependent variables of this research.

A strategy for integrating and comparing the data collected through the quantitative and qualitative methods is presented in this chapter.

4.1 *Quantitative Research Method*

In the quantitative phase of the research, measurement constructs based on the literature are developed to test out the proposed hypotheses in the conceptual model. A research instrument (*survey questionnaire*) was created and preliminary testing of the instrument was executed to further refine the measurement items. The questionnaire was then administered to an identified user population and the results were collected, analyzed and written up.

4.1.1 Quantitative Research Process

The quantitative research method we used followed the classical flow suggested by Bryman & Bell (2007) depicted in Figure 4.1. The diagram illustrates an idealized account of the process and rarely does quantitative research follow this exact flow but it provides an understanding of the general approach that was followed. First we start with theory, in this case the theory of dynamic capabilities as a general idea to improve organizational performance of firms. DC literature suggests that organizations that are successful in developing and deploying dynamic capabilities will hold a competitive edge over their peers. We then framed our research subject, CPM (*the technology system as*

well as the specific capabilities it fosters) against this theory to investigate the role it might play in the development and enhancement of core organizational capabilities that may impact organizational performance. We have stated in the earlier chapters that the dynamic capability is not the IT resource but rather the skills and capabilities that the firm develops in using the IT resource effectively. As is normally the case in theory testing research, specific hypotheses were developed to test the research subject against the theory. We proposed four hypotheses and two propositions based on our literature review, observation and certain assumptions as to how CPM systems and their usage might fit in with the concept of dynamic capabilities.

This research design takes an explanatory perspective interested in the “*how*” and “*why*” questions related to CPM systems. Rather than just making an observation of state, as would be the case in a descriptive research design, we are interested in knowing “*why*” some CPM systems have been implemented successfully and in investigating the underlying factors that lead to a successful implementation outcome. Also, we are very interested in “*how*” organizational performance is impacted and if CPM systems are able to alter the capability portfolio of firms. The selection of research design has implications on a variety of issues, such as the external validity of findings and the ability to impute causality to the findings (Bryman & Bell, 2007).

Next we determined the concepts studied in the research and determined suitable items that can be used as proxies to measure these concepts. The process of taking a concept and reducing it into a measure is known as “*operationalization*”, a term that originates in

the physical sciences. For example, a research study on the concept of intelligence might use the measurement of IQ as a proxy to measure the concept (Bryman & Bell, 2007). To be useful, the metric has to be causal, reliable and valid. The constructs of interest have been identified and developed along with the model in the previous chapter. From a review of the extant literature, a number of measures are now proposed to test these concepts. Scale items were developed that incorporate these measures. A group of subjects were identified to whom the survey was administered. Responses were collected and processed and conclusions made from the findings of the research.

FIGURE 4.1 – Process of quantitative research (Bryman & Bell, 2007)

4.1.2 Data Sample

It is well known in sampling theory that increasing the number of respondents increases the reliability of inferences in hypothesis testing. What is not as well known is that the design of a more reliable measurement scale can greatly reduce the number of respondents required to get the same level of confidence in the results (deVellis, 2003). Therefore, spending time on designing a more reliable scale is worthwhile if one wishes to increase the statistical power of a survey (deVellis, 2003).

The problem of non-response bias arises when potential respondents who have valuable perspectives choose not to respond to the survey, thereby limiting the analysis only to the results that are collected. To mitigate some of the effects of non-response bias, we followed up the original transmission with a reminder email and/or telephone call to urge respondents to complete the survey before the due date. We conducted various tests for non-response bias by comparing the early responders versus the late responders (Armstrong & Overton, 1977). We calculated Levene, Forsythe-Brown and ANOVA statistics to test for material differences between these two groups indicates the presence or absence of a non-response bias in the received data.

The quantitative data was obtained from individuals who work with a CPM system in the capacity of a manager, IT user or business user. These individuals are employees of firms that have implemented an enterprise wide CPM system. The names of these organizations were obtained from the publicly available customer lists of three major CPM vendors (*IBM, SAP and Oracle*) as well as customer support data. An appropriate

contact at each of these target responder companies was identified by making personal contact with the organization through email and/or telephone. The identities of these organizations were kept anonymous.

We anticipated that more than one survey response would get filled out in an organization. The firms selected represented a cross section of industries, united by some common characteristics such as size, revenue and industry sector. We made an assumption that the use of CPM systems was generally applicable only to organizations that have a minimum critical mass and would likely not be used by firms that are very small as the costs of acquisition and maintenance of such systems can be quite high (*source: personal communication from IBM*).

Once the target companies were identified, the respondents were contacted through email and/or phone requesting their participation in an academic research project. This initial communication explained the purpose of the study and assured the participants that the survey results were to be kept confidential and all results were to be published in aggregate form so that no identifying information is disclosed. The survey collection tool was designed not to capture any identifying information. The survey collected general characteristics of the company such as size, number of employees, revenues etc. Once the user agreed to participate in the survey, s/he was asked to click on a link in the email that took them to a web site where they were asked to fill out a confidential online survey. The respondents were considered to be knowledgeable individuals familiar with the strategic and operational issues related to CPM system implementation. If not the

case, the addressee was asked to forward the email to someone else in their organization who can respond appropriately to the questions in the survey. Respondents were given the chance to receive the results of the survey if they wished. Email addresses were collected in a separate form to maintain the respondent's anonymity. After the survey was completed, a thank-you letter was generated and sent to the respondent.

4.1.3 Survey Questionnaire

The survey questionnaire was broken down into multiple sections, designed to capture responses testing the hypotheses and propositions made in Chapter 3. A background section of the questionnaire collected data on the respondent firm and the respondent as well. It collected general information related to job responsibility, company name, industry and annual revenue to provide a demographic context and for control purposes. We also found out what role was played by the respondent (*manager, technical, end user etc.*) and this information was used as a filter for further questions. This information was used to develop individual and organizational profiles and was also used to conduct a statistical test for non-respondent bias.

We were also interested in understanding the motivation behind why firms chose to implement CPM and wanted to identify the driving factors behind the decision. Was it due to external environmental pressures or a realization that there was information available within the organization that could be put to more effective use?

The CPM performance model included three capability constructs, IT infrastructure, Human Capital and Strategic Leadership. Based on our literature review, we believed

that these constructs might influence the successful outcome of a CPM system implementation. Each of these constructs was tested independently with a separate section within the survey. We propose that a successful CPM system implementation leads to the creation of a dynamic capability that influences the creation of new organizational capabilities or the modification of existing ones. The survey included specific questions to examine all these constructs and relationships.

Empirical research has shown that having more points in a scale tends to produce slightly higher mean scores relative to the highest possible attainable score (Dawes, 2008). The survey questions were based on a 5-point Likert scale ranging from 1 – “*strongly disagree with statement*” to 5 – “*strongly agree with statement*”. A “*not applicable*” option was also provided in case the question did not apply to the respondent. Feedback from pre-testing indicated that a 5-point scale was appropriate for this study. The use of Likert scales can be affected by various biases including central tendency bias, acquiescence bias and social desirability bias (deVellis, 2003; Dawes, 2008). Appropriate scale design may help to alleviate some of these biases. We attempted to reduce such biases by keeping our survey anonymous and designing our scales with an odd number of response options as well as providing a neutral option.

4.1.4 Considerations in Measurement

The measures selected to test the hypotheses must satisfy the criteria of causality, reliability and validity. A brief explanation of each of these important concepts follows.

Causality

An important goal of quantitative research is to establish causality. In this research, we are examining a suspected cause-effect relationship between the implementation of CPM systems and organizational performance outcome. Cause in this context implies that the variation in the dependent variable can be explained through variation in the independent variable. Variables within the model are often referred to as endogenous and those outside the model are exogenous.

According to Bryman & Cramer (2008), to establish causality between two variables, three criteria must be established. First, it is important to establish a relationship between the two variables in question. Second, the relationship between the variables must not be spurious and attributable to some other factor. Third, the cause must precede the effect in time. A research design provides the structure within which such an investigation between variables can take place. The survey/co-relational design is a common technique used in social science research to test theory.

According to DeVellis (2003), mathematical models can be constructed to explain the behavior of the latent or dependent variable. The parallel tests model (*depicted below*) assumes that the variation in each item is explained by the direct relationship between the latent variable and the measurement item and the rest is explained by an error term. The diagram below illustrates a reflective relationship where the latent variable is not directly measureable but reflective through items that can be measured. The converse of this case

is a formative relationship where all relationships are reversed and a residual error term is introduced on the dependent variable.

A diagram of a parallel tests model, in which all pathways from the latent variable L to the items X1, X2 and X3 are equal in value to one another, as are all pathways from the error terms to the items.

From deVellis, Scale Development, p. 20

FIGURE 4.2 – Parallel tests model

The parallel tests model makes the assumption that the latent variable is affected by the items in equal measure and that the error is the same for each item. This means that the proportions of item variance attributable to the dependent variable and to error are equal for all items. The model assumes that the co-relation between any two items is the same as is the value of each of the path coefficients. These simplifying assumptions are significant restrictions.

There are other alternative tests that are not as restrictive as the parallel tests model. There is “*essentially tau-equivalent*” tests that relax the constraint that the error variance

associated with a given item need be the same for all items. Because errors may vary, item means and variances will also vary. Other more general tests include the “*congeneric*” tests which only make the assumption that all items share a common latent variable. The congeneric and tau-equivalent models are special cases of the general factor model. The general factor model allows multiple latent variables to underlie a given set of items (deVellis, 2003, p 25).

Reliability

The measurement scale designed to assess the strength of the latent variable must be reliable. Reliability deals with how much of the variance observed is attributable to the true score of the latent variable. Reliability is the consistency of the measurement, or the degree to which an instrument measures the same way each time it is used under the same conditions with the same subjects. Reliable scales must display internal consistency - that is all the items within the scale must be homogeneous, measuring the same concept.

Reliability can be estimated by using “*test/retest*” method and by measuring internal consistency. Test/retest is the more conservative method to estimate reliability. The idea behind test/retest is that one should get the same score on test 1 as on test 2 when the tests are conducted at different times. Internal consistency estimates reliability by grouping questions in a questionnaire that measure the same concept. For example, a concept can be tested by presenting two sets of questions that measure it and after collecting the responses, a correlation is run between those two groups to determine if the instrument is reliably measuring that concept. This is known as a split-half reliability test. Another

method of determining correlation values among the questions on the survey instrument is through calculating Cronbach's Alpha. A value of 0.7 and greater generally indicates a reliable measure (Nunnally, 1978; Cortina, 1993; Bryman & Bell, 2007). Cronbach's Alpha is calculated for every question pair on the instrument and computes correlation values for all pairs. The closer this value is to unity, the higher the reliability of the instrument. The primary difference between test/retest and internal consistency estimates of reliability is that test/retest involves two administrations of the measurement instrument, whereas the internal consistency method involves only one. Cronbach's Alpha is a less conservative estimate of reliability than test/retest but is more commonly used in social science research due to its convenience. This research used Cronbach's Alpha to determine internal consistency of the instrument.

In classical measurement theory, the assumption is that if items in the scale have a strong relationship to the latent variable, they should exhibit a strong relationship to other items in the scale. Although it may not always be possible to determine the relationship between the latent variable and the items, we can determine if the individual items are correlated to each other. If items are highly co-related, it would mean that the items are “*causal*” in that they affect each other or that they share a common cause. The idea is that strong correlations between items imply strong links between the items and the latent variables. Thus a scale should consist of a set of items that correlate well to each other. The actual variability in item scores is caused by actual variation across individuals in the phenomenon being measured and due to error. This can be thought of as “*signal*” and

“noise” components. Alpha is the proportion of total variance that is attributable to the signal or that alpha is equal to 1 - error variance.

Validity

Validity is concerned with whether the variable being measured is the underlying cause of item covariance (deVellis, 2003; Ping, 2004). Just because a scale is reliable does not mean that it is valid. There are generally three types of validity considered in the conventional interpretation, namely content, criterion-related and construct validity (deVellis, 2003). Validity is the strength of our conclusions, inferences or propositions. More formally, validity is defined as the best available approximation to the truth or falsity of a given inference, proposition or conclusion (Shadish et al., 2001). Tests of internal validity indicate whether the causal findings deriving from an investigation are relatively unequivocal. An internally valid study shows firm evidence of cause and effect. External validity refers to our ability to generalize the results of our study to other settings. Content or face validity is an estimate of whether a measure appears to measure what it is trying to measure. It is normally supported by the literature where there should be general agreement about the items used to measure a construct (Nunnally, 1978; Ping, 2004). Face validity of the survey instrument is also established through speaking with subject matter experts to build consensus that the items accurately represent the concept. Construct validity ensures that the scale is measuring what it is intended to measure (Davis, 2005). Construct validity is established by measuring convergent and discriminant validity. Convergent validity exists when different measurement tools are in agreement (Davis, 2005). Discriminant validity is the opposite of convergent validity and

refers to the extent a construct in a research model differs from other constructs in the same model (Churchill, 1979). A low correlation with other measures is commonly used as a substitute for discriminant validity (Ping, 2004).

Validity can be threatened by poor experimental design and other factors such as single group threat, historical threats etc. Mitigation strategies are abundant in the statistics literature to reduce threats to validity but are not discussed in this paper.

4.1.5 Construct Measurement

The capability scales and measures used in this study are based on earlier research by Grant (2003) and Chen (2004) in a study on enterprise systems. The scale items were validated by a review of the IT literature, pre-testing and through qualitative research interviews.

IT Infrastructure Capability

A well developed IT infrastructure capability has been cited as a major resource contributing to outstanding firm performance (Ross et al., 1996; Bharadwaj, 2000). In this study, the IT infrastructure capability refers to the physical IT architecture which consists of hardware, networking and communications and includes application software such as the CPM system as well as the IT governance policies of the organization (Weill et al. 2002; Weill & Broadbent, 2000; Byrd & Turner, 2002). Zhu (2004) found that the reliability and quality of the IT infrastructure has a strong impact on firm performance and e-commerce capability positively contributing to firm performance in terms of sales per employee, inventory turnover, and cost reduction.

Measurement items for the IT infrastructure capability is broken down along two themes; architecture and governance. The following table lists the measurement items and literature references for IT infrastructure capability.

TABLE 4.1 – Measurement items for IT infrastructure capability	
Survey Questions	Reference
My organization has a well-developed enterprise IT architecture that supports the deployment of an integrated, flexible, reliable, and secure business platform.	Bharadwaj (2000); Sambamurthy & Zmud (1999); Weill & Broadbent (2000)
My organization has a high quality physical IT infrastructure (hardware, software and communication networks) to connect users.	Weill & Broadbent (2000); Byrd & Turner (2001); Bharati & Chaudhary (2004); Zhu (2004)
Our IT applications are adequate to cover current and future corporate needs.	McAfee & Herman (2000); Ross et al. (1996)
Identifying, investing in and adopting new technology for business purposes is a high priority for my organization.	McAfee & Herman (2000); Byrd & Turner (2001); Mittal & Nault (2009)
IT infrastructure is based on a common and consistent technology platform.	Bharadwaj (2000); Weill et al., (2002)
My organization has strong data management standards.	Ross et al. (1996); Ross (1999)
My organization has well prepared disaster planning and business recovery processes.	Bhatt & Grover (2005); Ross (1999)
My organization has implemented an enterprise wide system (e.g. SAP, JD Edwards, Oracle etc.) successfully in the past.	Holsapple & Sena (2005); Bingi et al. (1999)
My organization is well supported by IT vendors with well established service level agreements (SLA) in place for support.	Bajwa et al. (1997)

Human Capital Capability

Human Capital capability breaks down along three competency related themes. Competence is assessed along the dimensions of IT staff competency, organizational competence in IT/IS and the individual' self-assessment of his or her personal

competence in terms of IT and CPM. The following table lists the measurement items and literature references for human capital capability.

TABLE 4.2 – Measurement items for human capital capability	
Survey Questions	Reference
I have a good understanding of my organization's mission and strategy to accomplish its goals.	Ray et al. (2007)
I clearly understand the purpose and objectives of the CPM system.	
I have received adequate training to use the CPM system.	Bharadwaj (2000); Sumner (2000); Lee & Lee (2000)
The IT staff possesses the proper education and background to do their jobs effectively.	Horner Reich (2007);
The IT staff is highly competent with CPM/BI software packages.	Ross et al. (1996)); Parr & Shanks (2000);
The IT staff is competent in deploying information systems projects.	Ross et al. (1996); Parr & Shanks (2000);
My organization has the ability to develop custom applications and information systems to meet its business needs.	
My organization has programs for continuously investing in the development and training of its IT staff.	Bharadwaj (2000); Sumner (2000); Lee & Lee (2000)
IT staff responsible for CPM are very responsive to my needs.	Horner Reich (2007);
I am very satisfied with the level of IT support.	

Strategic Leadership Capability

Studies on Executive Information Systems (EIS) have found that strategic leadership plays a moderating role in the successful adoption of these systems with top management influencing other variables such as IS support and vendor support (Bajwa et al., 1997). These researchers found no direct link between management support and EIS success but strong indirect linkages were found between supportive management practices and EIS success. A key impediment to diffusion of complex technology is the erection of

knowledge barriers between the providers and users of the technology and management support is essential to break down these barriers and create a supportive context where the new technology can take root and flourish (Bajwa et al. 1997).

Strategic leadership is a complex capability that is broken down along three themes; CPM strategy, CPM enabled change and CPM performance and risk. Good leaders plan appropriately for the CPM system implementation and rollout and then exhibit leadership by staying visible, connected and involved in the execution of the plan. The following table lists the measurement items and literature references for Strategic Leadership capability.

TABLE 4.3 – Measurement items for strategic leadership capability	
Survey Questions	Reference
Management has a well-established vision for CPM in my organization.	Grant (2003); Luftman & Kempaiah (2007); Ke & Wei (2008)
Management's CPM system strategy is fully integrated with the overall business strategy.	Davenport (1998); Davenport (2000); Grant (2003); Ke & Wei (2008)
Key milestones for the CPM system program have been identified and articulated by senior managers.	Markus & Tanis (2000); McAfee & Herman (2000); Parr & Shanks (2000); Sumner (2000)
Senior management in my organization has been significantly involved in developing the CPM strategy.	Sumner (2000); Davenport & Harris (2007)
Excluding senior management, others (such as end users, IT support staff etc.) have been significantly involved in developing the CPM strategy.	Sumner (2000); Davenport & Harris (2007)
Top management is highly supportive of and committed to CPM-related change processes.	Grover et al. (1995); McAfee & Herman (2000); Parr & Shanks (2000); Sumner (2000)
My organization has implemented an explicit change management plan.	Grover et al. (1995);); McAfee & Herman (2000); Parr & Shanks (2000); Sumner (2000)
Efforts are made to involve affected organizational members in designing the CPM-initiated change.	Parr & Shanks (2000); Sumner (2000)
The roles to be assumed by employees during and after the	Grover et al. (1995)

change are assigned.	
Incentive plans are restructured to ensure commitment of organizational members to CPM deployment and use.	Grover et al. (1995); Nolan (2001); Ross (1999)
My organization has the capacity to finance the acquisition, deployment and long-term maintenance of CPM systems.	McAfee & Herman (2000); Nolan (2001)
My organization has well established procedures for CPM/BI investment risk reduction and management.	Hirt (2000); Nolan (2001)
My organization has explicit, well-articulated and established procedures for evaluating the performance of CPM system acquisition, delivery, and use.	Parr & Shanks (2000); Brown & Vessey (2001); Nolan (2001)
Performance in delivering CPM to the business is benchmarked against best-in-class performers.	McAfee & Herman (2000)
The benefits of the CPM system are clearly identified and communicated.	Nolan (2001)
In deploying CPM in my organization, IT managers focus on delivering intermediate CPM products (early wins) to build commitment and involvement.	Bhattacharjee (2000)

CPM Implementation Outcome

How should the success or failure of a CPM system be assessed? Zmud & Cox (1979) refer to the success of a DSS implementation quite simply as the realization of its intended benefits. CPM systems are an extension of DSS so many of the concepts and measures attributed to DSS research are relevant in the study of CPM systems. Typical metrics to assess performance of DSS include the measurement of multiple variables such as system-use, decision-making performance (decision cost or profit), decision-making time, user satisfaction with the system, user confidence in the decisions, and user attitudes toward DSS. Similar measurements and benchmarks are applicable to CPM systems as well.

The success of a CPM system should not be taken as a guaranteed outcome. Poon & Wagner (2000) found that DSS systems projects are developed and deployed with high expectations but have ended in failure due to a number of causes, several unrelated to the system itself. Assessing success of a CPM system can be challenging. Keen (1981a, 1981b) showed that defining and quantifying the benefits of a DSS is very difficult. While the cost of such a system can be readily estimated, putting a dollar value on the benefits is difficult since the benefits of such systems are often intangible and transient

The outcome of CPM system implementation is largely a question of user perception. Since many of the impacts of a successful system are felt at the individual level, many scale items were designed to assess the user's level of satisfaction and perception of success. This is of interest because perception of success to an end user may vary considerably from IT staff which is likely to vary from a manager's perspective. It is assumed that end users are most concerned with whether the CPM system has changed their job for the better by giving them some capability that they did not have prior to its implementation. IT staff may have more interest in how the system is impacting the overall IT capability of the firm and managers may be more interested from a financial perspective. The following table lists the measurement items and literature references for CPM system implementation outcome.

TABLE 4.4 – Measurement items for CPM system implementation outcome	
Survey Questions	Reference
I believe that the CPM system implementation in this organization has been very successful.	Bhattacharjee (2000); Davenport (2000); Davis (1989); Foss et al. (2008); Gefen & Keil (1998); Markus & Tanis (2000); McAfee & Herman (2000); Shang & Seddon (2002); Soh & Markus (1995); Venkatesh & Davis (2000); Venkatesh et al. (2003)
The CPM system is very reliable.	
The CPM system is very easy to use.	
The CPM system is useful and has helped me to perform my job more effectively.	
The CPM system has given me better access to information that was previously difficult to obtain.	
The benefits obtained from the CPM system have far exceeded my initial expectations.	
The decision to implement CPM systems was the right choice for my organization.	
The CPM system implementation project was on schedule.	
The CPM system implementation project was delivered within budget.	

Impact on core organizational capabilities

The impact of CPM systems on firm capabilities was assessed around six fundamental organizational capabilities that all firms are expected to possess to some degree. Since we are issuing this survey to a large population representing a wide cross section of industries and types of firms, we decided to examine the impact on organizational capabilities that are common to all firms. The following table lists the measurement items and literature references for CPM capabilities.

TABLE 4.5 – Measurement item for Core organizational capabilities	
Survey Questions	Reference
An effective CPM project team has been assembled to execute the CPM strategy.	Alavi & Leidner (2001); Bardhan et al. (2007); Bhattacharjee (2000); Brown & Vessey (2001); Cohen & Levinthal (1990); Davenport (1998); Davenport (2000); Grover et al. (1995); Heijden (2001); Henschen (2008) Horner Reich (2007) Lee & Lee (2000); McAfee & Herman (2000); Mirani & Lederer (1998); Nolan (2001); Orlikowski & Hofman (1997); Parr & Shanks (2000) Price et al. (2008); Ross (1999); Sambamurthy & Zmud (1999); Sharma et al. (2009); Soderlund et al. (2008); Sumner (2000)
CPM project implementation teams comprise of an appropriate mix of business, IT, and consulting personnel.	
Business champions with sufficient authority and resources are associated with the CPM project.	
CPM outsourcing activities are supported by effective contract management structures and personnel.	
My organization has or is in the process of implementing a Business Intelligence Competency Centre (BICC) to ensure that all CPM projects are based on proven best practices.	
My organization has the expertise internally to develop its CPM strategy.	
My organization has a well-developed competence in carrying out assessment and procurement of IT and IT services.	
A majority of users (business and IT) are proficient in the use of the deployed CPM system.	
Implementation of CPM systems reflects business requirements.	
CPM/BI service and technology suppliers have substantial implementation competence.	
The CPM project team has a good track record of delivering projects effectively.	
Business processes have been redesigned to fit CPM-embedded best practice.	
Business process owners have overall responsibility for CPM applications in their units.	
The business processes reflect both business and IT strategies.	
My organization has established easy-to-apply evaluation criteria to measure the effectiveness of business processes.	
My organization has assembled a cross-functional team to support process integration.	
My organization has instituted incentive systems to encourage process thinking and process-driven decision making among employees.	
The CPM system has improved the quality of communication between users.	

<p>The CPM/BI system allows me to share information easily with others.</p> <p>I have a high degree of confidence in the information provided by the CPM system.</p> <p>My organization has a structured program for researching, acquiring and diffusing information and knowledge about new technologies and processes regarding CPM configuration, deployment and management.</p> <p>My organization has put in place procedures to capture, codify, and disseminate CPM knowledge held by individuals (such as technical specialists and consultants).</p> <p>My organization has established effective partnerships with CPM service and technology partners for knowledge transfer.</p> <p>My organization has in place well structured and managed information and knowledge repositories for supporting overall business functioning.</p> <p>The content of the information and knowledge repositories are relatively accurate, up-to-date, and relevant.</p> <p>My organization has excellent access to CPM information and knowledge held by partners, consultants, and research organizations.</p> <p>Organizational information can be easily accessed and shared across the enterprise by authorized employees.</p> <p>Diffusion of organizational information and knowledge is supported by robust and user-friendly knowledge management technologies.</p>	
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Organizational performance outcome

We believe that performance impacts due to a CPM system will be experienced both as organizational wide and individual level effects. Scale items were designed to determine if the CPM system has had impacts on respondents at both these levels. Using earlier work by Shang & Seddon (2002), DeLone & McLean (1992, 2003), Mirani & Lederer (1998) and Velcu (2007), a number of measurement items related to organizational

performance were prepared for the survey. The following table lists the measurement items and literature references for organizational performance outcome.

TABLE 4.6 – Measurement items for organizational performance outcome	
Survey Questions	Reference
CPM systems have significantly improved the quality and quantity of business information owned by or accessible to my organization.	DeLone & McLean (1992, 2003); Longinidis & Gotzamani (2009); Mirani & Lederer (1998); Shang & Seddon (2002); Sircar & Choi (2009); Velcu (2007)
CPM systems have had a direct role in improving the financial performance of my organization.	
CPM systems have allowed my organization to become more flexible and responsive in delivering products and services to its markets.	
CPM systems have made significant contributions to increasing the efficiency and effectiveness of existing organizational processes.	
CPM systems have helped in the creation of new organizational processes.	
CPM systems have been instrumental in the creation of new organizational capabilities.	
CPM systems have played an important role in improving the human resources performance and visibility within my organization.	
The use of the CPM system has enabled employees to develop process-oriented skills.	
I am able to make better decisions with the information I am able to retrieve from the CPM system.	
I am able to make decisions faster with the information I am able to retrieve from the CPM system.	
The CPM system has helped improve the performance of my job function.	

4.1.6 Data Analysis

The data collected in this study can be analyzed using multivariate techniques including multiple linear regressions (MLR), Partial Least Squares (PLS) or Structural Equation

Modeling (SEM). These techniques are useful in explaining the effect of latent variables although their predictive power is often subject to the size of the data sample. Depending on the size of the data sample, any of these techniques may be appropriate to use for social science research (Jaccard & Wan, 1996; Cohen, 2001). In this study, we anticipated around 200 surveys to be returned so we felt it may be possible to use SEM analysis for this study. The use of SEM is also dependent on the number of factors in the model.

When the sample size is small, multiple linear regressions may be more appropriate. However, certain theoretical conditions must be met for this technique to be used. Tobias (1995) states that when the number of independent factors is few, not significantly redundant (co-linearity) and have a well understood relationship with the dependent variable, then MLR might be a valid approach. However, if any of these three conditions breaks down, MLR can be inefficient and/or inappropriate.

When the sample size is small, PLS is also an appropriate technique to use. PLS is widely used in social science research because it relaxes some of the theoretical assumptions required by other techniques such as MLR. When there are a large number of factors that are co-linear and ill-understood relationships and the object is merely to create a good predictive model, PLS is appropriate (Tobias, 1995). PLS reduces the number of factors by extracting only those factors that explain the most variance in the latent variable. However, the reliability of PLS is sometimes questioned due to this (Jaccard & Wan, 1996).

To summarize, when the sample size and the number of factors in the model is large, SEM is the most appropriate technique to use. SEM is better than the other analytical methods as it is more rigorous and can provide more accurate predictions (Jaccard & Wan, 1996). Both PLS and SEM are robust data analysis techniques but need appropriate sample sizes to be used. If the sample sizes are inappropriate for the techniques selected, PLS and SEM can provide misleading results.

4.1.7 Pre-testing of survey questionnaire

A pre-test of the survey was conducted between October and November 2009. A small group of people were invited to preview the survey. These individuals were all experienced with the use of CPM/BI systems and were asked for feedback regarding the survey design and content. Using these individuals established the face validity of the instrument. The goal of the pre-test was to test the comprehensibility of the questions and to make adjustments to the wording of questions if necessary. We were also interested in getting feedback from users regarding the time taken to fill out the survey and the relevance of questions to the various user groups.

Invitations were sent via email to the pre-testing group requesting them to fill in the survey with actual responses. A total of 30 invitations were mailed out. Twenty eight individuals viewed the survey. Nineteen of them responded and filled out a part of or completed the entire survey questionnaire. Only thirteen of the respondents completed the survey in its entirety. The high level of dropouts was a cause for concern and was followed up through individual phone calls. We were informed that the survey length was a key issue in non-completion so efforts were made to shorten the survey and to

simplify the questions. The breakdown of the respondents is listed in the following tables.

TABLE 4.7 – Results from pre-testing

User Stats	
Views	28
Started	19
Completed	13
Drop outs	6

User participation statistics

Gender	
Male	10
Female	3

User participation by gender

Industry	
Government	8
Private Sector	2
Unknown	3

Response by industry

User Type	
Management	4
IT Staff	8
Business User	1

User participation by type

Some respondents raised a concern that the questions posed were less applicable to service-oriented organizations such as Government which did not operate under a profit motive. Although, this is indeed a valid point, we believe that organizational performance is more than just financial. It was felt that we have included enough representative questions of a non-financial nature on the survey to still make it applicable to Government clients so no changes were made based on this specific concern.

Some respondents commented that the neutral option was often applicable when they filled out the survey and that the choice of 7 options was too fine grained and that a 5 point scale may be more appropriate. To avoid a central tendency bias, the scale can be modified to force a choice that agrees or disagrees with the question being asked by removing the neutral option so that users are forced to choose a direction (agree or

disagree) in their response. However, after some consideration, it was decided to leave the neutral option in the survey.

The original survey consisted of 150 questions. After the pre-testing phase, a total of 33 questions were removed from the original questionnaire. In all cases, removal occurred because the question turned out to be redundant in some way as it may have been asked in a similar form elsewhere. These questions were removed, reducing the overall survey length to 117 questions. The text of 30 questions were modified or slightly re-worded to improve clarity and readability. To establish the validity of the instrument, Cronbach's Alpha was calculated for each of the sections on the survey and a value of 0.8 and higher was established for each of the constructs being measured.

4.2 *Use of Supplementary Interviews*

The strength of qualitative research is its ability to provide complex textual descriptions of how people experience a given research issue. It provides information about the “human” side of an issue – that is, the often contradictory behaviors, beliefs, opinions, emotions, and relationships of individuals (*cf. Qualitative Research Methods: A Data Collector's Field Guide*). The qualitative research method is a very effective way to capture a rich source of information (Yin, 1994). Similar to quantitative methods, qualitative approaches also follow scientific research principles but have different analytical objectives and approaches.

In the qualitative phase of the research, a series of interview themes were developed based on the literature review. Data was collected through personal interviews with

senior managers at firms that have implemented CPM systems. Interviewees were asked to reflect on various issues related to CPM systems and their thoughts were recorded in paper by the interviewer.

4.2.1 Research Method

Qualitative research is sometimes considered as “*research without numbers*” but this does an injustice to a bona fide method of seeking to enrich our understanding of various types of phenomena (Bryman & Bell, 2007).

The method of selection of our interview subjects was non-random. Interviews were conducted with managers who were able to provide enhanced context to the information that we collected in the questionnaire survey. Approximately 12 interviews are to be conducted.

The interview candidates were selected from medium to large sized organizations that have implemented a CPM system and have experienced the issues we are seeking to shed light on in this research. They are considered leaders in their respective industries and are dependent on these information systems for their day to day operations.

4.2.2 Data Collection

Some of the managers we interviewed may have come from organizations whose employees have already filled out quantitative surveys in the first round of data collection. We also interviewed three knowledgeable individuals who are connected with this area either as a vendor or in an academic capacity. The interviews were conducted

over the phone or in person as appropriate and the conversations were recorded on paper notes with the permission of the participants. The interviewer asked the respondent to answer several closed and open ended questions. The respondents were asked to reflect on these open ended questions and to speak extemporaneously on the subject with limited prompting and guidance from the interviewer.

Interview themes were designed to frame the interview and to set the context. The themes we developed were similar to those explored in the quantitative questionnaire and dealt with the role the subject played within the CPM project and covered motivations for the implementation, CPM plans for the future, assessment of success, impacts on firm, lessons learned etc. Since the subjects of qualitative interviews are senior managers, a level of insight that may not be possible exclusively from the quantitative survey is expected.

The organizations selected for qualitative interviews comprised a range of different industries and varied in size (based on global revenues and headcount) into small, medium and large organizations. The identity of the organizations are to be kept anonymous (as agreed) and referred to as Company A, B, C etc in the final write-up.

4.2.3 Data Analysis

Following Yin (1994) and Miles & Huberman (1994), the information collected from each of the interviews was reviewed independently (*within-case*) and against each other (*cross-case*). Comments made by the interviewees on similar themes were compared within industry and between industries. We were particularly interested in comments

pertaining to the constructs proposed in the CPM performance model, pertaining to IT infrastructure, human capital, organizational culture, strategic leadership, implementation outcome, capability portfolio management and organizational performance.

4.3 *Integrating quantitative and qualitative research*

There is no clear consensus as to what is the optimum way to integrate quantitative and qualitative research with some researchers recommending integration throughout the process (Mingers, 2001, 2003) and others advocating strict segregation (Bazeley, 2009). Kane & Trochim (2007) suggest that instead of simply combining qualitative and quantitative methods, it is better to perform concept analysis that intertwines the methods whereby qualitative information is represented quantitatively and qualitative judgment is applied to quantitative information. Yin (2006) and Mingers (2001, 2003) recommend the value of integrating both methods though all steps in a mixed methods study from the research questions being addressed, the definition of the units of analyses, the structure of the samples being studied, the instrumentation and data collected and the analytic strategies used. Integration in mixed methods can take multiple forms. Where integration is intentional, the mix of methods might occur through iteration, blending, nesting, or embedding or through serving a common substantive (holistic) or ideological (transformative) purpose (Greene, 2007 cf. Bazeley, 2009). Strategies for integration include intensive case analysis, employing analysis results from one data set into the analysis of another type of data. Other techniques include coding of qualitative data into categorical or scaled variables or the use of software programs to quantify case-oriented data.

In this study, we used the interview data to supplement our understanding of the data we gathered quantitatively to explain the results of hypothesis testing and to inform our findings. This approach is congruent with the sequential mixed methods research strategy suggested by Cresswell (2009).

This chapter has covered the methods through which data will be collected and we have discussed the way we will analyze data for this research study. The survey questionnaire has been developed based on a review of the IS literature. A pre-test of the survey has been conducted that has led to a number of modifications in the survey questionnaire, mainly to facilitate understanding and to reduce its length. Some of the pre-testers took in excess of one hour to fill out the survey and certain non-essential questions were removed to make the survey less onerous to complete. In the next chapter, we analyze our data using a combination of multiple regressions and SEM techniques.

5 Quantitative Data Analysis

In the previous chapter, the research model was presented and the data collection method was described. In this chapter, statistical analysis is performed on the survey data using the SPSS software with the AMOS add-on package. Descriptive statistics related to the respondents and responses collected are presented along with the results of Exploratory Factor Analysis (EFA), Multiple Linear Regression (MLR) and Structural Equation Modeling (SEM). The four hypotheses and two propositions presented in the previous chapter and tested and findings are discussed.

5.1 *Descriptive Statistics*

The survey questionnaire was prepared using QuestionPro, an online web resource. We acknowledge that the use of an online survey approach does not give the researcher any control over the time and location of measurement but research has suggested that the use of face to face interviews may introduce more bias than the impersonality associated with computer based surveys (Richman et al., 1999). In our estimation, the convenience and low cost associated with this method of data collection outweighed any negatives of using it. Our online questionnaire consisted of a total of 117 questions designed to test the various model constructs, hypotheses and propositions of this research.

As we described in Chapter 4, the participant list was obtained from publicly available customer information provided on the websites of major CPM vendors. Vendors often provide detailed case studies of their implementation experiences on their web sites. In many of these case studies, a client contact name and email address was supplied. Where

contacts were not readily obtainable, additional research was conducted using online search engines (*Google, Yahoo Finance, Bloomberg News etc.*) find potential contacts at these companies. In some cases, the company was contacted by phone and a contact person responsible for Business Intelligence or Performance Management was obtained.

In all, a total of 1132 email invitations were sent out to respondents requesting participation in this study. In total, 669 distinct firms were asked to participate in this study. After removing cases with incomplete responses, we were left with 165 responses that were used for data analysis. The email invitation assured respondents that their responses were to be treated as confidential and any information reported was to be in summary form in accordance with the ethical guidelines of Carleton University. Since the survey was designed to be anonymous, it is not possible to know accurately how many firms are actually represented in the sample. However, we asked respondents to provide their email address if they wished to receive a copy of the study findings and based on an analysis of this information, we believe that a minimum of at least 61 firms are represented within our data sample. Our initial contact email included an embedded link that respondents could click on to begin the online survey. Since the survey is quite long, a “*Save and Continue later*” option was provided to allow respondents to partially fill out the survey and return to it at a later time if desired.

The survey invitations were sent out in one large batch on Friday, February 19, 2010. The following table provides frequency information on the survey response. The

response rate we received was 14.6 % which appears to be in line with the expected response rate for IS research surveys (Sivo et al. 2006).

TABLE 5.1 – Survey response rate	
	Count
Total invitations sent out	1132
Survey viewed by	478
Survey was started by	326
Surveys discarded (no useful information)	116
Partially completed surveys	45*
Surveys fully Completed by	165
Response Rate (n = 1132)	14.6%

The survey was kept open for a period of two months (*from Feb 19- April 24, 2010*). In the days following the initial invitation, a high number of responses were received and over the next 2 months responses continued to come in. A reminder email was sent out to encourage participants to fill out the survey.

The following table provides the frequency with which survey responses were received over the 2 month period that the survey was kept open.

TABLE 5.2 – Survey responses by week	
Date Range	Responses Received
Feb 20 – Feb 27	50
Feb 28 - Mar 6	53
Mar 7 – Mar 13	45
Mar 14 – Mar 20	7
Mar 21 – Mar 27	6
Mar 28 - Apr 3	2
Apr 4 – Apr 10	0
Apr 11 – Apr 17	1
Apr 18 – Apr 24	1
	165

The respondents were divided into three groups, namely managers, IT staff and business users. During our pre-testing, we had received strong feedback from the testing groups that the survey included several questions that were simply not applicable to some of the respondents. These questions were strategic in nature that was more appropriately answered by a manager. Many pre-testers reported being unable to complete the survey and dropped out mid-way due to fatigue or lack of focus. Our research objective was to get a holistic perspective and we wanted responses from managers, IT staff and end users. Therefore, based on our pre-testing experience, a branching method was adapted within the online survey where a subset of questions was presented based on the group that the respondent self-identified with at the start of the survey. We chose to do this because we wanted to encourage completion of the survey and we wanted to ensure that the data collected was of a high quality. The following table depicts how the survey questions were distributed among the three user groups.

TABLE 5.3 – Survey question distribution by respondent group				
Survey Section	Total Items	Managers	IT Staff	Business Users
Demographics	12	12	12	12
Context	11	11	3	2
IT Infrastructure	9	6	9	2
Human Capital	11	11	6	10
Leadership – CPM strategy	5	5	3	3
Leadership – CPM enabled change	5	5	1	1
Leadership – Performance and Risk	6	6	3	2
Organizational Culture	12	12	10	10
Implementation Outcome	7	7	7	5
Capability – Project Governance	5	5	1	1
Capability – Organizational CPM Competence	3	3	2	1
Capability – Project Competence	3	3	1	2
Capability – Bus. Process Design	6	6	2	4
Capability – Info Sharing, Quality & Communication	3	3	3	3
Capability – Knowledge Management	3	3	1	0
Capability – Information and Knowledge Resources	5	5	2	2
Organizational Performance Outcome	11	11	11	11
TOTAL	117	114	77	71

Of the 117 possible questions, managers were asked to respond to a total of 114 questions. IT staff were asked to respond to a total of 77 questions and business users were asked 71 questions. Questions overlapped between the respondent groups. Table 5.4 and 5.5 show how the survey responses were distributed.

TABLE 5.4 – Survey response counts by user group			
Group	Classified as	Surveys	%age
Senior Executive CEO CIO CTO etc	Management	5	3.03 %
Senior Management VP Director etc	Management	15	9.09 %
Management non IT	Management	18	10.91 %
Management IT	Management	32	19.39 %
IT staff non management	IT staff	49	29.70 %
Consultant (with an IT focus)	IT staff	31	18.79 %
Business User	Consumer	15	9.09 %
		165	100.0 %

TABLE 5.5 – Survey response counts by user classification		
Classification	Surveys	%age
Management	70	42.42 %
IT Staff	80	48.48 %
Business Users	15	9.09 %
	165	100.0 %

The survey was sent to companies that varied considerably in terms of the number of employees. The majority of our responses were from large corporations with over 1000 employees. Table 5.6 shows the breakdown.

TABLE 5.6 – Survey responses broken down by firm size		
Organizational Employees	Surveys	%age
Less than 100	6	3.64 %
101 – 1000	40	24.24 %
1001 – 10000	71	43.03 %
More than 10000	45	27.27 %
Missing	3	1.82 %
	165	100.0 %

We were interested in knowing how experienced firms were with the use of CPM systems. We see that the majority of our respondents classified themselves as experienced with over 5 years of experience using these systems. Table 5.7 provides the breakdown.

TABLE 5.7 – Survey responses broken down by CPM/BI experience		
BI/CPM experience	Surveys	%age
Currently being implemented	8	4.85 %
Less than 1 year	3	1.82 %
1 to 5 years	45	27.27 %
More than 5 years	107	64.85 %
Missing	2	1.21 %
	165	100.0 %

5.2 *Data related issues*

Bias can be introduced into a data set by virtue of the method through which data is collected. When variance is attributable to the measurement method instead of the construct of interest, we have a case of common method variance bias (Bagozzi & Yi, 1990). Such variances can have a serious impact on research findings and the generalization of results. Examples of survey induced biases include common source/respondent, item characteristics, item context and measurement context. Reducing bias entirely can be a costly process and a healthy balance has to be struck to control bias through techniques that are documented in the literature. Common source biases such as socially desirable responses can be mitigated somewhat by ensuring client confidentiality and providing total anonymity to the respondent (Podsakoff et al., 2003). This was an important consideration we addressed in our data collection process. We collected no identifiable data from our respondents and assured respondents that all responses were anonymous and results to be presented in summary form only. Email

addresses were collected on a separate form if the respondent wished to receive a copy of the findings. To mitigate issues related to item context, questions were sometimes posed out of order and we took pains to ensure, as far as possible, that questions were clear, written in simple English and were singular in nature dealing with only one issue at a time.

5.2.1 Assumption of Normality in data set

We used the tests of Skewness and Kurtosis to test the assumption of normality in the data set. Skewness is concerned with the symmetry of the distribution. A positively skewed distribution has scores clustered to the left of the normal curve with a long tail on the right. A negatively skewed distribution denotes the opposite case. Absolute values for skewness should generally be under 2 (Stevens, 1996). Values outside of this range would indicate that the data is heavily skewed. Kurtosis is concerned with peaks in the data. A distribution with normal kurtosis would have a perfect bell-shape. Positive values for Kurtosis indicate a higher than normal peak to the data set and negative values for Kurtosis indicate that the data is less peaked than an ideal normal distribution. An acceptable range for the absolute value for Kurtosis scores is around 7 (Norusis, 2004). Every measurement item within our data set was tested for normality and there were no issues with any of them. All measurement items fell within the proscribed limits of these normality tests.

5.2.2 Outliers

An outlier is an observation whose value is distant from the values of the majority of observations and is technically defined as a value whose distance from the nearest

quartile is greater than 1.5 times the inter-quartile range (Norusis, 2004). Outliers pull the mean in their direction, and should always be carefully examined. We used exploratory techniques such as box plots to identify outliers for each of the constructs. In the dataset, there were a total of 24 unique cases with outlier issues. These cases were marked with a special variable in the dataset so that they could be excluded from analysis if required. The number of outliers found for each of the model constructs is provided in Table 10.10 in the appendix.

5.2.3 Partially completed surveys

Although we would have liked to see a higher response rate, it is understandable why some people did not fill in the survey. Incomplete surveys are a common problem with primary data collection. The researcher has no control over the respondent and collecting data in this manner can result in missing values and reduced sample size. Many potential respondents do not participate in research surveys because they lack the time or incentive to do so. Some respondents after being contacted by the researcher indicated that their company did not encourage participation in such surveys citing reasons related to confidentiality and corporate policy. Dillman (2000) and Stevens (1996) found that the length of the survey is directly related to overall response rate. We received negative feedback related to the length of the survey and believe that the 10+ page survey may have discouraged some respondents from participating.

Of the 326 surveys that were started by respondents, 165 were filled out completely. One hundred and sixteen (116) were left incomplete with much less than 50% of the questions filled out. These surveys were considered of no value and were simply removed from the

data set. Forty five (45) surveys were partially filled out with more than 50% of the questions answered. It was decided that these surveys may be worth keeping if the missing values could possibly be imputed from the rest of the data set and if the missing data was randomly distributed. These 45 surveys were specifically flagged so that they could be included or excluded from analysis if desired. To impute missing values, a commonly used technique is to use series means from other respondents that share a similar profile but such techniques are normally used when the missing data is random in nature (Cohen et al., 2003). Random missing data is less problematic to deal with than non-random missing data (Rubin, 1976). However, in our research, we noted that the dropouts were caused due to user fatigue and the missing data tended to be contiguous items from the drop out point right to the end of the survey. For this reason, we felt that imputing the values using series means would be a somewhat arbitrary process and would be better avoided. Therefore, we decided not to use any of the partially completed responses and did all further analysis using only the 165 responses that were fully completed.

5.2.4 Not applicable (N/A) selection in surveys

The survey was constructed using a 5 point Likert scale with responses ranging from 1- Strongly Disagree to 5 – Strongly Agree. A neutral option (3) was provided to indicate that the respondent neither agreed nor disagreed with the statement. We provided a 6th option (*Not Applicable or N/A*) as the default option for all the questions to avoid forcing a selection if a question did not apply to the respondent. The N/A responses were re-coded from 6 to 999 (*to make them stand out easily in the data*) and coded within the data set as a “*missing value*” so that they are automatically excluded in any analyses. Please

note that the selection of the “N/A” option is not the same as “*No Answer*”, the latter being the case when the question was never posed to the respondent. “*No Answer*” was reported as zero-values in the data set. Both cases were treated as missing values in the statistical analysis.

5.2.5 Non-response bias

Non-response bias is a practical problem in primary data collection methods resulting from limiting the survey analysis only to the available data and the failure to obtain data from a particular respondent within the sample (Kish, 1965). The implication of non-response bias is that respondents who chose not to answer the survey may hold potentially valuable information and whose lack of inclusion may affect the research findings adversely. Since we are limited to the respondents who actually answered the survey, a test for non-response bias using the data we have collected can be performed by segregating our data according to some common characteristics. Armstrong & Overton (1977) note that non-response bias can be detected by looking at the responses from early responders and late responders to see if there is any significant difference between the groups. Our data collection took place over a 2 month period so we classified our cases according to the date that the response was received on. Cases that came in within the first week the survey was available were classified as an EARLYRESPONDER. All other cases received after the first week was tagged as a LATERESPONDER. Fifty cases were placed in the early responder group and 115 were placed in the late responder group.

The following table represents the mean scores for each of the model constructs.

TABLE 5.8 – Mean scores for model constructs						
Construct	Mean (all)	Std. Dev.		Mean (Mgmt)	Mean (IT staff)	Mean (Bus. User)
IT Infrastructure Capability (ITC)	3.62	0.64		3.52	3.74	3.43
Human Capital Capability (HCC)	3.83	0.60		3.76	3.90	3.77
Strategic Leadership Capability (SLC)	3.30	0.61		3.28	3.34	3.16
Implementation Outcome (IO)	3.60	0.60		3.51	3.67	3.66
Core Organizational Capabilities (COC)	3.51	0.55		3.34	3.63	3.63
Organizational Performance (OP)	3.70	0.57		3.63	3.77	3.68

The variances between the groups are considered to be statistically equivalent and this determines the choice of tests that can be applied in the post-hoc multiple comparison. A test to assess the homogeneity of variance of each of the constructs was conducted by computing the Levene statistic. The Levene statistic is used to test the assumption of equal variance in two samples such as those belonging to the late and early responder groups. The Levene statistic is useful because it does not depend on the assumption of normality in the data (Brown & Forsythe, 1974). The null hypothesis is that there is no difference in the variance between the two respondent groups. Were the p-value of the Levene statistic to fall below a 0.05 significance level, the null hypothesis would be rejected and the assumption of equal variance cannot be assumed. Another robust test of equality was also conducted using the Brown-Forsythe statistic. The Brown-Forsythe statistic uses the median instead of the mean and is considered robust against non-normal data (Brown & Forsythe, 1974). The following table shows the results of the homogeneity of variance tests conducted on the early and late responder groups.

TABLE 5.9 – Levene and Brown-Forsythe tests for non-response bias				
Construct	Levene	Sig.	Brown-Forsythe	Sig.
IT Infrastructure Capability (ITC)	.319	.573	1.105	.296
Human Capital Capability (HCC)	.126	.723	.505	.479
Strategic Leadership Capability (SLC)	.803	.371	1.729	.192
Implementation Outcome (IO)	.215	.644	.006	.939
Core Organizational Capabilities (COC)	.098	.754	.130	.719
Organizational Performance (OP)	.056	.813	.007	.935

All our p-values are over the 0.05 significance level meaning we cannot reject the null hypothesis of equal variances between the groups. A one way Analysis of Variance (ANOVA) test was conducted to test for mean differences in the variables. The following table is the result of the ANOVA test on each of the model constructs.

TABLE 5.10 – ANOVA test for non-response bias						
Construct		Sum of Squares	df	Mean Square	F	Sig.
IT Infrastructure Capability (ITC)	Between Groups	.413	1	.413	1.011	.316
	Within Groups	66.587	163	.409		
	Total	67.000	164			
Human Capital Capability (HCC)	Between Groups	.189	1	.189	.518	.473
	Within Groups	59.376	163	.364		
	Total	59.565	164			
Strategic Leadership Capability (SLC)	Between Groups	.692	1	.692	1.875	.173
	Within Groups	60.143	163	.369		
	Total	60.834	164			
Implementation Outcome (IO)	Between Groups	.002	1	.002	.006	.938
	Within Groups	59.499	163	.365		
	Total	59.501	164			
Core Organizational Capabilities (COC)	Between Groups	.038	1	.038	.126	.723
	Within Groups	48.704	163	.299		
	Total	48.742	164			
Organizational Performance (OP)	Between Groups	.002	1	.002	.007	.933
	Within Groups	52.440	163	.322		
	Total	52.443	164			

In general, F statistic is used to establish if there is a difference between groups means, and means plots suggest where the difference may lie. The significance values of the F-tests in the ANOVA table shown above are all above 0.05 which means that we cannot reject the null hypothesis that the means are equal across both the early and late responder groups.

Based on the three tests we conducted, there appears to be no material difference between the responses from the two groups. The statistical results above confirm that the responding firms represent the research sample and that there is no response bias.

5.3 *Testing the survey instrument*

This section discusses tests conducted on the survey instrument to determine if the items selected appropriately and consistently measure the concept that they are supposed to be measuring.

5.3.1 Reliability

To test the reliability of the survey instrument, the value of Cronbach Alpha was calculated for the items used to represent the model constructs. The following table summarizes the values found for each of the constructs. Cronbach Alpha is a test of internal consistency to ensure that the items on the measurement scale are properly measuring the concepts that they have been designed to measure (Nunnally, 1979; Cortina, 1993). A score close to 1 indicates a high degree of consistency among the scale items. A score of 0.7 or above is generally considered to be highly reliable (Hair et al., 1998).

TABLE 5.11 – Cronbach Alpha test for reliability			
Construct	Scale Items	C.Alpha	C.Alpha (combined)
Demographics	12		N/A
Context	11		.595
IT Infrastructure Capability	9		.847
Human Capital Capability	11		.859
Strategic Leadership Capability – CPM strategy	5		.853
Strategic Leadership Capability – CPM enabled change	5		.739
Strategic Leadership Capability – Performance and Risk	6		.718
Implementation Outcome	7		.799
Core Org. Capability – Project Governance	5	.680	.911
Core Org. Capability – Organizational CPM Competence	3	.680	
Core Org. Capability – Project Competence	3	.690	
Core Org. Capability – Bus. Process Design	6	.728	
Core Org. Capability – Information Sharing, Quality & Communication	3	.763	
Capability – Knowledge Management	3	.800	
Capability – Information and Knowledge Resources	5	.814	
Organizational Performance Outcome	11		.900

The level of consistency for the various measures in the survey appears to be quite good. With the exception of the individual capability constructs, our values for Cronbach Alpha were 0.7 or better, which indicates a high level of internal consistency among the measurement items. The capability construct was divided into multiple sub-groups and taken individually the value of Cronbach Alpha was less than 0.7 for some of them. This is because some of these measures have 3 or less items in the scale and also the nature of the survey was that not all respondents were asked the questions so there was missing values within the response table. When all of the capability measures are aggregated into one overarching capability construct, the value of Cronbach Alpha increased to 0.911, which indicates a high degree of consistency for the overall construct.

5.3.2 Measurement Validity

A bivariate correlation analysis was performed between the mean scores of all of the major constructs in the model to see if correlations exist between them. Missing values were excluded from the analysis using a pair-wise strategy. A two-tailed test of significance was used. The following table summarizes the co-relation pairs.

TABLE 5.12 –Pearson's co-efficient correlation matrix						
Construct	ITC	HCC	SLC	IO	COC	OP
ITC	1					
HCC	.473	1				
SLC	.450	.622	1			
IO	.349	.426	.516	1		
COC	.561	.600	.713	.679	1	
OP	.380	.546	.589	.616	.696	1

Discriminant validity is demonstrated when measures of different concepts are distinct. This is detected by noting the strength of the correlations among the concepts (Ping, 2004). Brown (2006) notes that correlations greater than 0.85 would indicate poor discriminant validity. All of our correlations are below that cutoff threshold as observed in the table above.

Balasubramanian et al. (2003) suggest an additional test to establish discriminatory validity that we performed. Due to the endogenous, embedded nature of the constructs in the model, between construct tests of discriminant validity were conducted (Venkataraman, 1989; Sethi & King, 1994). Constructs were sequentially accommodated in measurement models – one model had the covariance fixed to unity (*implying the constructs are the same*) and a second where the covariance is free (*allowing the*

constructs to be different). A significant difference in the corresponding chi-square statistics indicate that the constructs are statistically different (*distributed chi-square with $df=1$*). Our tests indicated satisfactory discriminatory validity.

5.4 *Exploratory Factor Analysis*

Variable Reduction and Identification of Principal Components

Factor analysis is primarily used for two purposes. The first is to reduce the number of indicator variables used to represent a model construct and the second is to detect structural relationships between variables. The principal components method of extraction involves finding a linear combination of variables (*a factor*) that accounts for as much variation in the original variables as possible using the least number of items. The approach then finds the next factor that accounts for as much of the remaining variation as possible and is uncorrelated with the previous factor, continuing in this way until there are as many factors as there are original variables. A general rule of thumb is to discard all factors with an Eigenvalue less than 1 (Norusis, 2004). Usually, a few factors will account for most of the variation, and these variable items may be used to replace the original variables. This technique is most often used to reduce the number of variables in the analysis.

To use factor analysis, variables must be quantitative in nature and Pearson co-relation coefficients should be calculable. In addition, the data should have a bivariate normal distribution for each pair of variables and observations should be independent. The factor analysis model specifies that variables are determined by common factors (*the factors estimated by the model*) and unique factors (*that do not overlap between observed*

variables); the computed estimates are based on the assumption that all unique factors are uncorrelated with each other and with the common factors. (Norusis, 2004).

Each of the individual constructs and their corresponding measurement items were put through a factor analysis using Principal Components Analysis (PCA) method with Varimax rotation. The extraction was based on factors that displayed an Eigenvalue greater than or equal to 1. The results of the factor analysis follow.

Factor Analysis - IT Infrastructure Capability (ITC) Construct

Extraction communalities are estimates of the variance in each variable accounted for by the factors. With a couple of exceptions, the communalities for the measures of this construct were all quite high, which indicates that the extracted components represent the variables quite well.

TABLE 5.13 - Eigenvalue scores and variances for ITC construct				
Factor	Eigenvalue (initial)	Eigenvalue (rotated)	% variance (rotated)	Cumulative % (rotated)
ITC1	4.268	3.184	35.382	35.382
ITC2	1.167	2.250	25.005	60.387

The initial Eigenvalue represents the amount of variance in the original variables accounted for by each factor. The rotation maintains the cumulative percentage of variation explained by the extracted factors, but that variation is now spread more evenly over the factors. The large changes in the individual totals suggest that the rotated component matrix will be easier to interpret than the un-rotated matrix. The % of Variance column gives the ratio, expressed as a percentage, of the variance accounted for

by each component to the total variance in all of the variables, which is over 35 % to Factor 1 and 25 % to Factor 2. The Cumulative % column gives the percentage of variance accounted for by these 2 factors meaning that the extracted factors account for over 60 % of the variability in the original variables.

The rotated component matrix helps to determine what these factors represent and based on the loadings we observed, we believe that the potential factors for IT Infrastructure capability are:

TABLE 5.14 – Principal factors for ITC construct	
ITC1	IT Governance
ITC2	Physical Architecture

Note - For further details regarding which measurement items were used for the ITC construct, please refer to Table 10.12 in the appendix. Items that loaded primarily only onto one factor are identified with gray shading in the cell. In cases where we found that some items cross-loaded onto more than one factor, a decision was made to associate the measurement item under the factor that appeared to be most appropriate in the particular case. For example, measurement items V32 and V33 loaded on both factors but since these items are concerned with physical infrastructure and architecture, we have opted to select them for Factor 2.

Factor Analysis – Human Capital Capability (HCC) Construct

TABLE 5.15 - Eigenvalue scores and variances for HCC construct				
Factor	Eigenvalue (initial)	Eigenvalue (rotated)	% variance (rotated)	Cumulative % (rotated)
HCC1	4.705	3.130	28.456	28.456
HCC2	1.438	2.402	21.836	50.292
HCC3	1.119	1.635	14.867	65.159
HCC4	1.094	1.188	10.804	75.963

Based on the loadings, we believe that the potential factors for Human Capital Capability construct are:

TABLE 5.16 – Principal factors for HCC construct	
HCC1	IT Staff Support
HCC2	IT Staff Competence with IT/IS
HCC3	Personal Competence with CPM/BI
HCC4	Individual-Organization Alignment

In the above analysis, four factors were extracted. As can be seen in the table above, we did not have enough measurement items for the fourth factor and we have eliminated this factor from further analysis.

Note - The shaded boxes are examples of this type of decision being taken. For further details regarding which measurement items were used for the HCC construct, please refer to Table 10.14 in the appendix.

Factor Analysis – Strategic Leadership Capability (SLC) construct

TABLE 5.17 - Eigenvalue scores and variances for SLC construct				
Factor	Eigenvalue (initial)	Eigenvalue (rotated)	% variance (rotated)	Cumulative % (rotated)
SLC1	5.736	3.438	21.486	21.486
SLC2	1.970	2.689	16.809	38.295
SLC3	1.504	1.866	11.664	49.959
SLC4	1.136	1.776	11.097	61.056
SLC5	1.067	1.643	10.272	71.328

Based on the loadings we observed, we believe that the potential factors for Strategic Leadership Capability are:

TABLE 5.18 – Principal factors for SLC construct	
SLC1	Management Readiness for CPM / BI
SLC2	Organizational Readiness for CPM / BI
SLC3	Not Used
SLC4	Not Used - items are absorbed into SLC1
SLC5	Not Used – items are absorbed into SLC1

In the above table, we see that five factors were extracted in the analysis. Factors 4 and 5 did not have enough measurement items and upon consideration, we felt that there was not enough support for them to stand as independent factors. We also observed strong cross loading with the dominant first factor so the measurement items for Factors 4 and 5 were absorbed into Factor 1 increasing the variances represented by SLC1 to 42%. Factor 3 did not have enough support items and was dropped from the analysis. For further details regarding which measurement items were used for the SLC construct, please refer to Table 10.16 in the appendix.

Factor Analysis – Implementation Outcome (IO)

TABLE 5.19 - Eigenvalue scores and variances for IO construct

Factor	Eigenvalue (initial)	Eigenvalue (rotated)	% variance (rotated)	Cumulative % (rotated)
IO1	3.271	2.903	41.475	41.475
IO2	1.506	1.874	26.771	68.246

Based on the loadings we observed, we believe that the potential factors for Implementation Outcome are:

TABLE 5.20 – Principal factors for IO construct

IO1	Personal Impacts
IO2	Project Execution

For further details regarding which measurement items were used for the IO construct, please refer to Table 10.18 in the appendix.

Factor Analysis – Core Organizational Capabilities (COC)

TABLE 5.21 - Eigenvalue scores and variances for COC construct

Factor	Eigenvalue (initial)	Eigenvalue (rotated)	% variance (rotated)	Cumulative % (rotated)
COC_KM	9.319	4.062	14.506	14.506
COC_BPR	2.819	3.138	11.207	25.713
COC_ORGCOMP	2.182	2.711	9.684	35.397
COC_PROJGOVERN	1.807	2.617	9.348	44.745
COC_INFO	1.577	2.544	9.085	53.829
COC_PROJCOMP	1.396	2.501	8.932	62.761
COC_KNOWLRES	1.307	1.805	6.446	69.208
COC_8	1.065	1.762	6.292	75.500
COC_9	1.013	1.345	4.804	80.304

Based on the loadings we observed, we believe that the potential factors for core organizational capabilities are:

TABLE 5.22 – Principal factors for COC construct	
COC_KM	Knowledge Management Capability
COC_BPR	Business Process Re-Engineering Capability
COC_ORGCOMP	Organizational IT/IS Capability
COC_PROJGOVERN	Project Governance Capability
COC_INFO	Information Communication and Sharing Capability
COC_PROJCOMP	Project Team Capability
COC_KMRES	Not Used – absorbed into F1
COC_8	Not Used
COC_9	Not Used

The factor analysis yielded a possible 9 factors for the core organizational capabilities construct. Six of these factors mapped cleanly to the original constructs that we had proposed in the conceptual model. Factor 7 (*KM Resources*) was combined into Factor 1 that we refer to collectively as Knowledge Management. The remaining two factors did not have enough measurement items to support them and were dropped from further analysis. For further details regarding which measurement items were used for the COC constructs, please refer to Table 10.20 in the appendix.

Factor Analysis – Organizational Performance (OP)

TABLE 5.23 - Eigenvalue scores and variances for OP construct				
Factor	Eigenvalue (initial)	Eigenvalue (rotated)	% variance (rotated)	Cumulative % (rotated)
OP1	5.729	3.643	33.120	33.120
OP2	1.211	3.297	29.973	63.094

Based on the loadings we observed, we believe that the potential factors for Organizational Performance are:

TABLE 5.24 – Principal factors for OP construct	
OP1	Resource Base of Firm (Processes & Capabilities)
OP2	Decision Making

For further details regarding which measurement items were used for the OP construct, please refer to Table 10.22 in the appendix.

Use of Parceling Technique

For the core capabilities constructs, we adopted a partial disaggregation approach where items were combined into “*parcels*” and the mean of the parcel was used as the observed indicators of the first order construct. For example, the Knowledge Management construct was originally represented by 8 measurement items. We rolled these up into a mean score for each case called COC_KM. We did the same for all of the capability constructs. These parceled scores were then used as an indicator of the overall Core Organizational Capability latent variable. There is some debate in the literature about the pros and cons of disaggregation (Williams et al., 2009). Using the individual items from the questionnaire has the advantage that it provides information about each question used in the analysis and is as close as possible to the true response of the individual (Little et al. 2002). However, the disadvantage of using individual items include lower reliability and communality and a smaller ratio of common to unique variance than using parcels or scales (Williams et al. 2009). Parceling involves combining items to create “*parcels*”

which are then used as indicators of the latent variable. Parcels of items replicate well across samples and studies (Coffman & MacCallum, 2005; Little et al., 2002). Fewer parameters are estimated, which is important when sample sizes are small as it is in this research. There are also fewer chances for co-relations among uniqueness estimates when parcels are used (Williams et al. 2009). The most attractive approach to forming parcels is the “*item-to-construct balance*” where the best and worst items are balanced among the parcels so that no single parcel ends up with all the good or bad items (Williams et al., 2009).

The next section describes the multiple linear regressions that we performed to test our model.

5.5 *Multiple Linear Regression*

Multiple Linear Regression (MLR) estimates the coefficients of a linear equation, involving one or more independent variables that best predict the value of a dependent variable. Cohen et al. (2003) state that to use MLR the data has to meet the following conditions. First, the dependent and independent variables should be quantitative and not categorical in nature. Second, for each value of the independent variable, the distribution of the dependent variable must be normally distributed. Third, the variance of the distribution of the dependent variable should be constant for all values of the independent variable. The relationship between the dependent variable and each independent variable should be linear, and all observations should be independent. Our data meets these conditions.

Linear regression is used to model the value of a dependent scale variable based on its linear relationship to one or more predictors. The linear regression model assumes that there is a linear relationship between the dependent variable and each predictor. This relationship is described in the following formula.

$$y_i = b_0 + b_1x_{i1} + \dots + b_px_{ip} + e_i$$

Where

y_i is the value of the i^{th} case of the dependent scale variable

p is the number of predictors

b_j is the value of the j^{th} coefficient, $j=0, \dots, p$

x_{ij} is the value of the i^{th} case of the j^{th} predictor

e_i is the error in the observed value for the i^{th} case

The model is linear because increasing the value of the j^{th} predictor by 1 unit increases the value of the dependent by b_j units. Note that b_0 is the intercept, the model-predicted value of the dependent variable when the value of every predictor is equal to 0.

In the conceptual model proposed, there are 3 exogenous (*independent*) variables (IT Infrastructure Capability (ITC), Human Capital Capability (HCC) and Strategic Leadership Capability (SLC)) and 3 endogenous (*dependent*) variables (Implementation Outcome (IO), Core organization capabilities (COC) and Organizational Performance (OP)). Implementation Outcome and the Core Organization Capabilities variables also

act as independent variables. For brevity, from this point on, the constructs shall be referred to by their abbreviated forms.

To test the model using MLR, we divided the conceptual model into three individual sub-models and analyzed them separately.

When performing MLR, an assumption of normality of the sample data is made. The tests for Skewness and Kurtosis we performed indicated that our data appears to be normally distributed. In the data set, we aggregated measurement items and calculated mean scores for each model construct. First, a mean score was calculated based on all the original measurement items. Second, after EFA was performed, a mean score was calculated for each of the individual factors using only the measurement items that loaded cleanly on to each indicated factor. With very few exceptions, we were able to calculate mean scores for all of the constructs for each case. Table 5.25 on the following page shows the value for each of the construct means calculated according to the methods described above.

TABLE 5.25 – Tests of Skewness and Kurtosis							
	N	Mean	S.D.	Skewness	S.E.	Kurtosis	S.E.
ITCMEAN	165	3.6191	.63917	-.328	.189	-.210	.376
HCCMEAN	165	3.8312	.60266	-.313	.189	.003	.376
SLCMEAN	165	3.2983	.60905	-.203	.189	-.076	.376
IOMEAN	165	3.5977	.60234	-.335	.189	.057	.376
COCKNOWLMGMT	144	3.2836	.88105	-.016	.202	-.589	.401
COCKNOWLRES	162	3.5210	.73682	-.442	.191	-.279	.379
COCBPR	163	3.1882	.69262	-.019	.190	-.556	.378
COCORGCOMP	162	3.4722	.76212	-.129	.191	-.248	.379
COCPROJGOVERN	159	3.5468	.84188	-.587	.192	.169	.383
COCINFO	164	3.7927	.64381	-.289	.190	.320	.377
COCPROJCOMP	161	3.7857	.68400	-.912	.191	1.956	.380
COCMEAN	165	3.5056	.54517	.018	.189	.146	.376
OPMEAN	165	3.7017	.56548	-.315	.189	.017	.376
ITC1	165	3.6784	.70451	-.509	.189	-.009	.376
ITC2	165	3.5010	.83799	-.436	.189	-.645	.376
HCC1	165	3.6596	.81392	-.623	.189	.055	.376
HCC2	85	3.6637	.74529	-.532	.261	-.145	.517
HCC3	164	3.9573	.76021	-.575	.190	.301	.377
SLC1	165	3.3421	.63541	-.073	.189	-.078	.376
SLC2	70	3.2060	.75338	-.112	.287	-.492	.566
IO1	164	3.7355	.61586	-.429	.190	.130	.377
IO2	138	3.1920	.91883	-.475	.206	-.404	.410
COC_KM	165	3.4391	.71199	-.240	.189	-.394	.376
COC_BPR	160	3.4120	.76481	-.492	.192	-.406	.381
COC_ORGCOMP	146	3.6404	.85247	-.600	.201	.114	.399
COC_PROJGOVERN	160	3.5688	.86822	-.692	.192	.157	.381
COC_INFO	164	3.7927	.64381	-.289	.190	.320	.377
COC_PROJCOMP	159	3.7070	.72253	-.738	.192	1.258	.383
OP1	163	3.5738	.59765	-.245	.190	-.039	.378
OP2	161	3.9125	.67744	-.412	.191	-.090	.380

In our data, we had acceptable values for both Skewness and Kurtosis indicating we are dealing with normally distributed data. High values for Kurtosis indicate that there is a sharper peak to the data and longer, fatter tails in the distribution. Positive excess

Kurtosis is referred to as a “*leptokurtotic*” distribution and has a more acute peak around the mean (*a higher probability than a normally distributed variable of values near the mean*) and fatter tails (*a higher probability of extreme values than a normally distributed variable*). Positive values for Skewness mean that scores are clustered to the left of the normal curve with a long tail on the right. Absolute values for Kurtosis and Skewness should generally be under 2 and 7 respectively (Stevens, 1996). Values outside of this range indicate the data is not normally distributed. Our data fell within the acceptable ranges for the tests of Skewness and Kurtosis (Stevens, 2006; Norusis, 2004).

To use MLR, Cohen et al. (2003) states that the residual data must meet certain conditions (*normality, homogeneous variance and independence*). Our data meets these conditions (*see Figs. 5.3, 5.4, 5.6, 5.7, 5.9, 5.10*). A scatter plot was created for each of the independent variables and the relevant dependent variable to see if an assumption of linearity is justified. The results are presented below. Linear relationships between the variables appear to be evident in the scatter plots.

FIGURE 5.1 – Tests of linearity using scatter plots

To use MLR, we broke our conceptual model down into 3 sections, each having one dependent variable and a separate regression was performed for each section of the model. We did two passes for each MLR resulting in a total of 6 regressions. The first series of regressions (1A, 2A, 3A) treated all the constructs as a single factor and used all of the measurement items for the factor irrespective of model fit. The second pass (1B, 2B, 3B) broke the individual constructs down according to the factors that EFA had isolated. The measurement items used to construct the factor means were only based on the items that had cleanly loaded on to the factor in EFA. For further details regarding which items were used per factor, please refer to the tables in Section 10.3 of the appendix.

Regression Model 1A (uses all items)

Regression Model 1A examines the relationship between the IT Infrastructure Capability (*ITC*), Human Capital Capability (*HCC*) and Strategic Leadership Capability (*SLC*) constructs on the dependent variable Implementation Outcome (*IO*). The model constructs are based on all of the original items used in the survey. As we mentioned earlier, our data was collected on the basis of the respondent's role so the outputs reported below segregate the results based on ROLENUMBER. The following figure depicts which portion of the model is being tested in this section.

TABLE 5.26 – Model summary for Regression Model 1							
Role	N	R	R ²	Adj. R ²	S.E. of estimate	R ² change	Durbin-Watson
(all cases)	165	.542	.294	.280	.51093	.294	1.908
Management	70	.506	.256	.223	.53443	.256	2.147
IT Staff	80	.535	.286	.258	.48374	.286	1.927
End Users	15	.863	.744	.674	.43517	.744	2.254

Field (2009) instructs us on how to interpret the values in the table above. R is the value of the multiple correlation co-efficient between the predictors and the outcome. R² is a measure of how much of the variability in the outcome is accounted for by the predictors. For the model, its value is .294 which means that our model accounts for 29.4% of the variation in IO. Since all the variables have entered the model together, the value for the R² change is exactly the same as R² since there is only one block. If we were to use hierarchical linear modeling, variables could be entered in separate blocks and the change in R² can be assessed as each new set of variables enter the model. The adjusted R² gives us an idea of how well the model generalizes and ideally this should be the same as the original R² value. In this model, we observe a shrinkage of $(.294 - .280) = 1.4 \%$. This shrinkage implies that if the model were derived from the population rather than a

sample, it would account for approximately 1.4% less variation in IO. The Durbin-Watson statistic informs us whether the assumption of independent errors is tenable or not. The closer this value is to 2, the better and for this dataset the value is 1.908 which implies that this assumption has been met.

TABLE 5.27 – ANOVA test results for regression model 1

Role		Sum of Squares	DF	Mean Square	F	Sig.
(all cases)	Regression	17.471	3	5.824	22.309	.000
	Residual	42.030	161	.261		
	Total	59.501	164			
Management	Regression	6.503	3	2.168	7.590	.000
	Residual	18.851	66	.286		
	Total	25.354	69			
IT Staff	Regression	7.124	3	2.375	10.147	.000
	Residual	17.785	76	.234		
	Total	24.908	79			
End Users	Regression	6.059	3	2.020	10.666	.001
	Residual	2.083	11	.189		
	Total	8.142	14			

ANOVA tests whether the model is significantly better at predicting the outcome than just using the mean as a “*best guess*”. The F-ratio represents the ratio of the improvement in prediction that results from fitting the regression model relative to the inaccuracy that still exists in the residual model (Field, 2009). If the improvement due to fitting the regression model is much greater than the inaccuracy within the model then the value of F will be greater than 1 and the significance value associated is the probability of obtaining this value of F by pure chance. For this model when we look at all cases, the

value of F is 22.309, a highly significant result implying that the model significantly improves our ability to predict IO. The significance value of the F statistic is less than 0.05 which means that the variation explained by the model is not due entirely to chance.

Looking at the model, we are interested in finding out the coefficients of the linear equation that relates our three constructs (*ITC*, *HCC* and *SLC*) to IO. The coefficient (*beta*) indicates the individual contribution of each predictor to the model. The beta values tell us about the relationship between IO and each predictor. If the value is positive, we can tell there is a positive relationship between the predictor and the outcome whereas a negative coefficient represents the opposite case. The standard error term for each beta value is an indicator as to the extent that these values would vary across different samples and these standard errors are used to determine whether or not the beta value differs significantly from zero. The value of the t-statistic ($\text{beta} / \text{S.E.}$) tells us the significance of the predictor to the model. The larger the value of t and the lower the significance value, the greater is the contribution of the predictor.

TABLE 5.28 – Model parameters for regression model 1

Role	Construct	S.E.	Standardized coefficients	t-value	Sig.
(all cases)	Constant	.288		5.041	.000
	ITC	.073	.113	1.465	.145
	HCC	.088	.137	1.551	.123
	SLC	.086	.380	4.376	.000
Management	Constant	.473		3.552	.001
	ITC	.123	-.009	-.069	.945
	HCC	.149	.028	.207	.837
	SLC	.156	.494	3.392	.001
IT Staff	Constant	.403		3.860	.000
	ITC	.113	.209	1.810	.074
	HCC	.113	.157	1.205	.232
	SLC	.115	.274	2.121	.037
End Users	Constant	.859		-.932	.371
	ITC	.150	.171	1.029	.325
	HCC	.295	.424	2.020	.068
	SLC	.218	.490	2.440	.033

A residual is the difference between the observed and model-predicted values of the dependent variable (Norusis, 2004). A histogram or P-P plot of the residuals allows us to check the assumption of normality of the error term.

FIGURE 5.3 – Residual plot for regression model 1
FIGURE 5.4 – P-P plot of standardized residuals for regression model 1

The P-P plotted residuals should follow the 45-degree line. Neither the histogram (*normally distributed around zero*) nor the P-P plot indicates that the normality assumption is violated.

Regression Model 1B (uses items and factors from EFA)

Regression Model 1B also examines the relationship between the IT Infrastructure Capability (ITC), Human Capital Capability (HCC) and Strategic Leadership Capability (SLC) constructs on the dependent variable Implementation Outcome (IO) but only uses the measurement items and factors that we extracted from EFA described earlier. ITC, HCC, SLC break down into 2, 3 and 2 factors respectively.

TABLE 5.29 – Model summary for Regression Model 1

Role	N	R	R²	Adj. R²	S.E. of estimate	R² change	Durbin-Watson
(all cases)	165	.542	.294	.213	.53892	.294	2.278

TABLE 5.30 – ANOVA test results for regression model 1

Role		Sum of Squares	DF	Mean Square	F	Sig.
(all cases)	Regression	7.381	7	1.054	3.630	.002
	Residual	17.717	61	.290		
	Total	25.098	68			

TABLE 5.31 – Model parameters for regression model 1					
Role	Construct	S.E.	Standardized coefficients	t-value	Sig.
(all cases)	Constant	.519		2.730	.008
	ITC1	.115	.039	.291	.772
	ITC2	.093	.000	-.002	.999
	HCC1	.126	.159	1.031	.307
	HCC2	.125	-.190	-1.211	.231
	HCC3	.109	.190	1.564	.123
	SLC1	.153	.166	1.076	.286
	SLC2	.111	.323	2.327	.023

We see from the above analysis that of the three underlying constructs we proposed in our model only strategic leadership seems to play a role in determining the implementation outcome variable. This finding was also supported when we controlled by respondent role. When ITC and HCC are treated collectively as well as separately, these factors were seen to have relatively weak effects on the outcome variable.

Regression Model 2A (uses all items)

Regression Model 2A examines the relationship between the Implementation Outcome (IO) on the dependent variable Core Organizational Capability (COC). The model constructs are based on all of the original items used in the survey. As in the previous section, since data was collected on the basis of the respondent's role the outputs reported below segregate the results based on ROLENUMBER. The following figure depicts the portion of the model being tested in this section.

FIGURE 5.5 – Regression model 2

TABLE 5.32 – Model summary for Regression Model 2

Role	N	R	R ²	Adj. R ²	S.E. of estimate	R ² change	Durbin-Watson
(all cases)	165	.679	.461	.458	.40131	.461	2.007
Management	70	.559	.313	.302	.44014	.313	2.195
IT Staff	80	.724	.524	.518	.35284	.524	1.632
End Users	15	.878	.770	.752	.31935	.770	2.575

TABLE 5.33 – ANOVA test results for regression model 2

Role		Sum of Squares	DF	Mean Square	F	Sig.
(all cases)	Regression	22.490	1	22.490	139.646	.000
	Residual	26.251	163	.161		
	Total	48.742	164			
Management	Regression	5.989	1	5.989	30.913	.000
	Residual	13.173	68	.194		
	Total	19.162	69			
IT Staff	Regression	10.677	1	10.677	85.762	.000
	Residual	9.711	78	.124		
	Total	20.387	79			
End Users	Regression	4.442	1	4.442	43.558	.000
	Residual	1.326	13	.102		
	Total	5.768	14			

TABLE 5.34 – Model parameters for regression model 2					
Role	Construct	S.E.	Standardized coefficients	t-value	Sig.
(all cases)	Constant	.190		6.817	.000
	IO	.052	.679	11.817	.000
Management	Constant	.311		5.264	.000
	IO	.087	.559	5.560	.000
IT Staff	Constant	.262		4.678	.000
	IO	.071	.724	9.261	.000
End Users	Constant	.418		2.212	.046
	IO	.112	.878	6.600	.000

FIGURE 5.6 – Residual plot for regression model 2
FIGURE 5.7 – P-P plot of standardized residuals for regression model 2

Regression Model 2B (uses items and factors from EFA)

Regression Model 2B also examines the relationship between the Implementation Outcome (*IO*) construct and the dependent variable Core Organizational Capability (*COC*) but only uses the measurement items and factors that we extracted from EFA described earlier. *IO* breaks down into 2 factors.

TABLE 5.35 – Model summary for Regression Model 2

Role	N	R	R ²	Adj. R ²	S.E. of estimate	R ² change	Durbin-Watson
(all cases)	165	.680	.462	.454	.40051	.462	1.876

TABLE 5.36 – ANOVA test results for regression model 2

Role		Sum of Squares	DF	Mean Square	F	Sig.
(all cases)	Regression	18.466	2	9.233	57.588	.000
	Residual	21.495	134	.160		
	Total	39.960	136			

TABLE 5.37 – Model parameters for regression model 2

Role	Construct	S.E.	Standardized coefficients	t-value	Sig.
(all cases)	Constant	.218		5.411	.000
	IO_FAC1	.060	.630	9.331	.000
	IO_FAC2	.040	.119	1.756	.081

From the above analysis, it appears that there is basis to believe that there is a strong and significant relationship between firms that are able to successfully implement CPM systems and the further development of their core organizational capabilities. This finding is quite interesting because it supports our argument that such improvements to core organizational capabilities are directly related to the successful implementation outcome of the CPM system which has allowed the firm to develop the new dynamic capability.

Regression Model 3A (uses all items)

Regression Model 3A examines the relationship between the Core Organizational Capability (*COC*) construct on the dependent variable Organizational Performance (*OP*).

The model constructs are based on all of the original items used in the survey. As in the previous section, since data was collected on the basis of the respondent's role the outputs reported below segregate the results based on ROLENUMBER. The following figure depicts which portion of the model is being tested in this section.

FIGURE 5.8 – Regression model 3

TABLE 5.38 – Model summary for Regression Model 3

Role	N	R	R ²	Adj. R ²	S.E. of estimate	R ² change	Durbin-Watson
(all cases)	165	.696	.485	.482	.40705	.485	1.801
Management	70	.742	.550	.544	.38980	.550	2.101
IT Staff	80	.626	.392	.385	.42461	.392	1.730
End Users	15	.811	.657	.631	.38648	.657	1.729

TABLE 5.39 – ANOVA test results for regression model 3

Role		Sum of Squares	DF	Mean Square	F	Sig.
(all cases)	Regression	25.435	1	25.435	153.512	.000
	Residual	27.007	163	.166		
	Total	52.443	164			
Management	Regression	12.637	1	12.637	83.167	.000
	Residual	10.332	68	.152		
	Total	22.969	69			
IT Staff	Regression	9.080	1	9.080	50.363	.000
	Residual	14.063	78	.180		
	Total	23.143	79			
End Users	Regression	3.724	1	3.724	24.930	.000
	Residual	1.942	13	.149		
	Total	5.666	14			

TABLE 5.40 – Model parameters for regression model 3

Role	Construct	S.E.	Standardized coefficients	t-value	Sig.
(all cases)	Constant	.207		5.654	.000
	COC	.058	.696	12.390	.000
Management	Constant	.301		3.065	.003
	COC	.089	.742	9.120	.000
IT Staff	Constant	.345		3.900	.000
	COC	.094	.626	7.097	.000
End Users	Constant	.593		1.294	.218
	COC	.161	.811	4.993	.000

FIGURE 5.9 – Residual plot for regression model 3
FIGURE 5.10 –P-P plot of standardized residuals for regression model 3

Regression Model 3B (uses items and factors from EFA)

Regression Model 3B also examines the relationship between the Core Organizational Capability (*COC*) construct and the dependent variable Organizational Performance (*OP*) but only uses the measurement items and factors that we extracted from EFA described earlier. *COC* breaks down into 6 factors.

TABLE 5.41 – Model summary for Regression Model 3

Role	N	R	R ²	Adj. R ²	S.E. of estimate	R ² change	Durbin-Watson
(all cases)	165	.735	.540	.520	.38972	.540	1.579

TABLE 5.42 – ANOVA test results for regression model 3

Role		Sum of Squares	DF	Mean Square	F	Sig.
(all cases)	Regression	23.924	6	3.987	26.253	.000
	Residual	20.352	134	.152		
	Total	44.276	140			

TABLE 5.43 – Model parameters for regression model 3					
Role	Construct	S.E.	Standardized coefficients	t-value	Sig.
(all cases)	Constant	.224		4.739	.000
	KM	.061	.309	4.061	.000
	BPR	.054	.106	1.463	.146
	ORGCOMP	.045	-.024	-.351	.726
	PROJGOVERN	.047	.031	.417	.678
	INFO	.065	.425	5.645	.000
	PROJCOMP	.060	.046	.602	.548

From the above analysis, it appears that the Core Organizational capabilities construct shares a strong and significant relationship with the organizational performance outcome. This finding is consistent with theory and is what we were expecting to see in this analysis.

In this section we have looked at the effects of the model constructs on each of the dependent variables. We have examined these relationships through a series of 3 multiple regressions. While multiple regressions are useful in giving us information on the behaviors of one dependent variable at a time, we still lack a full understanding of what is going on at a full model level. In the next section, we will address the relationships that exist between all of the constructs within a full latent variable model and turn to Structural Equation Modeling (*SEM*) technique for this purpose.

5.6 *Structural Equation Modeling*

Structural Equation Modeling (SEM) is a statistical methodology that takes a confirmatory (*i.e. hypothesis testing*) approach to the analysis of a structural theory bearing on some phenomenon (Byrne, 2001). The theory includes “*causal*” processes that generate observations on multiple variables. The use of SEM permits causal processes to be represented by a series of structural regression equations and these equations can be modeled graphically to understand the relationships between them. Because SEM takes a confirmatory approach to data analysis, it is well suited to analyze data for inferential purposes (Byrne, 2001). Where traditional multivariate procedures are incapable of either assessing or correcting for measurement error, SEM provides explicit estimates of these error variance parameters allowing the researcher to estimate the coefficients within the research/structural model while controlling for the measurement error (Kline, 2005). SEM can incorporate models that include both observed and unobserved (*latent*) variables whereas other methods based on regression deal with observed variables only (Byrne, 2001).

An observed variable is one that can be measured directly (*e.g. temperature*) whereas an unobserved variable (*e.g. success*) can only be observed indirectly through its effects on other variables. Such abstract phenomena are called latent variables or factors (Byrne, 2001). The behavior exhibited by a latent variable is typically expressed as scores of the underlying observed variables that are presumed to represent it on a survey measurement instrument. Exogenous or independent variables cause fluctuations in the values of other latent variables in the model and changes to exogenous variables are not explained in the

model (Byrne, 2001). Endogenous or dependent latent variables are influenced by the exogenous variables in the model and fluctuations in their values are explained by the model.

SEM is based on the factor analytic model which includes both Exploratory Factor Analysis (*EFA*) and Confirmatory Factor Analysis (*CFA*) techniques. *EFA* is used when the researcher is uncertain about the relationship that exists between observed variables. The process examines the co-variation between the observed variables to gather information on their underlying latent constructs or factors. *EFA* is a parsimonious technique that is used to reduce the number of measurement items in a model and is used to transform a large number of observed variables into a smaller number of factors that can explain the majority of variance in the data and this is what we did in the previous section. *CFA* is appropriately used when the researcher has some knowledge of the underlying latent variable structure (Harrington, 2008). Based on theory or research, relationships between observed variables and factors are postulated and tested statistically. Measurement items would be presumed to load onto the conceptualized factor and not on any others. The SEM model evaluates the goodness of fit indicators to determine how well the data collected fits the model under study. Most models will not fit the data perfectly and will require model adjustments. This process is known as model-generating and is no longer strictly confirmatory (Byrne, 2001).

Determining the direction of the relationship between the latent variables and their indicators is very important. In management research, measures are usually treated as

reflective where they are the observed manifestations of the unobserved latent constructs (Diamantopoulos & Siguaw, 2006). In contrast, formative measures are considered to be correlated causes of the latent variable. For example, in our conceptual model, the IT Capability construct (ITC) is a second level factor formed by the underlying ITC factors (*IT Governance and Architecture*).

5.6.1 Measurement Models

Measurement models are used to link constructs to their indicator measures. Structural models which we discuss in the next section, associate constructs to each other. It is important for the measurement models to be properly specified and to exhibit good fit before meaning can be assigned to a structural model (Anderson & Gerbing, 1982). Measurement models were created for each of the constructs in this research. Section 10.4 in the appendix provides the details of our analysis of the measurement models. First, we created a general measurement model and then scaled it down by removing measures that were not applicable to a particular group.

Harrington (2008) and Byrne (2001) have noted that there are several different goodness-of-fit indices and most of them can be best viewed as describing the lack of fit of the model to the data. Brown (2006) has assessed model fit based on three categories - absolute fit, parsimony corrected fit and comparative fit. Absolute fit indices include the Chi-square which tests whether the model fits exactly in the population. Chi-square is very sensitive to sample size and will almost always be significant for large samples. Because of this, chi-square per degree of freedom is normally used to assess model fit. Parsimony corrected indices include a penalty for model complexity, meaning large,

complex models will be viewed as having poorer fit. The root mean square error of approximation (*RMSEA*) tests the extent to which the model fits reasonably well in the population but is sensitive to model complexity, but unlike the chi-square is relatively insensitive to sample size. Comparative fit indices (*CFI*) are used to evaluate the fit of a model relative to a more restricted baseline model and should be higher than 0.95. Brown (2006) and Kline (2005) have recommended that Chi-square per degree of freedom be around 2, *RMSEA* should be close to 0.06 or less. *CFI* should be close to 0.95 or greater for good fit.

The following table provides summary information regarding the goodness of fit values for each measurement model tested.

TABLE 5.44 – Indices of fit for the individual CPM measurement models								
Construct	Latent Factors	Indicator Items	N	CMIN	CMIN /DF	p	CFI	RMSEA
ITC	2	9	165*	50.2	2.009	.002	.916	.078
	2	6	150**	13.595	1.942	.059	.960	.080
	2	6	70***	12.454	1.779	.087	.939	.106
HCC	3	10	165*	56.382	1.762	.005	.931	.068
	2	4	150**	0.155	0.155	.694	1.000	.000
	3	10	70***	64.243	2.008	.001	.882	.121
SLC	2	15	165*	164.112	1.886	.000	.850	.074
	1	5	150**	3.130	1.043	.372	.998	.017
	2	15	70***	153.369	1.763	.000	.817	.105
IO	2	7	165*	13.038	1.185	.291	.995	.034
	2	7	150**	13.940	1.267	.236	.992	.042
	2	7	70***	17.959	1.633	.083	.958	.096
COC	1	6	165*	7.149	.794	.622	1.000	.000
	1	6	150**	8.908	.990	.446	1.000	.000
	1	6	70***	5.779	.642	.762	1.000	.000
OP	2	9	165*	37.568	1.633	.028	.979	.062
	2	9	150**	38.382	1.669	.023	.976	.067
	2	9	70***	25.422	1.105	.329	.991	.039

From the table, we can clearly see that the best fitting models were obtained when we restricted the case responses to managers and IT staff and this is what we ended up doing when we tested the structural model. This reduced the number of cases in our dataset to 150 which is around the minimum number needed to use SEM (Kline, 2005). The reason we get better fit when using the managers and IT staff is because we had the largest number of shared measurement items between these two responder groups. When we further restricted the model just to the manager group, the model fit seemed to improve again. Unfortunately, we only had 70 responses from managers so we decided to use a reduced SEM model and focused only on the manager and IT staff responders. Missing data can be very problematic for SEM as large amounts of missing data can lead to a covariance or correlation matrix that is not positive definite (Arbuckle, 1996; Byrne, 2001). With simple replacement schemes, the replacement value may be at fault. AMOS uses maximum likelihood to estimate missing values, a technique considered superior to list-wise and pair wise deletions, common schemes in many SEM programs. Such techniques are not advisable as with pair-wise deletion, the problem increases because each element of the covariance matrix is computed from a different subset of the cases (Arbuckle, 1996).

5.6.2 Structural Model

In this research, our objective was to model the full latent variable model (*see Figure 5.11a*) where we have hypothesized the impact of one latent construct on others in the model and have specified a causal direction. This would be considered a recursive model in SEM. A non-recursive model includes feedback effects between factors which we have not considered in our conceptual model. We would have like to use the complete

SEM to test our hypotheses against our data. We were unable to test the full model due to the nature in which the data was collected. As we have noted earlier, not all respondents were asked all the questions in the survey. Based on the role selected by the respondent, only a subset of questions was presented. This approach was used because pre-testing revealed that many of the management and strategy oriented questions did not resonate with IT staff and end users who were confused by the question and were consequently losing interest in completing the survey. We strongly believed that posing questions to individuals who did not understand the context would only create worthless data. Because of this decision, some respondents were not asked enough questions for some of the constructs. After conducting EFA, we ended up with a subset of indicator variables for each factor and found that there were cases with missing data as some of the variables in the measurement model had not been answered by any of the respondents in a particular group. The missing data also prevented the use of modification indices in AMOS which is a very useful technique that one can use to try and improve the model fit (Harrington, 2008). This created complications for us when trying to compute the full structural model as we ended up with missing co-relation pairs between some of the variables, making it impossible to estimate the Chi-square statistic for the full model when using all the cases.

Since we still wished to use SEM for the analysis we had to make some adjustments to our model (see Figure 5.11b) in order to do so. In Section 10.6 of the Appendix, we provide the survey questionnaire that was used to collect data for this research. The columns in the survey (*color coded*) indicate which questions were posed to each

respondent group. As one will notice there are cases where some groups were not asked to respond to certain questions. This impacted our ability to fit the model as we are constrained to use only measurement items that apply to all of the respondent groups we are testing for. In some cases, there were not enough measurement items and the factor had to be dropped as was the case for HCC-1 and SLC-2.

FIGURE 5.11a - Full SEM model (second order factors)

FIGURE 5.11b – Reduced SEM model (second order factors)

FIGURE 5.11c – Reduced SEM model (first order factors)

We ran the structural models depicted in Figure 5.11b and 5.11c in AMOS and received the following indicators of fit that are listed in the table below. In addition to the second order factors displayed in Figures 5.11a and 5.11b, we also modeled a first order factor model. In a first order factor model (*see Figure 5.11c*), a latent construct such as ITC which has two underlying factors (*ITC-1 and ITC-2*) is modeled so that both ITC-1 and ITC-2 share a causal relationship with both of the factors of IO and this ends up creating 4 paths in the model. A second order factor model (*see Figure 5.11b*) would represent the relationship between ITC and IO with a single regression path.

TABLE 5.45 – Indices of fit for the CPM structural models						
Model	N	CMIN	CMIN/DF	p-value	CFI	RMSEA
First Order Factor Model	150	1229.0	2.031	.000	.746	.083
Second Order Factor level	150	1200.1	1.974	.000	.759	.081

When compared to the threshold values we presented in Section 5.6.1, we see that the model fit we are getting is actually pretty reasonable all things considered. Byrne (2001, p. 79) provides a number of ad-hoc indices of fit. Our Chi-square per degree of freedom is below the value of 2 (Byrne, 2001) and our RMSEA value is quite close to the ideal of 0.06 (Byrne, 2001; Brown, 2006). RMSEA is considered the most robust estimate of model fit in covariance structure modeling (Byrne, 2001, p. 84) as it takes into account the error of approximation in the population. RMSEA is expressed per degree of freedom, making it sensitive to the number of estimated parameters in the model. RMSEA values between 0.08-0.10 indicate moderate fit between the data and the model (Byrne, 2001). Also, when sample size is small, RMSEA tends to over-reject true population models so the findings should be interpreted cautiously.

SEM estimates parameters using maximum likelihood and the use of this technique assumes that the following conditions are met – sample size is very large (*asymptotic*) and the distribution of observed variables is normal (Byrne, 2001, p. 70). Our small sample size was not ideally suited to the use of SEM and that is why we have also used MLR as well to analyze our data. Sobel & Bohrnstedt (1985) note that the use of such fit indices only reflect the extent to which the model is plausible. Assessment of model adequacy must be based on theory, statistics and practical considerations.

We strongly believe that the fit of this model would have been a lot better if we had been able to collect more data and designed the process to minimize the effects of missing data. Table 5.46 shows the factor loadings of all the constructs in the model. The results are separated for the two SEM's from which they were generated.

TABLE 5.46 – Factors weight scores from SEM model tests

First Order Factor Model					Second Order Factor Model				
Factor		Factor	Std. Regr. Wt.	p	Factor		Factor	Std. Regr. Wt.	p
ITC-1	--->	IO - 1	-0.585	0.249	ITC	--->	IO	0.534	***
ITC-2	--->	IO - 1	1.029	0.064	HCC	--->	IO	0.315	0.036
ITC-1	--->	IO - 2	-0.806	0.079	SLC - 1	--->	IO	0.759	***
ITC-2	--->	IO - 2	0.874	0.05	IO	--->	COC	1.061	***
HCC - 2	--->	IO - 1	0.075	0.575	COC	--->	OP	0.774	***
HCC - 3	--->	IO - 1	0.245	0.046	ITC	--->	ITC-1	0.681	0.002
HCC - 2	--->	IO - 2	-0.013	0.937	ITC	--->	ITC-2	0.908	***
HCC - 3	--->	IO - 2	-0.014	0.926	HCC	--->	HCC - 2	0.739	0.037
SLC - 1	--->	IO - 1	0.78	***	HCC	--->	HCC - 3	0.713	***
SLC - 1	--->	IO - 2	0.336	0.011	IO	--->	IO - 1	0.834	***
IO - 1	--->	COC	1.053	***	IO	--->	IO - 2	0.318	0.013
IO - 2	--->	COC	-0.167	0.07	OP	--->	OP-1	0.923	***
COC	--->	OP-1	0.767	***	OP	--->	OP-2	0.806	***
COC	--->	OP-2	0.7	***					

We now turn our attention to interpreting these outputs and discussing the effects it has on the hypotheses we proposed earlier in Chapter 3.

5.7 Hypothesis Testing

We set out to test four hypotheses and two general propositions in this research. A brief discussion on each is presented in this section. Two out of the four hypotheses were supported by our data. Both of our propositions were supported. For brevity, we shall refer to the various factors in the model by their shortened names. The individual factors for each construct are presented in the table below for easy reference.

TABLE 5.47 – Summary listing of all factors in the models			
ITC1	IT Governance	KM	Knowledge Management Capability
ITC2	Physical Architecture	BPR	Business Process Re-Engineering Capability
HCC1	IT Staff Support	ORGCMP	Organizational IT/IS Capability
HCC2	IT Staff Competence with IT/IS	PROJGOVERN	Project Governance Capability
HCC3	Personal Competence with CPM/BI	INFO	Information Communication and Sharing Capability
SLC1	Management Readiness for CPM/BI	PROJCOMP	Project Team Capability
SLC2	Organizational Readiness for CPM/BI	OP1	Impacts on organization's resource base (Processes & Capabilities)
IO1	Personal Impacts	OP2	Decision Making
IO2	Project Execution		

Hypothesis 1 is that firms with a well developed IT Infrastructure Capability (*ITC*) are more likely to have a successful Implementation Outcome (*IO*). EFA indicated that the *ITC* construct broke down into two sub-factors, namely IT governance and physical architecture. Under the second order factor model, this relationship was supported. However, when we looked at the first order factor model, we only found partial support

for this hypothesis. The second ITC factor, physical architecture, was found to have a positive relationship with the first implementation outcome factor (*IO1*) which represents the personal impacts on the end user and was significant at $p < 0.10$. However, when we controlled for the role of the respondent, we found something interesting. The manager group continued to show a weak relationship between ITC and IO while IT staff respondents showed a much stronger and significant relationship. This finding makes sense as managers may tend to be less aware of the role of IT Infrastructure as they are more likely to have non-technical backgrounds. IT staff who work with the technology on a day to day basis are much more likely to appreciate the importance of IT Infrastructure in determining the success of IS projects. Because we did not see a clear and unequivocal relationship between these two constructs, we are unable to reject the null hypothesis that IT Infrastructure has no impact on CPM system implementation outcome. To err on the side of conservatism, Hypothesis 1 is therefore rejected.

Our first proposition was that firms that had experience with ERP implementations in the past would be more likely to have a successful CPM implementation outcome. We based this proposition on Holsapple & Sena's (2005) paper that suggested that DSS success outcomes were positively associated with ERP success outcome. We believe that the experience firms have gained from implementing ERP has given them a solid foundation upon which to deploy their CPM systems more successfully. Moreover, the implementation of ERP has more than likely necessitated the creation of underlying data warehouses which enhance the value and utility of CPM systems greatly. To test this proposition, we cast successful ERP implementation as a binary variable. The mean

score for this item was 3.89 ($n=142$). Responses of 4 and greater were considered to be successful and responses in the range of 1 to 3 were considered as unsuccessful. We found that firms that reported less successful ERP implementations had a lower mean score (3.323) for IO when compared with firms that classified their ERP implementations as successful which reported a mean score for IO of 3.658. But is this difference significant? We then did an ANOVA test to see if the implementation outcome was significantly different between the two groups. The table below summarizes the results.

TABLE 5.48 – ANOVA test for Proposition 1						
		Sum of Squares	DF	Mean Square	F	Sig.
IO vs. ERPSuccess	Between Groups	2.456	1	2.456	7.784	.006
	Within Groups	44.169	140	.315		
	Total	46.625	141			

From the ANOVA table above, we see that the value of the F-statistic is 7.784 and the significance level is < 0.05 meaning that we should reject the null hypothesis that assumes no difference between the groups. Therefore, proposition 1 appears to be supported by our data set. Firms that have prior experience with ERP implementations appear to enjoy more success in their CPM implementation. The reasons for this will be discussed in more detail in Chapter 7.

Our second hypothesis was that firms with high levels of Human Capital Capability (HCC) are more likely to have a successful CPM system implementation outcome. HCC was measured along the dimensions of self competence and IT staff competence. Under the second order factor model, we see that this hypothesis is supported. Under the first

order factor model, we found that this hypothesis was not supported by three out of the four construct pairings. We did find a significant relationship between the user's personal competence with CPM/BI and the personal impacts factor from implementation outcome. Because we did not see a clear and unequivocal relationship between these two constructs, we are unable to reject the null hypothesis that HCC has no impact on IO. To err on the side of conservatism, Hypothesis 2 is therefore rejected.

Our third hypothesis is that firms that have strong levels of Strategic Leadership Capability (SLC) are more likely to have a successful Implementation Outcome (IO). SLC broke down along two factors, namely the readiness displayed by both management and the organization for CPM/BI initiatives. Both the first order and second order factor models strongly supported this hypothesis and we can therefore confidently reject the null hypothesis. The SLC construct seems to be highly significant in terms of IO. This finding is very important because senior leadership needs to take a very active role in CPM initiatives and create the readiness to ensure the project's success. This finding is unequivocal in that the implementation of CPM systems requires a strong and decisive hand at the tiller in terms of the involvement and visibility of senior leadership. Hypothesis 3 is fully supported.

Our fourth hypothesis involves the connection between a successful CPM system implementation outcome (*which serves as a proxy for the CPM specific dynamic capabilities that we propose are created after*) and the effect it has on the capability portfolio of the firm. Our thesis is that firms with successful implementation outcomes

(IO) develop CPM specific capabilities that enable them to enhance or create Core Organizational Capabilities (COC). We found strong support in our data for such a relationship. This finding was confirmed during our interviews as well with senior managers discussed in detail in Chapter 6. We tested core organizational capabilities as a rolled up construct (COC) against IO and then we also tested each of the individual capabilities against IO and found significant relationships in each of the cases. However, when we broke the IO construct down in the multi-factor model, we continued to see a strong relationship between IO-1 (*personal impacts*) and each of the six core capability factors. The second implementation outcome construct IO-2 (*Project execution*) only showed a significant relationship between the project governance and project competency factors and none whatsoever with the other 4 capability factors. This suggests that the IO construct and the CPM specific dynamic capabilities and their relationship to COC is dominated principally by the first factor which makes intuitive sense. Based on this evidence, we feel that this hypothesis is strongly supported and firms that are successful in their implementation outcomes will benefit from enhancements and creation of core organizational capabilities. A full discussion on this finding will be covered in Chapter 7.

In both models, we found strong support for a relationship between the core organizational capabilities (COC) and the organizational performance (OP) construct. Further, when each of the individual capabilities was examined, we saw strong support between the KM and INFO capabilities and organizational performance. The relationship between the other core organizational capabilities and OP was not very strong. In the first order factor model, KM and INFO are strongly related to OP1 (*resource base of*

firm) and KM and INFO also have a significant relationship with OP2 (*decision-making*). These findings are well supported by the literature and add weight to our proposal that CPM specific capabilities may contribute in enhancing capabilities that may then impact organizational performance by altering the resource base of the firm and this should be evidenced by improvements in strategic competencies such as decision-making.

Our second proposition was that firms that had successfully implemented CPM systems would experience significant improvements in decision-making. We did another test using ANOVA to see if there was a relationship between successful IO and improved decision making. All of the measurement items related to decision-making were consolidated and cast into a mean score for each of our survey cases. Respondents with a mean score on decision-making that was higher than the overall mean of 4.0362 ($n=152$) for all respondents were considered to be firms that had improved in their decision making capabilities. Respondents with a mean score less than the overall mean were considered to not have improved in decision-making. Based on this binary classification, we found that firms with improved decision making scored 4.0146 on the IO construct whereas firms that had not improved in their decision making scoring scored 3.4388. But is this difference significant? An ANOVA test was performed to see if there was a significant difference between the two groups. The table below summarizes the results.

TABLE 5.49 – ANOVA test for Proposition 2						
		Sum of Squares	DF	Mean Square	F	Sig.
IO vs. Decision Making	Between Groups	10.502	1	10.502	34.746	.000
	Within Groups	45.339	150	.302		
	Total	55.842	151			

From the ANOVA table above, we see that the value of the F-statistic is 34.746 and the significance level is < 0.05 meaning that we must absolutely reject the null hypothesis that assumes there is no difference between the groups. Firms that have implemented their CPM systems successfully appear to have certainly improved in their decision making capabilities. Therefore, proposition 2 appears to be strongly supported by our data.

5.7.1 Summary of findings

TABLE 5.50 – Summary and results for all hypotheses tested in model		
#	Hypothesis	Supported
1	Firms with a well developed IT infrastructure capability are more likely to have a successful CPM implementation outcome than counterpart firms that have not developed the capability to the same degree.	PARTIAL
2	Firms that exhibit a high level of human capital capability are more likely to have a successful CPM implementation outcome than counterpart firms that have not developed the capability to the same degree.	PARTIAL
3	Firms with highly developed strategic leadership capability are more likely to have a successful CPM implementation outcome than counterpart firms that have not developed the capability to the same degree	YES
4	Firms with successfully implemented CPM systems will be successful in creating new capabilities or enhancing existing capabilities.	YES
#	Proposition	Supported
1	Firms that have successfully implemented enterprise systems in the past are more likely to have a successful CPM implementation outcome than counterpart firms with lower levels of enterprise system experience.	YES
2	Firms with successfully implemented CPM systems will experience improvements in decision making.	YES

In this chapter we have used multiple statistical techniques (*EFA, MLR and SEM*) to examine the data collected against our conceptual model and have attempted to answer

our three research questions. The original conceptual model was put through an exploratory factor analysis process and the single factor model devolved into a more atomic model based on multiple factors for each of the constructs. Three regression models were examined to study the impacts on the three dependent variables in our model and the overall model was assessed with two SEM analyses. The prima facie evidence would indicate that 2 out of our 4 hypotheses and both of our propositions appear to be supported by the data collected. In the next chapter, we shall continue to collect evidence through personal interviews with subject matter experts that should help us to expand our understanding of the strategic use, value and impacts of these information systems.

6 Qualitative Data

To supplement the quantitative aspect of this research, we also conducted twelve personal interviews by telephone and in person with subject matter experts (*senior managers at firms that had implemented CPM systems, academics and vendors*). Some of these firms participated in our survey. We believe that these open-ended conversations allowed us to obtain a richer perspective on the survey themes. The interviews were done during and after the data collection period and helped to provide perspective and narrative around our quantitative findings. Our quantitative findings suggested that ITC is not a significant predictor of IO which was somewhat unexpected as earlier studies (Mata et al., 1995; Bharadwaj, 2000; Weill & Broadbent, 2000) had suggested otherwise. Limitations in the quantitative methodology (*the missing data issue*) similarly affected our interpretation of the HCC and SLC construct. Often such inconsistencies in quantitative findings may benefit from qualitative descriptive data collection (Miles & Huberman, 1994). Our quantitative findings suggested a causal linkage between the implementation of CPM systems and changes to firm capabilities. This finding seems to support our assertion that such changes follow as a result of the creation of a CPM specific dynamic capability and we wished to confirm this through our interviews. The result of our qualitative interviews suggested that the development of CPM specific capabilities was indeed a realistic possibility and the moderating effects of senior management buy-in, governance policies and culture of the organization are critical elements affecting such development. Other interesting insights relating to the importance of IT business alignment, knowledge management and competency development were also obtained.

The interviews were conducted between the dates of March 16 – May 4, 2010. Some of the interview subjects were selected by reviewing the list of respondents who had indicated they would like a copy of the research findings (*and had provided an email address*) and might be interested in participating in further research. A small pool of candidates was created and these people were contacted requesting their participation in an interview. We were successful in arranging an interview with twelve subjects. Interviews typically ranged between 60 to 90 minutes in duration.

The interviewees were typically at the level of Director or above and their opinions represented a senior management viewpoint. The background of the interviewee is presented in the table below. The firms are kept anonymous for confidentiality purposes as was agreed during the interview as some of the information they shared with us was sensitive in nature.

TABLE 6.1 – Background of interviewees		
Interviewee Job position	Organization	Industry
Director of BI	Government (Department A)	Government
National Services Director	Major IT/CPM vendor (FIRM B)	Services Consulting
V.P. Information Technology	Private Charter School (FIRM C)	Education
Professor (Human Computer Interaction)	Canadian University (FIRM D)	Academic
Director of BI and PM	Provincial Lottery Corporation (FIRM E)	Gaming / Lottery
Director of IT	Government (Department F)	Government
Senior BI Architect	Government (Department G)	Government
Manager of BI	Government (Department H)	Government
Professor of PM	Canadian University (FIRM I)	Academic
Director of BI	Major Pharmaceutical Company (FIRM J)	Pharmaceutical
Senior BI Manager	American Media Company (FIRM K)	Media
Senior Operations Manager for BI/DW	Government Financial Services Organization (FIRM L)	Financial

Prior to the interview taking place, the respondents were informed about the nature of the research, the time that would be required and our note taking policy. During this initial conversation, some respondents indicated that they were not comfortable with their comments being recorded digitally. The work performed by these individuals is strategic in nature and information they provide is sensitive that could have negative implications to their organizations were it to be publicly revealed and the source identified. Because of these concerns, interviews were manually recorded by taking handwritten notes and transcribing it after the interview was completed. This approach was satisfactory for all subjects.

The following themes were explored during the interviews:

- Pervasiveness of CPM systems within firm
- CPM systems maturity level
- Motivations and goals for CPM systems
- IT infrastructure Capability
- Human Capital Capability
- Strategic Leadership Capability
- Organizational Culture
- CPM specific dynamic capability and the effects on firms

6.1 Pervasiveness of CPM system within firm

As we discussed in Chapter 2, CPM systems consist of 3 major components (BI, S&D and EP). We found that in general, the interviewed companies are making use of at least two these components with all of the companies using BI reporting and analytics extensively. Five of the companies in the sample were making use of metrics and scorecards and four of these companies were using CPM to perform some form of

enterprise financial planning and budgeting. Of this latter group, only two were making heavy use of their CPM systems to do their financial planning and budgeting. The other two were still using spreadsheet based solutions, complemented by reports obtained from the CPM system. We found the complementary use of spreadsheets a very common situation within all of the firms we interviewed.

The following table shows the breakdown in usage based on CPM component.

TABLE 6.2 – Usage of CPM components in interviewed firms	
CPM Component	Firms that are actively using this component (n=12)
BI Reporting	100%
BI Analytics	100%
Metrics	56%
Planning	44%

We were keen to understand the scope of the CPM implementations in the firms being studied. Were they enterprise-wide implementations that touched on a vast number of employees or were they mainly localized, limited to one or two departments? In this context, an enterprise wide deployment was considered in terms of the scope of the company. For instance, what a large multinational drug company with worldwide operations would consider enterprise wide varies considerably from a Canadian Government department. The respondent was asked to think about the CPM implementation in terms of how many people in the company were affected directly or indirectly by the system before providing a response to this section. We found that half of our respondents assessed their implementations as enterprise-level with the other half of the respondents assessing the implementation as essentially localized in scope.

One respondent firm made use of three CPM vendors based on geography. CPM vendors Hyperion, Business Objects and IBM Cognos were used in Canada, USA and Europe respectively. This was quite unusual as we believe that the use of multiple CPM systems increases complexity and the ability to integrate and compare information (*especially when creating enterprise wide reports*) is difficult when outputs are produced by different systems. When asked why, we were told that it was sometimes unavoidable to have this kind of *mélange* due to mergers and acquisitions and the need to integrate with other technologies and architectures.

6.2 CPM Maturity Level

In the TDWI maturity curve we discussed earlier, the progression of a CPM system through a six-stage life cycle was presented. We were keen to understand how respondents self-assessed the maturity of the implementations within their firms. We found that most of the firms ranked the maturity level of their implementations between the child and adult stages. We were a bit surprised at these low ratings considering these were all large firms that had been using CPM systems for a long period of time. The table below shows the breakdown in how the respondents assessed their CPM system implementation maturity.

TABLE 6.3 – Level of maturity of CPM implementations	
CPM System Maturity	Count (n=9)
Pre-natal	0
Infant	0
Child	33%
Teenager	33%
Adult	33%
Sage	0

A third of the firms assessed their implementations as adult, a stage where the benefits of CPM are supposed to be high. A respondent from a large media and entertainment company in the USA had this to say about the level of maturity of the CPM initiative in his company.

“...using a CRAWL, WALK, RUN analogy I feel that our organization is WALKING in terms of our implementation and integration of CPM...we spent almost 80% of our energy on infrastructure and architectural issues and only 20% went towards value creating endeavors...” (Senior IT manager from Firm K)

In terms of CPM maturity, a common factor was the development of a data warehouse strategy. All of the firms that classified their implementation at adult stages of maturity had established major data consolidation activities and have shifted calculations, aggregation and summarization down to the data layer to improve overall performance and reliability of their CPM systems. A respondent from a large pharmaceutical organization had this to say on the topic of data consolidation.

“...Overall I would have to say that our implementation is quite mature and more so at the localized level...the key to this is that the local data warehouses are very advanced. We are having problems with the global data warehouse as consolidation of data from across our enterprise has been challenging. In our firm, we see consolidation of data as a necessary evil and something that is the efficient thing to do but I am not necessarily convinced that it is always the right thing to do. Executives tend to look at consolidation and rationalization as a tremendous cost savings opportunity. I feel sometimes that the expectations set by senior management are far too high...” (Executive from Firm J)

Data integrity and the issue of consolidating data from different sources were also highlighted as an issue by a senior IT manager in a Canadian Government department.

“...In the past, our organization had a “silo” approach with each group doing their own thing from their own data source. Nowadays we are a lot more integrated and capable of managing history very well. I feel that this is largely due to the high level of integration we have achieved for the CPM project. This lack of integration can seriously affect business processes. At present, our HR process is the most heavily integrated making use of data from various consolidated sources. Because of the success that HR has enjoyed, others groups including finance and property management are now jumping on the CPM bandwagon...” (Govt. Dept. A)

6.3 Motivations for implementing CPM systems

We were interested in understanding the motivations behind why firms wanted to implement CPM systems and whether these initial goals had been met after the CPM system has been in place for some period of time. In our interviews, the following reasons emerged as the principal motivations behind the implementation of CPM systems in these firms.

- Sheer necessity
- Need to improve quality of decision-making
- Improved reporting capability
- Desire to make better use of untapped information
- Improve efficiency and effectiveness of business processes
- Improved service to stakeholders
- Cost reduction

We found that firms sometimes implemented CPM because it was viewed as a strategic necessity by senior managers but its execution and impacts were not well thought out. IT managers reported that such projects became an IT responsibility with business users taking a “hands-off approach” relying on technical resources to provide them with the

answers they needed from the data warehouse. Such approaches are inconsistent with findings relating to the importance of IT business alignment (Luftman & Kempaiah , 2007; Grant, 2003; Worthen, 2002). Managers also informed us that CPM system projects were often overly “*solution oriented*” with the focus being on providing a shared reporting capability. Senior managers are apparently willing to make the initial investment but either due to a lack of understanding or interest are not promoting the use of the system among the user community. Markus & Benjamin (1997) have cautioned against this type of thinking. The use of CPM systems in fast paced environments (*such as Firm G*) was marked by simple, experiential based routine execution, a finding consistent with the perspective of Eisenhardt & Martin (2000). For further details and quotes from our interviewees, please consult Appendix A2 at the end of the document.

6.4 *IT Infrastructure Capability*

Our conceptual model suggested that ITC was an important underlying construct for CPM implementation outcome. However, this was not supported by our quantitative data. We asked our interviewees to think about the importance of IT infrastructure capability and the role it had played in their CPM project. Responses varied among the interviewees with opinions ranging from ITC being highly important to not important at all. In general they felt that IT infrastructure capability was a necessary part of the puzzle that required a lot of attention at the early stages of the project. All of the respondents agreed that IT infrastructure should lessen in importance over time and become a “*part of the plumbing*” as the project matures. This finding is consistent with what others have found (Clemons & Row, 1991; Markus & Soh, 1993; Soh & Markus, 1995).

6.5 *Human Capital Capability*

Due to limitations in the research methodology, our quantitative findings for this construct were not very clear so we were quite interested in following up on this with our interview subjects to assess the importance of the human element in terms of having a successful CPM project. We asked them to reflect on the value of general IT skills as well as specific CPM competencies among their user communities. We were most interested in knowing if there were additional areas of competence that needed to be developed to facilitate a successful project. Most of the respondents agreed that overall IS/IT competency was a vital element in determining the eventual success outcome of the CPM system and technical competency of the IT staff was critical especially at the start when the system is being put in place. In the short term, competency might be gained through training and hiring external consultants to fill in the gap but eventually the firm's resources have to acquire this competency internally for the project to be successful in the long run.

The investment of time is very important in developing competence and to this end, the importance of “*playing*” or exploring the technology, sometimes in an unstructured way as Ciborra (1996) proposed can be vital. If one does not personally invest time in learning the system and understanding its capabilities, the ability to exploit its potential is inherently limited. We found that users generally resist doing this because it means giving up personal time. Greater commitment from end users is needed to master these technologies. This was identified as an important issue, especially in the government context where the motivational levers (*such as firing, demotion etc.*) are non-existent.

General consensus was that the only way to get workers to agree to do this was to use incentives such as overtime pay or other forms of compensation and such motivators are usually not available to managers in the public sector.

While exploring this theme, an interesting finding emerged relating to how senior managers and end users had quite a different understanding of the capabilities of these systems.

“...senior managers tend to understand the capabilities of these systems and can articulate their value proposition. Similarly, power users tend to understand the capabilities of these systems quite well. However, end users often have great difficulty in relating the capabilities of these systems to their jobs. Even though we feel that the product is easy to use, end users often have great difficulty in using them...”(Executive from Firm B)

Establishing a good relationship between IT staff and consumers was cited as an important success factor. In terms of IT staff competence, it is essential that the IT staff understand the needs of the business user and have the appropriate social skills to be able to communicate effectively with the consumers. All of our respondents were in agreement that if the CPM project is viewed solely as an IT initiative it will not work. A symbiotic relationship between these two groups is essential and IT staff should be able to put themselves in the shoes of the business user and vice versa to make the project successful.

In light of what we learned in our interviews, we concluded that HCC is an important success factor of implementation out and did not exhibit a positive association with

implementation outcome mainly due to methodological issues. Changes to the research design may be required to highlight the importance of this underlying construct.

6.6 Strategic Leadership Capability

All of our interviewees agreed that strategic leadership was a very important component in determining the success of the CPM initiatives and this finding was also strongly supported in the quantitative analysis we performed in Chapter 5. Senior management is expected to provide support and most importantly must secure funding to ensure project success. Department wide solutions often did not require very high level senior management involvement but to accomplish enterprise wide BI success, senior level buy-in and involvement is critical.

Interestingly, we were told that senior managers are not always the ones that drive the CPM project and do not necessarily provide the implementation roadmap. We learned that these systems allow strategy to be driven from the middle and bottom of the organization and not only from the top. The technology is now visible to end users who are capable of doing their own analysis, flagging problems and potential issues and driving it up the chain to more senior levels of management. We were not clear if senior management acts on this information.

“...quite frankly, our senior managers do not understand the capabilities of these technologies as well as the IT staff do and therefore they rely on us to tell them what the technology is capable of and the novel ways in which it can be used in the firm to drive profitability and performance. This may seem backwards in principle but it is what happens in reality...” (Executive from Firm K)

“...I am not convinced that the top management fully gets it regarding the importance and vital nature of the information that we are collecting and aggregating. There is definitely a bit of “fear of being left behind” in terms of using such technologies and that has in some ways worked positively for us in terms of getting funding and other resources...”
(Executive from Firm J)

The role of the IT staff in demonstrating the usefulness of CPM to senior management came up several times in our interviews. One respondent told us that the early successes they had with CPM had won them the attention of senior management as they are using the technology and its capabilities to offer different perspectives on the business. CPM systems are showing senior managers how to increase productivity and decrease unit costs through more effective hiring and retaining practices. Determining which projects will benefit from these systems is driven by the fact that the champions often only get one opportunity to make a good impression on senior leadership so selecting the right projects to get maximum impact and to be able to clearly demonstrate value to the organization is very important.

Senior leaders need to think in terms of end goals. It is important to think of what decisions they need to make and then decide on the mental models they need to use and then determine what data is needed. Sometimes data may be available but you need to have a mental model in order to make sense of the data. Some respondents felt that making decisions driven by currently available data is a limiting strategy if their expectation is to create new information resources. This is a departure from the RBV which stresses the need to focus on the resources on hand and to maximize utility in the

most efficient and effective manner and suggests an enhanced role for the CPM specific dynamic capabilities to do just this.

6.7 *Organizational Culture*

Although not part of our conceptual model and keeping an eye for further research in the area, we asked our interview subjects to reflect on the role of organizational culture in the success of CPM initiatives. We felt that culture might be an important determinant of success as CPM systems permit information to be shared easily among stakeholders in a firm, creating democracies and transparencies that might have been previously lacking. We asked our interviewees to think about how their users had adapted to the new information systems and to share such experiences with us.

Many of our respondents spoke of the importance of getting people vested in the final outcome and using an inclusive strategy to make them part of the process. Resistance to change was a concern especially when the new system replaced an existing one that users had become used to. We were told that resistance could be overcome when people saw tangible evidence of the benefits of use. Difficulties associated with getting people to use a new information system have been well documented in the IS literature (Markus & Keil, 1994; Gefen & Keil, 1998). To be successful, support must come from the business users so getting their buy-in to use the new system is critical.

“...old systems tend to have a seductive quality and it is very hard to get people to believe the new system is better, more accurate or more reliable. It astonishes me how people give their trust to an old system even when that level of trust is not deserved. There is a certain comfort in familiarity and this extends very naturally to information systems...”
(Govt. Dept. H)

A respondent informed us that the use of CPM systems might actually change ingrained aspects of the firm's culture. We were told a story of an organization that provided a valuable service to the community and had been founded on an inclusive culture that welcomed participation from all donors. Cost analysis facilitated by their CPM system forced them to change their culture so that donations from certain groups were no longer accepted. This was a big change and led to a cultural shift where the firm switched from a purely values driven approach to a "*facts first plus values*" approach. Getting everyone to adapt to this was difficult but in the end, the facts won out. It is important for senior managers to buy into this kind of thinking.

"...Changing the mindset to a fact-based culture is not easy. Even though the tool may indicate a contrary position, it is people's behavior that is very hard to change..." (Executive from Firm E)

Creating an information and fact oriented culture was cited by one respondent as being very important. Getting users to use information and statistics as part of their decision making was a challenge at one of the firms we interviewed. This affected the recruiting strategy at this firm whereby employees were hired with basic qualifications in this area as they were considered more likely to be successful with the CPM system.

At one of our respondent firms, a large government department, people at first felt threatened by the new system. The reason for this was that there was a lot of bad data in the system and the presence of BI shed light on some of these problem areas.

“...People were getting protective when mistakes were pointed out in their work or in the processes they manage. People saw CPM as a threat to the status quo....errors indicate trends and provide an opportunity to fix problem areas. CPM strengthens our ability to develop processes. We worked with the ones who were scared and won them over eventually to see that we are working together to make a better solution. Building credibility and measuring your progress was a key to changing our culture....there is a need to measure and share data with people so that they see positive and tangible progress...” (Govt. Dept. A)

We believe that a CPM system might actually foster a more creative organizational culture by allowing users to process information quickly and remove many of the mundane aspects of team work. When working in a team, one can quickly feed information into a system, play “*what-if*” scenarios and immediately get feedback which then in turn can spur other creative thoughts. People working together with a system can be far more effective and creative than an individual working alone with a system.

Our interview subjects stressed that organizational culture is an important determinant of CPM project success. After conducting the interviews, we are left with the impression that our conceptual model might have been made more complete if organizational culture were to be included as a moderating variable on the other underlying success constructs.

6.8 *CPM specific capabilities and its effects on the firm*

In this thesis, we have made the argument that the creation of CPM specific dynamic capabilities is a plausible strategy that requires deliberate and systematic action on the part of managers to materialize. As we had expected most of our interview subjects were not aware of dynamic capability theory but many of them alluded to a sense that the introduction of the CPM system had endowed the firm with additional capabilities that

were lacking before. Some managers informed us of their capacity to do new processes that were not possible before and of their ability to refine existing processes and routines to operate more efficiently. As theory would suggest, it is this ability to change, create and reconfigure resources and capabilities that is the hallmark and definition of a dynamic capability (Helfat et al., 2007). Such change to VRIO resources might lead to the generation of economic rents (Barney, 1991; Peteraf, 1993).

Effects on other firm capabilities

The potential of a dynamic capability to impact other firm capabilities, processes and potentially alter the competitive position of firms is a central argument made by the dynamic capability perspective. The CPM specific capabilities we have proposed in this research appear to change the underlying resource base of the firm and might eventually having a positive impact on competitive position of firms. We feel that this point was mostly supported by the managers we interviewed. With one exception, all respondents were in agreement that CPM specific capabilities had enhanced their core firm capabilities. This finding is consistent with what we observed quantitatively where we noted a strong relationship between the implementation outcome construct and the basket of core firm capabilities.

“...I believe that CPM has improved the HR department’s core capability to attract and retain the best human talent available. We know that our competitors are doing their best to attract people from the same resource pool so it is a competitive necessity for us to implement technologies that can help us to do our jobs better...” (Executive from Firm K)

CPM systems provided Firm K the ability to do things that it just could not do before. They have been able to bring together disparate information for analysis in the same software tool. Employee performance data from PeopleSoft and recruiting information from another product (*Kaneza*) is now analyzed in the CPM system allowing metrics to be measured consistently across the organization making a massive difference to understanding how well people are doing at their jobs and where the best sources of talent are coming from. Since CPM data is in a warehouse and centrally available, it has impacted their existing capabilities. Users can access the data and manipulate it in different ways and are constrained by their imaginations to analyze the data. It has enhanced core competencies in all of Firm K's capabilities.

"...We can now compare how employees we recruit through a service such as Monster.com are performing at their jobs 1 year, 2 years and 5 years later. The CPM system is providing us with tremendous insight into where we should be focusing our limited resources and into activities such as education, training etc..." (Executive from Firm K)

CPM systems were said to provide a consistent, reliable picture of business operations from one trusted source and this is important for firms that are multi-regional in nature. In the past, head office would need to talk to each region separately and get back many versions of the same report, usually formatted differently that they would have to try to consolidate and make sense of. CPM systems have imposed a level of data standardization and this has increased the overall level of confidence in the information.

CPM specific capabilities can help to identify weaknesses in an organization by helping to mature existing capabilities and creating the need for new ones. Very few companies

have all the resources and requirements to fully implement CPM. It can definitely add new capabilities such as improved decision making as well as predictive analytics that allows firms to focus limited resources more effectively – e.g. vandalism occurs in certain areas of the city so police direct scarce resources to these areas before criminals strike. CPM systems are also useful in uncovering anomalies and patterns in terms of data issues, quality, infrastructure and security.

“...Yes, we have definitely improved our capabilities. For example, we now have a trade scorecard that has improved our ability to better manage our services for exporters around the world. What used to take a team of five people weeks to produce is now instantly accessible to our users. This is a much improved capability. This is something we could not do before...” (Govt. Dept. A)

The use of CPM systems can also impact the governance structure of firms. At Firm J, we were informed that four years ago the organization made a decision as to how CPM was to be implemented within the company and this required a change in governance. The IT department was under pressure from senior management to contain costs and the firm was also in the middle of a major acquisition and market definitions were changing rapidly. A VP changed the organizational chart so that the Director of CPM and the IT Director fell under the same manager. In the past, these two important CPM resources reported under different hierarchies so getting them to synchronize priorities was difficult. All the people responsible for analysis as well as IT were brought under the same manager. A solution had to be forced and irreconcilable differences were no longer acceptable as an option. The result was a shared understanding where the CPM people started to understand what the IT people were up against and vice versa. This shared

understanding made a big difference in how the two teams worked together and was a key success factor.

Not all respondents agreed that CPM systems added new capabilities. They spoke about the bureaucracies of their organizations that prevented them from radically altering their capability portfolio.

“... I do not believe CPM systems add any new capabilities to a firm. Everything we do in Government is fixed. We cannot do new things and we cannot stop doing things that we are currently doing. We are very constrained in this aspect. For example, we may have a transactional system that does some function very well. We do not have the flexibility that say a private sector company has to leverage that system to do something similar but different from what it currently does. If the sphere of activities of the Government can be thought of as a big circle, the addition of CPM systems will not necessarily widen that circle. I believe that what these systems do is to enhance existing capabilities to make certain processes and capabilities more effective and efficient...” (Govt. Dept. H)

Effects on Business Processes

We were interested to learn how CPM specific capabilities might alter firm processes and if they were implicated in the creation of new business processes. We asked interviewees to reflect on these aspects.

“...One of our goals for our system was to use this technology as a means to influence strategic process. It has definitely affected our ability to plan and to make better decisions faster as we have a lot more faith in our information now...” (Executive from Firm K)

CPM systems and their usage evolve over time as humans become more expert at using them. These systems augment human intellect. Systems and humans evolve in tandem

(Englebart, 1962). Because of this, an individual can leave a firm and take his expertise but is often unable to replicate previous successes at a new firm. This is because the system depends on multiple factors and each firm is different and evolutionary paths area critical differentiator (Nelson & Winter, 1982; Teece et al., 1997). What we see in such cases is that the process turns out to be bigger than the individual players.

Before one can get to the point of changing processes, it is important to get the process right. Firm G is going through an initiative called Business Process modernization where all the processes in the firm are being reviewed. Only after this is done are they going to consider how CPM can inform these processes. We feel this is a strategic mistake. The outputs of CPM should be considered concurrently as something that can make a process better and should be “*designed in*” right from the start and not be viewed as an afterthought.

“...I do not believe that the tools are going to give us competitive advantage. I believe it is the processes and capabilities that they enable that might do this. I would not say we are at this stage yet. The most important things are the business processes. The more efficient we can make these, the better we become and then potentially we can reach competitive advantage...” (Executive from Firm E)

The use of CPM forced Firm E to examine the makeup of its business processes and has helped to uncover inefficiencies. Interestingly, even though they find something that is not being done properly, they are still encountering quite a bit of resistance to change their processes. Processes have a lot of inertia and once entrenched are difficult to change. People just do not like to change their processes. The problem with changing processes is often not the technology. CPM may often point towards the “*single throat to*

choke” and people tend to stymie the system for fear of being exposed. This is one of the reasons that some big enterprise systems have not been as successful as anticipated. Even when a process is shown to be ineffective or inefficient, people tend to dither and not make a positive move to change it. Even when confronted by facts, people will tend to do what they know best.

CPM systems can change processes by infusing them with more information, providing insight and more alternatives to managers to consider. In the charter school we interviewed, the output of CPM systems has changed the way that teachers are teaching the student. They are taking this information feedback and doing different things with it or altering existing approaches. These are all clearly changes to their existing business processes. Similarly, their HR department has changed its hiring business processes as a result of information that CPM systems now provide. They look at teacher performance in terms of student performance and are using this information to drive the teacher hiring strategy. For example, they can see now that teachers hired out of University X seem to do better in district Y. This allows them to be able to assess a teacher’s performance working in a certain geographic region in terms of his or her experience in years.

“...I believe it has changed our business processes. There is a willingness to succeed now and there is a desire to use CPM as part of the solution. CPM is providing crucial linkages and allowing us to join groups that were previously disconnected. Through the use of the department’s LDAP server, we are able to link PeopleSoft and SAP information so that we can do comparisons and analysis that was just not possible before. The manager’s dashboard is leveraging the Active Directory to determine what content to show each user. We have become a lot more proactive as a result of this...” (Govt. Dept. A)

CPM has to be designed around the business processes and not vice versa. In very large companies, processes are driven by head office and are not open to change. Sometimes these enterprise processes have created inefficiencies within the localized business. CPM can drive business processes by complementing existing information systems and existing business processes.

Effects on competitive position

At the end of the day, the CPM system is just a productivity software tool. Ultimately it is the synergies that are created due to its addition that really matters. Any company has the ability to buy the software and the hardware but it is in the way that it is used and the skills and experiences that managers and users can develop in leveraging it to do their jobs is where the competitive differentiation really occurs in a way that is not replicable by competitors. In general, our interview subjects agreed that CPM systems had added something tangible to the firm in terms of improvements to competitive position as evidenced by the quotes below.

“...Yes, I feel that our systems provide us with a definite competitive edge. We use the outputs of these systems to differentiate ourselves from our competitors. We can show our parents and students (our customers) how well we can serve them and why they should entrust their education to us. Our ability to proactively do interventions is a great difference from our competition. We also have a huge volume of data that has been collected on performance, student testing etc that others will not be able to easily replicate. Our ability to use this data is also something we have learned to do and will be something other firms cannot start with...”
(Executive from Firm C)

“...We are making faster decisions now. We are more accurate in our forecasts and I think our decision quality is much improved too. I believe that the trade scorecards have improved the quality of finance data by 50% and the quality of our HR data by 50%. This has led to more effective decision making...” (Govt. Dept. A)

“...Yes, I would say it has altered our competitive position. In terms of the day to day information we are able to put into the hands of our sales agents, we are definitely ahead of our competitors...” (Executive from Firm J)

We were interested to learn if CPM specific capabilities could actually alter competitive position within a government context. The notion of competition differs between the public and the private sector. Since government has technically no competition for its services and is not driven by a profit orientation we wondered if this was even a relevant question. The following thought offered by a senior IT manager at a large federal government department shed an interesting perspective on how the skillful use of such systems might offer a competitive differentiation within a government context.

“...Yes, I believe that skillful use of these systems can provide a competitive differentiator within a government context. In our organization and in all of Government, there is a process where Deputy Ministers have to compete with each other to get funds from Treasury Board. Since there is a scarce quantity of money available, all of the senior executives compete for this pot of money. CPM can be a very important differentiator to justify the request for money. If the department can better plead their case and back it up with hard facts, it makes their case all that much stronger. Similarly, within the department itself, managers (Directory Generals and Directors) can use CPM in a similar fashion to compete for internal budgets. The planning aspects can provide a huge competitive advantage in terms of getting a competitive edge...” (Govt. Dept. H)

We feel that the above perspective is not an obvious use for CPM but it has proved to be very useful to Firm H in this regard. This view was also echoed by the interviewee from Firm B, a senior director for a large CPM vendor who agreed that the same type of behavior happens within a private sector company as well where CPM specific capabilities are being used to compete for internal resources as well.

Effects on organizational performance

Handy (1993) identified over 60 factors that impact organizational performance so attributing improvements in organizational performance solely to a CPM system is not realistic as there are too many influencing variables.

In the quantitative analysis, we found that taken as a whole, there was a significant relationship between the core organizational capabilities and the performance construct. For the most part, our interviewees agreed that this was correct. We asked them to consider the usefulness and utility of these systems in terms of decision-making.

*“...It has allowed us to make better decisions, faster decisions...”
(Executive from Firm K)*

*“...It has allowed us to comply better with regulatory requirements. For example, as part of our hiring, we are supposed by law (FCC) to have certain ratios in hiring with regards to gender, visible minorities etc. If for some reason, we fall short of these requirements, we have to provide solid reasons backed up by our data to show that every reasonable effort was made to meet the requirements. These systems are vital in this regard to provide backup to our decision making processes...”
(Executive from Firm K)*

“...Yes, I think it has been a positive impact in terms of our ability to provide better services to our clients. As a government department, we are not profit driven but more quality of service driven. I think these systems have definitely helped...” (Govt. Dept. G)

One problem with attributing performance improvements to a technology intervention is that people's perspective of performance within the same firm can be quite different. What one person considers good performance is not necessarily the same as another. How individuals assess the impact and success of technology systems is also variable. Since people come from varying backgrounds, it is possible for expectations to be set that do not coincide. People have their own mental models that they impose on whatever it is that they are involved with and this will color their perspective and ability to assess success. These divergent perspectives of success can be challenging. It is important to get people to agree on something that will be a proxy for performance. Firms therefore need to establish metrics that can be used to know if something has become better or not as a result of a technological intervention.

Secondly, there is an inherently social aspect towards success and performance. People tend to imitate their bosses and managers and become their intellectual clones. This is often seen in large organizations (*e.g. IBM*) where the goals of the manager are filtered down and employees base their goals for the upcoming year on the immediate manager's goals which are in turn based on his or her manager's goals. The idea behind this is that the goals of the lower level employees echo the goals of the senior management. We are not sure if this actually works or if people just pay lip service to such practices.

Thirdly, the presentation of metrics is something to be considered carefully. It is quite difficult to determine the metrics – what exactly do we need to measure and how do we get the data? ERP systems have brought the data into one place but silos still exist within most firms. Often, people are amazed or surprised by familiar information that has been presented in a somewhat different looking way. This phenomenon is known as “*de-familiarization*”. Also, one must remember that metrics tend to get corrupted over time and people find a way to work around measurements.

We believe that the reason systems work differently and enjoy different levels of success in two firms is that people may see the same things and do two different actions. One firm may do nothing with the information and it may be the right choice for them. The other firm may do something else and it may be a better choice. Ultimately, it comes down to the choices that are made with the information at our disposal. We believe CPM specific capabilities can bring this information to the surface in ways that were not possible earlier, or at least not as easily. The problem is often that people tend to not make decisions and this dithering at the highest level is the culprit.

Not all of our interviewees agreed that CPM systems have improved organizational performance. They agree that CPM systems have helped firms to uncover inefficiencies and in some cases they were actually doing the same type of activity more than once which is inefficient and a waste of resources.

Finally, in the context of federal government, defining organizational performance can be a tricky thing as the basis of measurement is not always financial, as it tends to be in the private sector. Every year, the government does a strategic review of its programs to determine what it should be doing and what it should not be doing. CPM specific capabilities can be helpful in providing useful information and performance measures that allow managers to assess the impact and usefulness of government programs. A word of caution though, just because something is not profitable does not mean the government has the freedom to stop doing it. This is something unique about government organizations. The government's mandate is to serve the population, even sometimes when the delivery of such services may not be very efficient and may often be better done privately.

Effects on Decision Making

Since improvements in decision-making are an anticipated benefit of CPM systems projects, we explored how these systems have impacted this important area and may have increased insight that was previously lacking. The speed of decision making can definitely add tangible value to CPM systems but decision quality is a lot harder to assess and this is a lot more important than speed of decision. The interviewee from Firm B stated that ROI can definitely be realized and provided an example of an oil company that used BI to manage its inventory better and with an investment of less than 100K, managed to save up to \$1M per month. Rolls Royce Aircraft engines was able to save time and money by quantifying and standardizing their finance data allowing people to all have the same information. The firm and executives became more efficient by not

wasting time on determining what the numbers are and were able to focus on their meaning instead as all the rules required to get the numbers were determined and agreed upon by all stakeholders in advance.

“...I would say that the use of the system has definitely improved decision making in some areas. We have been able to identify about \$ 28 M in new revenue opportunities so far. But it has been a bit of a struggle getting people to change the way that they make decisions. For instance, we had compelling data that indicated that a certain project should not proceed but it was a pet project of an executive who pushed it forward despite the facts that indicated otherwise. They spent \$ 4.5 M and then pulled the plug on the project...” (Executive from Firm E)

“...Yes, CPM systems have definitely helped us increase our level of insight into our operations and have helped us to make decisions better and faster. The faster that we know a classroom is going in a negative direction, the quicker we can intervene and act in a way to provide value...” (Executive from Firm C)

“Definitely, we have become more insightful and are making better decisions now.” (Govt. Dept. A)

“...I definitely feel CPM systems have increased our level of insight into our HR recruiting operation...” (Executive from Firm K)

“...Decision making is now taking place at all levels of the organization. Sometimes problems are spotted by end users who are able to run reports and to spot anomalies. These problems can now be dealt in a more proactive manner before they blow out of control and become serious issues. CPM systems have given us more insight into our processes and democratized access to information within the firm...” (Executive from Firm K)

Not all respondents agreed with this view. One respondent felt that localized decision making has become more efficient but this is not only due to analytical tools. He felt that the use of other tools like ARIBA, global expense management etc. had made great improvements in his firm's efficiency. Also increases in connectivity in terms of quality,

speed and coverage has helped his firm to get faster and more agile. At the global aggregate level, he was of the opinion that there is still a lot of work to do in terms of decision making.

“...Yes, I think some of us in the organization are using BI to make better decisions. We have definitely used the BI system outputs to feed information to others to facilitate their decision making process. Data integrity is a key to adoption. Users have to trust the data that is in the reports or they will never use it. I also believe that it is important not to mandate the use of the system. I still believe in a voluntary model...”
(Executive from Firm J)

“What-if” scenarios are very likely to help drive decision-making. On the issue of CPM systems driving automated decision-making, it appeared to be a unanimously held view that the day when systems were making automated decisions is still in the distant future.

6.9 *Key takeaways from the interviews*

We believe that the interviews we have documented above and in the appendix provide rich context and narrative around the subject of CPM systems and have helped to inform our understanding of how CPM systems are implemented in firms, how they are used and how their outputs are integrated into business processes thereby changing firm capability and possibly impacting firm performance. The following is a list of the five most important points that we extracted from these interviews.

- The deliberate creation of CPM specific dynamic capabilities is a plausible strategy and can be actively pursued by managers through the levers of incentives, usage, policies and training.
- CPM outputs should be a core part of all business processes and be designed in from the start and not as an afterthought.

- Even large, well endowed firms struggle with CPM integration and realizing tangible business value from their investments.
- Implementing CPM successfully is usually harder than what vendors suggest.
- It is critical to build an effective partnership between the IT and business stakeholders.

Our quantitative data suggested that ITC was not positively associated with IO and our interviews confirmed that this is likely correct. This might be due to the fact ITC is a pre-existing capability that the firm already has and such capabilities may be absorbed into new projects as they are well established and mature. Our data indicated that HCC was not an important predictor of outcome but we would interpret this finding with caution as our interviews suggested that HCC appears to be very important to get a successful implementation outcome. In particular, the requirement for IT and business users to work together requires the development of social and technical competences in both groups to ensure that such alignment is successful. Leadership and the readiness exhibited by both managers and the organization is a vital factor in ensuring the successful implementation and integration of these systems within the firm. And finally, the interviews seem to support our proposed notion that the implementation of these systems causes the firm to develop special capabilities that may impact the core capability portfolio which affects organizational performance.

In this section, we have comprehensively explored eight research themes and offered an interpretation as applicable. We have attempted to link the qualitative insights back to the conceptual model and have compared them with the quantitative results. In cases where the results between the quantitative and qualitative data have been inconsistent, we

have used the qualitative findings to provide an explanation. In all cases, we have taken pains to report the interviewee's words faithfully and made minor alterations to improve the readability but not the context or spirit of the quotes. In the next section, the results of the quantitative and qualitative research will be discussed in terms of how it relates to our original three research questions.

7 Discussion

In this thesis we have looked at how CPM systems may be successfully implemented in firms and have explored how they might be used to develop CPM specific capabilities that enable firms to dynamically alter their resource bases. We have proposed the notion that firms develop a dynamic capability as a result of their use and experience with CPM systems. We contend that these CPM specific capabilities are a dynamic capability per the definition in the strategy and information systems literatures and that the extent of this dynamic capability varies between firms and might be used to create competitive differentials. We believe that the deliberate development of such a dynamic capability is possible and managers should encourage this process through various levers at their disposal including mandating use, providing incentives, changing culture and enfranchising users to impact business process. We believe that when firms change their business processes as a result of such insights, the capability portfolio of the firm undergoes a change either through enhancement of existing capabilities or the creation of new ones. In either case, the resource base of the firm should change and as Barney (1991) and Helfat et al. (2007) have argued, this should translate into organizational performance impacts.

Reflecting on the quantitative and qualitative findings

The quantitative data that was collected and analyzed in this research appears to be mostly congruent with our qualitative findings and offers interesting insights into how CPM systems are implemented and how they might impact firms along a varied number of capability dimensions. An advantage of doing mixed-methods research is that

qualitative data can often provide confirmation for what is suggested by quantitative data and we found that to be the case in this research.

We set out to test four hypotheses and two propositions. Two of the hypotheses and both our propositions were supported by our quantitative data and confirmed by the managers we interviewed. Our conceptual model framed the successful implementation of CPM systems as depending on three capability constructs - IT Infrastructure, human capital and strategic leadership. Our first research question proposed that firms needed to develop these underlying capabilities in order to enjoy a successful implementation outcome. Our quantitative analysis suggested that the first two constructs ITC and HCC were not all that significant as far as determining a successful implementation outcome but SLC turned out to be quite significant. In fact, we found this to be consistently true in all cases as well as when we controlled by respondent role. We shall discuss each of these in turn.

The quantitative data analysis indicated that the IT infrastructure did not significantly affect the outcome of a CPM implementation. This was a somewhat surprising finding as earlier studies such as (Weill et al., 2002; Weill & Broadbent, 2000; Byrd & Turner, 2001; Zhu, 2004) had suggested ITC would be an important factor. When we did further analysis and controlled for the role of the respondent, we detected a change in the relationship between IT infrastructure and the implementation outcome construct. We found that IT staff placed a higher value on IT infrastructure than did the other two respondent groups. We reasoned that this may be due to the fact that managers and IT staff typically have different backgrounds and exposure to the system. This is likely the

reason that IT staff placed a greater value on the role of ITC in determining the implementation outcome. This reasoning was supported in our interviews as well as there was general consensus that ITC was an important factor but one that diminishes in importance and eventually become unnoticeable as the project matures.

We agree that IT infrastructure if taken to mean the physical components (*computers, servers, networking etc.*) should be largely ubiquitous and invisible but we feel that there is another explanation that may be plausible to explain this finding. We believe that ITC shows up as less significant because much of the ITC that is required for CPM generally exists in the firm already in terms of IT architecture and governance policies as a result of the firm's prior experience with ERP. In fact, we did find a positive linkage between firms that had implemented ERP and the CPM implementation outcome. The ANOVA test (Table 5.48) indicated a significant difference in the implementation outcome between groups that had reported successful ERP implementations than those that did not. CPM systems are usually implemented after ERP systems so much of the physical infrastructure that is needed for CPM to succeed exists and has likely been in place for some time. CPM systems are used to do reporting and analysis from data created in these underlying transactional systems. This data is made available from a data warehouse and is normally ready long before the CPM project is implemented. We believe that this explains part of the reason why management respondents did not consider IT infrastructure as an important factor in terms of implementation outcome. IT staff being closer to the infrastructure on a day to day basis are far more likely to highlight and be aware of its importance.

Exploratory factor analysis indicated that HCC was a multi-factor construct with the components broken down along two broad dimensions that may be viewed as technical and social in nature. Technical competence includes knowledge of the system and related technology. Social competence encompasses the ability to deal with users in an appropriate manner in terms of providing support and helpful interactions. HCC turned out to be non significant in our quantitative analysis but we feel that our ability to test this construct was affected by the modified SEM that we had to use (*see Figures 5.11b and 5.11c*). One of the key factors of HCC (*IT staff support*) had to be excluded from the analysis as we did not have enough common measurement items within our respondent sample. Qualitative interviews suggested that competency of IT Staff, support and personal competence are all relevant factors to an implementation outcome.

Strategic leadership turned out to be an important determinant of implementation outcome. This is something we had strongly suspected from our practical experiences and even though we lost one of the factors (*Organizational Readiness for CPM*) of SLC in the SEM model, the relationship still turned out to be strong and significant. This finding was also strongly supported by our interview data. All of our interviewees concurred that SLC was a vital ingredient in predicting implementation success outcome. We expected that leaders would inherently understand the capabilities of this technology and what these systems might do for their firms. We found that this was not always the case. Senior leaders often do not understand the capabilities of CPM and rely heavily on IT staff to tell them what is do-able with the data and information that the firm collects. Our quantitative data suggested the importance of leadership and the information we

gathered in the qualitative interviews suggested that leadership was important in terms of sponsorship and support for the CPM project with respect to funding and provisioning of adequate resources. Leaders were expected to be engaged in the project and to act as champions with senior management to add life to the CPM project and to serve as ambassadors promoting the benefits of the system within the firm. It is important for senior managers to avoid “*magic bullet theory*” where the belief is that the mere introduction of IT will cause organizational changes (Markus & Benjamin, 1997). It is critical to manage change and to empower middle managers to act as change agents.

We provided a review of the resource-based and dynamic capability literature in Chapter 2 and discussed how the deliberate development of CPM specific capabilities might fit in within these theoretical frameworks. The RBV posits competitive advantage resulting from the possession and control of strategic and value creating resources (*assets and capabilities*). There is an inherently static quality to this perspective as it assumes that the firm’s resources simply exist and does not consider how such resources materialize, evolve and change (Teece et al., 1997). The DC perspective adds an element of motion to the RBV and is concerned with how resources interact with each other and potentially change other resources (Helfat et al, 2007). Capabilities that possess an ability to change the resource base are considered to be a dynamic capability and if these capabilities can create or enhance VRIO resources, then economic rents are generated that may lead to superior performance (Ambrosini et al., 2009). This leads us into our second research question which suggests that firms that successfully implement and integrate CPM systems develop CPM specific capabilities that are dynamic in nature and affect the

development and expression of other firm capabilities. We believe that CPM systems, if considered merely as a software package are no more than a valuable asset (Soh & Markus, 1995). However, we argue that the way in which they are used and the skills the firm develops in using them represents a valuable dynamic capability, the expertise of which will vary heterogeneously among firms. Some firms will develop superior capability in the use of CPM systems and some will not. If the use of a CPM system causes other resources and capabilities to change then we might consider these CPM specific capabilities as a dynamic capability per the theoretical definition. This was strongly supported in our interviews with senior managers as well as by the quantitative data where we noted a very significant positive relationship between the implementation outcome and core capability constructs.

Our quantitative data as well as a majority of the respondents we interviewed agreed with the notion that CPM specific capabilities are a real artifact and plays a definite role in enhancing existing organizational capabilities and have potentially added new capabilities to their firms. The strength of the regression scores between implementation outcome and capabilities suggests that this is indeed quite a significant relationship. This relationship was also strong and significant in both of the SEM's we tested. This is an important finding because if the successful implementation of CPM systems are capable of altering other firm capabilities it supports our thesis that CPM specific capabilities are a dynamic capability and managers may be able to deliberately influence the development of such capabilities through new technology as well as by mandating use, providing incentives, changing culture and enfranchising users to affect process.

From our interviews, we found that many of the firms implemented CPM systems with a modest goal to improve their reporting and analytic capability. In some cases, systems were implemented after recognition that data existed within the enterprise that was not being effectively utilized. In fact, one of the questions that we asked our respondents was whether their firms were utilizing their data effectively. A high percentage of respondents (65%) agreed that they had information that was not being utilized properly. Higher scores were observed in both the outcome and capability scores for firms that indicated that they were making effective use of their information. An ANOVA test found a significant difference ($p < 0.05$) between these groups for the capabilities score.

Our third research question dealt with how changes to core firm capabilities impact organizational performance. We examined six capabilities in this research and rolled them up into an overarching capabilities construct. In both of the regression models we found a strong relationship between the capabilities and the organizational performance outcome construct. When we separated out the capabilities, the regression model indicated a particularly strong and significant relationship between two of the capability constructs (*Knowledge Management and Information Sharing/Quality/ Communication*) and Organizational Performance. This finding emphasizes how important knowledge management may be in terms of CPM system success outcomes. We further explain this by noting that these two capabilities are dependent on each other. The ability to store and share information reliably is fundamental to organizational learning and a CPM system greatly facilitates this activity. The ability to store high quality information reliably within knowledge repositories that employees can access should presumably increase the

knowledge management capability of the firm. Firms that scored high on these capabilities showed commensurate improvements in the performance construct. When we tested both of the SEM's, we again observed a strong and significant relationship between the capability and organizational performance constructs.

Simon (1947) argued that decision making relies on the selection of alternatives and proposed the well known model of alternate identification, selection and assessment. Decisions are made by boundedly rational managers who attempt to process as many of the feasible alternatives and then satisfice by picking the best (*or least harmful*) alternative. Managers will never know all the alternatives or have perfect information on all the alternatives. CPM systems may be particularly useful for decision making where one is dealing with asymmetrical information and may help in alternative identification, selection and assessment.

In terms of decision-making specifically, we found strong support for the hypothesis that firms that have implemented CPM systems successfully have seen improvements in their decision-making. Decision-making has become more fact-based and data driven. This is an important result as this has the potential to significantly impact organizational performance. Improvements in the speed and quality of decision-making can have a direct effect on profits and performance. The use of CPM specific capabilities to assist in decision making may reduce the reliance on intuition but we doubt if it will ever be fully replaced. An editorial in The Wall Street Journal (Oct 23, 2007) noted that “...*intuition is useful in business...but it often just isn't enough...*” An article in a similar vein

appeared in The Financial Times (April 18, 2007) stating that “...*the traditional ways of seeking competitive advantage are redundant and that the future lies with the ability of the firm to analyze the very considerable volumes of data it amasses about itself...*”

Running a business effectively involves making trade-offs and cost-benefit decisions. Tools such as a CPM system that can balance all of the necessary variables to assist in decision making may be essential as the complexity of running a large enterprise can no longer be made purely on instinct.

Why have some firms been more successful with CPM?

Since CPM systems are easily acquirable, why is it that not all firms are able to successfully integrate them and enjoy high levels of success? We believe that variance occurs due to the evolutionary paths the firm has followed, causal ambiguity and social complexity, three conditions that may be important in explaining such differences (Barney, 1991; Teece et al., 1997; Eisenhardt & Martin, 2000; Winter, 2003)

Porter (1980) has argued that although firms are heterogeneous in terms of their histories, this is not relevant towards understanding organizational performance. We believe that this position is in stark contrast with the resource based view. The resource based view would counter that firms are intrinsically historical and social entities and their ability to acquire and exploit resources depends on the unique positions they occupy in time and space. Penrose (1959) noted that the capacities of managers and in particular their experience with the firm’s resource base inherently sets a limit to the expansion of the firm in any given period of time (*aka the Penrose effect*) and such management

possessing firm-specific abilities cannot be easily acquired in the marketplace. CPM systems enhance the abilities of managers to understand their businesses and to deepen their understanding of the firm's resources. Managers are able to perform their own analysis and can use this as input into intelligent decision making and we confirmed this happens in our interviews. As a result, managers gain insight into their operations in ways that was simply not possible before. Firm performance depends on the paths that the firms have followed to get to where they are now and firms that lack the history and the path experience should not be able to implement similar strategies (Winter, 2003; Dierickx & Cool, 1989). We believe this is a highly relevant point when one considers why CPM systems have been successfully implemented at some firms and have been less successful at others. CPM systems reside on top of ERP systems and a lot of expertise has been built up in how to successfully use these ERP systems and in particular what data in the ERP is relevant and needs to be monitored and measured. We believe that such learning takes place over time and cannot be easily replicated by competitors.

What can managers do to make CPM more successful in their firms?

Easterby-Smith & Prieto (2008) have argued that dynamic capabilities are intrinsically linked to knowledge management. Unused productive services shape the scope and direction of the search for future knowledge within a firm (Mahoney, 2004). Knowledge and an economic incentive to search for new knowledge are built into the very nature of firms possessing entrepreneurial resources of even average initiative (Mahoney, 2004). CPM systems are critical for knowledge management as they facilitate the creation and management of new information resources that can be stored in

centralized content management repositories and shared with others. As such, they may be a platform within which to harness tacit and explicit knowledge.

Physical resources are purchased in the strategic factor markets for what managers believe they can do for their firms but as soon as these resources are integrated, the range of services they are capable of yielding changes. The services that these resources yield depends on the skills and abilities of the people using them but the development of the capacities of people is equally shaped by the resources they deal with. Taken together, these two conditions create a distinctive and productive opportunity set for a particular firm (Helfat, 1997).

When value is created from intangible assets like knowledge, it is a lot more difficult to measure because the impact such intangibles have on the bottom line may occur through complex chains of cause and effect relationships. Kaplan & Norton (2004) have noted that value creation is often indirect and contextual and depends on the alignment of such efforts with overall firm strategy. Knowledge based intangible assets rarely create value by themselves. They exhibit complementarities in behavior and exhibit value when bundled with other assets (Alavi et al., 2006; Horner Reich, 2007; Ho, 2008).

Firms will be more successful with their CPM projects if users are encouraged with appropriate incentives to develop mastery and to keep seeking ways in which usage can be expanded. Our quantitative data showed support for the notion that appropriate incentives are needed to encourage and foster usage. CPM systems are an important

technological resource that can find potential usage in many parts of the organization. We found that many firms are not using these systems fully or effectively and that business intelligence capabilities are not always considered when new processes are designed. This untapped potential represents an internal avenue for firm expansion and as long as resources are not used fully in current operations, there is an economic incentive for a firm to find creative ways of using them more completely. More importantly, the possibilities of using these technologies changes as knowledge evolves. Consequently, there is a close connection between the type of knowledge possessed by the personnel of the firm and the services obtainable from such resources.

Role of CPM within the modern firm

In Figure 2.1, we described three components of CPM and defined the role of each and the particular business question that it seeks to answer. We noted that each of the components has a very different purpose but we believe that there is a synergy that exists between all of them. We argue that building up the firm's CPM specific capabilities is vital for all three of these components to work well together as they likely have system effects where the outputs of one component feeds in as the input into another component. We propose the following model that shows how these components might relate to each other and illustrate how CPM may play a bridging role within the firm. This model reflects our findings from this research and also the personal experiences of the author who has managed several CPM implementation projects over the past ten years.

FIGURE 7.1 – Role of CPM system within the firm

We see in the above diagram how the three components of CPM work together. The firm's strategy is articulated as a series of short and long term goals by senior managers. These objectives are translated into metrics that are measurable. These metrics become inputs for the S&D component of CPM. Simultaneously, the daily activities of the firm are captured as transactions within the corporate data warehouse from which EP, BI and S&D outputs are generated. These outputs then feed back into the strategic vision allowing managers to adjust and refine goals as needed. We argue that the CPM system and the specific capabilities the firm develops play a central role in coordinating and managing these processes.

Looking back at DSS

In our review of the DSS literature, we observed that the definition of DSS has changed considerably and has become so general that any information system can now be potentially considered as a DSS. We have proposed that CPM systems are an organizational decision support system that has broadened the reach of DSS in an unprecedented way to a much bigger audience than it was ever intended to serve. A CPM system can mean different things to its users. It can play the part of a simple reporting tool at its lowest level of utility to a very sophisticated ad-hoc inquiry-supporting analytic tool capable of probing into the recesses of the corporate data warehouse to unravel the mysteries and complexities of the business. Power (2008) has broadened the definition of a DSS to be enterprise wide but this is new ground. CPM systems share elements of individual level DSS as well as Group DSS where people can work in teams to make decisions together. They are an emerging form of DSS with an evolving form and potential impacts that have not been fully understood and researched.

DSS promised many of the benefits that CPM systems do today. When DSS first appeared in the management literature, significant challenges existed that prevented these systems from enjoying widespread usage. We believe that CPM systems have a greater chance of being successfully implemented and used due to the following fundamental changes that have taken place in organizations over the past two decades.

1. The widespread adoption of high-speed networking technologies has linked previously disconnected parts of the organization together.
2. The successful implementation of enterprise wide systems (*ERP, SCM and CRM*) allows organizations to collect data in centralized and integrated data sources.

3. The success of data warehousing initiatives has enabled the organization to collect data in central sources making it possible to do reporting and analysis easily.
4. The advances in server hardware and processing power and drop in costs for memory and hard drive storage.
5. The advances in database technology making high speed querying over vast quantities of data realistic.
6. The advent of modern, enterprise wide reporting tools that remove the underlying complexity involved with data retrieval and analysis through the creation of meta-data layers of abstraction to hide complexity from end users.
7. The use of rich media client applications accessed through standard web browser based interfaces over Internet protocols.
8. The widespread adoption of mobile work enabling technologies such as Blackberries, cell phones and laptop computers and the supporting technological standards that allow rich media to be used on portable devices through high speed wireless connections.

As a result of this research, we are convinced that CPM systems have much to offer to the modern firm seeking to gain a competitive edge within its industry peer group. They are not as intrusive or likely to cause as many changes as the larger ERP system implementations did. They are also designed to be complementary in nature to the existing technologies and data management processes of the organization. Because of this, the potential of them being successfully implemented, integrated and used may turn out to be higher.

Using the RBV and DC perspective as our theoretical guide, we see that these systems although commonplace can be woven into the existing business processes of the firm in unique ways and are capable of creating efficiencies both planned and unanticipated. Researchers (Eisenhardt & Martin, 2000; Feldman & Pentland, 2003; Salvato, 2009) also

found this to be the case where common resources, routines and capabilities may be the basis to create powerful dynamic capabilities.

This research has established both quantitatively and qualitatively, that firms with successful CPM system implementations show tangible differences in capability than firms that have been less successful in their implementation. CPM systems are normally adopted as a focused solution to a discrete problem faced by the firm and are usually introduced either to facilitate reporting or to increase a firm's analytical capacities. We believe that they need to be thought of as much more than this as their utility is potentially more wide-ranging and pervasive. They should become a cornerstone of business process design and users need to consider CPM systems as the first place they look for an answer to the myriad of business problems managers face daily. We have observed that the most successful projects are able to make the value of the system so obvious to the users that it becomes the preferred alternative. Firms need to try to identify and solve problems using these systems so that users see business intelligence as a valuable tool that can help them to do their job more effectively. Simple changes such as having a custom URL that is easy to remember can make a difference. Just like we say "*just google it*" when we want to search for information, people should come to think of these systems in the same way when seeking insight and answers about their businesses.

This research has implications for theory and practice. From a theoretical perspective, the literature on dynamic capabilities argues for their primacy but is vague in providing

tangible methods through which dynamic capabilities are to be developed. While the definition, form and action mechanism for dynamic capabilities is still being argued over (Ambrosini & Bowman, 2009; Easterby-Smith et al., 2009; Arend & Bromiley, 2009; Helfat & Peteraf, 2009 etc.), we have taken a positive stance, supported by quantitative and qualitative data to assert that managers can indeed deliberately develop dynamic capabilities as a plausible competitive strategy. We have grounded the development of such capabilities in theory using the RBV and DCV to build up and support our argument for the creation of a CPM specific dynamic capability. Heterogeneity of firm resources is the bulwark of the RBV and DCV and our research suggests that the use of easily acquirable resources such as a CPM system might be used to create resource heterogeneity when overlaid on the distinctive resource base and history of the firm.

There is a dearth of academic research on the topic of CPM that must be urgently addressed and we have reduced this deficit by acknowledging the importance of implementation, provided a holistic model to achieve integration and suggested an action mechanism through which these dynamic capabilities evolve. CPM vendors are spending vast amounts of resources to develop new functionality and to increase the level of integration of these systems within the modern firm. The payoffs for such investments are substantial as the market is very large and firms are anxious to find new ways to elicit competitive advantage and are increasingly turning to internal sources of data and information as a means of doing this. The lack of attention being paid to this important IS growth area by academics needs to change. As researchers we are obligated to better understand these information systems and their action mechanisms and to suggest

methods through which firms can maximize their investments. We have proposed the notion that business processes can be actively changed as a result of CPM specific capabilities and by managers adopting a CPM capability mindset. These ideas are novel but they need to be explored further and to be validated in practice. As Benbasat & Zmud (1999) have pleaded, IS researchers should focus on relevant topics that are important to stakeholders and actively work to reduce the time lag and possibly reverse this trend of academic attention lagging practice. There is a real need for a coherent implementation framework that takes into account all the antecedent factors, three of which we have identified in this thesis to ensure that these systems are implemented and integrated with greater success in the future.

From a practical perspective, vendors need to address why CPM systems are not being more widely used and why firms are not moving out of the adolescent stage of maturity. We believe that until usage increases, these systems will not accomplish their mandate and will largely remain localized solutions. We believe that vendors share a great deal of responsibility for this sorry state of affairs. Vendors are constantly changing the system interfaces and adding functionality, hype and hyperbole with each new release. As Markus & Keil (1994) have noted, building information systems that users want to use is more than just adding fanciful features. Most software has functions that a large majority of users will never need or use yet newer versions continue to get more complex, integrated and all-encompassing. Just as users start to gain competency with one version of the software, a new release promptly emerges with new features obviating much of the progress made by the user. Often new releases are rushed to market and are not tested

adequately. We recognize that vendors view the constant changing of the software landscape as an economic necessity but this has created confusion and ultimately affected usage. Various studies have established that mastery of applications or process can only be attained after a great deal of personal time investment (Gladwell, 2008). In our view, keeping the system interface stable and consistent is very important for if the landscape keeps changing, users are always being made to start over and this has deleterious impacts on productivity and usage.

8 Conclusion

This thesis has provided an introduction to CPM systems and the discipline of performance management. The dynamic capability view of strategy has proven to be a suitable lens through which to study these phenomena. We have sought a potential nexus between CPM specific capabilities and superior firm performance and believe that such a relationship is plausible and possible. We have looked at the process of CPM system implementation and use against the framework of dynamic capability and are satisfied that the capabilities afforded by these information systems possess the necessary attributes that permits us to classify them as such. We believe that the use of dynamic capability perspective is wholly appropriate to study these systems because they may act as a change agent, affecting processes and altering the capability portfolio of firms.

The fact that so many firms have experienced variability in success in their CPM projects implies that there is still much that remains to be understood about how they are implemented and integrated successfully. Such variability and heterogeneity is not unusual however when viewed from a DC perspective. We believe that causal ambiguity and path dependent history are the underlying reasons for heterogeneity.

At the time of writing little academic attention has been focused on CPM systems and how such systems might contribute to organizational performance. We feel that this IS trend that is causing so much excitement in the practitioner sphere has been largely ignored by academics. CPM systems will continue to be an important IS growth area for

some time to come. According to IBM Cognos, the following are the reasons why CPM has moved from vision to practice:

- *Organizations have squeezed efficiency out of operations through ERP systems and are now looking to information as a strategic and competitive weapon.*
- *Sarbanes-Oxley and similar legislation are driving a new era focused on good governance. Companies are progressing from regulatory compliance, to providing greater visibility, and to transparency as a corporate competitive differentiator.*
- *The underlying technologies necessary for CPM have matured.*

(Source: IBM Cognos white paper – “The Evolution of the CPM system”, 2008)

With an almost complete absence of empirical evidence, the relationship between CPM system usage and organizational performance has been taken as a given based on the marketing strategies of vendors without any rigorous academic research to support such claims. More research on CPM systems is required to better understand how they impact organizational performance as there is a shortage of empirical research on these types of systems (Busi & Bititci, 2006). We hope that this research study has addressed this shortage in a small way. More research is required for the following three reasons.

CPM systems are large IT investments with high corporate visibility - Initial investment in a CPM system plus maintenance contracts for services and support can represent a fair percentage of the yearly IT budget for most firms. These costs are significant and are typically ongoing in nature (Burns, 2006). The greater focus on accountability means that managers have to provide greater transparency in their decision making and must

justify to their stakeholders the rationale behind important decisions. Also, executives are expected to demonstrate results faster than ever before. C-level executive turnover has accelerated rapidly in the past few years with CEO churn at an all time high (Paladino, 2008). Research from IBM Cognos has shown that the finance department tends to drive the adoption of CPM systems but they gradually find utility in manufacturing, human resources and customer services and may eventually become interwoven into many organizational functions.

CPM systems may cause organizational change - Rockart & Scott Morton (1984) noted that information systems play an essential role in organizational change and in driving strategy. Because CPM systems may impact the end user directly by providing more decision making power at lower levels, its use might well impact the organizational culture.

CPM systems implementation is complex with uncertain outcomes - The implementation of enterprise systems is richly documented in the literature and stories abound of the difficulties in getting these complex systems implemented (Umble et al. 2003, Soh et al. 2000). Alavi & Joachimsthaler (1992) found that the success of DSS implementation relied more on user-situational variables such as involvement, training and experience than on psychological factors (such as cognitive style, personality and demographics) and attention to these factors could improve DSS implementation success rates by up to 30%. Further research is required on CPM systems to understand how implementation success rates can be improved.

This research paper has made the following contributions. First, it provides an introduction and a better understanding of a recent IS phenomenon and has provided an entry point for us to gain some insight into how these systems and their usage might impact an organization. This represents an independent and unbiased academic research that has examined prevailing vendor notions relating to CPM systems and may be useful to firms that have implemented CPM or are considering such an implementation in the future. Most importantly, we have argued for an enhanced role for CPM systems within the firm. By taking a capabilities approach, we feel we have broadened the utility of these systems to the firm. Whereas CPM systems have been largely implemented as a means to solve a particular problem by providing a firm with reporting or OLAP analytics capability, we have now positioned it as a crucible in which a specific dynamic capability might be created and incubated.

Second, researchers have called for the need to operationalize the DCV in practice and to do more empirical tests in real world situations. We have proposed that managers can deliberately create CPM specific dynamic capabilities by encouraging the use and proliferation of the CPM system. We have also suggested that managers should take CPM information outputs into consideration when designing and changing business processes. Looking at these information systems through the lens of the DCV is novel and has not been done by other researchers to the best of our knowledge. Performance management is an important technique that managers are using to assess and monitor their firm's capability portfolio and is used to drive firm strategy and to create competitive differences between firms. By thinking in terms of internal capabilities as

well as other external drivers, a firm may be in a better position to address the challenges posed by change within their respective industries.

Third, we have attempted to cast CPM under the broader framework of DSS and have presented some arguments as to why it fits under several of the existing DSS taxonomies. Where the practitioner literature might attempt to portray a CPM system a completely new IS artifact, we would argue that it is in fact a manifestation of a decision support system and is in fact, an organizationally accessible DSS. The notion of considering CPM systems as an organizational wide DSS has received scant attention within either the academic or practitioner literature based on our extensive literature review.

Fourth, we know that based on personal observation and research that the process of implementing such systems presents significant organizational and technological challenges that affects the potential level of integration within the firm, thereby curtailing their usefulness and impact. We have proposed a practical framework that may enhance the success of such implementations in the future.

This research has some limitations and areas where it should be improved. One, in this research we have focused only on a small basket of core organizational capabilities that we believed to be critical for organizational performance and have attempted to establish a linkage between CPM specific capabilities and these core capabilities. Our quantitative data appears to have established this relationship and we have also validated this qualitatively through subsequent interviews with senior managers at twelve firms. We

were successful in showing such a linkage and thus we feel that the transitive logical argument can be made that CPM specific capabilities may indeed impact organizational performance. That being said, we freely recognize that there are many other firm capabilities that we have not considered that may be equally relevant to overall performance.

Second, in our survey sample, we restricted it to firms that had implemented these systems and we drew these names from public lists posted by vendors. We acknowledge that there is a potential for bias as vendors are likely to highlight success stories but this was done out of necessity. We mitigated this to some degree by finding more than one respondent at a firm and asking recipients to forward the survey to others within the firm. Future studies may benefit from a larger pool of candidate respondents and potentially include customers of more system vendors. Interesting insight may be gained from interviewing firms that have attempted CPM initiatives and failed. Understanding the causes for their failures may provide insight into how these systems may be successfully implemented.

A total of 165 survey responses were used for quantitative analysis. We would have liked to get a larger number of responses but practical constraints impeded the collection of a much larger data sample. The nature of this research involved firms providing sensitive information so this likely affected the number of responses that were collected. The length of the survey was also believed to be a limiting factor in determining the number of responses we collected. In the various structural models we tested in Chapter

5, we ended up restricting our data set to 150 responses (*from managers and IT staff*). SEM is an effective analysis technique but ideally requires a high number of responses (Kline, 2005; Byrne, 2001). At 150, we were definitely at the lower end of the acceptable range to use SEM as an analytic technique.

We tested three different ideas in this paper. We wanted to understand what it takes to implement a CPM system successfully in a firm, the impacts of such an implementation on capabilities and the impacts of capabilities on performance. Each of these topics is substantial in itself and worthy of individual attention. Second, we wanted a holistic view of CPM from the enterprise and sought participation from three kinds of users. We now believe we might have been better off just focusing on one kind of respondent and tailoring the survey instrument for them alone. Adopting a branching method in a survey where all respondents are not asked all the questions created data analysis complications. Our pre-testing indicated the appropriateness of using a branching approach and this may have been fine if the number of responses had been higher as separate SEM's could have been created for each respondent type although this would have increased the effort required to analyze the data. Another approach might have been to simply reduce the number of items on the survey, simplify the scope of the research and ensure that each respondent filled out all the questions. This would have reduced or eliminated the "*missing data by design*" issues we had to deal with in this research.

Originally, we considered including organizational culture as part of this research but eventually removed this construct to simplify our model and subsequent analysis. The

culture of the organization is believed to play a critical role in the success of an information system initiative (Romm et al, 1991). Martinsons & Chong (1999) found that even good technology can be sabotaged if it is perceived to interfere with the established social network. Cooper (1994) found that when IT conflicts with an organization's culture, the implementation will be resisted in one of two ways – either the system will be rejected or it will be modified so that it matches the existing culture. The culture of the organization may therefore hold the key to aligning the three capability constructs we discussed earlier and determine the success of the implementation outcome. Future research studies on CPM may wish to study the effects of organizational culture on successful implementation outcomes. We believe that CPM may be more successful in firms that possess supportive and nurturing organizational cultures. CPM systems disseminate information widely within the firm and empower users who may not have had access to this information prior to their implementation. Firms with unsupportive cultures are less likely to engage in information sharing and knowledge management, factors that we found are essential for CPM success. We feel strongly that cultures that are based upon information democracies and equality, where employees are empowered to act wisely on information with mindful managers taking proactive action to correct problems may be far better suited to succeeding with CPM (Downes and Barclay, 2008)

Future studies in this area may also consider looking at firms that have implemented CPM systems and compare their current performances with previous years to see if CPM

systems have made a difference in concrete, measurable terms. This may be challenging given the difficulty in trying to isolate the performance construct.

The requirement to make good decisions, coupled with the desire for uniformity in reporting and analysis and to make effective use of latent information resources is the most compelling argument driving the implementation of CPM systems within the modern firm. In the past, information was collected in various pockets within organizations and was not shared effectively between groups. Redundancy and duplication of effort was considered a normal and acceptable part of doing business. With the institutionalization of enterprise systems in the last decade, the use of centralized databases has given managers the ability to tap into a common master data source. CPM appears to provide the ability to be able to address a number of problematic issues and should continue to grow in relevance as new forms of information such as social media outputs, unstructured text data, documents, blogs and phone calls get included in data repositories and need to be analyzed for decision-making. By virtue of sitting atop of all of these data sources CPM systems may offer fresh perspectives into the workings of the organization and are likely to remain a strategic IT imperative and an object of academic attention in the future.

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10 Appendix A1

This appendix contains all supplementary information regarding this research project including the survey invitation letter and survey users were asked to fill in to collect our data. In addition, ancillary tables are placed in this section to avoid cluttering the main document.

10.1 *Survey response demographic tables*

The following tables provide descriptive information as to the composition of the survey respondents.

TABLE 10.1 – Question groupings and counts	
Groupings (question was posed only to this particular group)	Count
Management	32
IT Staff	3
Business Users	0
Management, IT Staff	11
Management, Business Users	8
IT Staff, Business Users	0
Management, IT Staff, Business Users	63

TABLE 10.2 – Survey responses broken down by gender		
Gender	Surveys	%age
Male	128	77.58 %
Female	35	21.21 %
Missing	2	1.21 %
	165	100.0 %

TABLE 10.2 – survey responses broken down by age of respondents		
Age Range	Surveys	%age
18 – 25	1	0.60 %
26 – 35	31	18.79 %
36 – 50	91	55.15 %
51 +	40	24.24 %
Missing	2	1.21 %
	165	100.0 %

TABLE 10.3 – survey responses broken down by service of respondent with organization

Respondent Service	Surveys	%age
Less than 1 year	7	4.24 %
1 to 5 years	53	32.1 %
More than 5 years	100	60.66 %
Missing	5	3.03 %
	165	100.0 %

TABLE 10.4 – survey responses broken down by respondent influence on BI/CPM selection

Influence on BI/CPM selection	Surveys	%age
Yes	76	46.06 %
No	85	51.52 %
Missing	5	3.03 %
	165	100.0 %

TABLE 10.5 – survey responses broken down by respondent use of BI/CPM technology

Day to Day usage of BI/CPM	Surveys	%age
Yes	144	87.27 %
No	18	10.91 %
Missing	3	1.82 %
	165	100.0 %

TABLE 10.6 – survey responses broken down by geographic dispersion of organization

Multinational Firm	Surveys	%age
Yes	127	76.97 %
No	35	21.21 %
Missing	3	1.82 %
	165	100.0 %

TABLE 10.7 – survey responses broken down by number of CPM users		
CPM users	Surveys	%age
Less than 100	47	28.48 %
101 – 1000	81	49.09 %
1001 – 10000	24	14.55 %
More than 10000	7	4.24 %
Missing	6	3.64 %
	165	100.0 %

TABLE 10.8 – survey responses broken down by respondent industry		
Industry Sector	Surveys	%age
Manufacturing	17	10.30 %
Financial	11	6.67 %
Consulting	17	10.30 %
Government	55	33.33 %
Services	13	7.88 %
Non profit	1	0.61 %
Retail	8	4.85 %
Other	43	26.06 %
	165	100.0 %

TABLE 10.9 – survey responses broken down by annual revenue of organization		
Annual Revenue	Surveys	%age
Less than 10 M USD	21	12.73 %
10 M – 100 M USD	26	15.76 %
100 M – 1 B USD	43	26.06 %
More than 1 B USD	53	32.12 %
Missing	22	13.33 %
	165	100.0 %

10.2 Data outliers

Table 10.10 – Outliers within the data set		
Construct	# of outliers	Case #
ITCMEAN	0	
HCCMEAN	1	91
SLCMEAN	1	91
IOMEAN	4	39, 48, 49, 140
COCPROJGOVERN	2	45, 137
COCORGCOMP	0	
COCPROJCOMP	12	51, 80, 92, 109, 121, 126, 133, 137, 140, 145, 146, 157
COCBPR	0	
COCINFO	10	47, 49, 51, 101, 109, 126, 133, 140, 148, 162
COCKNOWLMGMT	0	
COCKNOWLRES	0	
COCMEAN	1	94
OPMEAN	5	15, 39, 40, 133, 140

*Note: case numbers marked in **bold** type face are unique*

10.3 Exploratory Factor Analysis Results

The following series of tables are outputs from EFA and are included in this appendix to provide details regarding item communalities, measurement item selection and factor loadings.

10.3.1 IT Infrastructure Capability Construct

Table 10.11 - Table of Extraction Communality scores for the IT Infrastructure construct

Variable Item	Extraction
V32 - My organization has a well developed enterprise IT architecture that supports an integrated flexible reliable and secure	.702
V33 - My organization has a high quality physical IT infrastructure hardware software and communication networks to connect users	.633
V34 - Our IT applications are adequate to cover current and future corporate needs	.611
V35 - Identifying investing in and adopting new technology for business purposes is a high priority for my organization	.476
V36 - IT infrastructure is based on a common and consistent technology platform	.646
V37 - My organization has strong data management standards	.634
V38 - My organization has well prepared disaster planning and business recovery processes	.650
V39 - My organization has implemented an enterprise system (SAP JD Edwards Oracle etc successfully in the past	.386
V40 - My organization is well supported by IT vendors with established service level agreements in place for support	.697

Table 10.12 - Rotated component matrix for IT Infrastructure construct

Variable Item	F1	F2
V38 - My organization has well prepared disaster planning and business recovery processes	.805	-.041
V40 - My organization is well supported by IT vendors with established service level agreements in place for support	.828	.112
V35 - Identifying investing in and adopting new technology for business purposes is a high priority for my organization	.645	.246
V37 - My organization has strong data management standards	.597	.526
V39 - My organization has implemented an enterprise system (SAP JD Edwards Oracle etc successfully in the past	.529	.326
V36 - IT infrastructure is based on a common and consistent technology platform	-.104	.797
V34 - Our IT applications are adequate to cover current and future corporate needs	.334	.707
V32 - My organization has a well developed enterprise IT architecture that supports an integrated flexible reliable and secure	.483	.685
V33 - My organization has a high quality physical IT infrastructure hardware software and communication networks to connect users	.666	.435

10.3.2 Human Capital Capability Construct

Table 10.13 - Table of Extraction Communality scores for Human Capital Capability construct	
Variable Item	Extraction
V43 - I have a good understanding of my organizations mission and strategy	.881
V44 - I clearly understand the purpose and objectives of the CPMBI system	.800
V45 - I have received adequate training to use the CPMBI system	.864
V46 - The IT staff possess the proper education and background to do their jobs effectively	.638
V47 - The IT staff are highly competent with CPMBI software packages	.760
V48 - The IT staff are competent in deploying information systems projects	.758
V49 - My organization has the ability to develop custom applications and information systems to meet its business needs	.858
V50 - The IT staff has strong interpersonal skills that help them in training and supporting CPMBI users	.641
V51 - My organization has programs for continuously investing in the development and training of its IT staff	.657
V52 - IT staff responsible for CPMBI are very responsive to my needs	.756
V53 - I am very satisfied with the level of IT support	.743

Table 10.14 - Rotated component matrix for Human Capital Capability construct				
Variable Item	F1	F2	F3	F4
V51 - My organization has programs for continuously investing in the development and training of its IT staff	.760	.040	.039	.277
V52 - IT staff responsible for CPMBI are very responsive to my needs	.800	.164	.293	.061
V53 - I am very satisfied with the level of IT support	.817	.270	-.047	.009
V50 - The IT staff has strong interpersonal skills that help them in training and supporting CPMBI users	.578	.544	.094	.046
V49 - My organization has the ability to develop custom applications and information systems to meet its business needs	-.027	.859	.025	.345
V46 - The IT staff possess the proper education and background to do their jobs effectively	.470	.562	.314	-.057
V47 - The IT staff are highly competent with CPMBI software packages	.555	.595	.275	-.145
V48 - The IT staff are competent in deploying information systems projects	.513	.691	-.124	.041

V45 - I have received adequate training to use the CPMBI system	-.040	.232	.890	-.126
V44 - I clearly understand the purpose and objectives of the CPMBI system	.314	-.189	.743	.335
V43 - I have a good understanding of my organizations mission	.131	.172	.037	.912

10.3.3 Strategic Leadership Capability Construct

Table 10.15 - Table of Extraction Communalities scores for Strategic Leadership construct

Variable Item	Extraction
V56 - Management has a well established vision for CPMBI in my organization	.702
V57 - Managements CPMBI strategy is fully integrated with the business strategy	.812
V58 - Key milestones for the CPMBI system program have been identified and articulated by senior managers	.765
V59 - Senior management in my organization has been significantly involved in developing the CPMBI strategy	.839
V60 - Excluding senior management others such as end users IT support staff etc have been significantly involved in developing	.555
V63 - Top management is highly supportive of and committed to CPMBI related change processes	.680
V64 - My organization has implemented an explicit change management plan	.718
V65 - Efforts are made to involve affected organizational members in designing the CPM initiated change	.639
V66 - The roles to be assumed by employees during and after the change are assigned	.766
V67 - Incentive plans are restructured to ensure commitment of organizational members to CPMBI deployment and use	.704
V70 - My organization has the capacity to finance the acquisition deployment and long term maintenance of a CPMBI system	.611
V71 - My organization has well established procedures for CPMBI investment risk reduction and management	.713
V72 - My organization has explicit well articulated and established procedures for evaluating the performance of CPMBI system a	.842
V73 - Performance in delivering CPMBI to the business is benchmarked against best in class performers	.755
V74 - The benefits of the CPMBI system have been clearly identified and communicated	.681
V75 - In deploying CPMBI in my organization IT managers focus on delivering intermediate CPMBI products early wins to build confidence	.630

Table 10.16 - Rotated component matrix for Strategic Leadership construct					
Variable Item	F1	F2	F3	F4	F5
V56 - Management has a well established vision for CPMBI in my organization	.682	-.407	.046	-.211	-.158
V63 - Top management is highly supportive of and committed to CPMBI related change processes	.742	-.135	-.097	.277	-.158
V57 - Managements CPMBI strategy is fully integrated with the overall business strategy	.650	-.597	-.057	-.164	.062
V58 - Key milestones for the CPMBI system program have been identified and articulated by senior managers	.721	-.449	-.032	-.194	-.072
V59 - Senior management in my organization has been significantly involved in developing the CPMBI strategy	.779	-.390	-.127	.161	-.196
V60 - Excluding senior management others such as end users IT support staff etc have been significantly involved in developing the CPMBI strategy	.542	.103	-.365	-.134	-.315
V67 - Incentive plans are restructured to ensure commitment of organizational members to CPMBI deployment and use	.513	.144	.152	.624	-.084
V74 - The benefits of the CPMBI system have been clearly identified and communicated	.514	.096	-.135	-.234	.578
V75 - In deploying CPMBI in my organization IT managers focus on delivering intermediate CPMBI products early wins to build confidence	.546	-.163	-.067	.166	.523
V72 - My organization has explicit well articulated and established procedures for evaluating the performance of CPMBI system acquisition, delivery and use.	.560	.280	.496	-.441	.096
V70 - My organization has the capacity to finance the acquisition deployment and long term maintenance of a CPMBI system	.441	.011	.469	.430	.104
V64 - My organization has implemented an explicit change management plan	.501	.536	-.369	-.120	-.170
V65 - Efforts are made to involve affected organizational members in designing the CPM initiated change	.678	.365	-.164	.030	.137
V66 - The roles to be assumed by employees	.608	.517	-.271	.092	.218

during and after the change are assigned					
V71 - My organization has well established procedures for CPMBI investment risk reduction and management	.549	.476	.182	-.119	-.372
V73 - Performance in delivering CPMBI to the business is benchmarked against best in class performers	.405	.124		-.132	-.042

10.3.4 Implementation Outcome Construct

Table 10.17 - Table of Extraction Communality scores for Implementation Outcome construct

Variable Item	Extraction
V92 - I believe that the CPMBI system implementation in this organization has been very successful	.593
V93 - The CPMBI system is very reliable	.607
V94 - The CPMBI system is very easy to use	.616
V95 - The CPMBI system is useful and has helped me to perform my job more effectively	.644
V96 - The CPMBI system has given me better access to information that was previously difficult to obtain	.628
V97 - The CPMBI system implementation project was on schedule	.838
V98 - The CPMBI system implementation project was delivered within budget	.852

Table 10.18 - Rotated component matrix for Implementation Outcome construct

Variable Item	F1	F2
V93 - The CPMBI system is very reliable	.745	.228
V94 - The CPMBI system is very easy to use	.775	-.125
V95 - The CPMBI system is useful and has helped me to perform my job more effectively	.799	.077
V96 - The CPMBI system has given me better access to information that was previously difficult to obtain	.774	.169
V92 - I believe that the CPMBI system implementation in this organization has been very successful	.690	.341
V97 - The CPMBI system implementation project was on schedule	.172	.899
V98 - The CPMBI system implementation project was delivered within budget	.067	.920

10.3.5 Core Organizational Capabilities Construct

Table 10.19 - Table of Extraction Communality scores for Core Organizational Capabilities construct	
Variable Item	Extraction
V101 - An effective CPMBI project team has been assembled to execute the CPMBI strategy	.833
V102 - CPMBI project implementation teams comprise of an appropriate mix of business IT and consulting personnel	.831
V103 -Business champions with sufficient authority and resources are associated with the CPMBI project	.823
V104 - CPMBI outsourcing activities are supported by effective contract management structures and personnel	.771
V105 - My organization has or is planning on setting up a Business Intelligence Competency Centre BICC to ensure that all CPMBI	.872
V108 - My organization has the expertise internally to develop its CPMBI strategy	.832
V109 - My organization has a well developed competence in integrating and managing enterprise wide production environments	.800
V110 - A majority of users business and IT are proficient in the use of the deployed CPMBI system	.792
V113 - Implementation of CPMBI systems reflects business requirements	.753
V114 - CPMBI service and technology suppliers have substantial implementation competence	.794
V115 - The CPMBI project team has a good track record of delivering projects effectively	.858
V118 - Business processes have been redesigned to fit CPMBI embedded best practice	.770
V119 - Business process owners have overall responsibility for CPMBI applications in their units	.703
V120 - The business processes reflect both business and IT strategies	.653
V121 - My organization has established easy to apply evaluation criteria to measure the effectiveness of business processes	.762
V122 - My organization has assembled a cross functional team to support process integration	.809
V123 - My organization has instituted incentive systems to encourage process thinking and process driven decision making	.826
V126 - The CPMBI system has improved the quality of communication between users	.849
V127 - The CPMBI system allows me to share information easily with others	.871

V128 - I have a high degree of confidence in the information provided by the CPMBI system	.870
V131 - My organization has a structured program for researching acquiring and diffusing information and knowledge about new technologies	.703
V132 - My organization has put in place procedures to capture codify and disseminate CPMBI knowledge held by individuals such a	.835
V133 - My organization has established effective partnerships with CPMBI service and technology partners for knowledge transfer	.781
V136 - My organization has in place well structured and managed information and knowledge repositories to support overall business function	.811
V137 - The content of the information and knowledge repositories are relatively accurate up to date and relevant	.867
V138 - My organization has excellent access to CPMBI information and knowledge held by partners consultants and research organizations	.831
V139 - Organizational information can be easily accessed and shared across the enterprise by authorized employees	.834
V140 - Diffusion of organizational information and knowledge is supported by robust and user friendly knowledge management technologies	.754

Table 10.20 - Rotated component matrix for Core Organizational Capabilities construct

Variable Item	F1	F2	F3	F4	F5	F6	F7	F8	F9
V132 - My organization has put in place procedures to capture codify and disseminate CPMBI knowledge held by individuals such a	.831	.182	-.021	.203	.067	.054	.146	.038	.199
V133 - My organization has established effective partnerships with CPMBI service and technology partners for knowledge transfer	.791	.135	.063	.171	.211	.056	.077	-.023	.223
V131 - My organization has a structured program for researching acquiring and diffusing information and knowledge about new	.730	-.118	.190	.106	.197	-.015	.171	.153	.126

technologies									
V105 - My organization has or is planning on setting up a Business Intelligence Competency Centre BICC to ensure that all CPMBI	.679	.071	-.239	-.010	-.263	.344	-.306	.013	-.260
V136 - My organization has in place well structured and managed information and knowledge repositories to support overall business function	.687	.083	.204	-.154	.137	.121	.444	.146	-.120
V139 - Organizational information can be easily accessed and shared across the enterprise by authorized employees	.523	.418	.033	.218	.309	.130	.035	.317	-.351
V140 - Diffusion of organizational information and knowledge is supported by robust and user friendly knowledge management technologies	.460	.395	.209	.096	.457	.095	.149	.289	-.097
V137 - The content of the information and knowledge repositories are relatively accurate up to date and relevant	.295	.171	-.120	-.041	.024	-.078	.321	.228	-.046
V118 - Business processes have been redesigned to fit CPMBI embedded best practice	.126	.588	.582	.051	.072	.112	-.107	-.041	-.190
V119 - Business process owners have overall responsibility for CPMBI applications in their units	-.001	.652	.364	.170	-.016	.107	.318	.067	.005
V120 - The business processes reflect both business and IT strategies	.061	.629	.180	.005	.318	.058	.045	.318	.114
V121 - My organization has	.044	.604	-.101	.546	.149	-.078	-.046	-.144	.188

established easy to apply evaluation criteria to measure the effectiveness of business processes									
V108 - My organization has the expertise internally to develop its CPMBI strategy	-.075	.172	.828	-.008	-.022	.141	-.129	.104	.251
V109 - My organization has a well developed competence in integrating and managing enterprise wide production environments	.260	.088	.732	.201	.246	.022	.260	-.125	-.061
V102 - CPMBI project implementation teams comprise of an appropriate mix of business IT and consulting personnel	.045	-.179	.495	.657	.081	.227	-.036	.163	.187
V103 -Business champions with sufficient authority and resources are associated with the CPMBI project	.249	.268	.075	.684	.253	.329	.185	-.029	-.091
V122 - My organization has assembled a cross functional team to support process integration	.137	.021	.045	.882	.054	.024	-.018	.074	-.009
V128 - I have a high degree of confidence in the information provided by the CPMBI system	.105	.047	.024	.224	.847	.198	.056	.216	-.006
V127 - The CPMBI system allows me to share information easily with others	.361	.246	.089	.064	.711	.370	.054	-.147	-.029
V126 - The CPMBI system has improved the quality of communication between users	.169	.542	.333	.045	.567	.177	.039	.029	.242
V101 - An effective CPMBI	.065	.057	.337	.414	.114	.689	-.125	.140	.131

project team has been assembled to execute the CPMBI strategy									
V115 - The CPMBI project team has a good track record of delivering projects effectively	.077	.206	.082	.008	.277	.847	.050	.075	-.029
V104 - CPMBI outsourcing activities are supported by effective contract management structures and personnel	.356	.040	-.031	.186	.202	.523	-.088	.521	.119
V114 - CPMBI service and technology suppliers have substantial implementation competence	.222	.705	-.091	-.149	.041	.389	.228	-.047	.097
V138 - My organization has excellent access to CPMBI information and knowledge held by partners consultants and research organizations	.155	.099	.024	.065	.093	.102	.204	.546	.126
V123 - My organization has instituted incentive systems to encourage process thinking and process driven decision making among employees	.233	.141	.127	.075	.018	.089	-.035	.169	.832
V110 - A majority of users business and IT are proficient in the use of the deployed CPMBI system	.304	.198	.419	.209	.164	.185	.449	-.421	-.031
V113 - Implementation of CPMBI systems reflects business requirements	.064	.240	.290	.259	.293	.489	.440	-.050	.138

10.3.6 Organizational Performance Construct

Table 10.21 - Table of Extraction Communality scores for Organizational Performance construct	
Variable Item	Extraction
V143 - CPMBI systems have greatly improved the quality and quantity of business information available to me	.627
V144 - The use of the CPMBI system has enabled employees to develop process oriented skills	.627
V145 - I am able to make better decisions with the information I am able to retrieve from the CPMBI system	.766
V146 - I am able to make decisions faster with the information I am able to retrieve from the CPMBI system	.779
V147 - CPMBI systems have had a direct role in improving the financial performance of my organization	.387
V148 - The CPMBI system has helped improve the performance of my job function	.709
V149 - CPMBI systems have allowed my organization to become more flexible and responsive in delivering products and services to	.531
V150 -CPMBI systems have greatly helped to increase the efficiency and effectiveness of existing organizational processes	.633
V151 - CPMBI systems have helped in the creation of new organizational processes	.710
V152 - CPMBI systems have been instrumental in the creation of new organizational capabilities	.654
V153 - CPMBI systems have played an important role in improving the human resources performance and visibility within my organization.	.517

Table 10.22 - Rotated component matrix for Organizational Performance construct		
Variable Item	Factor 1	Factor 2
V151 - CPMBI systems have helped in the creation of new organizational processes	.832	.131
V152 - CPMBI systems have been instrumental in the creation of new organizational capabilities	.785	.197
V150 -CPMBI systems have greatly helped to increase the efficiency and effectiveness of existing organizational processes	.751	.261
V144 - The use of the CPMBI system has enabled employees to develop process oriented skills	.691	.387
V153 - CPMBI systems have played an important role in improving the human resources performance and visibility within my organization	.649	.311
V149 - CPMBI systems have allowed my organization to become more flexible and responsive in delivering products and services to	.516	.514
V146 - I am able to make decisions faster with the information I am able to retrieve from the CPMBI system	.204	.859
V145 - I am able to make better decisions with the information I am able to retrieve from the CPMBI system	.206	.851
V148 - The CPMBI system has helped improve the performance of my job function	.270	.797
V143 - CPMBI systems have greatly improved the quality and quantity of business information available to me	.476	.633
V147 - CPMBI systems have had a direct role in improving the financial performance of my organization	.473	.405

10.4 SEM Measurement Models

IT Infrastructure Capability Measurement Model

<p>General (all cases, n=165)</p>	<p>General (all cases, n=165)</p>
<p>(Mgmt and IT staff, n=150)</p>	<p>(Mgmt and IT staff, n=150)</p>
<p>(Mgmt only, n=70)</p>	<p>(Mgmt only, n=70)</p>

Human Capital Capability Measurement Model

	General (all cases, n=165)
	(Mgmt and IT staff, n=150)
	(Mgmt only, n=70)

Strategic Leadership Capability Measurement Model

Implementation Outcome Measurement Model

Core Organizational Capability Measurement Model

<p>General (all cases, n=165)</p>	<p>General (all cases, n=165)</p>
<p>(Mgmt and IT staff, n=150)</p>	<p>(Mgmt and IT staff, n=150)</p>
<p>(Mgmt only, n=70)</p>	<p>(Mgmt only, n=70)</p>

Organizational Performance Measurement Model

10.5 *Invitation to participate in survey*

Dear <<Mr. / Mrs. / Ms.>> <<Respondent Last Name>>,

You are receiving this letter to invite you to participate in a research survey on Corporate Performance Management (CPM) and Business Intelligence (BI) that is being conducted by John Ajit Thomas, a doctoral research student at The Eric Sprott School of Business at Carleton University, Ottawa, Canada as part of the requirements of a Ph.D. degree. The project is being conducted under the supervision of Dr. Gerald Grant, Associate Professor of Information Systems at The Eric Sprott School of Business at Carleton University, Ottawa, Canada.

You have been selected to participate in the survey because you have been identified as an individual who is knowledgeable about the CPM/BI implementation at your organization and may be able to provide insight that may be useful for this research project. This research is concerned with exploring the key factors that result in successful implementations of such systems and the impact of such systems on organizational performance.

An online survey questionnaire has been prepared to collect your input. The survey takes approximately 20-30 minutes to fill out with all questions presented in a multiple - choice / single selection format. Filling out the survey is quite simple and can be done at your convenience using a standard web browser.

Please be assured that your responses will be held in confidence and presented anonymously in summarized form only. The survey is secured with SSL technology that allows data transmitted on the Internet to be encrypted for security. The survey is hosted by www.questionpro.com, an online survey provider located in the United States. Please note that data collected is subject to US laws and regulations including The Patriot Act. The responding computer IP address will not be stored in the survey results to guarantee anonymity. Study results will only use aggregate data from all responses and no identifying information will be used. All data collected from this survey will be purged after the research project is completed by June 30, 2010. The student researcher and the supervising professor are the only people allowed access to your responses.

Participants in this research will not receive any monetary compensation. The benefits of your participation in this study would assist the research student to deepen our understanding of the impact of CPM/BI systems on organizational performance. If you wish to provide an email contact address, a copy of the research findings will be provided to you by email upon completion of the project.

Please note that you are free to answer all or part of the questionnaire as you see fit. You may choose not to answer certain questions if you wish. If at any time you wish to withdraw from the survey, you are free to do so prior to the final submission of the

responses. The last question on the survey will confirm your agreement to allow us to use your responses for this research. Please note that since the survey is anonymous, we cannot remove or edit responses once they have been submitted.

This study has been reviewed and approved by the Ethics Committee of Carleton University. If you have any concerns or questions about this study, please feel free to direct any questions to the Chair of the Ethics Committee. The contact details are provided below.

Professor Antonio Gualtieri, Chair
Carleton University Research Ethics Committee
Office of Research Services
Carleton University
1125 Colonel By Drive
Ottawa, Ontario K1S 5B6
Tel: 613-520-2517
E-mail: ethics@carleton.ca

If you have any questions about this study, please feel free to contact me or my thesis supervisor at the following co-ordinates.

Ajit Thomas Ph.D. Student (Information Systems) Sprott School of Business Carleton University Ottawa, Ontario Email: jathomas@connect.carleton.ca	Dr. Gerald Grant Associate Professor, Information Systems Sprott School of Business Carleton University Ottawa, Ontario Tel: (613) 520-4427 Email: Gerald_grant@carleton.ca
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Yours sincerely,

Ajit Thomas
Student Researcher

Dr. Gerald Grant
Thesis Supervisor

CONSENT FORM: Where applicable a consent section may be added at the end of the letter of information:

I, <<Mr. / Mrs. / Ms.>> <<Respondent Last Name>> have read the above letter and understand that I am participating in a research project and I voluntarily agree to participate.

[Click here to take the survey](#)

10.6 Survey Questionnaire

Mgr	IT	User	Demographics
			A1. What is your gender?
			A2. What is your age range?
			A3. How long have you worked within this organization?
			A4. Were you involved with the decision to implement a CPM/BI system in your organization?
			A5. Do you use a CPM system as part of your day-to-day job?
			A6. For how many years has your organization been using a CPM/BI system?
			Organization Information
			A7. Is your firm geographically dispersed?
			A8. What industry is your organization in?
			A9. Number of employees in your organization.
			A10. Number of employees who use the CPM system in your organization.
			A11. Annual Revenues
			A12. Please select the role that best suits your official job description.
			General Environmental Context
			B1. In the past 12 months, my organization has undergone a major rethinking of its strategic priorities to respond to developments in the general business environment.
			B2. The industry to which my organization belongs has been transformed significantly in response to regulatory changes.
			B3. In the past 12 months, my organization has experienced significant shifts in demand for its products or services.
			B4. My organization is considered to be a leader in terms of implementing new technology and innovation.
			B5. My organization competes for business in a highly competitive industry.
			Business Environmental Context
			B6. Our industry has undergone intensive restructuring activities in the last two years.
			B7. My organization faces increasing pressure from stakeholders, financial markets, or government to improve performance and profitability..
			B8. My organization's profitability has been sharply affected by current economic trends (growth or recession).
			B9. I believe that my organization produces potentially useful information that is not being utilized effectively.
			B10. My organization has been forced to deploy a CPM/BI system for business survival and growth.
			B11. CPM/BI systems are being implemented to address a specific business need or shortcoming.
			IT Infrastructure Capability (ITC)

			C1. My organization has a well-developed enterprise IT architecture that supports an integrated, flexible, reliable, and secure business platform.
			C2. My organization has a high quality physical IT infrastructure (hardware, software and communication networks) to connect users.
			C3. Our IT applications are adequate to cover current and future corporate needs.
			C4. Identifying, investing in and adopting new technology for business purposes is a high priority for my organization.
			C5. IT infrastructure is based on a common and consistent technology platform.
			C6. My organization has strong data management standards.
			C7. My organization has well prepared disaster planning and business recovery processes.
			C8. My organization has implemented an enterprise system (e.g. SAP, JD Edwards, Oracle etc.) successfully in the past.
			C9. My organization is well supported by IT vendors with established service level agreements in place for support.
			Human Capital Capability (HCC)
			D1. I have a good understanding of my organization's mission and strategy.
			D2. I clearly understand the purpose and objectives of the CPM/BI system.
			D3. I have received adequate training to use the CPM/BI system.
			D4. The IT staff possess the proper education and background to do their jobs effectively.
			D5. The IT staff are highly competent with CPM/BI software packages.
			D6. The IT staff are competent in deploying information systems projects.
			D7. My organization has the ability to develop custom applications and information systems to meet its business needs.
			D8. The IT staff has strong interpersonal skills that help them in training and supporting CPM/BI users.
			D9. My organization has programs for continuously investing in the development and training of its IT staff.
			D10. IT staff responsible for CPM/BI are very responsive to my needs.
			D11. I am very satisfied with the level of IT support.
			Strategic Leadership Capability (SLC)
			E1. Management has a well-established vision for CPM/BI in my organization.
			E2. Management's CPM/BI strategy is fully integrated with the overall business strategy.
			E3. Key milestones for the CPM/BI system program have been identified and articulated by senior managers.
			E4. Senior management in my organization has been significantly involved in developing the CPM/BI strategy.
			E5. Excluding senior management, others (such as end users, IT support staff etc.) have been significantly involved in developing the CPM/BI strategy.
			F1. Top management is highly supportive of and committed to CPM/BI related change processes.
			F2. My organization has implemented an explicit change management plan.

			F3. Efforts are made to involve affected organizational members in designing the CPM-initiated change.
			F4. The roles to be assumed by employees during and after the change are assigned.
			F5. Incentive plans are restructured to ensure commitment of organizational members to CPM/BI deployment and use.
			G1. My organization has the capacity to finance the acquisition, deployment and long-term maintenance of a CPM/BI system.
			G2. My organization has well established procedures for CPM/BI investment risk reduction and management.
			G3. My organization has explicit, well-articulated and established procedures for evaluating the performance of CPM/BI system acquisition, delivery, and use.
			G4. Performance in delivering CPM/BI to the business is benchmarked against best-in-class performers.
			G5. The benefits of the CPM/BI system have been clearly identified and communicated.
			G6. In deploying CPM/BI in my organization, IT managers focus on delivering intermediate CPM/BI products (early wins) to build commitment and involvement.
			Implementation Outcome (IO)
			I1. I believe that the CPM/BI system implementation in this organization has been very successful.
			I2. The CPM/BI system is very reliable.
			I3. The CPM/BI system is very easy to use.
			I4. The CPM/BI system is useful and has helped me to perform my job more effectively.
			I5. The CPM/BI system has given me better access to information that was previously difficult to obtain.
			I6. The CPM/BI system implementation project was on schedule.
			I7. The CPM/BI system implementation project was delivered within budget.
			Core Organizational Capabilities (COC)
			J1. An effective CPM/BI project team has been assembled to execute the CPM/BI strategy.
			J2. CPM/BI project implementation teams comprise of an appropriate mix of business, IT, and consulting personnel.
			J3. Business champions with sufficient authority and resources are associated with the CPM/BI project.
			J4. CPM/BI outsourcing activities are supported by effective contract management structures and personnel.
			J5. My organization has or is planning on setting up a Business Intelligence Competency Centre (BICC) to ensure that all CPM/BI projects are based on best practices.
			K1. My organization has the expertise internally to develop its CPM/BI strategy.
			K2. My organization has a well-developed competence in integrating and managing enterprise-wide production environments.
			K3. A majority of users (business and IT) are proficient in the use of the deployed CPM/BI system.
			L1. Implementation of CPM/BI systems reflects business requirements.
			L2. CPM/BI service and technology suppliers have substantial implementation competence..

			L3. The CPM/BI project team has a good track record of delivering projects effectively.
			M1. Business processes have been redesigned to fit CPM/BI embedded best practice.
			M2. Business process owners have overall responsibility for CPM/BI applications in their units.
			M3. The business processes reflect both business and IT strategies.
			M4. My organization has established easy-to-apply evaluation criteria to measure the effectiveness of business processes.
			M5. My organization has assembled a cross-functional team to support process integration.
			M6. My organization has instituted incentive systems to encourage process thinking and process-driven decision making among employees.
			N1. The CPM/BI system has improved the quality of communication between users.
			N2. The CPM/BI system allows me to share information easily with others.
			N3. I have a high degree of confidence in the information provided by the CPM/BI system.
			O1. My organization has a structured program for researching, acquiring and diffusing information and knowledge about new technologies and processes regarding CPM/BI configuration, deployment and management.
			O2. My organization has put in place procedures to capture, codify, and disseminate CPM/BI knowledge held by individuals (such as technical specialists and consultants).
			O3. My organization has established effective partnerships with CPM/BI service and technology partners for knowledge transfer..
			P1. My organization has in place well structured and managed information and knowledge repositories to support overall business functioning.
			P2. The content of the information and knowledge repositories are relatively accurate, up-to-date, and relevant.
			P3. My organization has excellent access to CPM/BI information and knowledge held by partners, consultants, and research organizations.
			P4. Organizational information can be easily accessed and shared across the enterprise by authorized employees.
			P5. Diffusion of organizational information and knowledge is supported by robust and user-friendly knowledge management technologies.
			Organizational Performance (OP)
			Q1. CPM/BI systems have greatly improved the quality and quantity of business information available to me.
			Q2. The use of the CPM/BI system has enabled employees to develop process-oriented skills.
			Q3. I am able to make better decisions with the information I am able to retrieve from the CPM/BI system.
			Q4. I am able to make decisions faster with the information I am able to retrieve from the CPM/BI system.
			Q5. CPM/BI systems have had a direct role in improving the financial performance of my organization.
			Q6. The CPM/BI system has helped improve the performance of my job function.
			Q7. CPM/BI systems have allowed my organization to become more flexible and responsive in delivering products and services to its markets.

		Q8. CPM/BI systems have greatly helped to increase the efficiency and effectiveness of existing organizational processes.
		Q9. CPM/BI systems have helped in the creation of new organizational processes.
		Q10. CPM/BI systems have been instrumental in the creation of new organizational capabilities.
		Q11. CPM/BI systems have played an important role in improving the human resources performance and visibility within my organization.

11 Appendix A2 – Supplementary Interview Information

Section 6.3 Motivations for implementing CPM systems

Firm J implemented a CPM system due to sheer necessity. The organization was in the process of being spun off from a larger parent entity and were forced to develop their own systems for reporting and HR management as the parent company was no longer going to supply these functions for them in the future. Facing a legal deadline to sever ties with the parent company, it became a huge necessity to come up with a solution and this added great urgency to their requirements to get something in place. Other clients implemented the system primarily to improve the quality of reporting available to their end users and management. Others adopted CPM as a means to gain efficiency within existing operations, to identify bottlenecks and to encourage senior managers to make fact-based decisions.

CPM systems are supposed to promote future oriented thinking but this was not always the case. At Firm A and Firm G, we found that the main focus is to report on past activity. Management did not appear to be all that concerned about the future. Senior management at Firm G had told our respondent that they are more past and present focused and care less about the future, a truly puzzling position. Firm G deals with international incidents and is a fast paced environment that is evolving constantly making it hard to stick to a plan as the nature of the organization is that its priorities are constantly shifting. This is frustrating for technology managers who are always asked to be in a reactive posture. To us it sounded like management were too busy fighting fires in the present and did not have time to plan effectively for the future.

Other firms have implemented CPM systems to improve the quality and efficiency of their business processes. Firm E knew that they needed to be able to measure performance better so that they could uncover deficiencies in their processes. At the start, they were not even sure what exactly they had to measure. Others wanted to provide a central location for managers to be able to access business views. Managers at Firm A were not very technology savvy and did not want to connect to the operational

systems so there was a strong desire to simplify the process. CPM technology helped this firm to create a “*one stop shop*” for managers where they can get all the information they need to do their jobs in one central location in a very accessible manner and simplified the access to information based on specific business requirements.

CPM systems are finding utility as a marketing tool to promote the business in the eyes of present and potential customers. Firm C, a private “*for profit*” charter school in the United States implemented these systems to improve student performance. They wanted to provide better information to stakeholders (*Government, schools, teachers, principals, parents, community groups*) and wanted to drive proactive decision-making that was based entirely on factual information. They wanted to give power to the end users (*teachers, principals etc.*) so that they could take meaningful action. This organization has been using their CPM to distinguish themselves from other charter school operators and have used this approach successfully to secure new contracts and to increase the level of confidence that parents have in their organization.

Cost reduction is a big motivation for implementing CPM systems. Firm J implemented CPM due to pressures created by a global cost reduction program. Senior management was looking to save costs on reporting by consolidating information into one common data source. That was the global view and reflected the thinking of senior management taking a very enterprise view of the system. Interestingly, the global view is often different from localized views. At the country level, the goals were to be able to provide timely information to sales and marketing people to help them to do their jobs better. The pharmaceutical business is somewhat unique in that drug representatives talk to doctors, educating them on the latest products and encourage them to consider products for patient treatment. However, due to regulatory and privacy laws, these firms are unable to close the marketing loop to actually determine if this planting of the seed actually bore fruit through a purchase being made. So, they are forced to use syndicated data regarding usage, sales from pharmacies etc that is bought from third party providers. This data is used along with internal data and then extrapolated by comparing sales of

certain drugs in various geographies making the drawing of objective conclusions from this approach more art than science.

During the interviews, respondents were asked how closely they had met their CPM goals. The following comments were recorded.

“...I would say that we have met many of our goals so far but there is still much more to be done...” (Executive from Firm J)

“...Our goals were to meet the enterprise wide requirement for better reporting and insight into the HR and recruiting function. The other major goal was to be able to drive strategic policy centered on a Human Capital Management (HCM) philosophy.....we have been partially successful in both these areas...” (Executive from Firm K)

“...Our goal was to create a reliable, sustainable environment that was heavily automated. We also wanted to improve decision making so that it became much more fact-based and relied less on instinct and gut based decision making...” (Govt. Dept. G)

“...We wanted to be able to measure performance more effectively....” (Executive from Firm E)

“...We wanted our teachers and principals to have full access to the system, to be able to run their own reports to assess performance in their classrooms, schools, states. We wanted teachers to be able to compare the performance of their classes and kids against peer groups in other parts of the country based on demographic dimensions. We are trying to bring a private sector, performance based mentality into education, an area which has traditionally been done by the Government and has been plagued with inefficiencies and lack of progress...” (Executive from Firm C)

A majority of the respondents we interviewed felt that they were well on their way to meeting the goals they had set out at the start. Some felt that the goals had to be adjusted as they gained more experience with the system and understood its capabilities better. Four of our respondents informed us that goals were kept relatively modest to begin with. Several respondents believed that the implementation of the CPM system had opened up new possibilities within their organization. The following is a quote from a senior IT manager at a gaming and lottery corporation.

“...After doing the CPM project, the integration possibilities for this technology have greatly increased and other opportunities to implement this technology in other areas of the business are being explored currently...” (Executive from Firm K)

In a similar vein, a senior IT manager at a major Canadian federal Government department had this to say on whether their CPM goals had been achieved.

“...Yes, we have met our goals and more. I state this based on metrics such as the growth in our consumer usage. Also, the level of volunteerism is on the rise. More and more groups from within the department are keen to join and support the project. They want us to take their data and integrate it into our data warehouse. This is a good problem to have. We have not done any type of formal survey but my feeling is that we are meeting our goals quite well...” (Govt. Dept. A)

However, this view was not unequivocal. Not all of our respondents felt that the CPM project had achieved its goals. Problems cited include immature business processes, a lack of awareness of the system, incorrectly specified or missing key performance indicators. Our respondents had the following comments:

“...No, our goals have not been met as yet. The main problem is that the business processes in our organization are very immature and have not been well defined. What is happening is that there is a perception that BI is not universally applicable and may be good for one group but not necessarily another...this is a perception we are working hard to change...” (Govt. Dept. G)

“...Different groups have their own way of doing things and often what they are trying to measure in each group is different. Often managers do not know what it is that they want to measure and the way a metric is defined between two groups can vary as well...there is a general lack of consistency in this organization that makes CPM very challenging...” (Govt. Dept. F)

“...Yes, I would say that our goals have been partially met. We are a little more efficient in our processes but there is lot of room for improvement still. On a scale from 0-100, I would say we deserve a score of around 25 in terms of efficiency and we are way lower (around 5%) in terms of fact-based decision making capability...” (Govt. Dept. H)

“...Our CPM project has been targeted towards the various functions within the company. We have seen a lot of improvement in the Sales & Marketing area. Finance is looking to become more automated. We are struggling to find efficiencies in terms of managing risk, auditing and planning where we are still relying on lagging indicators to assess our performance. We would like to get to a position where we are able to predict our performance based on leading indicators...” (Executive from Firm E)

“...For example, we have a master product process in our product life cycle. At this point in time, we are not able to even identify, let alone understand all of the underlying processes. We may decide to launch a new product but we are not yet in a position to tell which of our existing products that the new one might affect (cannibalize). We are still launching products and then assessing the impact on the existing portfolio of products. This is clearly not an ideal situation and we are looking at CPM to help us in this area. We would like to have this intelligence prior to the launch of a new product...” (Executive from Firm E)

“...I would say that we have partially met our objectives. There have been some stumbling blocks especially in the area of data quality. Our source data that we were collecting was a bit suspect. So if you put garbage in, you are going to get garbage out. Scorecards are something we are very interested in and I am a bit disappointed that we have not been able to implement successful dashboards and scorecards yet. Definition of common metrics that is applicable to all stakeholders is an ongoing challenge...” (Executive from Firm C)

Section 6.4 IT Infrastructure Capability

These selected quotes from our interviewees gives an idea as to how varied their opinions were when it comes to the importance of IT infrastructure capability.

“...IT infrastructure was an essential element for us...we had problems with capacity, networking and performance that threatened to sink the project...these issues consumed a huge amount of time and energy at the start and was a lot more complicated than we had bargained for. Our goal is to reach a point where maintaining and managing the infrastructure is a routine activity...” (Executive from Firm K)

“...IT infrastructure is not very important. It should become less important as time goes by. In my opinion, the problem is not with infrastructure...” (Govt. Dept. F)

“...I believe IT infrastructure is massively important in the success of these projects. I have implemented CPM projects twice in my career. The first was very successful and what stands out in my mind was that the IT organization was much more responsive and engaged than in my current organization. We have been struggling with IT from the start because they view the BI project purely as a technical exercise. I would go so far as to say that the reason we are getting a grade of B+ instead of an A is due to the fact that this factor is not working as well as it should be working...” (Executive from Firm E)

“...I think IT infrastructure is a very important element in these projects. When you do a national rollout, you have to have good IT infrastructure that is reliable, fast and redundant. That being said, getting the IT infrastructure part done right is the easiest part. You can buy hardware and hire expertise as required so this is usually pretty easy to get in place...” (Executive from Firm C)

“...The IT infrastructure is quite important in the success of these projects. Our enterprise is widely distributed – we go all across the world, linking offices in over 150 countries. Each of these offices has data that needs to be coordinated and made available for comparative purposes. Our infrastructure and IT processes have to be very reliable and robust to meet such demanding requirements...” (Govt. Dept. A)

“...I would say that IT infrastructure is of medium importance. You have to have a robust and reliable IT infrastructure to base such technologies upon as you want response to be uniform and reliable across the entire company. Since our company is located all over the world, we have to ensure that we have reliable and fast networking between locations. IT infrastructure, although definitely important, was not the “make-or-break” item in our projects...” (Executive from Firm J)

“...I think it is pretty important but not the most important thing. The capability of your IT infrastructure and your ability to deal with problematic situations related to architecture can determine usage. For example, when we launched our BI initiative, we had problems co-existing with another application that all employees needed to use. BI ended up losing as the other system was more important for the employee to do their jobs. We had to find a solution architecturally to remove this issue. Poorly performing or overly problematic infrastructure can negatively impact performance and will kill usage...” (Govt. Dept. H)

Section 6.5 Human Capital Capability

A basic level of competence was expected from consumers and improving competence, usually done through training and ongoing education is a challenging and expensive proposition. One of the companies we interviewed expected their end users to have competence in statistics because that is what their business (*risk management*) was all about. Such highly skilled users are not typical as specialized skills were required to allow them to take advantage of the system.

“...Competence at all levels for IT staff and consumer is vital. However, I feel that the competence shown by the IT staff is most important as they are the ones who have to flesh out and articulate the requirements of the user and provide them with the tools and solutions that they need to be successful...” ...” (Executive from Firm K)

However, this view is not universal. Another of our respondents felt that consumer competence was the most important.

“...I feel that IT staff competence is not as important as the competence of the consumers as they are the ultimate audience for this technology. The success or failure of these systems will ultimately be judged by their embracing or rejecting the system. To this end, you have to ensure consumers have proper level of education and the right skill sets to make use of these systems effectively. Training is an important element...” (Govt. Dept. H)

Finding competent CPM IT staff in the government context is a challenge. A senior CPM manager of a large federal department informed us that the ability to find competent staff to do CPM projects was limited by the occupational group classifications used by the Canadian federal government. The practice of bracketing individuals into an education based role (*e.g. CS, CR, EC etc.*) was inherently limiting as CPM projects straddle many knowledge areas and ideal candidates need a wide background capable of working across the full spectrum of the business. This policy is a historical artifact that is less applicable to the way business is conducted today. Employees need to have both strong technical and business skills to be successful. The current system is good at finding employees who are good at one of these skills due to the classification system we

use. The people from these groups are not ideally suited to be a CPM analyst. Finding properly skilled people is very challenging and continues to be so for the Government of Canada.

“...the philosophy I am trying to implement is that technology needs to serve the human and we should not have to contort ourselves to fit the technology. It is hard to get expertise in all the areas that CPM touches. Our ideal analyst needs to be an economist, accountant, engineer and writer all rolled up into one. CPM is all about bringing disparate data together and making sense out of it – but who exactly has all the skills needed in one package? Training and cross pollination of skills is a very important element in our CPM strategy...” (Govt. Dept. A)

Section 6.6 Strategic Leadership Capability

Often, senior Management does not have a clear understanding of CPM. Expectations are often set too high and they believe that they will be able to have all the data at their fingertips, driven through high-performance dashboards. This is often due to unrealistic expectations created by the vendor. A strong CIO is required to temper expectations and to keep timelines realistic. A champion in the senior management suite who is capable of translating expectations and to set realistic goals is very important. A senior person may sometimes be required to act as a liaison between the other senior leaders and the operation/line managers who are implementing CPM. Another method is to use a consultant to fill in for this person but often consultants cannot get the same level of trust of an employee. The new breed of CIO's should strike a balance between business and technical knowledge and this can often make the difference between a CPM project succeeding or failing in practice.

The CPM champion has to be supportive and enthusiastic about the CPM project. S/he also has to be in a senior position within the organization so that s/he can procure the resources and exposure that is needed for the project to be successful. Some of the interviewees felt that the ideal champion should have a strong background in IT. This champion has to be able to engage the senior leadership so that they can have realistic expectations for CPM. Normally senior managers are well educated or have risen to their

position due to their ability to see past the obvious. With the right coaching, they will be able to see the potential of these systems and providing outputs that help them with their jobs is the key.

In some cases, senior leadership does not get engaged enough in the CPM initiative and this was cited as a problem by one respondent.

“...I think senior managers have an important role to play. In our case, the senior leadership has taken on a passive role in this project. They have been great in terms of giving us a budget (my budget for this year is \$ 6M) but we are missing their active support. By active support, I mean that they are not fully engaged in our project. I do not believe the senior management fully understands how we can be using our data as an asset...” (Executive from Firm E)

Lack of leadership continuity and turnover in the senior management team was cited as a problem by some respondents. These projects need a massive amount of commitment from the senior management team.

“...Leadership is very important but our experience has been that often leaders do not stick around to guide the projects through to completion. Especially in the Government, these projects tend to be multi-year in time frame and the initial champions of these initiatives tend to move on and the project stalls...” (Govt. Dept. F)

Section 6.7 Organizational Culture

A respondent who had managed two large CPM implementations reflected on how the culture at both organizations affected the adoption and integration of the CPM system. In the end, the users eventually came on board but they had to be mandated to use the system. The firm had initially tried to encourage voluntary use of the system but that did not work. Cultures that are open to change tend to enjoy success with these systems. We found that successful CPM systems are often mandated so that users do not have a choice in their use. Not all of our respondents agreed with this approach. A senior IT director in a Government department said this about the issue of mandating use of the CPM system.

“...I do not believe in mandated use. Users have to be compelled to use your systems because that is the best kind of adoption. You have to show users the benefits of the new system and solve their problems using the new system. This is the key! Get power users on board and try to score some early and easy wins. Building credibility early in the cycle is very important...” (Govt. Dept. H)

All of the respondents noted the importance of identifying champions among users who can take the baton and provide leadership to their peers. We were told of “*special people*” in an organization who seem to have a halo around them and they are given special privileges to do things that others are not allowed to. These people need to be found and recruited onto the CPM team. These people are usually experienced and have earned trust from others in the organization. These golden employees can be used to drive change and get others to pay attention. The other way change happens is to actually have a total breakdown and amidst the ensuing chaos, change can result as there is quite frankly, no other alternative. Sometimes, things can get so bad, that the only alternative is to completely stop a project. Then people might listen, smarten up and make changes. Some respondents felt that technology systems may be more easily adopted in flat organizations. If the culture of the organization is one of openness to ideas and is end results oriented, then any technology system, including a CPM system, is more likely to be successful.

“...in the military, a soldier tends to develop loyalty to his unit and that is how people tend to think. You think in terms of your immediate team, group or family. To this end, the culture of the firm is very important. Countries and firms that have a “can-do” attitude with “low-ceremony” where the members are more focused on results and getting things done tend to make good use of technology systems such as CPM...”(respondent from Firm D)

The size of the group also makes a difference as it is a lot easier to influence the behaviors and practices of small groups instead of large ones. Scaling a successful prototype from a small group to a larger context is very difficult. The scope of the initiative is a relevant factor. Our interviewee from Firm F told us of two CPM projects he had managed. The first one had 2000 employees in the IT department alone and the

second had 2000 employees in total in the organization so the scope of the implementation was quite different. In a smaller group, it is a lot easier to get people to buy into the project and to take ownership.

The importance of accuracy and data quality was raised by the interviewees as being an important factor in getting users to adopt the system. If users lose confidence in the information that they are getting from the system, they are not likely to keep using it. Managers are asking the questions - is data really a resource anymore? Do we have too much data? Managers are drowning in data. Light analytics gives us some of the story but the harder question is – what should we be doing with it?

Another important issue is to try to create familiarity in the system so that users have less of a learning curve. Since most users are familiar with Microsoft Office, CPM system vendors have tried to incorporate this functionality into their products. This made a big difference in adoption for one of the respondents.

Developing trust between the IT staff and users is an important feature of successful CPM firms. Our interviewee from Firm J informed us that the data warehouse needed to be completely re-organized so that all calculations needed to be pushed down to the data layer to improve system performance. Doing this required new development to stop for 9 months and some urgent priorities had to be delayed. In the end, the visible changes to the end users were zero but they accepted this decision because they trusted the IT group to provide them a superior solution in terms of response and flexibility. It took effort to convince the business to trust that IT would deliver. Getting the business users to trust the IT/BI team is very important. One of the reasons that CPM has been so successful in this firm is that IT have created a culture where users have made going to the system a habit and people think of CPM first as a possible solution.

Section 6.8 CPM specific capabilities and effects on the firm

One benefit of having all the relevant data in the same place is that it allows firms to play what-if scenarios. For example, if Firm K knows there is a glut of qualified applicants in

the American Mid-west and they can tell this from seeing spikes in recruiting applications from certain regions, they can use this information to target recruiting efforts to certain regions and hire good people at very competitive rates. This allows the firm to increase its market penetration in these areas and the increased revenue generated with a less than normal investment directly affects unit costs and profitability.

Firms now have the ability to serve their clients better and to react faster to requests for information. They have the ability to automate certain processes that were done manually or took a lot longer to get all the information needed to feed into the processes. CPM allows firms to get access to this information quickly and there is a higher degree of confidence in the information as well. They have the ability to detect patterns and trends and are better able to display and share information with others in the organization. The ability to interface with others has been helped by user-friendly Graphical User Interfaces (GUI).

CPM was credited by respondents for providing their firms the ability to be more efficient and effective in carrying out capabilities that they already had but maybe not to the extent that they had prior to the CPM project. Is the ability to do something more efficiently and effectively a new capability or is it just an enhancement of an existing capability that may not be as efficient? We believe it is more than semantics as how does one assign cause and give credit? This is a difficult thing to attribute. Let's say that CPM systems enable us to make better decisions and if these decisions lead the firm into new areas that they may not have gone into under normal circumstances, then they may be responsible for adding new capability to the firm, albeit in an indirect manner.

“... CPM systems give us the capability of better identifying problems. We were able to identify problems before as well, just not as efficiently so in that sense, I would say that it has enhanced our capability ...” (Govt. Dept. H)

Many of the interviewees were of the opinion that their skills and abilities in using these systems had given their firms an edge that they were lacking previously. One respondent, a private charter school in the United States noted that the ability to look at trends in

grades, down to the classroom level has given them the capability of doing interventions proactively which is a huge competitive differentiator for them. We include some relevant comments made on the notion of whether these systems had altered the firm's competitive position or not.

“...Firms that can get the most out of these systems tend to be hungry for success. Sometimes it can be an issue of luck and an alignment of various factors. Senior level commitment is definitely important. These systems can definitely create a competitive difference if used properly...”
(Executive from Firm B)

So does the use of CPM systems increase business value and eventually lead to a net Return on Investment (ROI) as expected. This is not a unanimously held view. Some respondents felt that they were moving in this direction, others felt that this expectation was overstated and others felt it was misleading at best.

“...We are definitely moving in the right direction with regard to this. Our costs at the beginning were quite high but not more than we had budgeted for. We were also very happy that the vendor subsidized some of our costs at the beginning. Since this product was new to all parties, we were a bit of a guinea pig and a great deal of delays at the start were absorbed by the vendor (IBM) which is not standard practice in the services consulting and software business...as we continue to gain knowledge, our costs are getting more streamlined and our reliance on contractors and vendors is reducing...” (Executive from Firm K)

ROI is a tricky measure to consider when dealing with CPM systems as ROI is sometimes achieved by cutting IT staff.

“...I would say that the value of CPM and BI has definitely been recognized in our company. ROI has been positively impacted. We are starting to create value in certain areas and have been successful in driving revenue up. Costs are starting to go down in some areas. A disturbing trend is that the increase in automation has caused us to cut some positions so if you factor the reduction in head count, our ROI has been positively impacted. Clearly this is not an ideal way to increase ROI...” (Executive from Firm E)

Costs tend to get rationalized as a “*cost of doing business*”. Even enormous upheavals are explained in this way. For example, when an ERP system (*e.g. SAP or Banner*) is introduced into an environment, the great disruptions are often just accepted. Estimating the costs of such disruptions is difficult and often impossible to ascertain.

“...Our costs are still high but they are stabilizing and hopefully moving downwards. Value was only seen after 2 years. We anticipate costs to move downwards. Our IT infrastructure costs are going up but value is definitely increasing (we have better performing schools)...” (Executive from Firm C)

“...I would say that we are definitely making a positive ROI right now. Our cost automation project has the ability to bring in a lot of revenue from other groups for the services we are providing. The cost was pretty modest to develop the project (around 250K) and we may save up to \$ 30 M over the next few years through having a better capability to manage these positions. In the past, it took us close to 45 minutes to enter a classification for a position and to do all the associated work required. Now we can do close to 25 in the same time. This is a huge improvement in our efficiency...” (Govt. Dept. A)

Again, these positive outcomes were not shared among all our interviewees. This respondent was less than impressed with the impact on ROI.

“...We are not seeing any ROI as yet. We are still spending more than we are getting out of the system in terms of value created. I assess value in terms of our efficiency in getting things done, less frustration from staff and users, not having to rely so heavily on outside consultants and not getting heat from senior managers and The Minister of the Department...” (Govt. Dept. H)

Section 6.9

Other important takeaways from our interviews include the following:

- Integrating CPM with the other systems used by the business can be challenging.
- Have realistic expectations of CPM and set clear objectives.
- Don't go with a big bang approach to CPM. Small wins are the key.
- Senior leadership often does not even understand CPM. Leaders need education too.
- Senior leaders should effectively communicate a consistent CPM vision.
- Trusted senior leader(s) should be a strong sponsor/champion/evangelist for CPM.
- CPM usage needs to be mandated. Voluntary usage is ideal but not likely.
- Encourage CPM usage.
- Grow CPM champions among users.
- Prospect of everyone becoming a DSS user is compelling but hard to realize and may need to be addressed through HR hiring policies, training and additional incentives.
- Cultivate a strong CPM culture among users.
- Create a CPM dependency so that users turn to the system for answers.
- Establish a data warehouse. Never implement CPM on a transactional database.
- Invest in CPM training for IT staff and business users.
- Establish a BICC to coordinate and set standards for CPM projects
- Align the IT governance model so IT staff and CPM teams have shared interests.
- Align the interests of IT group and business users