PATTERNS IN INFORMATION TECHNOLOGY PORTFOLIO DECISION MAKING:
AN INDUCTIVE APPROACH

BY

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DISSERTATION

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ABSTRACT

This dissertation examines the structural properties of patterns in the decision-making processes used for information technology (IT) portfolio management with an emphasis on two key issues; (1) strategic alignment and (2) the mitigation of risks early-on during planning. Based on the cross sectional analysis of a large portfolio of decisions, I build on the Defender-Prospector-Analyzer typology and the corresponding IT strategies to develop theoretical profiles of decision models in alignment with these archetypes. I theorize key differences in decision models across these three strategic orientations and empirically test hypotheses by analyzing actual decisions for a large portfolio of IT initiatives in a unique, naturally controlled empirical setting. By examining decision-making processes over a two-year consecutive period, I systematically address risk mitigation during IT portfolio planning. I build on the logic of appropriateness, to propose an endogenous explanation for the evolution of these planning routines. Using an organizational routine as the unit of analysis; I propose their characteristics that are likely to explain the generation, deletion, retention and adaptation of these routines over time. I corroborate my hypotheses in a unique empirical setting using a three-stage methodology. This dissertation examines strategic alignment and risk-taking from an inductive perspective. Findings reported in this dissertation, based on minimal assumptions, indicate that a pattern-enabled approach to planning for IT portfolios can potentially alleviate the planning paradox. Decision trees I present offer insights for alignment and have substantial managerial implications for IT governance. Meta-routines presented in this dissertation — based on the evolutionary analysis of routines over a two-year period — give us a visual vocabulary for articulating the anatomy of dynamic capabilities. These findings have substantial implications for improving the maturity of IT portfolio management processes within organizations.

To My Mother and Father

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CHAPTER 1: INTRODUCTION

1.1. NATURE OF THE RESEARCH PROBLEM

Executive decision-making on Information Technology (IT) initiatives is critical to organizational performance (Piccoli & Ives 2005, Dhar & Sundararajan 2007). Such initiatives have delivered a variety of benefits in the past; changed the competitive landscape (McFarlan 1984, Clemons & Weber 1990); improved transaction processing and enterprise resource planning efficiency (Camillus & Lederer 1985, Gattiker & Goodhue 2005, Cotteleer & Bendoly 2006); and enabled inter-organizational cooperation (Johnston & Vitale 1988, Kumar & van Dissel 1996). At the same time, substantial losses due to failed IT initiatives or projects have also been reported. For instance, it has been reported that an estimated 68% of all IT projects are neither on time nor within budget, and furthermore they do not deliver their originally stated business goals. Some reports even claim that during the years from 2002 to 2004, over $100 billion worth of IT projects within the United States have failed altogether (Standish Group 2003, Jeffery & Leliveld 2004).

To derive potential benefits from their investments in IT, executives also continue to be concerned with aligning their IT initiatives with organizational goals. Given the high value-at-risk due to failed IT initiatives, senior executives are now devoting their attention to systematically managing risks associated with these IT initiatives during planning. But, executive attention is the limiting resource (Simon 1982). Executives simultaneously need to ensure that their plans are being developed after systematically managing risks associated with

IT initiatives (Dewan & Fei 2007). These twin challenges, alignment of initiatives and risk management are emerging as key concerns relevant for the strategic planning of IT portfolios.

Several methodologies have been suggested for conducting planning for IT initiatives including business systems planning (IBM 1975, Lederer & Putnam 1986), portfolio management (McFarlan 1981), strategic systems planning (Holland Systems 1986), and information engineering (Martin 1982). Portfolio management (McFarlan 1981) is one such approach that has been relatively understudied; but is now gaining widespread executive attention. Unfortunately, there exists no single way to plan portfolios as there are several points of failures when managing IT assets. These points of failure are scattered across the entire IT lifecycle (Maizlish & Handler 2005). An aggregate view of portfolios nevertheless can assist planners to (1) systematically evaluate the benefits, risks and mitigation approaches relevant to the initiatives in their portfolio and more importantly (2) arrive at planning decisions using well-defined consistent decision rules (McFarlan 1981).

This dissertation examines the decision-making associated with planning for portfolios of organizational IT initiatives. Such initiatives (Piccoli & Ives 2005) are competitive moves that depend on the use of IT and are designed to improve a firm's position. Examples of such initiatives include business process reengineering initiatives, expansive enterprise resource planning (ERP)-enabled programs, customer service management programs and electronic business initiatives. These organizational programs are much broader in scope than information systems development (ISD) projects and encompass a much larger activity system, with IT being a critical resource.

1.1.1 Importance of Research on Decision-Making

Executives responsible for planning need to grapple with at least two concerns. First, Gresham's law of planning states that "Daily routine drives out planning. Stated less cryptically, we predict that when an individual is faced both with highly programmed and highly un-programmed tasks, the former tend to take precedence over the latter even in the absence of strong overall time pressure" (March and Simon 1958, p.185). Planners need to ensure that they adopt a portfolio perspective and devote attention to key planning issues. Secondly, the planning paradox suggests that planners are expected to complete planning rapidly so that plan implementation can commence; but doing so reduces the likelihood of success during implementation (Lederer & Sethi 1996).

For instance, Jeffery and Leliveld (2004) found that when the North American division of a large foreign car manufacturer decided to subject its 352 initiatives to the rigors of portfolio diagnosis, only 30 core initiatives survived. Those that lacked clear links to business objectives were terminated. The estimated savings from adopting such a portfolio view of IS initiatives were $45 million on an annual basis. In this case, portfolio analysis revealed that the automaker had a myriad of conflicting unaligned projects. By adopting a portfolio-view of IT initiatives during planning, executives can obtain a more holistic view enabling them to focus their limited attention on the key planning concerns. A systematic understanding of the attributes that explain planning decisions on IT initiatives is thus important to improve the efficacy of planning.

1.1.2 Gaps in the Research Literature

An extensive survey of the research literature on IT planning and alignment reveals the following two gaps that I intend to address in this dissertation. First, low success rates of plan implementations have been often attributed to inadequate attention to risk management during planning (Boynton & Zmud 1987). Thus, planners must first determine an ideal risk posture for their organization and then evaluate the extent to which this posture is embodied in the planned portfolios (McFarlan 1981). However, a systematic emphasis on risk assessment and management during planning (as opposed to during plan implementation) continues to be a relatively understudied area and this dissertation aims to fill this gap.

Second, this dissertation also aims to fill a methodological gap. A substantial body of prior research that examines strategic IT planning issues (i.e. alignment and risk management) relies on survey-based methodologies (in particular the matched-pair survey research design). This dissertation maintains that systematically analyzing *actual* portfolio decisions in organizations and more importantly, examining the decision-making processes used to arrive at those decisions will enable the development of a better understanding of alignment and risk management during planning. By developing a data-driven methodology that relies on inductive methods, this dissertation provides a richer understanding alignment and risk management. Findings from this dissertation complement and augment the existing body of research on IT planning issues pertaining to alignment and risk management.

1.2. PURPOSE OF THIS DISSERTATION RESEARCH

1.2.1. Objectives

Portfolio thinking gives Chief Information Officers and other key stakeholders a holistic view of their investments, which has strong governance implications. This dissertation addresses two key issues pertaining to strategic IT planning; namely strategic alignment of IT initiatives and the systematic mitigation of risks associated with such IT initiatives early on during planning. To systematically study alignment, I build on the Defender-Prospector-Analyzer (Miles and Snow 1978) typology and the corresponding information technology (IT) strategies to develop theoretical profiles of decision models in alignment with these archetypes. I theorize key differences in decision models across these three strategic orientations and empirically test my hypotheses by analyzing actual decisions for a large portfolio of IT initiatives in a unique, naturally controlled empirical setting.

To address risk mitigation during IT portfolio planning, building on the logic of appropriateness (March 1994), I propose an endogenous explanation for the evolution of these planning routines. Using an organizational routine as the unit of analysis; I propose their characteristics that are likely to explain the generation, deletion, retention and adaptation of these routines over time. I corroborate my hypotheses in a unique empirical setting using a three-stage methodology. In stage one, an inductive methodology enables me to systematically discover tacit decision routines used for prioritizing proposals of IT initiatives within a large portfolio. In stage two, by relying on the schemata of routines (i.e. the abstract representation of the routine) and

their application (i.e. the instantiation of an abstract routine) (Feldman and Pentland 2003); I determine the outcomes of the underlying, unknown evolutionary process over a consecutive two-year period. In stage three, inductive methods help me discover true, stable patterns of evolution to support my hypotheses.

1.2.2. Contributions

This dissertation contributes to the research on IT planning and portfolio management along at least three dimensions. First, based on minimal assumptions, a pattern-enabled approach to planning provides substantial advantages and can potentially alleviate the planning paradox. This dissertation examines strategic alignment and risk-taking from an inductive perspective. Decision trees I present offer insights for alignment and have managerial implications for IT governance.

Second, I find that the appropriateness of routines is a key characteristic guiding their evolution over time. My dissertation has implications for research on (1) organizational routines, (2) organizational learning, and (3) dynamic capabilities. Implications for a pattern-enabled approach to IT portfolio management are developed.

Third, my methodological approach enables me to codify tacit decision-making knowledge. This externalization of knowledge (i.e. conversion from tacit knowledge to explicit decision rules) has strong implications for effective knowledge management within organizations (Nonaka and Takeuchi 1995).

CHAPTER 2: PATTERNS IN IT PORTFOLIO MANAGEMENT DECISION MAKING

2. 1. INTRODUCTION

For most organizations today, expenditures in initiatives that critically depend on information technology (IT) are growing in size (Piccoli and Ives 2005)[1]. Large Fortune 100 organizations often have hundreds or even thousands of initiatives running simultaneously (Jeffery and Leliveld 2004, Gartner 2008). Prioritizing these large numbers of initiatives such that they are aligned with business goals of the organization is a key challenge (King 1978, Boynton and Zmud 1987, Clemons and Weber 1990). IT portfolio management — defined as the practice of systematically prioritizing and managing these large collections of initiatives (Weill and Vitale 1999, Jeffery and Leliveld 2004, Maizlish and Handler 2005) — and alignment in the corresponding executive decision-making processes is critical for organizational performance (Venkatraman 1989, Sambamurthy and Zmud 2000, Dhar and Sundararajan 2007). From an IT governance standpoint, organizations can derive the potential gains from their investments if their IT-strategies are in alignment with their business goals (Clemons and Weber 1990, Brown and Magill 1994, Segars and Grover 1998, Sabherwal and Chan 2001, Bharadwaj and Tiwana 2005, Oh and Pinsonneault 2007). Organizations rely on portfolio management practices to improve the governance of their initiatives and to ensure decisions are made in a systematic manner using aligned decision rules.

Anecdotal evidence reveals at least two substantial gains from adopting portfolio thinking for managing IT initiatives (Potts 2008), specifically in the form of improved IT governance. First, portfolio thinking can improve the transparency of the decision-making rationale used during strategic IS planning (for e.g., Gartner 2008). Consider as an illustration, the viewpoint of

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[1] I study IT-dependent initiatives (Picolli and Ives 2005): from now onwards referred to as initiatives.

the CIO of KeySpan Energy, Frank LaRocca: "*[after adopting portfolio management practices] there was much less skepticism about the value of the projects and a richer dialogue about IT and business strategy was possible.*" Further, LaRocca notes additional benefits the portfolio approach offered —*"it has re-established our credibility and trust and has allowed senior executives to get engaged with IT at a much more strategic level"* (Hoffman 2005). Second, portfolio thinking can also help key stakeholders ascertain alignment between IT and business strategies by giving them the ability to holistically examine their decision-making rationale. Critical to improving IT governance is the ability of executives to monitor decisions about major technology initiatives. For example, effective monitoring of large-scale initiatives requires that decision makers ensure that key sources of risks are systematically managed during the planning process (for e.g. Vitale 1986, Gupta and Raghunathan 1989, Raghunathan and Raghunathan 1989, Nidumolu 1996, Schmidt et al 2001, Alter and Sherer 2004, Grover and Segars 2005). As a case in point, FedEx created an IT oversight committee that included board members who oversaw decisions including risk mitigation plans on major IT initiatives (Hoffman 2004). While anecdotal evidence, such as the above, brings to light the relevance of portfolio management practices, I maintain that rigorous research that examines the characteristics of decision-making processes and strategic alignment is much needed.

This research study seeks to contribute to the extant literature on alignment and strategic management of IS by pursuing three goals. First, by adopting a theory driven approach, I build on prior research on the Defender-Prospector-Analyzer typology (e.g., Miles and Snow 1978, Kabanoff and Brown 2008) and the corresponding IS strategies (Sabherwal and Chan 2001) to develop theoretical profiles for decision models in alignment with these archetypes. Though prior research has examined various aspects of decision-making processes (for e.g. Sabherwal

and King 1995, Bharadwaj and Tiwana 2005), I find that there exist few studies that examine actual decision-making during strategic IS planning. To the best of my knowledge, my study is the first of its kind in this evolving stream of research and thus would augment the existing body of knowledge on alignment. Second, I incorporate insights from research on actual decision-making processes (Tessmer et al. 1993, Gentry et al. 2002) and theorize key structural properties of decision models in alignment with the three archetypes. I test my hypotheses in a unique empirical setting. Third, my findings, based on the inductive analysis of a unique portfolio data set which contains initiatives that were approved and more importantly initiatives that were rejected, complement existing survey-based insights on alignment[2].

2.2. THEORETICAL BACKGROUND

The Miles and Snow (1978) Defender-Prospector-Analyzer typology suggests that the fundamental difference in these three business strategies is the rate of change preferred in the organizational domain. *Defenders* are characterized by their risk-averse nature, their emphasis on operational efficiency, a focus on a narrow domain through control of secure niches in their industry, and limited new product development efforts. In contrast, *Prospectors* are risk takers, who constantly explore emerging opportunities by stressing new product development. While *Defenders* and *Prospectors* represent extreme ends of the spectrum, *Analyzers* exhibit traits of both *Defenders* and *Prospectors*. Like *Defenders*, they are considered risk averse as they enter new markets only after they have been explored by other *Prospectors*, but they often try to achieve a balance between the two conflicting perspectives.

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[2] For an extensive review of the literature on IT alignment, see Chan and Reich (2007).

Given these systematic differences in the goals associated with these strategic archetypes, in order to be in alignment with their business objectives, I expect systematic differences in the corresponding decision-making processes used by organizations pursuing these different strategies. Building on prior research on the analysis of decision making (for e.g., Tessmer et al. 1993, Gentry et al. 2002), I hypothesize differences in decision models across three strategic orientations along three key dimensions.

2.2.1 Complexity of the Decision-making Process

Because of its stable domain, decision-making in the Defender tends to be oriented towards exploitation (March 1991). Defenders tend to discourage environmental scanning and instead focus on long-range planning. The Defender's inclination to perceive a relatively simple environment permits an intensive approach to planning that is likely to take into consideration *only a narrow spectrum of factors*. Defender decision-making processes and the resulting decision models are expected to be of low complexity. Since the Prospector continuously monitors an eclectic array of external events, it must process a diverse flow of information about conditions in potential domains of operation. Thus, decision-making for a Prospector is usually broad rather than intensive and tends to be oriented towards exploration (March 1991). Prospectors perceive a complex environment (Doty et al. 1993), which is likely to necessitate decision-making processes that take into consideration *a broad spectrum of factors*.

The inclusion of a broader spectrum of factors is likely to lead to decision models for the Prospector that are likely to be more complicated when compared to Defender decision models. Analyzers adopt traits from both Prospectors and Defenders; seeking effectiveness through efficiency and new product development. Analyzers strive to achieve efficiency in their stable

domains and explore relatively new markets after they have been explored by other Prospectors. Given their dual focus of balancing exploitation and exploration, Analyzer decision-making processes are likely to take into account a *broader spectrum of factors* (Segev 1989). The resulting Analyzer decision models are thus likely to be most complicated.

> *Hypothesis 1: The complexity of the Defender decision model is likely to be lower*
>
> *than the complexity of the Prospector decision model; which in turn, is likely to*
>
> *be lower in complexity when compared to the Analyzer decision model.*
>
> *(Complexity of Decision Model) Defender < Prospector < Analyzer*

2.2.2 Strength of Themes in the Decision-making Process

Defenders create a stable domain by developing a single-core technology that is highly cost-efficient. Defenders grow mainly through market penetration and perhaps through limited new product development. Relying on their intensive decision-making processes, Defenders are likely to maintain stability in their environment by adopting strong, singular decision-making themes focused on efficiency improvements (for e.g., Camillus and Lederer 1985). Prospectors maintain a continuously evolving dynamic domain, by monitoring a wide range of environmental conditions, in search of new product development opportunities. Such dynamism in the environmental condition is likely to translate to a decision-making process that relies on a broad spectrum of factors and continues to be tentative. This tentativeness in the decision-making process is likely to manifest in decision models for Prospectors that lack strong decision-making themes (Zahra and Pearce 1990).

Given the Prospector's goal ─ a focus on growth through the exploration of new opportunities ─ I maintain that decision-making processes for Prospectors are likely to be characterized by some decision-making themes; but ones of lower strength when compared to those that represent Defender decision-making. Analyzers exploit new product opportunities, while maintaining a firm base of traditional products; therefore, have a dual technological core encompassing a stable and a flexible component (Slater et al. 2006). Given these dual goals, I maintain that decision-making processes for the Analyzer are not likely to contain the presence of any strong unifying themes. In other words, Analyzer decision-making processes are likely to be characterized by the presence of weak themes even when compared to Prospector decision-making models.

> *Hypothesis 2: Defender decision-making processes are likely to be characterized by the presence of stronger themes when compared to themes in Prospector decision-making; themes in Prospector decision making are likely to be stronger than themes characterizing Analyzer decision-making.*
> *(Strength of Theme) Defender > Prospector > Analyzer*

2.2.3 Mix of Attributes used in the Decision-making Process

Defenders tend to be risk averse and maintain stability in their domain by engaging in intensive planning that is likely to be characterized by the presence of strong decision-making themes focused on efficiency improvements. Similarly, Analyzers are risk averse and are likely to enter new markets only after they have been explored by other Prospectors (Kabanoff and Brown 2008). Unlike Defenders and Analyzers, Prospectors thrive on change in the environment

and often are likely to create this change by taking risks. To be in alignment with their strategic goals, Defender and Analyzer decision-making is thus expected to more heavily focus on systematically managing and mitigating risks to the extent possible (Lambert 1986). These low risk preferences of Defenders and Analyzers are likely to manifest themselves in their decision-making processes, which are likely to consume a broad spectrum of factors that pertain to the risks and risk mitigation mechanisms (Lambert 1986) associated with their proposed initiatives.

Benefit attributes — information regarding the potential benefits that can be extracted from proposed initiatives — are more likely to be associated with exploration and these factors are likely to be more pronounced in Prospector decision-making. Difference in the degree of risk aversion between Prospectors and both Defenders and Analyzers (Hambrick 1983) is likely to manifest itself with a higher proportion of benefit related attributes consumed in Prospector decision-making when compared to the proportion of benefit related attributes consumed in Defender or Analyzer decision-making.

Hypothesis 3: The proportion of benefit attributes included in decision models by Prospectors is likely to be greater compared to the proportion of benefit attributes included in decision models by Defenders and Analyzers.
(Proportion of Benefit Attributes Included in Decision Models)
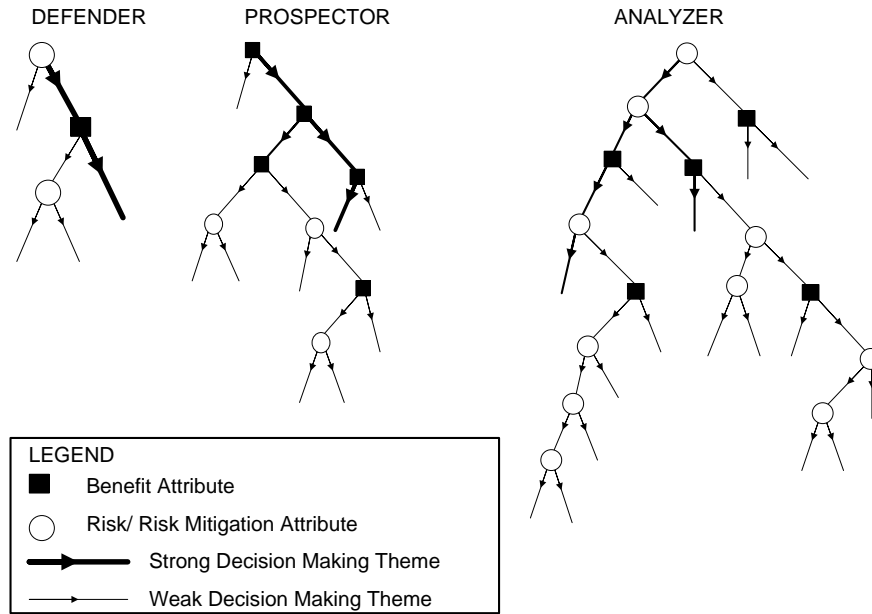*Prospector > Defender, Prospector > Analyzer*

2.2.4 Decision Trees: Representing Outcomes of the Decision-making Process

Rationale used during decision-making can often be tacit (Cyert and March 1963). Decision trees are effective approximations of this tacit knowledge contained within a decision

process (Quinlan 1990). Inductive learning methodology discovers and represents this tacit knowledge contained in a decision process in a comprehensive way. Decision tree representations compactly describe the target concept — the tacit decision rules — using a set of conjunctives (Quinlan 1986). Trees create an ordering among the decision-making attributes characterizing examples that belong to a particular decision class and the ones that do not. Decision models possess predictive validity comparable to other statistical classifiers (Mingers 1989). Furthermore, trees represent decision-making knowledge in a form that can be easily understood and scrutinized by human decision makers. Decision trees are approximations that represent the nature of questioning that is often involved in prioritization and can be effective for developing narratives explaining decision themes. Given this structured, comprehensive approach to discovering and representing the underlying structure of the data, decision trees possess high descriptive validity and offer advantages over statistical classifiers (Tessmer et al. 1993). My methodological approach enables me to codify tacit decision-making knowledge. This externalization of knowledge has strong implications for effective knowledge management within organizations (Nonaka and Takeuchi 1995).

Figure 1 presents an abstract representation of the hypothesized differences in the decision models across the three different strategic archetypes. The three hypotheses developed in the prior section can now be tested by using the structural properties of decision trees. An interpretation of the paths in decision trees provides insights concerning the underlying structure of the data, which highlights a collection of attributes used during decision-making. The length of (or the width or the number of decision attributes included in) the decision tree effectively represents the complexity of the underlying decision process.

Figure 1: Hypotheses: Differences in Decision Models

DEFENDER   PROSPECTOR   ANALYZER

LEGEND
■ Benefit Attribute
○ Risk/ Risk Mitigation Attribute
——► Strong Decision Making Theme
—► Weak Decision Making Theme

The number of examples classified on a particular decision path serves as an effective proxy for the strength of the decision theme and guides me in the discovery of strong themes or patterns during decision-making.

The kinds of attributes included in the decision trees reveal underlying preferences of decision makers to make decisions based on certain kinds of information attributes. Given that it is often possible to characterize decision attributes as belonging to one of the two categories (ones describing the potential benefits a proposed initiative can offer, and ones regarding the nature of risks and risk mitigation mechanisms associated with the given initiative) I can develop measures of the proportion of benefit related attributes contained in the decision model.

Table 1: Summary of Hypotheses

Hypothesis 1: Complexity of Decision Models			
	DEFENDER *Low decision-making complexity*	PROSPECTOR *Medium decision-making complexity*	ANALYZER *High decision making complexity*
Length of model	*Length of Defender's Model < Length of Prospector's Model < Length of Analyzer's Model*		
Hypothesis 2: Strength of Themes in Decision-making			
	DEFENDER *Strong decision-making theme*	PROSPECTOR *Medium decision-making themes*	ANALYZER *Weak decision-making themes*
Strength of main path	*Strength of theme (Defender's Model) > Strength of theme (Prospector's Model) > Strength of theme (Analyzer's Model)*		
Hypothesis 3: Mix of Attributes used in Decision-making			
	DEFENDER *Low Risk Appetite*	PROSPECTOR *High Risk Appetite*	
Benefit attributes	*Proportion of benefit attributes in the Prospector's Model > Proportion of benefit attributes in the Defender's Model*		
		PROSPECTOR *High Risk Appetite*	ANALYZER *Low Risk Appetite*
	Proportion of benefit attributes in the Prospector's Model > Proportion of benefit attributes in the Analyzer's Model		

Thus the *complexity of the underlying decision-making process*, *themes in decision-making* and the *mix of decision attributes used to arrive at decisions* can be effectively studied by relying on structural properties of decision trees. These structural properties of decision trees (length, strength of the main path, and the proportion of benefit attributes in the model) serve as effective proxies for my hypothesized outcomes. The hypothesized decision models across the three different strategic orientations or archetypes can be tested by relying on this inductive learning approach. Table 1 summarizes my three hypotheses and restates them in terms of the structural properties of decision trees which are effective approximations of the underlying, unknown, decision-making processes.

2.3. AN EMPIRICAL ANALYSIS OF DECISION-MAKING

I adopt a research methodology with two stages to investigate my research questions and to test my hypotheses in a unique research setting. The first stage of my methodology was mainly concerned with the *generation of decision models* across three business units pursuing three different business strategies. The second stage of my methodology was mainly concerned with the systematic *comparison of decision models* across the three different business strategies to comprehensively test my hypotheses.

2.3.1 Stage One: Generating Decision Models

I choose a large Fortune 50 organization as my research site. Specifically, I selected a large multi-business subsidiary of this organization for further analysis. Within this subsidiary, I focus on three business units which were ascertained to pursue three different strategic orientations. This field setting gives me a naturally controlled environment to systematically compare the impact of differences in strategic orientation on IT portfolio decision models. This was an opportune time to conduct the study as this was the first time within this organization, where proposals for IT dependent initiatives were pooled across several different business units for decision-making and were presented to a steering committee comprising the CIO, members of the CIO office and other senior business executives.

I do not believe self-selection is a concern here. Managers proposing initiatives can "figure out" the decision rules used by planners and are likely to self correct their proposals only in the next year's strategic IS planning session.

Data collection for stage one of my research methodology was a two-step process.

(1) Ascertaining the business strategy: Defensiveness and proactiveness of organizational decision makers (Miles and Snow 1978, Hambrick 1983, Segev 1989, Doty et al. 1993, Sabherwal and Chan 2001) have been argued to be some of the key indicators to identify different strategic orientations. Qualitative data exploring these dimensions were gathered via various mechanisms to ascertain the business strategy of a chosen business unit. Data were collected based on interaction with key informants of this steering committee (Vice President and CIO of this large multi-business subsidiary, and five senior business executives in the CIO office). For effective triangulation, data were collected by the following methods; content analysis of information presented in the annual reports; face-to-face semi-structured interviews with all key informants spanning 20 hours; unobtrusive participation in a planning session lasting two hours; conference calls with all informants spanning 20 hours; and exchange of several confidential documents between the researchers and the key informants. Based on the qualitative data collected for this investigation, the three business units within this subsidiary were chosen for analysis after they were ascertained to be pursuing three different business strategies. One business unit was classified as a Defender, another as a Prospector and the third business unit chosen for this study was classified as an Analyzer. Appendix A describes the process used to identify the strategic orientation of business units.

I used the following criteria to select proposals to analyze for this study. The main objective of this selection process was to retain only initiatives pertaining to business applications of IS. Prior research has also exclusively focused on one kind of portfolio to study alignment (for e.g., Sabherwal and Chan 2001). Mandatory SOX-related proposals were eliminated as the decision-making for such proposals is not guided by the strategic orientation.

Similarly, proposals from a business unit strictly pertaining to IT infrastructure investments/IT hosting services intended to be shared across all businesses within this subsidiary were also eliminated. Furthermore, low priority initiatives were eliminated given their low substantive significance. By focusing only on these 161 proposals for IS initiatives (or business applications of IS), I believe I am accounting for alternative explanations for observed differences in decision-making (due to differences in different kinds of investments in IT infrastructure, etc) and can attribute differences in decision-making to differences in the strategic orientation of individual business units across this subsidiary.

(2) Portfolio data: This dataset contains 161 proposed IT-dependent initiatives across these 3 business units chosen for this study and the associated strategic planning decisions. These executive decisions are substantively significant as almost 30% of these 161 proposed initiatives were estimated to cost less than 100 thousand dollars each, and over 10% of these 161 initiatives were expected to cost more than 1 Million dollars each. Table 2 summarizes the attributes used for characterizing the portfolio data used in this study which were further analyzed using an inductive learning methodology.

2.3.1.1 Portfolio Data and Measure Development

2.3.1.1.1 Characterizing Risks

Several different classical approaches have emerged in the literature with regards to risk assessment (Alter and Sherer 2004). Please see Lyytinen et al. (1998) for a systematic, comparative analysis of four classical approaches to risk management. I adopt McFarlan's (1981) risk assessment approach for two reasons: (1) McFarlan's (1981) model is geared towards

the analysis of portfolios and easily lends itself to my research objectives. (2) Decisions on initiatives within a portfolio require planners to compare the risk associated with two initiatives. McFarlan's(1981) conceptualization of risk allows for easy comparison between initiatives. I adopt McFarlan(1981)'s measurement scheme for assessing the risk of proposed initiatives.

Initiative Size: This attribute was measured based on the estimated investment required to execute the initiative. The risk associated with an initiative increases with its size (McFarlan 1981, Vitale 1986). This variable was assigned the following three values: low (required investment less than one hundred thousand dollars), medium (required investment greater than one hundred thousand dollars but less than one million dollars) and high (required investment was greater than one million dollars). This data transformation: converting from a continuous number representing the size of the initiative to three (low, medium and high) ranges was validated for me by the key planners at the site.

Initiative Structure: Some initiatives by their very definition are well-defined in terms of their inputs and outputs. The corresponding organizational tasks required to execute such initiatives; to convert inputs to outputs, are relatively straightforward (Eisenhardt 1985). Initiatives where the expected outputs are vulnerable to change are low structured. Initiatives of high structure are less risky (McFarlan 1981) when compared to initiatives of low structure. This variable was assigned two values: high structure (well-defined objectives for the initiative) and low structure (initiative with relatively fluid objectives).

Prior Experience: As the familiarity of an organization with a technology increases, the likelihood of encountering technical problems reduces. Higher the prior experience with technologies used in the execution of initiatives, lower the risk associated with such initiatives (McFarlan 1981, Weill and Vitale 1999). This variable was assigned three values: low (initiatives with new, emerging technologies with low familiarity within the organization), medium (initiatives involving technologies when the familiarity with that technology was neither high nor low) and high (initiatives involving standard technologies highly familiar to the organization).

2.3.1.1.2 Characterizing Benefits

A rigorous quantification of benefits associated with initiatives (such as a ROI measure) would typically be a desirable decision-making aid. But often, arriving at such a numeric measure is extremely difficult given the bounded rationality of economic actors (Simon 1955) and the planning paradox (Lederer and Sethi 1988). The planning paradox as described by Lederer and Sethi (1988) states: Planners are often required to develop plans quickly in order to facilitate their implementation; but doing so can lead to inappropriate plans.

Type of Potential Benefits

Detailed discussions with the decision makers revealed the organizational challenges associated with quantifying the benefits associated with proposed initiatives. Further discussions revealed that especially in the early planning stages, ROI metrics were not exclusively used as decision making criteria. For large and substantively relevant initiatives, like the ones I examine in my study, key informants from the steering committee I interviewed on the site indicated that though

characterizing benefits was important, quantifying them with a number was not. In other words, decisions did not exclusively depend on such a numeric measure of benefits.

These insights revealed that decisions on proposed initiatives were made on a tacit-level based on *qualitative* information on the types of benefits proposals were meant to provide. This insight guided me in the design of a data transformation. Detailed qualitative information on proposed initiatives was used to develop 5 qualitative measures on the kinds of potential benefits possible from proposals. I created 4 variables: operational support systems (OSS) benefits, marketing information systems (MIS) benefits, strategic decision support systems (SDSS) benefits and inter-organizational systems benefits. Proposed initiatives that had the potential to offer business processes improvements were also addressed by the creation of an additional variable named "Process Improvements". Recommendations from prior research (Kettinger et al. 1997, Broadbent et al. 1999, Sabherwal and Chan 2001) guided this transformation[3]. Thus, these five kinds of benefits that initiatives could potentially offer were used to create five variables to comprehensively characterize benefits associated with initiatives. These variables that richly characterize the benefits associated with proposed initiatives were tacitly used as decision criterion. Thus these variables also enable me to tease out aspects of decision making with regards to achieving strategic alignment.

2.3.1.1.3 Mitigating Risks

The successful implementation of large IT-dependent initiatives depends on several diverse kinds of capabilities (Piccoli and Ives 2005). Prior research has found support for three

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[3] For e.g., based on the definitions presented in Sabherwal and Chan (2001), three raters individually used descriptive information on proposals to code these variables. For all the four types of initiatives the inter-rater reliability was over 95%. Inconsistencies were amicably resolved by discussions between the three raters. I adopt the same naming convention for the sake of consistency.

categories of capabilities (a) software or technological capabilities (for e.g., Earl 1993), (b) capabilities pertaining to the management of software development processes or methodologies (for e.g., Ramasubbu et al. 2008), and (c) capabilities pertaining to the business process redesign implications of large initiatives (for e.g., Kettinger et al. 1997). Data on these three groups of decision criteria, used for systematically managing risks pertaining to these IT-dependent initiatives, are presented next.

Software or Technological Capabilities

Internal Technological Capabilities

In-house Software Applications: Software applications developed in-house potentially embed organizational knowledge (Earl 1993) and thus their use in the execution of proposed initiatives can be viewed as a risk mitigating factor. This variable was assigned a value of 1 if a proposed initiative could leverage a software application developed in-house or a value of 0 otherwise.

External Technological Capabilities

Specialized Software Applications: Organizations can potentially manage successful delivery of large initiatives by procuring specialized software products (Mitchell 2006). These partial solutions to specialized organizational problems can potentially expedite initiative progress and improve likelihood of success (McFarlan 1981). This variable was assigned a value of 1, if the initiative proposed the procurement of specialized software and a value of 0 otherwise.

Third-Party Software Applications: Executives can potentially manage successful delivery of large initiatives by leasing third party technologies (McFarlan 1981). Third party applications model best practices and thus can expedite the delivery of proposed initiatives simultaneously

improving likelihood of success (Mitchell 2006). This variable was assigned a value of 1, if the proposed initiative recommended leveraging third party software applications and a value of 0 otherwise.

Process Capabilities

Internal Maturity: Risks associated with an initiative decrease as the maturity associated with a proposed initiative increases (for e.g., Ramasubbu et al. 2008). Uncertainties associated with an initiative are often resolved by dedicating more resources to develop the plan for a proposed initiative and advancing it further along the software-development-life-cycle (SDLC) maturity phases. An idea that is more developed, further along the SDLC maturity phases, i.e., is likely to be less risky. This variable has been assigned three values: low (proposed initiative in its early stages of conception), medium (requirements and goals associated with the initiative are defined) and high (design of partial solutions to support the initiative was complete).

External Capabilities: Specialized consultants can add value to large IT initiatives and integrating these external sources of knowledge can mitigate diverse sources of risks (Earl 1993, Mitchell 2006). Consultants can offer expertise in specific areas, and their exposure of several different organizational process contexts can be helpful in minimizing the likelihood of project failure (Dong-Gil et al. 2004). For each initiative, this variable was assigned a value of 1 when managers proposed leveraging capabilities from external partners and a value of 0 otherwise.

BPR (Business Process Redesign) Capabilities

Technology-dependent initiatives often have substantial impact on the business processes of an organization. Large initiatives (with a strong technological component) can either constrain or facilitate BPR initiatives and vice versa (Broadbent et al. 1999). Managing the BPR implications of IT initiatives and vice versa is critical for successfully executing proposed initiatives.

BPR Accomplished: Exerting effort and performing BPR tasks before starting IT-dependent initiatives is critical to minimizing process risks (Broadbent et al. 1999). This variable was assigned a value of 1 when BPR tasks were completed prior of the planning effort and a value of 0 when the BPR tasks were not completed prior to planning.

BPR Resources Committed: Identifying organizational resources and committing them for undertaking BPR tasks before starting initiatives can be a critical internal risk mitigation factor (Lambert 1986, Kettinger et al. 1997). This variable was assigned a value of 1 when resources were identified and assigned to proposed initiatives for conducting BPR tasks and a value of 0 otherwise.

2.3.1.1.4 IS Portfolio Decisions

A steering committee comprising of the CIO and senior business executives were responsible for portfolio planning decisions. Decisions on each proposed initiative belonged to one of the following three classes: the proposed initiative (a) was rejected; (b) was approved with partial funding (c) was approved with full funding. Summary of the portfolio data used for analysis in this study is presented in Table 3.

Table 2: Defining Portfolios

	Variable	Variable renamed in the decision tree	Prior Literature	Values	Interpretation of the values
	Characterizing Risks Associated with Proposed Initiatives				
1	Initiative Size	Initiative Size?	McFarlan(1981) Vitale (1986)	Low/Medium/High	Risks increase with initiative size
2	Prior Experience	Prior Experience?	McFarlan(1981) Weill and Vitale (1999)	Low/Medium/High	Risks decrease as prior experience with technology increases
3	Initiative Structure	Initiative Structure?	McFarlan(1981) Eisenhardt(1985)	Low Structure or High Structure	Initiatives with high structure are less risky compared to low structured initiatives.
	Characterizing Benefits Associated with Proposed Initiatives				
1	Initiative Type	Efficiency Improvements? Marketing Systems? Inter-Organizational Systems? Strategic Systems?	Sabherwal and Chan(2001)	OSS and/or MIS and/or IOS and/or SDSS Benefits	Operational support (OSS), supplier/customer coordination (IOS), strategic benefits (SDSS), explore new markets/opportunities (MIS)
2	Process Improvements	Process Improvements?	Kettinger et al. (1997) Broadbendt et al. (1999)	Yes/No	IS investments which enable process improvements are desirable
	Mitigating Risks Associated with Proposed Initiatives				
	Software or Technological Capabilities				
1	In-house Software Applications	Leverage In-house Applications?	Earl (1993), Mitchell (2006)	Yes/No	Minimize risks be leveraging internal sources of knowledge
2	Specialized Software Applications	Purchase Specialized Applications?	McFarlan (1981), Mitchell (2006)	Yes/No	Manage risks be purchasing partial solutions
3	Third Party Software Applications	Use Third-Party Applications?	Earl (1993), Mitchell (2006)	Yes/No	Manage risks be leveraging partial solutions
	Process Capabilities				
1	Internal Maturity	Internal Maturity?	Ramasubbu et al. (2008)	Low/Medium/High	More mature initiatives are less risky
2	External Capabilities	Use External Capabilities?	Dong-Gil et al. (2004) Mitchell (2006)	Yes/No	Manage risks be seeking external knowledge
	Business Process Redesign (BPR) and Process Risks				
1	BPR Accomplished	BPR Accomplished?	Broadbendt et al. (1999)	Yes/No	Completing BPR before starting IS initiatives can minimize process risks
2	BPR Resources Committed	BPR Resources Committed?	Kettinger et al. (1997), Broadbendt et al. (1999)	Yes/No	Committing resources before commencing on IS initiatives can minimize process risks

Table 3: Portfolio Data Summary

	Inputs to the decision process		Outputs: Executive Decisions
Strategic Orientation	Benefits Associated With Initiatives	Risks/ Risk Mitigation Mechanisms Associated with Initiatives	
Defender's Portfolio of Proposed Initiatives (n=72)	<u>Initiative Type</u> OSS Benefits (82%) MIS Benefits (61%) IOS Benefits (60%) SDSS Benefits (24%) Process Improvements (93%)	Initiative Structure (Low Structure = 26%, High Structure = 74%) Initiative Size (Low = 28%, Medium = 61%, High = 11%) Prior Experience (High = 57%, Medium = 36%, Low = 7%) BPR Accomplished (Yes = 4%), BPR Resources Committed (Yes = 39%) In-house Software Apps. (Yes = 11%), Specialized Software Apps. (Yes = 11%), Third Party Software Apps. (Yes = 31%), Internal Maturity (Low = 19%, Medium = 68%, High = 12%), External Capabilities (Yes = 17%)	Reject Initiatives (8%) Fully Fund Initiatives (92%)
Prospector's Portfolio of Proposed Initiatives (n=32)	<u>Initiative Type</u> OSS Benefits (56%) MIS Benefits (16%) IOS Benefits (50%) SDSS Benefits (34%) Process Improvements (78%)	Initiative Structure (Low Structure = 50%, High Structure = 50%) Initiative Size (Low = 37%, Medium = 59%, High = 3%) Prior Experience (Low = 81%, Medium = 19%) BPR Accomplished (Yes = 12%), BPR Resources Committed (Yes = 53%) In-house Software Apps. (Yes = 12%), Specialized Software Apps. (Yes = 9%), Third Party Software Apps. (Yes = 12%), Internal Maturity (Low = 75%, Medium = 25%), External Capabilities (Yes = 9%)	Reject Initiatives (50%) Fully Fund Initiatives (50%)
Analyzer's Portfolio of Proposed Initiatives (n=57)	<u>Initiative Type</u> OSS Benefits (79%) MIS Benefits (53%) IOS Benefits (49%) SDSS Benefits (32%) Process Improvements (82%)	Initiative Structure (Low Structure = 32%, High Structure = 68%) Initiative Size (Low = 23%, Medium = 61%, High = 16%) Prior Experience (Low = 67%, Medium = 23%, High = 10%) BPR Accomplished (Yes = 16%), BPR Resources Committed (Yes = 23%) In-house Software Apps. (Yes = 8%), Specialized Software Apps. (Yes = 28%), Third Party Software Apps. (Yes = 22%), Internal Maturity (Low = 70%, Medium = 28%, High = 2%), External Capabilities (Yes = 56%)	Reject (25%) Partially Fund Initiatives (30%) Fully Fund Initiatives (45%)
Total Portfolio of Proposed Initiatives (n=161)	<u>Initiative Type</u> OSS Benefits (76%) MIS Benefits (49%) IOS Benefits (54%) SDSS Benefits (29%) Process Improvements (86%)	Initiative Structure (Low Structure = 33%, High Structure = 67%) Initiative Size (Low = 28%, Medium = 61%, High = 11%) Prior Experience (Low = 65%, Medium = 28%, High = 7%) BPR Accomplished (Yes = 10%), BPR Resources Committed (Yes = 36%) In-house Software Apps. (Yes = 10%), Specialized Software Apps. (Yes = 17%), Third Party Software Apps. (Yes = 24%), Internal Maturity (Low = 48%, Medium = 45%, High = 6%), External Capabilities (Yes = 29%)	Reject Initiatives (22%) Partially Fund Initiatives (11%) Fully Fund Initiatives (67%)

2.3.1.2 Inductive learning methodology

In its general form, the inductive learning process contains three phases: (1) the instance space; (2) an algorithm used for inductive learning; (3) a formalism to represent the output describing the target concept. The instance space is an *n-dimensional* space where each instance is described by *n attributes* and a classification concept. For every run of the learning algorithm, the instance space is represented by a *training* sample. In my case, the target concept is a description of the executive tacit decision process. The purpose of induction is to discover the most precise approximation of this target concept. From an instance space, an approximation of the target concept, called a *hypothesis* is induced. Each such approximation forms an instance in the *hypotheses* space. Each hypothesis, i.e. decision tree model, represents a more or less credible approximation of the underlying, unknown decision process.

The standard method for inducing a decision tree from a training set of pre-classified examples, each of them described by a fixed set of attributes, is summarized as follows (Quinlan 1986, 1990)

> • *If all training examples belong to a single class, the tree is a leaf labeled with that class.*
>
> *Otherwise,*
>
> — *select a test, based on one attribute, with mutually exclusive outcomes;*
>
> — *divide the training sample into subsets, each corresponding to one outcome; and*
>
> — *repeat the same procedure with each subset.*

This procedure partitions the training sample into smaller subsets, in step with the growth of the induced tree. The *selection of the most relevant attribute* on which to split the training

sample efficiently has been a primary concern. Among several contingency table statistics and measures based on information theory, Mingers (1989) empirically shows that Quinlan's *entropy* criterion (Quinlan 1986) generates the smallest trees.

Originating in thermodynamics, the concept of entropy has been used in information sciences since Shannon's contribution on message transmission (Shannon and Weaver 1963).

An attribute's entropy, $H = -\sum_i p_i \log_2 p_i$

where *$i = 1...n$; n = alternative events for this attribute;* and *p_i = the probability of alternative i*, gives the amount of information or the reduction in uncertainty provided by an attribute, for classifying the training examples (Quinlan 1986). The entropy is equal to 0 if and only if all the *p_i's* but one are equal to 0, that is, the entropy vanishes when the outcome of an event is certain, and thus no valuable information is provided by the attribute. The entropy is maximum when all the *p_i's* are equal; that is, when all alternatives are equally likely, that is, the most uncertain situation exists. Any change toward an even distribution of *p_i's* increases the entropy but as soon as some alternatives become more probable than others the entropy decreases.

The methodological approach to generate these alternative decision models per business unit is presented next. A randomly drawn sample of 50% of the portfolio was used for training and the prediction accuracy of the induced model was tested on a disjoint randomly drawn sample of 50% of the total portfolio. Every random sample was selected such that all the classes of the decision were represented; ensuring purity of induced trees. Trees were bootstrapped, randomized 20 times at this stage to generate alternative induced decision models. Each such induced decision model serves as a credible approximation of the underlying decision process.

To further improve the validity of the findings, the same analysis was conducted using a 60%/40% training/testing sample split and a 70%/30% training/testing sample split. All the decision trees were induced by using the C4.5 learning algorithm (Quinlan 1986). Thus, I induced in total 60 decision models to comprehensively study the decision process for each of the three business units in the sample.

2.3.2 Stage Two: Comparing Decision Models

A group of 60 alternative decision models were generated across each business unit. Thus, in total these 180 models were then studied and elaborate structural data were collected on these decision models to test my hypotheses. Structural data collected on decision models pertained to the complexity of the underlying decision model (*the length of the decision model, the width of the decision model and the total number of factors used in the decision model*). The strength of the main path (*the path that classifies the most number of examples*) was used to represent themes in decision-making. Data were also collected on the proportion of benefit attributes that were included in the induced decision models to study the extent to which exploration was emphasized during decision-making.

Simultaneously comparing decision models across these three dimensions helped me comprehensively compare decision models across business units pursuing different strategic archetypes. The structural properties of the 180 decision models were then systematically analyzed using ANOVA and MANOVA methodologies. Table 4 summarizes data collected based on the decision models generated in stage one.

Table 4: Structural Properties of Decision Models

	DEFENDER		PROSPECTOR		ANALYZER	
	N = 60 Decision Models		N = 60 Decision Models		N = 60 Decision Models	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Overall Complexity of the decision model						
Length of model	3.22	0.85	4.78	0.90	7.48	1.32
Themes in decision-making						
Main Path Strength	80.9%	11.5%	39.97%	6.6%	20.87%	6.33%
Mix of Attributes used in decision-making						
% of benefit attributes	23.63%	14.83%	36%	13.41%	26.06%	10.37%

2.4. DISCUSSION OF RESULTS

Comparing decision models across the Defender and the Prospector yielded the following results. Given that 60 decision models were induced for each strategic orientation, I believe that violation of the normality assumption is not likely to be a concern here. The initial set of decisions from which these models were induced were also sufficiently large (72 decisions for the Defender, 32 decisions for the Prospector and 57 decisions for the Analyzer). The ANOVA with the length of the decision model (dependent variable) and type of strategic orientation (independent variable) was used to test H1.

Hypothesis testing for H1 was comprehensively conducted using two other proxies (width and the number of attributes in the decision model) for the complexity of the decision model. All these three proxy measures revealed similar results and yielded similar insights.

The homogeneity of variances assumption was violated. But given that the largest standard deviation was never greater than the smallest standard deviation by a factor of 2, this violation is also not a concern for my analysis (Lindman 1974).

I find the results support H1 $(F(1,118) = 96.15, p = 0.000)$. Scheffe tests[4] revealed that the difference in the Prospector and Defender tree lengths was 1.56. The ANOVA with the strength of the main path (dependent variable) and type of strategic orientation (independent variable) was used to test H2. The results support H2 $(F(1,118) = 781.52, p = 0.000)$. Scheffe tests revealed that the difference between the strength of the main path in the Defender and Prospector was more than 47%. Finally, the ANOVA with the proportion of benefit variables in the decision model (dependent variable) and type of strategic orientation (independent variable) was used to test H3. The results support H3 $(F(1,118) = 22.94, p = 0.000)$. Scheffe tests revealed that the difference between the proportion of benefit attributes used in the Prospector and Defender models was more than 12%.

Comparing decision models across the Prospector and Analyzer yielded the following results. The ANOVA with the length of the decision model (dependent variable) and type of strategic orientation (independent variable) was used to test H1. I find the results support H1 $(F(1,118) = 170.72, p = 0.000)$. Scheffe tests revealed that the difference in the Analyzer and the Prospector tree lengths was 2.7. The ANOVA with the strength of the main path (dependent variable) and type of strategic orientation (independent variable) was used to test H2. The results support H2 $(F(1,118) = 105.07, p = 0.000)$. Scheffe tests revealed that the difference between the strength of the main path in the Prospector and Analyzer was more than 12%. Finally, the

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[4] Bonferroni and Sidak tests of contrasts revealed similar insights.

ANOVA with the proportion of benefit variables in the decision model (dependent variable) and type of strategic orientation (independent variable) was used to test H3. The results support H3 *(F(1,118) = 20.58, p = 0.000)*. Scheffe tests revealed that the difference between the proportion of benefit attributes used in the Prospector and Analyzer models was more than 9%.

Finally, comparing models across the Defender and the Analyzer yielded the following results. The ANOVA with the length of the decision model (dependent variable) and type of strategic orientation (independent variable) was used to test H1. I find the results support H1 *(F(1,118) = 443.93, p = 0.000)*. Scheffe tests revealed that the difference in the Analyzer and Defender tree lengths was 4.26. The ANOVA with the strength of the main path (dependent variable) and type of strategic orientation (independent variable) was used to test H2. The results support H2 *(F(1,118) = 1249.29, p = 0.000)*. Scheffe tests revealed that the difference between the strength of the main path in the Defender and Analyzer was more than 60%.

A MANOVA was also conducted to consider the overall impact of strategic archetype on the three dependent variables comprehensively characterizing decision making across these three archetypes. Given that I have more than two groups, I rely on the *Wilks' Lambda* statistic which was significant (p < 0.05); indicating that all the three dependent variables (i.e., complexity of the decision model, strength of the main path in the decision model and proportion of benefit-related attributes included in the decision model) systematically vary across the different strategic archetypes. The MANOVA indicates complexity of decision models *(F(2,177) = 255.85, p = 0.000)*, strength of main path in the decision model *(F(2,177) = 837.88, p = 0.000)*, and proportion of benefit attributes used in the decision model *(F(2,177) = 15.217, p = 0.000)*

are all significantly impacted by the chosen strategic orientation providing support for H1, H2 and H3.

There is a concern in the MANOVA, however, in that some of the dependent variables are correlated; the correlation between complexity of the decision model (measured in terms of the length of the longest decision path in each decision model) and the strength of the main path is -0.803 ($p = 0.000$); the correlation between the strength of the main path and proportion of benefit attributes in the decision model is -0.1476 ($p = 0.048$).

Following up the significant results from the MANOVA, the Roy-Bargmann procedure was used to determine the impact of strategic orientation on the three dependent variables when controlling for the correlation between the structural properties of the decision models (Roy and Bargmann 1958, Finch 2007). The procedure was a three-step process in which variables were entered based on their theoretical importance (Finch 2007).

In step one, complexity of the decision model (theoretically the most relevant variable) was tested in an ANOVA to confirm the significance of strategic archetype.

In step two, the strength of the main path (theoretically the second most important variable) was tested using an ANCOVA to test for the effect of strategic archetype while controlling for complexity of the decision model (i.e., using complexity of the decision model as a covariate).

Step three repeated the ANCOVA using the last variable, proportion of benefit-related variables included in the model to test for the effect of strategic orientation while controlling for both complexity of the decision model and the strength of the main path (included as covariates).

In all these three steps, the impact of strategic archetype on the dependent variable was significant.

Thus, in other words, I did not find any evidence to suggest that structural properties of the decision models (i.e. complexity of the decision model and the strength of the main path) when incorporated as covariates had any mediating effect on the proportion of benefit related attributes used in the decision model. Hence, results of the three-step Roy-Bargmann procedure corroborate H1, H2 and H3 and suggest that the differences in the chosen business strategy significantly and consistently influence the structural properties of the corresponding decision models.

CHAPTER 3: EVOLUTION OF ROUTINES

3. 1. INTRODUCTION

For most organizations today investments in initiatives that critically depend on information technology (IT) are growing (Piccoli and Ives 2005). Fortune 100 organizations often have hundreds of such initiatives running simultaneously (Gartner 2008). Systematically prioritizing these large numbers of initiatives is a challenge (Clemons and Weber 1990). IT portfolio management — the practice of systematically managing collections of IT initiatives (Jeffery and Leliveld 2004) — and the appropriateness of the related decision-making is critical for organizational performance. From an IT governance perspective, organizations can derive the most value from their IT portfolios if they systematically manage their risk exposure early on during planning (Boynton and Zmud 1987, COBIT 2007). A recent survey of over two hundred IT executives revealed that emphasis on IT portfolio management practices is growing (Forrester 2006). Portfolio thinking gives Chief Information Officers (CIO's) and other stakeholders a holistic view of their investments. This holistic view has strong governance and risk implications (Sambamurthy and Zmud 1999, Xue *et al*. 2008). IT portfolio management is thus a key priority for most executives today.

IT portfolio management nevertheless continues to be a complex activity for at least three reasons (Maizlish and Handler 2005). First, organizations have to prioritize large numbers of proposals for IT initiatives and the size of this decision problem is a source of complexity. Second, diverse sets of organizational stakeholders are responsible for IT portfolio management. Communicating tacit domain-specific knowledge — to other members of the group responsible for IT portfolio management — can often be difficult for every stakeholder. Third, stakeholders

responsible for IT portfolio management need to ensure that decision-making rationale used for prioritization is consistently applied to all the initiatives in the portfolio. A repertoire of well-defined, decision routines can thus attenuate the planning paradox (Lederer and Sethi 1988); assist boundedly rational actors expedite planning and yet help them develop appropriate plans.

Organizational actors are often required to learn to adapt their repertoire of routines as information technologies and their potential business applications are constantly evolving. Portfolio planners are thus expected to adapt their decision making rationale to benefit from possibilities in the evolving technological landscape. Though routines create a foundation of stability and simplify organizational action, they can also be viewed as a source of adaptation and flexibility (Feldman and Pentland 2003). Few research studies have examined the structure of this evolutionary process and examined the antecedents of this organizational learning; I intend to address these gaps by choosing an organizational routine as my unit of analysis.

I contribute to research on routines and their evolution by pursuing four specific goals. First, by building on the logic of appropriateness (March 1994), I adopt a theory-driven approach and submit that appropriateness of routines is a key attribute guiding their evolution. Second, to the best of my knowledge, my empirical study is the first to endogenously explain the evolution of routines. Third, I incorporate insights on decision-making processes (Tessmer et al. 1993) and theorize the impact of endogenous structural properties of routines — appropriateness of routines, frequency of routine usage and routine complexity, after controlling for causal ambiguity of planned tasks — on their evolution. I corroborate my hypotheses in a unique, naturally-controlled empirical setting. Finally, my findings, based on a rigorous inductive analysis of a unique longitudinal portfolio data set and the related prioritization decisions help me develop meta-routines explaining the evolution of routines. Meta-routines give us a visual

vocabulary for articulating the anatomy of dynamic capabilities. My findings have implications

for improving the maturity of IT portfolio management. My study indicates that emergent change

(Mintzberg and Waters 1985) can be characterized by systematic evolutionary paths guided by

the appropriateness of routines.

3. 2. THEORETICAL BACKGROUND

3.2.1. Logic of Appropriateness

March (1994, p. 58) proposes that decisions are often shaped by situational recognition, identity

of decision makers, and application of rules. Logic of appropriateness serves as a theoretical

foundation for my research[5]. Decisions result from decision makers answering for themselves the

following question, "What do actors like me (us) (1: Identity) do (2: Rules) in a situation like this

(3: Recognition)?"

I elaborate the theoretical building blocks pertaining to the logic of appropriateness in

decision making for IT portfolio management for two reasons. First, IT and their potential

business applications are constantly evolving. Decision makers are expected to adapt to these

evolving sets of possibilities and correspondingly adapt their routines (Maizlish and Handler

2005). Second, large organizations are often managing hundreds of IT initiatives. Appropriate

routines are relevant for IT portfolio management as they can expedite the planning effort and

ensure that decision making rationale is consistently applied when prioritizing large numbers of

initiatives (Byrd et al. 1995).

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[5] Logic of appropriateness contrasts the dominant expected utility models (Luce and Raiffa 1957) often referred to as *logic of consequences*. Prior research has adopted the logic of appropriateness as a theoretical foundation: See Weber et al. (2004) and Heide and Wathne (2006) as exemplars.

Figure 2: Issues in Planning
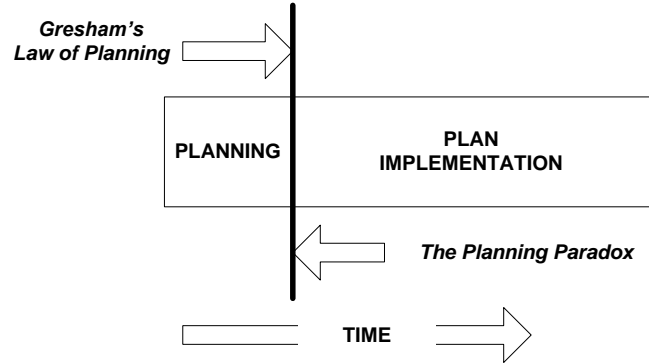
Two predicaments faced by planners during IT portfolio management are presented in Figure 2. First, Gresham's law of planning (March and Simon 1958, p.185) states that "Daily routine drives out planning[6]". Planners should devote their limited attention to planning concerns and not be distracted by tactical plan-implementation issues. Second, the planning paradox suggests that planners are expected to complete planning rapidly so that implementation of plans commences; but expediting planning can often lead to the development of inappropriate plans reducing the likelihood of success during implementation (Lederer and Sethi 1988). Rules[7] can address these challenges associated with planning via three mechanisms. First, rules assist the boundedly rational actor (Simon 1955); potentially simplifying his/her actions. Second, rules facilitate knowledge sharing by routinizing complex activities (Tsoukas 1996). Third, decision makers can use rules as incentive alignment mechanisms; (Eisenhardt 1985) rewarding rule-following and penalizing rule-defiant behavior. Repertoire of rules assist planners expedite

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[6] "Stated less cryptically, we predict that when an individual is faced both with highly programmed and highly un-programmed tasks, the former tend to take precedence over the latter even in the absence of strong overall time pressure (March and Simon 1958, p.185)".

[7] When decision rules are applied frequently, I maintain that the usage of that rule becomes an organizational habit. One way to define an organizational routine would be the application of a (tacit or explicit) decision rule with some (minimum) frequency.

planning and simultaneously develop appropriate plans. Identity of decision makers, a key building block in the logic of appropriateness is discussed next.

3.2.1.1. Identity

Identity of decision makers includes a set of idiosyncratic factors that they bring with them into a situation. Similar stimuli are likely to elicit different responses from organizational actors with distinct identities. In other words, in similar situations decision makers with different identities will behave differently. Correspondingly, different actions are likely to be deemed as appropriate for actors with different identities.

For instance, strategies adopted by businesses are often used to develop identities for actors belonging to these different kinds of organizations. The Miles and Snow (1978) Defender-Prospector-Analyzer classification is one such typology which has been often used for developing organizational identities (Segev 1989). Defenders are risk-averse; stress efficiency of operations; emphasize a narrow domain by aggressively controlling niches in their industry and engage in little or no new product development. Prospectors — at the other end of the risk spectrum — are risk-takers; constantly explore emerging opportunities and emphasize new product development. Analyzers exhibit characteristics of both Defenders and Prospectors and are risk averse. When planning portfolios of IT initiatives — performing essentially the same activity — decision makers with Analyzer-like identities are expected to prefer a higher proportion of low risk initiatives; decision makers with Prospector-like identities are more likely to prefer a higher proportion of high risk initiatives (Sabherwal and Chan 2001). A discussion on routines appropriate for actors with distinct risk-taking tendencies is presented next.

3.2.1.2. Routines

March and Simon (1958, p. 140) define routines as follows:

> When a stimulus is of a kind that has been experienced repeatedly in the past, the response will ordinarily be highly routinized. The stimulus will evoke, with a minimum of problem-solving or other computational activity, a well structured definition of the situation that will include a repertory of response programs, and programs for selecting an appropriate specific response from the repertory.

Two concepts define routines. First, is the idea of actors enacting an almost fixed response to pre-defined stimuli. Second, applying a routine, or applying an automatic response to a given situation often is accompanied by the absence of extensive search. Thus, routines can be defined by decision rules used by actors in situations described by a set of predefined stimuli. A routine or a rule thus identifies a set of contingencies that uniquely define a situation along with a managerial response (Nelson and Winter 1982). As the number of contingencies required for describing a situation increases, the complexity of the routine increases. This increase in routine complexity makes it difficult to effectively communicate this routine to other actors.

The difficulty in communicating a complex routine can hinder its adoption; and diminish its usage in the future. On the other hand, as decision rules are frequently applied, they get engrained in the organization and create a stable foundation which simplifies future actions (Thompson 1967). Simplification assists the boundedly rational actor and facilitates retention of routines. Extensive usage of existing routines can also create inertia which discourages flexibility (Cyert and March 1963). For instance, routines for approving proposals of high risk initiatives during IT portfolio management could include a rich set of contingencies describing the nature of benefits that can be extracted from initiatives, diverse sources of risks associated with these initiatives and the related control mechanisms devised to mitigate these sources of risks. Rules serve as repositories of organizational experiences; these artifacts are described next.

3.2.1.3. Rules as Artifacts

Rules are key artifacts within organizations. Scott (1998, p. 231) maintains that "organizations performing the simplest and most routine tasks rely primarily on rules to secure acceptable outcomes. Organizations carrying on even the most complex types of work perform many activities that are regulated by rules. Rules as structural devices represent agreements about how decisions are to be made or work is to be processed that predate the work performance itself." Rules can either be written (March et al. 2000) or can be largely tacit. Such unwritten rules represent norms which are shared tacit understandings that are created and sustained through interactions among group members (Markus et al. 2002). There exist several similarities between written and unwritten rules.

First, rules are communicated through the process of socialization. Second, rules create standards for appropriateness (March 1981). Third, rules are self enforcing. Even when rules are unwritten and the internalization of rules is incomplete, rule following is enforced by other actors who are present (March et al. 2000). Rules thus are vital artifacts that facilitate the reproduction of social structure within organizations. These artifacts serve as repositories of organizational capabilities (Langlois 1995). Rules as artifacts accumulate past experiences. These artifacts are often the deliverables of learning investments which enable the retention of experiences over generations of rule followers (Zollo and Winter 2002). A discussion on the contingencies that routines describe — which help actors recognize decision making situations — is presented next.

3.2.1.4. Recognition

A set of contingencies are often used to comprehensively describe decision-making situations. It is this set of contingencies that enables decision makers to recognize different decision-making scenarios and determine a course of action. For instance, when planning IT portfolios, decision makers with Analyzer-like and Prospector-like identities are expected to manage high risk initiatives differently (Miles and Snow 1978). Analyzers are risk averse and are likely to devise mechanisms to manage risk. Two perspectives on risk-taking (March and Shapira 1987) can guide managers: (1) managers — especially strategic planners — perceive risk-taking as a key expectation of their jobs and (2) managers take risks willingly believing that risk can be managed. Therefore, executives make a sharp distinction between gambling (where the odds are exogenously determined) and risk-taking (where managerial effort can control risks). Before plan implementation commences, executives with Analyzer-like identities are expected to exert effort (Lambert 1986) (gather information or develop skills) enabling them to manage risks. High risk proposals within a portfolio — comprehensively described by a set of certain contingencies — can be easily identified by risk-averse Analyzers and such a description is likely to help them devise mechanisms to manage these sources of risks.

3.2.2. Appropriateness of Routines used for IT Portfolio Management

Decisions result from decision makers answering for themselves the following question, "What do actors like me (us) (1: Identity) do (2: Rules) in a situation like this (3: Recognition)?" These theoretical building blocks — identity of decision makers, rules and situational recognition — together help me define appropriateness (March 1994, p. 58). For instance, addressing sources of risks during planning is critical and appropriate for risk-averse Analyzers (Boynton and Zmud

1987). Appropriate behavior during planning requires planners with Defender- or Analyzer-like identities to arrive at approval decisions on high risk initiatives only after devising mitigation mechanisms to control risk. Planners with Analyzer-like identities who approve proposed high risk initiatives without devising mechanisms to control risk are gambling and behaving inappropriately. Rejecting a large majority of high risk initiatives without exerting any effort to manage risks is also inappropriate; as planners are expected to take some risks during planning. High risk initiatives should be appropriately approved by decision makers with Analyzer-like identities only after devising mechanisms to manage risks (March and Shapira 1987). Rules for approving high risk initiatives that show evidence of the presence of such mitigation mechanisms are defined to be appropriate (for risk averse Analyzers who should take risks intelligently).

3.2.3. Hypotheses: Evolution of Routines

March et al. (2000) studied the evolution of administrative rules (e.g. rules for allotting sick leaves, sale of surplus university property, etc) and academic rules (e.g. rules determining requirements for degree programs, rules for faculty appointments, promotions including tenure policy, etc) over an extended period.

 An example of an administrative rule from the March (et al. 2000) study guiding the conduct of students on the University campus is the Fundamental Standard "(written in 1911) students at Stanford are expected to show both within and without the University such respect for order, morality, personal honor and the rights of others as is demanded of good citizens. Failure to do this will be sufficient cause for removal from the University." This rule remained unchanged until 1988 when it was changed following incidents pertaining to racial slurs on the Stanford campus. Based on these external events (e.g. racial slurs and abuses on the campus

grounds) the Fundamental Standard was extended to a new area for the first time in its entire history.

An academic rule from the March (et al. 2000) study is the tenure policy at Stanford which reads that "The first criterion for tenure is that the individual has achieved, or gives every promise of achieving, true distinction in scholarship. The published materials must clearly reveal that the person being proposed for tenure is among the very best in the field". The tenure policy was changed rarely (e.g. three times over a century in response to a few specific cases).

Using an event history approach, March et al. (2000) explained the evolution of rules (rule births, revisions, and suspensions) based on the presence of exogenous factors. Covariates in this explanation of rule dynamics included factors such as changes in external environment (e.g. number of legislative acts enacted by the federal government that were related to higher education) and changes in organizational structure (e.g. changes in the organizational size in terms of the number of students) and changes in organizational complexity (e.g. number of academic programs offered at the university). Early in the century, at Stanford as elsewhere at American Universities, university presidents tended to "make" written rules unilaterally. Only later in the century, as a response to the large organizational size, was the development of academic rules delegated to committees.

The current study systematically differs from March et al. (2000) along at least three dimensions. First, I examine unwritten rules, norms which are shared tacit understandings that are created and sustained through interactions among group members. Scott (2001, p. 32) maintains that "firms can thus be viewed as historical entities, their routines being the result of an endogenous, experience-based learning process." Second, I propose an explanation for the evolution of these rules largely based on endogenous factors and the properties of routines

themselves. Third, my study — pertaining to the prioritization of IT initiatives — contributes to the existing research on IT planning and the evolution of IT planning routines.

Routines create a foundation of stability (Nelson and Winter 1982); yet at the same time can be viewed as a source of flexibility and organizational adaptation (Feldman and Pentland 2003, Garud et al. 2006). Information technologies and potential business initiatives that critically depend on IT are constantly evolving, and therefore require decision makers to constantly evolve their routines. Appropriateness of routines is a key factor guiding their evolution. The set of routines employed by an organization is thus expected to evolve to a more effective set of routines over time via at least two paths. First, an organization is likely to employ two mechanisms of change that challenge the status quo — new routines of certain characteristics will be added to the existing repertoire of routines, and old routines of certain other traits will be discontinued from future use. Second, in addition to the retention of certain desirable routines, an organization is likely to adapt their routines before future use.

I examine the outcomes of evolutionary change along four dimensions: (1) new routines are likely to be added to the repertoire of routines (rule births); (2) old routines are likely to be dropped from the existing repertoire of routines (rule deaths); (3) certain old routines are likely to be retained as-is for future use (rule retentions); and finally (4) certain old routines are likely to be adapted or modified before future use (rule revisions).

I propose that these four outcomes are likely to be explained endogenously based on the characteristics of routines themselves (Feldman and Pentland 2003, Pentland and Feldman 2005). The following sections develop my hypotheses that theorize the outcomes of the evolutionary process (Zollo and Winter 2002) based on three key characteristics of routines — (1) appropriateness of routines; (2) frequency with which a routine is applied and finally; and (3)

complexity of the routine. My conceptual model is presented in Figure 3 and Table 5 summarizes my hypotheses.

Figure 3: Conceptual Model

Challenging the Status Quo   Status Quo and Adaptation
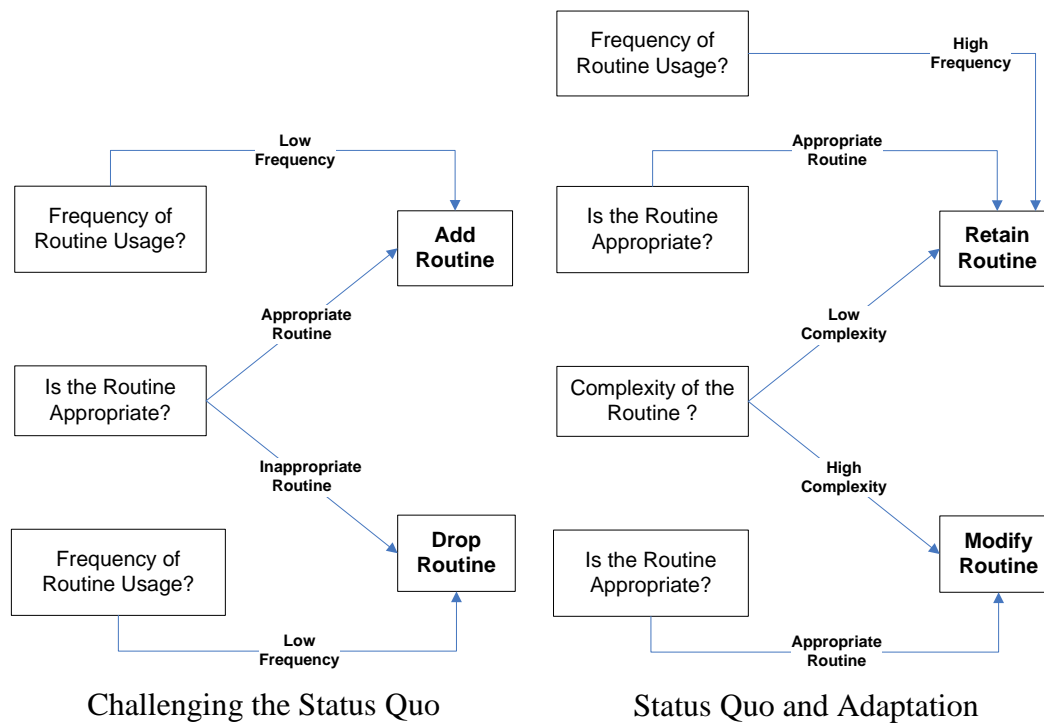
3.2.3.1. Challenging the Status Quo

The repertoire of routines employed by an organization is expected to evolve to a more effective set of routines via two paths. First, inappropriate routines are expected to be discontinued from future use. Second, new appropriate routines are expected to be added to the repertoire of routines. These mechanisms challenge the status quo but improve the effectiveness of routines employed by an organization. These extreme changes to the repertoire of routines used by an organization (i.e., generation of new routines and discontinuing the usage of old routines) are likely to be implemented in gradual steps (Vaast and Levina 2006) due to at least two reasons.

	Complexity of the Routine	Appropriateness of the Routine	Frequency of Routine Usage	Evolutionary Outcome
	Challenging the Status Quo: Adding New and Dropping Old Routines Rule Births and Rule Deaths			
H1	——	Appropriate	Low Frequency	Add Routine
	If (Is the Routine Appropriate? = "Yes") & (Frequency of Routine Usage? = "Low") → Add New Routine			
H2	——	Inappropriate	Low Frequency	Drop Routine
	If (Is the Routine Appropriate? = "No") & (Frequency of Routine Usage? = "Low") → Drop Old Routine			
	Adopting the Status Quo: Retaining Old Routines Rule Retentions			
H3	Low Complexity	Appropriate	High Frequency	Retain Routine
	If (Is the Routine Appropriate? = "Yes") & (Frequency of Routine Usage? = "High") & (Routine Complexity? = "Low") → Retain Routine As-Is			
H4	——	Inappropriate	High Frequency	Retain Routine
	If (Is the Routine Appropriate? = "No") & (Frequency of Routine Usage = "High") → Retain Routine As-Is			
	Adaptation of the Status Quo: Modifying Old Routines Rule Revisions			
H5	High Complexity	Appropriate	——	Modify Routine
	If (Is the Routine Appropriate? = "Yes") & (Routine Complexity? = "High") → Adapt Routine			

First, discontinuing the use of existing routines can cause disruption of organizational activities (Stinchcombe 1959). Second, introducing new routines or "habits" can be difficult since they need to be effectively communicated to organizational actors before they can be adopted. Both these mechanisms of change are likely to be implemented in small, gradual steps by ensuring that the routines are only applied in relatively few decision instances (Nelson and Winter 1982). I expect that appropriate routines applied in relatively few instances are likely to be successfully incorporated in the repertoire of existing routines of an organization; whereas

inappropriate routines which used to be applied in relatively fewer instances in the decision

space in the past are likely to be discontinued from usage or unlearned relatively easily.

> *H1: Routines that are applied with a low frequency, and are <u>appropriate</u> are likely to be <u>added</u> to the repertoire of routines employed by an organization.*

> *H2: Routines that are applied with a low frequency, and are <u>inappropriate</u> are likely to be <u>dropped</u> from the repertoire of routines employed by an organization.*

3.2.3.2. Status Quo and Adaptation

Routines can create inertia (Hannan and Freeman 1983). This attribute of routines creates

stability, which assists the boundedly rational actor in efficiently implementing routinized tasks.

This reuse of routines allows actors to offer an almost automatic response to a predefined set of

stimuli (March and Simon 1958) thus minimizing the need for extensive search, and improving

the effectiveness of decision making. Simple (low-complexity) routines can be effectively

communicated to diverse sets of organizational actors and thus can be easily reused. Appropriate

routines are more likely to be retained as they adhere to some criteria of appropriateness intrinsic

to the identity of the concerned actors. The more frequently a routine is used, the greater is the

likelihood of inertia associated with it; and which is more likely to facilitate the retention of that

routine for future use.

> *H3: Routines that are applied with a high frequency, and are <u>appropriate</u>, and are <u>not</u> <u>complex</u> are likely to be <u>retained as-is</u> for future use.*

Routines that are frequently used are deeply ingrained in the organization. Such routines are often difficult to change even if they are inappropriate with regards to certain intrinsic criteria of appropriateness (Blau 1955, Stinchcombe 1959). Organizational inertia has a dark side, which facilitates the retention of these "bad" habits, which cannot be easily unlearned. Given this dark side of organizational inertia created by the frequent application of routines (Hannan and Freeman 1983), I expect that inappropriate routines that are applied frequently are also likely to be retained as-is for future use.

> *H4: Routines that are applied with a high frequency, and are <u>inappropriate,</u> are likely to be <u>retained as-is</u> for future use.*

Appropriate routines are more likely to be retained and less likely to be discontinued from future use since they adhere to some criterion of appropriateness. Reuse of routines — as an automatic response to predefined set of stimuli — is likely to be difficult when routines are complex (March and Simon 1958). Routines are likely to be easily reused only if the application of these routines simplifies actions for boundedly rational actors (Simon 1955). If the routine is of high complexity, actors are likely to find it difficult to reapply these routines. As the complexity of a routine increases, it is less likely to attract organizational adopters (Thompson 1967). Appropriate routines of high complexity are likely to be reused more easily after they have been modified and simplified. I expect that appropriate routines of high complexity are likely to be adapted before future use.

> *H5: Routines that are <u>appropriate</u>, and of <u>high complexity</u> are likely to be <u>adapted or modified</u> before future use.*

3.3. AN EMPIRICAL ANALYSIS OF THE EVOLUTION OF ROUTINES

I adopt a methodology with three stages to corroborate my hypotheses in a unique empirical setting. The first stage is dedicated to the generation of inductive models with the purpose of discovering (tacit) decision-making routines applied within this large organization. In stage two, sets of routines representing decision making over two consecutive years within this organization were systematically compared to determine the outcomes of the evolutionary process. The third stage was concerned with understanding the antecedents of the evolutionary process and systematically corroborating my hypotheses. To do so, multiple evolutionary models were induced to discover — with a high consistency and stability — the characteristics of routines that guided their evolution. My methodological roadmap is presented in Figure 4.

Decision making — especially during strategic planning — has been represented as a complex network of issues involving a whole host of linkages, more or less tightly coupled. An analogy is that of "the moving stream, a context in which issues float along, sometimes getting washed up on shore as actions, sometimes sinking and disappearing, and often bumping into each other with the effect of changing another's direction, slowing one down, speeding one up, joining two together, or having a single issue burst into several new ones" (Langley et al. 1995, p. 275). Mintzberg (1994) submits that plans are often formed, rather than formulated when actions converge into patterns; where analyses of planners involved in the effort merge into a fluid process of learning. Much "feel" is thus often involved in decision-making during planning.

Figure 4: Methodological Roadmap

STAGE ONE:
DISCOVERING ROUTINES

STAGE TWO:
COMPARING SETS OF ROUTINES:
DETERMINING OUTCOMES OF THE EVOLUTIONARY PROCESS

STAGE THREE:
VALIDATING
RESEARCH HYPOTHESES

IT Portfolio (Year One)

Random Sample 1

Random Sample 2

Random Sample N

Inductive Learning

Decision Tree 1: Set of Decision Rules

Decision Tree 2: Set of Decision Rules

Decision Tree N: Set of Decision Rules

Selecting "True" Routines from Decision Rules:
(1) High Model Prediction Accuracy
(2) Lower bound on frequency of Rule Usage

Set of Routines: Year One

Proposals characterized by:
5 Benefits Attributes
3 Risk Attributes
7 Mitigation Mechanisms

3 possible decisions for each proposal:
(1) Rejected
(2) Partially Approved
(3) Fully Approved

Comparing sets of routines
Attention given to two aspects:
(1) Ostensive Form
(2) Performative Form

AFTER COMPARISON

EVOLUTIONARY SCENARIOS: SET OF ROUTINES
With a new outcome (of the evolutionary process) associated with each routine:
(1) New Routine Added
(2) Old Routine Deleted
(3) Old Routine Adapted
(4) Old Routine Retained

Inductive Learning

After drawing multiple random samples for improved consistency and structural stability

Meta-Routine

A stable, consistent, best representative evolutionary model:
A routine explaining the evolution of routines over time

Characteristics describing each routine:
(1) Frequency of Routine Usage
(2) Complexity of Routine
(3) Appropriateness of the Routine
(4) Task Causal Ambiguity

IT Portfolio (Year Two)

Random Sample 1

Random Sample 2

Random Sample M

Inductive Learning

Decision Tree 1: Set of Decision Rules

Decision Tree 2: Set of Decision Rules

Decision Tree M: Set of Decision Rules

Selecting "True" Routines from Decision Rules:
(1) High Model Prediction Accuracy
(2) Lower bound on frequency of rule usage

Set of Routines: Year Two

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Strategic planning — and the related decision-making effort — has also been described as "assemblages of deliberations, with unpredictable triggers and fluid courses, evolving organically as the situation changes" (Pava 1983). More recently, planning has been also conceptualized as an emergent process, in which problem interpretations, deliberations, and actions unfold unpredictably (Markus et al. 2002). Such patterns of organizational activity are characterized by (1) an emergent process of deliberations with no best structure, (2) an actor set that is unpredictable in terms of job roles, and (3) intensive knowledge requirements and distributed expertise. A diverse set of actors (line managers, business planners, IS specialists) could thus initiate the process of strategic planning. Further, given the knowledge intensive nature of planning, decision makers are likely to work in collaboration with others in the organization.

Planning is a knowledge-intensive emergent process requiring a high level of expert knowledge content, which often remains tacit. Knowledge requirements for strategic planning are difficult to capture and share. This difficulty inevitably means that, when tacit knowledge can be made explicit, it cannot easily be represented numerically, but must instead be represented as if-then rules (Baligh et al. 1996). Planning for portfolios of IT initiatives often necessitates participation of a steering committee comprising a diverse set of stakeholders. Effective planning depends on a large spectrum of decision factors. Planning for large portfolios can often span several weeks at a time. The logics employed in planning effectively continue to be tacit[8] given that the contextual knowledge utilized for decision making is often embedded idiosyncratically in organizational interactions and practices.

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[8] Unobtrusive participation in several planning sessions within this organization and semi-structured interviews with several key decision makers at this site validated my beliefs.

3.3.1 Stage One: Extracting Organizational Routines

I chose a Fortune 50 organization as my research site. This organization, head-quartered in the United States, is in the manufacturing industry with over 35,000 employees, and annual revenues exceeding $18 billion dollars. Organizations in the manufacturing industry have often been chosen for studying decision making rationale in IT. See Oh and Pinsonneault (2007) as an exemplar. Central to the logic of appropriateness is the need to ascertain the identity of decision makers. Based on the analysis of the annual reports of this organization and after validating my evaluations with the senior executives in this organization, I classified this organization (and the decision makers in this organization) as Analyzers (Kabanoff and Brown 2008). I choose an Analyzer organization for my study for at least two reasons. First, Analyzers — given their tendency to rely on a large number of internal and external decision-making attributes — are expected to use relatively complex decision routines. Second, Analyzers are expected to follow a comprehensive planning effort. Choosing an Analyzer organization for my empirical study on routines and their evolution thus enriches the potential insights I can offer. Appendix A describes the process used to systematically ascertain the strategic orientation of the organization chosen for this study. I systematically examined the (tacit) decision-making processes used for prioritizing IT initiatives within this large Analyzer organization over two consecutive years.

Table 6: Two-Year Longitudinal Portfolio Data Summary

Inputs to the decision process		Outputs:
Benefits Associated With Initiatives	Risk Factors & Mitigation Mechanisms	Executive Decisions
YEAR ONE: PORTFOLIO OF PROPOSED INITIATIVES (N = 57)		
Initiative Type OSS Benefits (79%) MIS Benefits (53%) IOS Benefits (49%) SDSS Benefits (32%) Process Improvements (82%)	Structure (Low Structure = 32%, High Structure = 68%) Size (Low = 23%, Medium = 61%, High = 16%) Prior Experience (Low = 67%, Medium = 23%, High = 10%) BPR Accomplished (Yes = 16%), BPR Resources Committed (Yes = 23%) In-house Software Apps. (Yes = 8%), Specialized Software Apps. (Yes = 28%), Third Party Software Apps. (Yes = 22%), Internal Maturity (Low = 70%, Medium = 28%, High = 2%), External Capabilities (Yes = 56%)	Reject (25%) Partially Fund Initiatives (30%) Fully Fund Initiatives (45%)
YEAR TWO: PORTFOLIO OF PROPOSED INITIATIVES (N = 106)		
Initiative Type OSS Benefits (46%) MIS Benefits (19%) IOS Benefits (41%) SDSS Benefits (20%) Process Improvements (89%)	Structure (Low Structure = 58%, High Structure = 42%) Size (Low = 60%, Medium = 27%, High = 13%) Prior Experience (Low = 20%, Medium = 33%, High = 47%) BPR Accomplished (Yes = 10%), BPR Resources Committed (Yes = 43%) In-house Software Apps. (Yes = 16%), Specialized Software Apps. (Yes = 28%), Third Party Software Apps. (Yes = 25%), Internal Maturity (Low = 65%, Medium = 23%, High = 12%), External Capabilities (Yes = 58%)	Reject (18%) Partially Fund Initiatives (25%) Fully Fund Initiatives (57%)

3.3.1.1 Portfolio Data

I examined a set of 163 decisions for prioritizing proposals — each characterized by 15 decision-making attributes — in a large IT portfolio within this large organization spanning two consecutive years. This rich set of attributes consumed during decision making is described in Section 2.3.1.

Though initiatives in my data were proposed by individual managers, these initiatives are owned and governed by the senior leadership within the organization. Thus my data, in its aggregated form, represent an organization-level IT portfolio. Prioritization decisions on these portfolios were made by a steering committee comprising of senior IS (CIO, members of the CIO team) and business leadership (Vice President, other senior executives) during strategic IS planning sessions, in collaboration with the individual managers who proposed these initiatives. Prioritization decisions on each proposed initiative belonged to one of three classes: a proposed initiative (a) was rejected; (b) was approved with partial funding (c) was approved with full funding. Summary of the portfolio data used for analysis in this study is presented in Table 6.

The size of the second year's portfolio is almost twice as big when compared to the first year's portfolio. A closer inspection of Table 6 reveals two findings. First, the second year's portfolio has a large number (60%) of low-sized (low-risk) initiatives as compared to the first year's portfolio which had a higher proportion (61%) of medium-sized (medium-risk) initiatives. Second, as compared to the first year, which had a higher proportion (68%) of (low-risk) high structured initiatives, the second year's portfolio had a higher proportion (58%) of (high-risk)

low structured initiatives. These observations reveal tradeoffs potentially involved in the

definition of proposals for IT initiatives.

3.3.1.2 Inductive Learning

Strategic planning — a knowledge-intensive emergent process — requires a high level of

expert knowledge, which often remains tacit (Langley et al. 1995, Markus et al. 2002). These

knowledge requirements for planning are difficult to capture and share. This difficulty inevitably

means that, when tacit knowledge can (and if at all) be made explicit, it cannot easily be

represented numerically, but can instead be represented as if-then rules (Baligh et al. 1996).

Decision makers can often articulate the rationale they used during strategic planning in the form

of if-then rules. But this description is often limited to some decision making episodes or

instances. Given that decision making during planning is accomplished as a group and driven by

tacit knowledge — knowledge which is embedded in the interactions between organizational

members — it is often difficult for planners to describe the entire decision making process in

terms of a cohesive set of rules. Articulating the nature in which these decision-making episodes

interrelate and fit together to create the whole is also often difficult. Mechanisms in which these

decision making episodes combine thus remain largely unknown. A holistic view of the entire

decision making activity which could span several weeks, is thus difficult to articulate[9].

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[9] Challenges associated with research on formal planning revolve around choosing a dependent variable. The anticipated outcome ultimately associated with successful IT planning is improved organizational performance. Such outcomes are causally distant from the decision making rationale employed during the planning. *Quality of the plans,* as a dependent variable, developed has a more direct causal relationship (Byrd et al. 1995). Using quality of plans as the dependent variable seems to be appropriate. First, the quality of the plan produced at the end of planning served as a basis for resource allocation in this case. These plans are reviewed by several senior members (not involved in planning but) responsible for

Inductive learning methodology holistically discovers tacit knowledge contained in a

decision process. Decision trees — outputs of the inductive learning — are approximations of

this tacit decision making rationale (Quinlan 1990). Decision trees compactly describe the target

concept —decisions driven by tacit knowledge — using a set of conjunctives (Quinlan 1986).

Trees create an ordering among the decision attributes characterizing examples that belong to a

particular decision and the ones that do not. Trees represent knowledge in a form that can be

easily understood by humans. My methodological approach enables me to codify tacit decision-

making knowledge. This conversion from tacit knowledge or rationale to explicit decision rules

has strong implications for the discovery and effective management of knowledge within

organizations (Nonaka and Takeuchi 1995).

Inductive learning is driven by classification algorithms (Quinlan 1986). But, *the essence*

of inductive learning is conceptual rather than computational. Induction progressively discovers

the underlying structure of the data by partitioning it along key informative decision attributes.

These decision attributes that guide the partition of the data are chosen such that they provide the

most information about the final decision. The most informative decision attribute is chosen first

and represents the top most attribute in the decision tree. These steps progressively collect sub-

groups within the data set which were all similar with regards to the final decision. At the end of

this iterative mining effort that is grounded in data, we arrive at a decision tree where all the data

governance of initiatives within this organization. There is a strong causal link between the quality of
plans produced and the funding awarded to proposals; better plans get better funding. Investigation on
how plans actually affect an organization's performance would require a separate study of the
implementation process itself. In such a study, the quality of the plan is an independent variable, with
organizational performance as a dependent variable. Even with that research focus, a measure of plan
quality would be necessary. I presented the induced models to the key decision makers. They validated
the appropriateness of these decision trees and suggested that they effectively represent the rationale
applied to develop appropriate plans. They were very happy to see compact models that resembled the
inherent complexity of the underlying decision making process.

instances on the leaf — a point at which the decision tree cannot be "grown" anymore — are similar with regards to the final decision. In the process, decision tree give us decision paths — comprising of decision making attributes — to "arrive" at these decisions. Decision paths can be discovered by tracing the tree from its root node — the top most classification attribute of the tree — to each leaf. Figure 5 and 6 represent sample decision trees induced from my data set. Figure 5 a decision tree induced on the first year's portfolio data set yields 16 individual decision rules. Figure 6 a decision tree induced on the second year's data yields 12 decision rules.

Decision making during strategic planning can have multiple narratives or alternative rationales. Decision trees are thus approximations that represent the informational interactions and emergent knowledge exchanges between planners and can be effective for developing holistic decision making narratives. Given this structured, comprehensive approach to discovering and representing the underlying structure of the data, decision trees possess high descriptive validity (Tessmer et al. 1993). Individual paths or rules in decision trees systematically highlight a collection of attributes used during decision-making. The length of these paths effectively represents the complexity of the underlying decision process. Number of examples classified on a particular decision path serves as a proxy for the strength of decision themes (the frequency of decision rule or routine usage) and guides the discovery of decision-making routines. To comprehensively discover these alternative decision making rationales and to faithfully represent the inherent alternative decision themes, inductive learning methodology is often applied on separate, randomly drawn sub samples of the data. For instance, in this case, a randomly drawn sample of 80% of the portfolio was used for training (the process of discovering the decision making rationale) and the prediction accuracy of the induced model (a measure of

how faithfully this discovered decision rationale generalizes to the entire set of decisions) was tested on a disjoint randomly drawn sample of 20% of the total portfolio. Every random sample was selected such that all classes of decisions were represented; ensuring purity of induced trees.

Trees were randomized 20 times at this stage to generate alternative induced decision models. A typical decision model followed a familiar pattern: About 80% instances were classified or explained by about 20% of the decision rules. Thus it would be accurate to infer that a large majority of the decisions are based on application of a small set of tacit routines, and a relatively small fraction of the decisions could be described as exceptions to the rules. Each induced model serves as a credible approximation of the underlying decision process. Prediction accuracy of a decision model represents this credibility measure. To further improve the validity of the findings, the same analysis was conducted using a 90%—10% training/testing sample split and a 70%—30% training/testing sample split. Inducing models at a different training-testing sample split ensured high consistency and the discovery of unique routines. After inducing about sixty different decision models at three training-testing sample splits, the discovery of routines converged. No new routines could be extracted. The process of discovering new routines converged after about sixty iterations.

Discovery of organizational "habits" depended on two criteria used for retaining only "true" routines from the plethora of rules discovered from decision trees. First, rules were retained only if the prediction precision of the decision models was sufficiently high. I retained rules from models with a prediction precision of 55% or higher. Decisions on proposals belong to three classes — proposals were: (1) rejected; (2) partially approved; or (3) fully approved and funded. Without induced decision models, the probability with which one can predict a decision

is 33%. I choose models induced on the portfolio data that significantly improve these odds. A lower bound of 55%, improves these odds by at least two-thirds.

One more criterion was considered: the frequency with which the decision rule was applied. A decision rule applied to make just one decision out of a total of 100 decisions typically does not symbolize a routine. It is the frequency with which a rule is applied that makes it an organizational "habit". I only retained rules that were applied in at least 10% of the total decisions. This mechanism of choosing only rules that classified at least 10% of the total decisions served as an effective pruning mechanism. Steps were also taken to eliminate duplicates. I obtained two sets of routines; each faithfully representing decision making rationale used in planning. The first year's decision making was represented by a set of 31 unique routines. Similarly, the second year's decision making was represented by a set of 38 unique routines. Descriptive data on these sets of routines are presented in Table 7.

Sub-portfolios that included some proposals for initiatives of low structure were considered as tasks with higher causal ambiguity. Proposals with low structure are different from proposals with high structure. Higher causal ambiguity pertaining to low-structured tasks inhibits the easy adoption of routines pertaining to organizational decisions on such sub-portfolios.
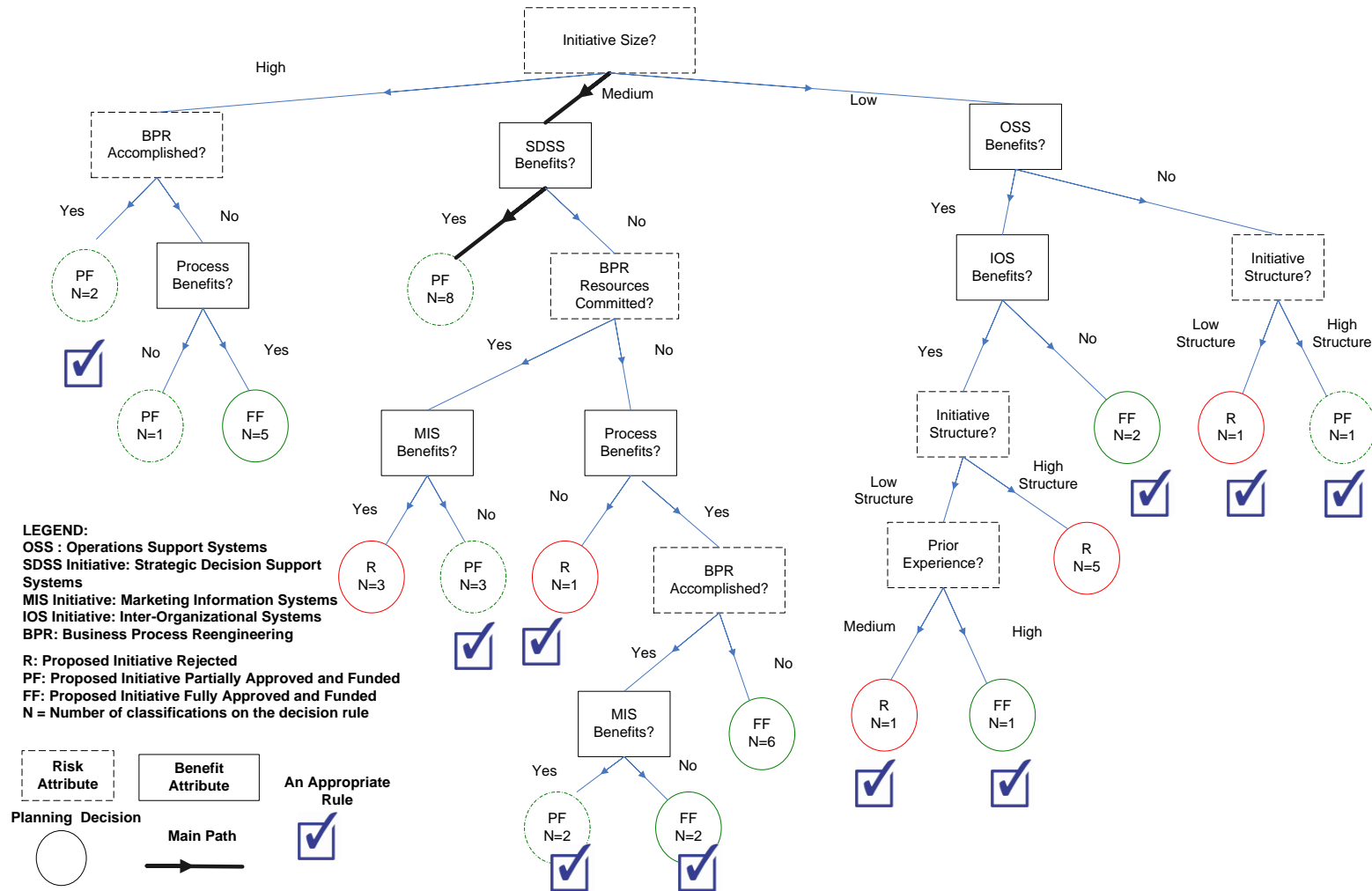
Figure 5: A Sample Decision Tree (Year One)

LEGEND:
OSS : Operations Support Systems
SDSS Initiative: Strategic Decision Support Systems
MIS Initiative: Marketing Information Systems
IOS Initiative: Inter-Organizational Systems
BPR: Business Process Reengineering

R: Proposed Initiative Rejected
PF: Proposed Initiative Partially Approved and Funded
FF: Proposed Initiative Fully Approved and Funded
N = Number of classifications on the decision rule

Figure 6: A Sample Decision Tree (Year Two)

Legend:
OSS : Operations Support Systems
SDSS Initiative: Strategic Decision Support Systems
MIS Initiative: Marketing Information Systems
IOS Initiative: Inter-Organizational Systems
BPR: Business Process Reengineering

SCENARIO A

R: Proposed Initiative Rejected
PF: Proposed Initiative Partially Approved and Funded
FF: Proposed Initiative Fully Approved and Funded
N = Number of classifications on the decision rule

Risk Attribute   **Benefit Attribute**

Planning Decision

Main Path   **An Appropriate Rule**

Table 7: Sets of Routines

	Year One	Year Two
Is the Routine Appropriate?	Inappropriate (8), Appropriate (23)	Inappropriate (9), Appropriate (29)
Complexity of the Routine *(measured in terms of the numbers of contingencies in the routine definition)*	2 Contingencies (5), 3 Contingencies (7), 4 Contingencies (11), 5 Contingencies (5), 6 Contingencies (5), 7 Contingencies (3), 8 Contingencies (1), 9 Contingencies (1)	2 Contingencies (2), 3 Contingencies (5), 4 Contingencies (7), 5 Contingencies (11), 6 Contingencies (3), 7 Contingencies (1), 8 Contingencies (1), 9 Contingencies (1)
Frequency of Routine Usage *(measured in terms of the proportion of decisions explained by the routine)*	10% (17), 13% (9), 15% (1), 18% (3), 23% (1)	10% (13), 11% (8), 12% (5), 15% (4), 16% (3), 17% (3), 18% (2)
Task Causal Ambiguity *(considered high if the sub portfolio contained some proposals with low structure)*	Low Ambiguity (7), High Ambiguity (24)	Low Ambiguity (3), High Ambiguity (33)
Kind of Decision	Rejection (7), Partial Funding (9), Fully Funding (15)	Rejection (1), Partial Funding (4), Fully Funding (33)
Total # of Routines	31	38

3.3.1.3. Operationalization of Appropriateness

Appropriate behavior requires planners with Analyzer-like identities to arrive at approval
decisions on high-risk initiatives only after devising mitigation mechanisms to control risk.
Planners with Analyzer-like identities who approve high-risk initiatives without devising
mechanisms to control risk are behaving inappropriately (March and Shapira 1987). Rules for
approving high-risk initiatives that show evidence of the presence of risk mitigation mechanisms
are defined to be appropriate (for risk-averse Analyzers). Figure 5 and 6 are examples of trees
induced on my data set. The rule schemata (i.e. the abstract representation of a rule; e.g. Feldman
and Pentland 2003) extracted from decision trees guides my operationalization of
appropriateness. Consider the following rule extracted from Figure 5.

If (Size= "Low") & (OSS Benefits = "Yes") & (IOS Benefits = "Yes") & (Structure = "Low")
& (Prior Experience = "High") → Fully Fund Initiative

This rule was coded as an appropriate rule as it shows evidence that high risk factors
[fluid, low structured initiatives (McFarlan 1981)] were mitigated [(1) size of initiatives was low,
(2) prior experience associated with technology was high] before approving such initiatives.
Consider another rule extracted from Figure 5.

If (Size= "High") & (BPR Accomplished = "Yes") → Partially Fund Initiative

This rule was coded as being appropriate as it shows evidence that the risk factors [high size of the initiative (McFarlan 1981)] were mitigated (business process redesign tasks associated with such large proposals were completed) before partially approving such initiatives. Consider the following rejection rule extracted from Figure 6.

If (Size="Low") & (SDSS-Benefits="No") & (IOS-Benefits="Yes") & (Structure="Low") & (Prior Experience="Low") & (BPR Accomplished ="Yes") → Reject Initiative

This rejection rule was coded appropriate as it does not show evidence that high risk factors [fluid, low structured initiatives (McFarlan 1981)] were mitigated (size of such initiatives was low, but prior experience associated with the technology was *low* and business process redesign tasks associated with these initiatives were *not* completed). Such initiatives were appropriately rejected. Rules of the following two abstract forms or schemata (Feldman and Pentland 2003), were operationalized as being appropriate:

1. If (Risk = "High/Medium") & (Mitigation Mechanisms = "No") → Reject Initiative
2. If (Risk="High/Medium") & (Mitigation Mechanisms = "Yes") → (Partially or Fully) Approve Initiative

Table 7 revealed two findings. First, the proportion of appropriate routines in year one was 74% and the proportion of appropriate routines in year two was 76%. This slight improvement in the proportion of appropriate routines in the second year is notably relevant

given that the size of the second year's decision space was almost twice as large as the first year's decision space. Second, the proportion of rejection routines used in the second year is also lower when compared to rejection routines used in the first year. This finding provides explicit evidence of the tacit learning that is occurring where managers are self-correcting their proposals in the second year.

3.3.2 Stage Two: Evolutionary Outcomes

Routine schemata and their applicative forms (Feldman and Pentland 2003) helped me determine the routines that were essentially the same, ones that were modified, ones that were added new and others that were discontinued from usage. Routines in their abstract form which were discontinued from usage — present in the first year's set of routines and absent from the second year's set of routines — were considered as routines that were truly discontinued from usage. Abstract representation of all routines in both sets of routines was compared to consistently make this determination. This determination was conducted by multiple raters. The inter-rater reliability across all four evolutionary outcomes was greater than 90%.

I identify 12 routines that were discontinued from usage from the first year's set of routines as they did not appear in the second year's set. Similarly, routines in their abstract form that appeared only in the second year's set of routines and were not present in the first year's set were deemed as being new routines. I identify 14 routines as being new since they (in their abstract form) were present only in the second year's set of routines.

Routines that were identical in their schemata or abstract form in both sets of routines were identified as ones that were retained as-is. Though these routines differed in their application, they were essentially the same abstract routines being reapplied. I identify 11 routines that were retained as-is across both the sets of routines spanning two years. After inspecting the instantiated routines, systematic changes to the abstract form or the schemata of a routine helped me detect routines that were truly adapted. I identify 8 routines from the first year's set of routines that were modified to create 13 routines in the second year's set of routines.

Thus the total set of outcomes of the evolutionary process comprised of 45 cases (12 routines that were deleted, 14 that were added new, 8 routines that were modified or adapted, and 11 routines that were retained as-as across the two years). Table 8 gives examples of routines across two years — in their abstract and instantiated forms — and the corresponding evolutionary outcomes. Table 9 presents a summary of the routine data set including 45 evolutionary scenarios used for discovering the structure of the underlying, unknown evolutionary process.

Table 8: Determination of Evolutionary Outcomes

Routines (Year One)		Routines (Year Two)		Outcomes
Abstract Form	Instantiated Form	Abstract Form	Instantiated Form	
No routine in year one considered all three risk factors. This routine (abstract representation) was present only in the second year's routine set.		RRR → FF	If (Size = "Medium") & (Structure = "High") & (Prior Experience = "High") → FF	Added New
No routine in year one used a combination of a risk attribute and mitigation mechanism to arrive at a partial funding decision. This routine (abstract representation) was present only in the second year's set.		RM → PF	If (Structure = "High") & (Third Party Software Apps. = "Yes")→ PF	Added New
BM→FF	If (Strategic Benefits = "Yes") & (Specialized Software Apps. = "Yes") → FF	BM→FF	If (Process Improvements = "Yes") & (BPR Accomplished = "Yes") → FF	Retain As-Is
BRM → FF	If (Process Improvements = "Yes") & (Structure = "Low") & (External Capabilities = "Yes") → FF	BRM→ FF	If (Process Improvements = "Yes") & (Size = "Medium") & (Internal Maturity = "Medium") → FF	Retain As-Is
BM→ FF	If (Marketing Benefits = "Yes") & (External Capabilities = "Yes") → FF	BBM→FF	If (Marketing Benefits = "Yes") & (Strategic Benefits = "Yes") & (External Capabilities = "Yes") → FF	Modified
RMM→ FF	If (Size = "Medium") & (In-house Software Apps = "Yes") & (BPR Resources Committed = "Yes") → FF	RRM→ PF	If (Size = "Medium") & (Structure = "High") & (In-house Software Apps = "Yes") → PF	Modified
BR → FF	If (Strategic Benefits = "Yes") & (Size = "Medium") → FF	This routine (abstract representation) was not present in the second year's routine set.		Deleted
BMM → R	If (Strategic Benefits = "Yes") & (Third Party Software Apps.= "No") & (Specialized Software Apps.= "No")→ R	This routine (abstract representation) was not present in the second year's routine set.		Deleted

B = Attributes characterizing potential benefits associated with initiatives

R = Attributes characterizing risks associated with initiatives

M = Attributes characterizing risk mitigation mechanisms associated with initiatives

Managerial Decisions:

R = Reject Initiative, PF = Approve and Partially Fund Initiative, FF = Approve and Fully Fund Initiative

Table 9: Evolutionary Outcomes

	Combined Routine Evolutionary Dataset
Is the Routine Appropriate?	Inappropriate (14), Appropriate (31)
Complexity of the Routine	Low Complexity *(Less than 5 contingencies)* (19), High Complexity *(Greater than or equal to 5 contingencies)* (26)
Frequency of Routine Usage	Low Frequency *(Less than or equal to 15%)* (26), High Frequency *(Greater than or equal to 15%)* (19)
Task Causal Ambiguity	Low Ambiguity (11), High Ambiguity (34)
Kind of Decision	Rejection (10), Partial Funding (15), Fully Funding (20)
Outcomes of the Evolutionary Process	Routine Added (14), Routine Deleted (12) Routine Retained As-Is (11), Routine Modified (8)
Total # of Evolutionary Scenarios	45

3.3.3 Stage Three: The Evolutionary Process

To study patterns of evolution, I relied on an inductive methodology. This methodology reveals meta-routines explaining the evolution of routines. For comprehensively studying reliable patterns in this evolution, multiple models were induced on the routine data set which included 45 instances. These multiple models were induced on this routine data set in order to verify high *consistency* and *structural reliability* of the evolutionary process. A randomly drawn sample of 80% of the total data set was used for training where as another randomly drawn sample of 20% of the total data set was used for testing the prediction accuracy of the induced model. Similar analysis was conducted at the 90% — 10% sample split. Fifteen evolutionary models were induced at each stage. I induced more models at each stage. I induced evolutionary models at the 70%-30% sample split. Given the high consistency of the models, I present results based on 30 models. Of the 30 decision models induced, 28 models had "*Is the Routine Appropriate?*" as the top classification attribute. The best representative model chosen represents a very consistent, evolutionary process.

The evolutionary process had 4 outcomes: Routines were (1) added, (2) deleted, (3) retained as is, or (4) modified. Probability of predicting an evolutionary outcome in the absence of an evolutionary model is 25%. The best representative model I chose has a prediction accuracy of 50%. I have thus improved the odds of predicting the proper evolutionary outcome by 100%. Figure 7 reveals the structure of this meta-routine, which compactly represents the tacit, yet stable, evolutionary process. My findings have implications for empirical research on routines and dynamic capabilities.

3.4. DISCUSSION OF RESULTS

H1 dealt with understanding the characteristics of routines that facilitate their *addition* to an existing repertoire of routines. The thirty evolutionary models induced on the routine data set (obtained at the end of Stage two) resulted in a total of 63 rules pertaining to the addition of new routines. Of these 63 rules, 25 rules represented strong evolutionary patterns [instances classified on those evolutionary paths $> = 6$ (approximately 15% of the total routine data set)]. When an evolutionary path classifies about 10-15% of total instances; it signifies that this rule represents a true evolutionary pattern and not just a spurious case of change (Zollo and Winter 2002). Strong evolutionary patterns indicate systematic support for my hypotheses.

Of these 25 paths, 9 paths were in support of H1 [were of the form *If (Is the Routine Appropriate? = "Yes") & (Frequency of Routine Usage? = "Low")* → *Add Routine]*. None of the evolutionary paths discovered were of the form *If (Is the Routine Appropriate? = "Yes") & (Frequency of Routine Usage? = "High")* → *Add Routine*. My findings corroborate H1 (36% of the evolutionary paths validated H1) and this support is presented in Figure 7.

I find another path in Figure 7 that explains the generation of new routines. Tasks of high causal ambiguity are difficult to plan for. New routines added were of low complexity, and pertained to tasks of low causal ambiguity (Zollo and Winter 2002) thus facilitating their easy adoption in the second year's set of routines. Low causal ambiguity associated with these newly planned tasks in conjunction with the low complexity of the new routine used for decide upon such new initiatives facilitates easy socialization of these new rules. Routines that are easy to socialize are likely to gain adopters more easily when compared to routines that cannot be easily communicated (e.g. routines that are complex or pertain to tasks of high causal ambiguity).

The path in Figure 7 validating H1 classified 8 scenarios of the total 45 evolutionary scenarios. This finding suggests that change is likely to proceed in gradual steps and extreme changes to the status quo are less likely to be implemented successfully given the foundation for stability created by routines.

Figure 7: Meta Routines Explaining the Evolution of Routines
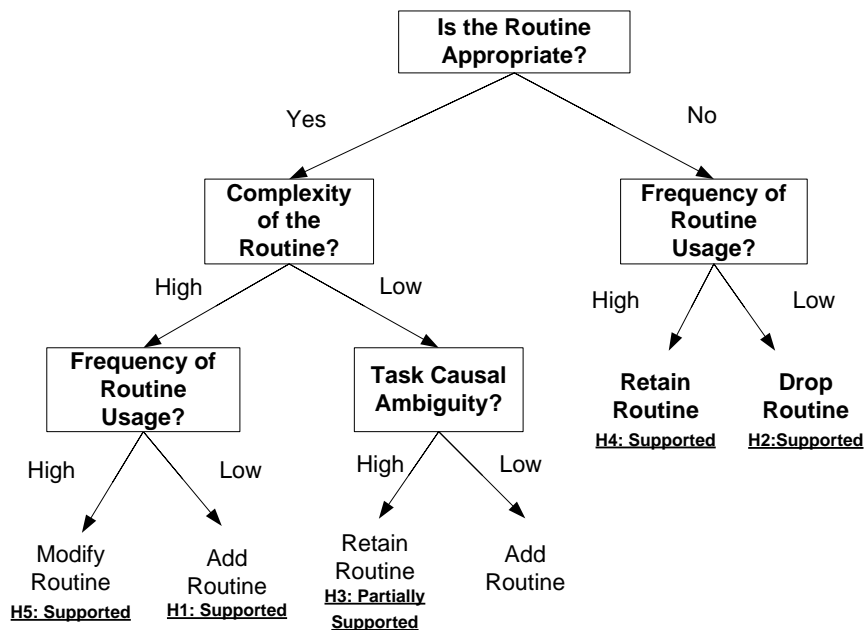
H2 dealt with understanding characteristics of routines themselves that are likely to explain which routines are expected to be discontinued from usage. The thirty evolutionary models resulted in a total of 32 rules explaining the deletion of old routines. Of these 32 rules, 22 rules represented strong evolutionary patterns (instances classified on those evolutionary paths > = 6). Of these 22 evolutionary paths, 14 paths were in support of H2 [were of the form *If (Is the Routine Appropriate? = "No") & (Frequency of Routine Usage = "Low")* → *Delete Old Routine]*. My findings corroborate H2 (63% of the evolutionary paths discovered validated H2) and this support is presented in Figure 7. The path in Figure 7 validating H2 classified 10 scenarios. This finding suggests that unlearning "bad" habits is difficult and is likely to proceed in small steps.

H3 maintained that appropriate, simple routines that are frequently used are likely to be retained for future use. The thirty evolutionary models resulted in a total of 68 rules explaining the retention of old routines. Of these 68 rules, 38 paths represented strong evolutionary patterns (instances classified on those evolutionary paths >= 6). My findings could support this hypothesis in its entirety [the evolutionary paths discovered were not of the form *If (Is the Routine Appropriate? = "Yes") & (Frequency of Routine Usage = "High") & (Routine Complexity = "Low")* → *Retain Old Routine]*, but my findings provide partial support for H3 [i.e. evolutionary paths discovered were of the form: *If (Is the Routine Appropriate? = "Yes") & (Routine Complexity = "Low")* → *Retain Old Routine]*. Of the total 38 strong evolutionary paths discovered, 20 paths were in partial support of H3. My findings partially corroborate H3 (52% of the evolutionary paths discovered partially validated H3).

This support is presented in Figure 7. The path in Figure 7 validating H3 classified 8 scenarios. This finding suggests that simple, appropriate routines are likely to be retained as-is for future use and the almost automatic response they offer simplifies organizational action.

H4 maintained that along with appropriate routines; inappropriate routines that are frequently applied are also likely to be retained. Thirty evolutionary models induced offered a total of 68 rules leading to the retention of old routines. Of these 68 rules, 38 rules represented strong evolutionary patterns (instances classified on those evolutionary paths >= 6). Of these 38 paths, 16 paths were in support of H4 [i.e. were of the form: *If (Is the Routine Appropriate? = "No") & (Frequency of Routine Usage = "High")* → *Retain Old Routine*].

My findings corroborate H4 (42% of the evolutionary paths discovered validated H4) and this support is presented in Figure 7. The path in Figure 7 validating H4 classified 8 scenarios. This finding reveals the dark side of organizational inertia which assists in the retention of "bad" habits.

H5 dealt with understanding the characteristics of routines that guide their adaptation. Thirty evolutionary models induced resulted in a total of 34 rules explaining the adaptation of existing routines. Of these 34 evolutionary rules, 17 represented strong evolutionary patterns (instances classified on those evolutionary paths > = 6) explaining the adaptation of routines. Of these 17 paths, 12 paths validated H5 [were of the form If *(Is the Routine Appropriate? = "Yes") & (Routine Complexity? = "High")* → *Adapt or Modify Old Routine*]. My findings corroborate H5 (over 70% of the evolutionary paths discovered validated H5) and this support for H5 is presented in Figure 7. The path in Figure 7 supporting H5 classified 4 scenarios of the total 45 evolutionary scenarios. This finding suggests that complex, appropriate routines are less likely to be reused as-is and are more likely to be modified before future use (March and Simon 1958).

Given that I defined a routine based on a lower bound on the rule strength set at 10% of instances classified on a rule from the entire population of the decision space, sensitivity analysis was further conducted to improve the consistency of the reported findings. In this sensitivity check, we increased the lower bound on the definition of a routine to a minimum requirement of a rule that classified at least 15% instances from the entire population within the decision space. This sensitivity check reduced our set of evolutionary outcomes from the earlier set of 45 scenarios to a total of fifteen scenarios. Inductive methods were used to analyze the characteristics of routines that endogenously explained the evolutionary mechanisms underlying these fifteen scenarios. This sensitivity analysis yielded the following two sets of insights.

First, the anatomy of the dynamic capability (as reported prior to conducting this sensitivity check) continues to be structurally reliable. "Appropriateness of the routine" continues to be the top most classification criterion guiding the evolution of routines over time.

Second, presented below is the partial support for the hypotheses developed in my work. Given that the sensitivity check reduced my routine dataset to fifteen scenarios, H1 could not be tested in this new setting. My analysis yielded partial support for H2. Routines that were inappropriate and that were applied with a low frequency were discontinued from usage over time. This finding seemed contrary to my expectations as I found evidence to suggest that appropriate routines were being discontinued from usage over time. But a closer investigation revealed that the routines that were being discontinued were rejection routines. This finding provides explicit evidence to suggest the learning that has occurred over time where proposals presented in the second year were being self corrected based on the first year's rejection decisions. Results also indicate partial support for H3 where appropriate routines were retained for future use. These routines were applied with a low frequency suggesting that certain habits

were retained over time in spite of them not being "strong" habits. H4, which empirically tests the dark of inertia, i.e. the retention of "bad" habits, was also validated. Findings suggest that some inappropriate routines, i.e. routines that do not adhere to some criterion of appropriateness intrinsic to the identity of the decision makers in a given decision making situation, are likely to be retained for future use. Finally, findings also provide partial support for H5.Appropriate routines applied with a high frequency, were modified before future use. Given this analysis conducted as a different threshold (pertaining to the definition of organizational routines) provides partial support for four of the five hypotheses discussed in my work. This sensitivity check potentially improves the robustness of my findings.

The organization chosen for this study enabled me to examine the evolution of routines in a naturally controlled setting. My explanation for the evolution of routines is based largely on the endogenous characteristics of routines themselves. My setting was naturally controlled along at least four dimensions.

First, over the two year period, there were no substantial change in terms of the organizational size (e.g. number of employees) or the revenues generated by this organization and its market capitalization. The stock price of this organization did not change significantly over this two year period. A change in organizational size was a key covariate explaining (written) rule changes (March et al. 2000).

Second, the senior leadership responsible for portfolio management did not change over the two year period. The decision makers responsible for planning: Chief Information Officer,

Chief Executive Officer, the Vice President, and other senior IT staff and business leadership were the same. Changes in senior leadership can be an exogenous factor in triggering changes in routines (Vaast and Levina 2006).

Third, there were no substantial regulatory changes in the external environment. This study was conducted over the two year period from 2005-06. Thus, this study was conducted well after year 2000 (e.g. an event like Y2K during the course of the investigation would have been a substantial external force influencing change). This study was also conducted well after another recent substantial event, the passage of the Sarbanes-Oxley Act of 2002. Regulatory changes in the external environment (e.g. the passage of a federal regulation) were covariates explaining rule changes (March et al. 2000). The passage of the Sarbanes-Oxley regulation led to the creation of a compliance portfolio. After the initial spike, expenses in this portfolio stabilized.

Fourth, this corporation was organized such that portfolios were planned in the US and were implemented at an off-site location. The same off-site location was responsible for implementing these plans over the two year period. This outsourcing strategy (Garud et al. 2006) remained stable for a year before and after the two year period over which this study was conducted. My controlled setting thus helps me eliminate several alternative explanations and potentially significant external events guiding changes in routines and lends credibility to my findings.

CHAPTER 4: CONCLUDING COMMENTS

4.1. LIMITATIONS

Every research endeavor suffers from some limitations. Data analyzed in this dissertation — for both the research studies — were gathered from one large organization. This could imply that my research suffers from limited generalizability. Given that the business units I have chosen for my analysis are pursuing identifiable strategic orientations from the well accepted generic Defender-Prospector-Analyzer typology (Miles and Snow 1978), I suggest that the decision making insights I generate are applicable to a large majority of organizations that can be classified using this typology. This limitation in the research design, however, does offer some advantages; it enables me to systematically test differences in decision making across three business units pursuing different strategic orientations within a controlled setting. This naturally controlled environment helps me account for other confounding factors (such as differences in decision making due to individual differences in personal leadership styles across organizations, etc) and attribute differences in decision making to the differences in the strategic orientations of the individual businesses.

In the evolutionary study, I examined a set of 163 decisions based on fifteen decision attributes, within this large organization spanning two consecutive years which yielded 69 organizational routines. Based on a systematic comparison of routines used over time, I was able to isolate 45 systematic evolutionary scenarios. This focus on one rich organizational setting and this context specificity helps me generate rich insights. Definitions of proposals for IT initiatives are specific to an organizational context and are often idiosyncratic to each organization. Actions of decision makers are likely to be intricately embedded in an idiosyncratic, organizational context (March et al. 1991, Orlikowski 1996, Vaast and Levina 2006). I propose a process for the

evolution of routines along two paths — (1) a mechanism that challenges the status quo, (2) a mechanism that adopts or adapts the status quo. Though my data were obtained from one organization, the process of organizational learning proposed here is potentially generalizable and hopefully will stimulate future research in this stream.

4.2. IMPLICATIONS FOR IT PORTFOLIO MANAGEMENT

My research has three key managerial implications. First, articulating tacit decision making knowledge and representing this rationale as decision trees can offer managers several advantages. Trees cluster decision-making attributes and managerial decisions along distinct decision paths or rules giving me gestalts that holistically explain organizational actions (Miller 1981, Quinlan 1986). Decision trees can equip boundedly rational planners with rules from the past which can expedite future decision making and potentially alleviate the planning paradox (Simon 1955, Lederer and Sethi 1988). Repositories of decision rules can be communicated to a diverse group of stakeholders for facilitating consensus building (Tsoukas 1996, Eisenhardt and Sull 2001, Heugens et al. 2004). Ensuring that key checks and balances are in place before approving initiatives is critical from a governance perspective. Well-defined rules can provide managers with the right incentives; i.e. encourage rule following and discouraging rule-defiant behavior in the future (for e.g., Prendergast 1999). In other words, managers can refine their future proposals to ensure that they meet the "hurdles" set by planners.

Figure 8: Best Representative Defender Decision Model
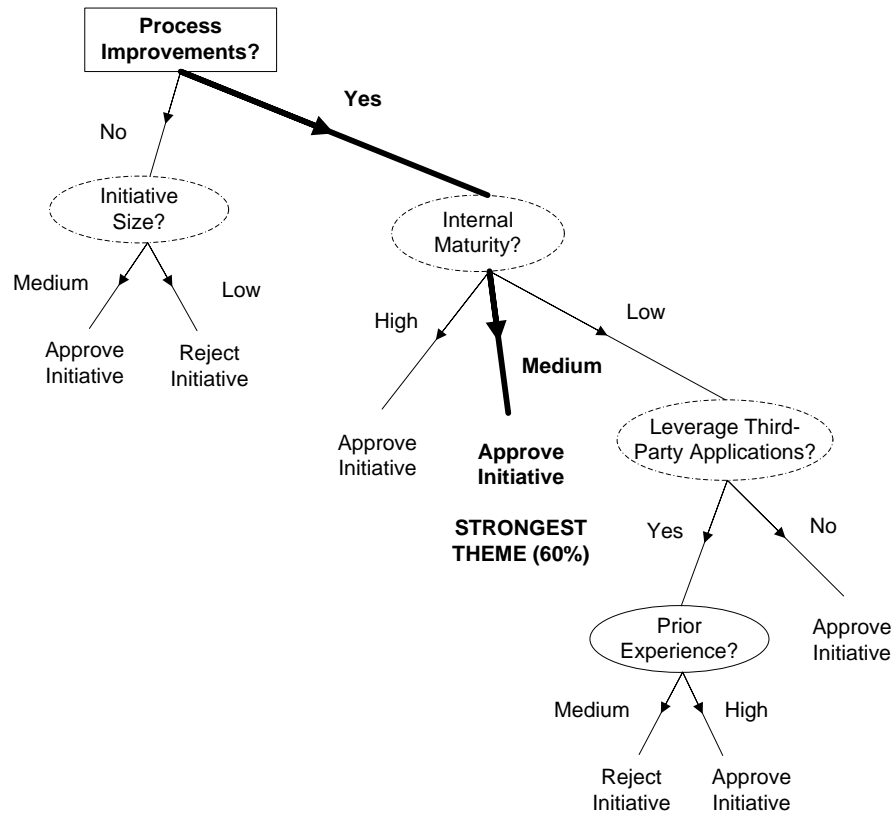
Second, decision trees can give planners an ex-ante indication of the extent of their risk-taking and help them better manage these risks during plan implementation. A diverse group of stakeholders now need to ensure rationale that is in alignment with organizational objectives is applied when deciding upon IT portfolios. Defenders are risk averse and need to ensure risks are being managed early on during planning. Presented in Figure 8 is the best representative decision model for the Defender chosen from the 60 alternative models based on its (a) high structural stability and (b) high prediction accuracy. In this compact decision model, I find strong decision-making themes given that majority (over 60%) of decisions on the proposed initiatives were

made using just one decision rule. These approvals were made if proposed initiatives had the

potential to improve efficiency of the business processes of the Defender.

Figure 9: Best Representative Prospector Decision Model
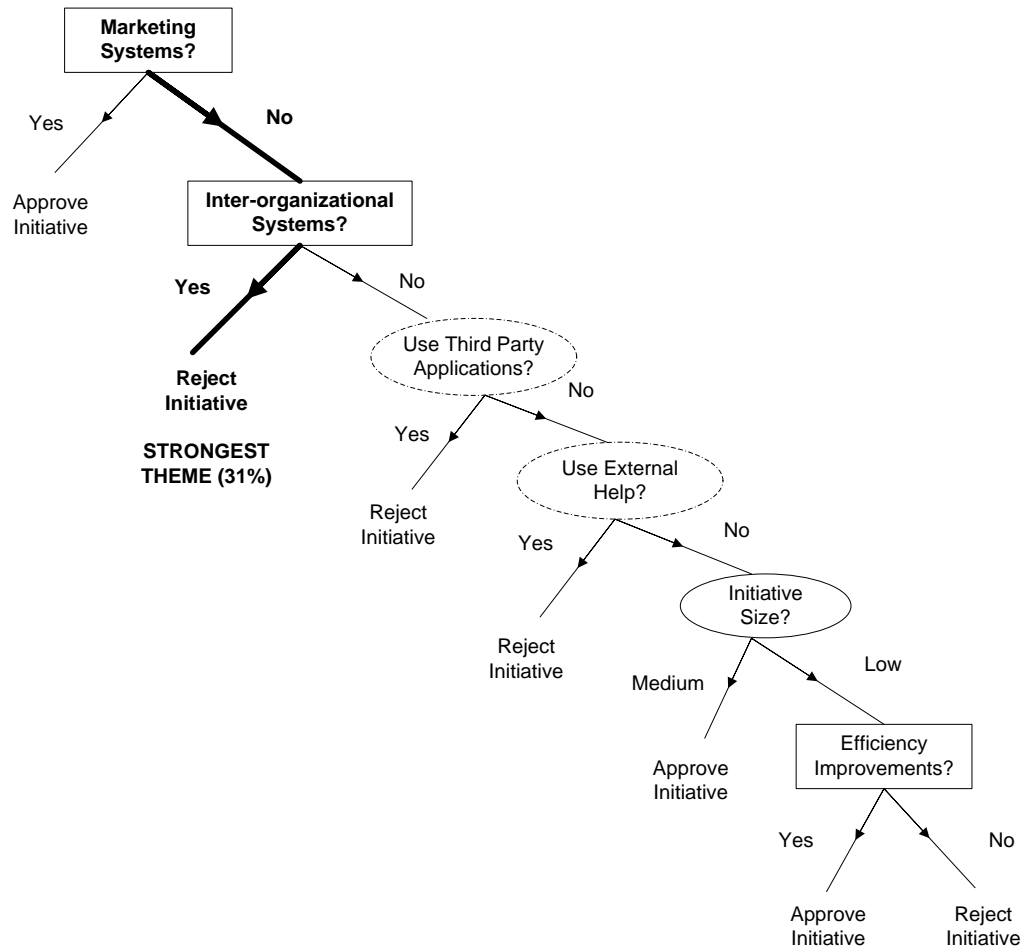
I find that a large number of proposed initiatives were approved only after ascertaining

that the internal maturity of these initiatives was not low. This reliance on a risk mitigation factor

(medium or high internal maturity of proposed initiatives) during decision-making (Lambert

1986) provides validation for aligned Defender behavior which deemphasizes risk-taking.

Additionally, of all the attributes consumed in the decision-making, only one attribute pertains to the nature of benefits offered by the proposed initiatives. This low proportion of benefit attributes suggests that decision-making in the Defender is geared towards understanding and mitigating risks associated with proposed initiatives. The Analyzer's best representative decision model, presented in Figure 10 reveals similar findings. Given the dual goals associated with Analyzer behavior, the Analyzer model is significantly more complex when compared to the Defender decision model. The risk-averse nature of both these kinds of organizations manifests itself in decision models which consume a greater proportion of risk and risk mitigation attributes when compared to benefit related attributes.

Third, decision trees help managers approach *alignment* using a unique perspective and ensuring the right mix of initiatives is approved; potentially enhancing the likelihood of success (Chan and Reich 2007). Prospectors have higher risk taking tendencies and are more likely to encourage flexibility by encouraging IT initiatives that enable them to tap into emerging markets. The best representative decision model for the Prospector is presented in Figure 9.

The decision model reveals that the Prospector consumes a larger proportion of decision attributes which describe the potential benefits of proposed initiatives. A Prospector's low emphasis on efficiency improvements is also demonstrated by the fact that this attribute is considered last. A higher proportion of benefit related attributes in the decision model is aligned with exploratory Prospector behavior. This decision model also is in alignment with the higher risk taking tendencies of the Prospectors as very few risk mitigation factors are considered before approving proposed initiatives. Inter-organizational systems are rejected because the creation of strong electronic links between suppliers and customers can be perceived as being restrictive by the Prospector who values flexibility (Das et al. 1991).

Figure 10: Best Representative Analyzer Decision Model
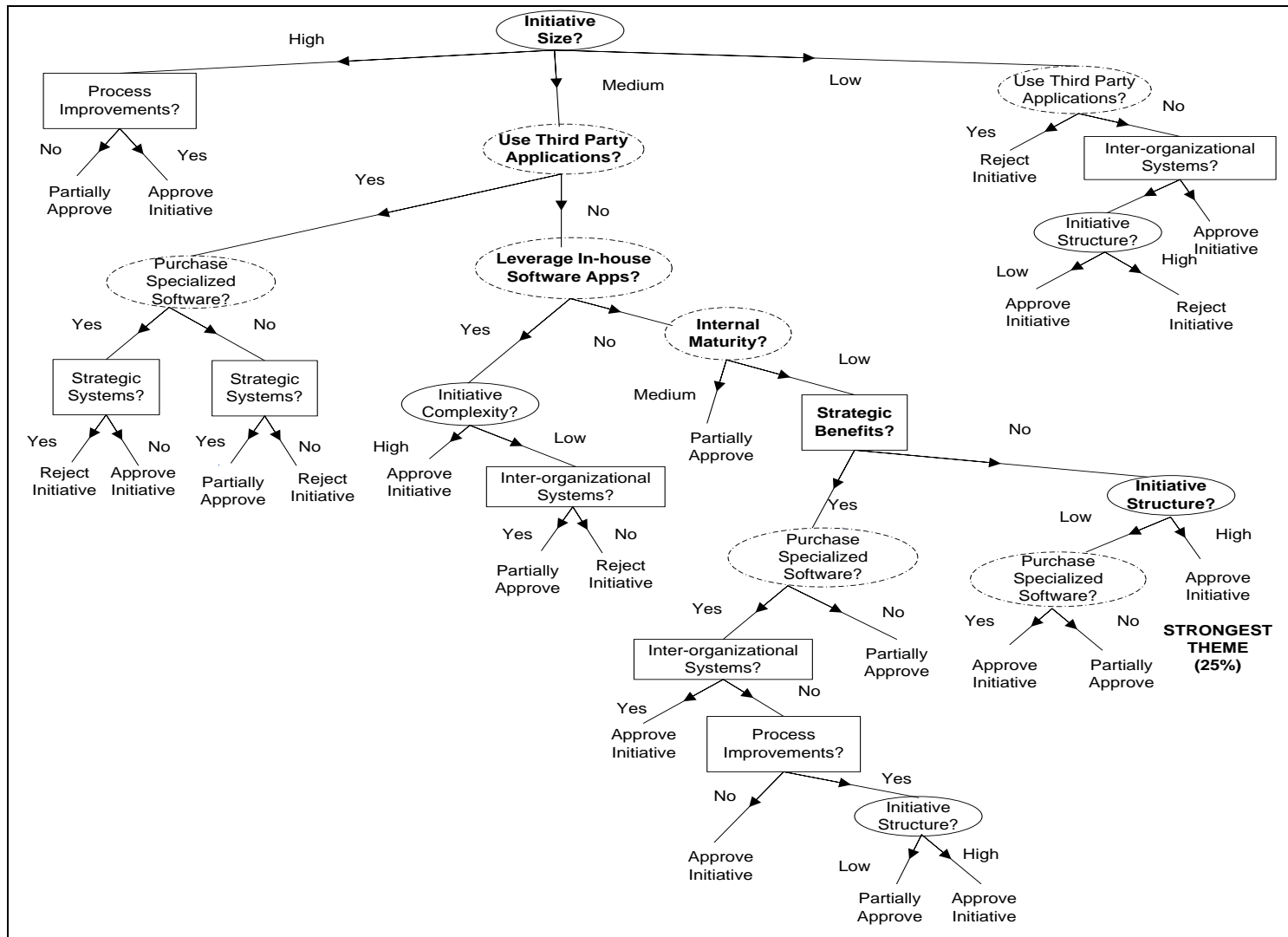
Decision trees presented in my research can help managers simultaneously understand (1) the *risk posture* embedded in their portfolios (Boynton and Zmud 1987), validate if this posture is in alignment with their risk appetite (McFarlan 1981) and (2) ensure *strategic alignment* by validating a right mix of initiatives is being approved (Sabherwal and Chan 2001).

Table 10: Decision Trees and Implications for Alignment

	Main Decision Making Theme or Decision Rule	Implications for Alignment	
		Strategic Alignment	Alignment with Risk Appetite
Defender	*If (Initiative Benefits = "Process Improvements") && (Internal Maturity = "Medium") → Approve Initiative*	A large proportion of initiatives are approved after ascertaining that they have the potential to offer business process efficiency improvements.	The risk averse Defender mitigates risks associated with initiatives by ascertaining that requirements associated with these proposals are well defined.
Prospector	*If (Initiative Benefits = "IOS systems benefits") → Reject Initiative* *If (Initiative Benefits = "Marketing systems benefits") → Approve Initiative*	IOS initiatives set up restrictive electronic links with suppliers and customers; limiting flexibility which is valued by the Prospector. Initiatives that enable them to tap into new markets are readily approved.	Prospectors have a high risk appetite. Their decision making tends to be tentative. Decision rules are very short depicting tentative decision making process. The Prospector decision model does not reflect many risk mitigation concerns.
Analyzer	*If (Initiative Size = "Medium") && (Internal Maturity = "Low") && (Initiative Structure = "High") → Approve Initiative*	Analyzers have a preference for all types of initiatives: Analyzer does not have strong preference for only certain kinds of initiatives.	Risk averse Analyzer mitigates risks associated with low maturity, proposals by ensuring objectives of these proposals are well defined.

The Prospector decision model reveals the presence of themes that are weaker when compared to the Defender corroborating the tentative nature of the decision process. The Analyzer decision model revealed even weaker decision themes corroborating that the planning process with

organizations pursuing this kind of strategic orientation lacks strong unifying decision themes. Key research findings from the decision trees are summarized in Table 10.

Evolutionary mechanisms I propose have substantial implications for improving the maturity of the portfolio management (Maizlish and Handler 2005) within organizations. IT portfolio management and the related prioritization of large numbers of proposals for initiatives is an important organizational activity requiring participation of diverse sets of executives. This decision problem can be managed efficiently by employing a repertoire of routines. Within organizations that continually learn, this set of routines is expected to evolve to a more effective set along evolutionary paths proposed in my research.

Interestingly enough, based on the analysis of evolutionary outcomes, in some instances I found that some appropriate routines were being dropped. This observation at first was puzzling; but a closer examination revealed further insights. These routines that were being dropped were appropriate routines employed for rejecting proposals. Dropping appropriate rejection routines was actually evidence to suggest that managers proposing initiatives were not repeating their mistakes. Managers were self-correcting their proposals. Based on the rejections that were being given out to proposals with certain traits; managers in the second year, were not developing proposals of similar traits. Managers were reducing the size of the decision problem by this self correction. Such improvements expedite planning. Such explicit evidence for a tacit pattern of learning has implications for improving the maturity of IT portfolio management.

A repertoire of routines provides a systematic mechanism for screening proposals. Applying routines consistently would improve the quality of the planning effort and help organizations systematically manage their risk exposure. A consistent set of routines would help organizations achieve a "managed" (Jeffery and Leliveld 2004) portfolio management process.

Frequent reviews of the routines applied would be necessary to continually improve the efficacy of planning. Incrementally improving the repertoire of routines by adopting the evolutionary mechanisms I propose, as a part of continuous improvement can help organizations bridge the gap between a "managed" and a more desirable "synchronized" portfolio management process. I propose a pattern-enabled approach to IT portfolio management.

4.3. IMPLICATIONS FOR RESEARCH

This dissertation contributes to research on IT portfolio management, in particular strategic alignment and risk management, along the following dimensions. I contribute to the literature on alignment and strategic management of IS in three ways. First, building on literature on business strategy typologies (Miles and Snow 1978) and the corresponding IS strategies (for e.g. Sabherwal and Chan 2001) I develop theoretical profiles for decision models based on the systematic differences in decision processes across these archetypes. My research defines the structural properties of a family of decision models; which serve as theoretical building blocks for studying alignment in decision making across different strategic orientations.

Second, my research design and methodological approach enables me to test my hypotheses by analyzing actual decisions on a portfolio of IT initiatives. My research site is unique in that it offers natural controls for me to test the impact of differences in strategic orientation on the corresponding decision models. My large data set of over 160 actual executive decisions includes information on proposals for IT initiatives that were approved and other proposals that were rejected. To the best of my knowledge, my research with its research site and dataset will be a first of its kind in the stream of literature on strategic IS management. Comparing decision rules that executives use to simultaneously reject and approve initiatives

help me present a systematic theoretical explanation of the key selection and rejection criteria employed by decision makers. The structural properties of decision models I present have substantial managerial implications.

Third, I simultaneously study alignment and risk-taking from the decision-making perspective and provide corroborating evidence based on the analysis of actual decisions in a multi-business organization. By using an inductive learning methodology, my research findings complement existing research on alignment which adopts a survey based-research approach.

Building on literature on strategic orientations (Miles and Snow 1978) I develop theoretical profiles for decision models based on the systematic differences in decision processes across these archetypes. My research uses structural properties to define families of decision models, which serve as theoretical building blocks for studying alignment and risk taking across different strategic orientations. Though prior research has studied various aspects of decision-making processes (for e.g. Sabherwal and King 1995, Bharadwaj and Tiwana 2005), to the best of my knowledge, there exist no studies that examine actual decision-making during strategic IS planning. Furthermore, I study decision making processes from an information-theoretic perspective (Quinlan 1990) thus complementing existing approaches.

My research which combines insights on strategic orientation (Miles and Snow 1978) and research on the analysis of actual decision-making processes (for e.g. Tessmer et al. 1993, Gentry et al. 2002) helps me address this gap. My research theorizes systematic differences in the structural properties of the decision models: in order to do so, the complexity of the decision model, the strength of decision making themes and the mix of decision attributes consumed in decision making together help me parsimoniously characterize decision models; giving me theoretically grounded decision templates across the three strategic archetypes. Thus, I believe

that my research helps develop empirical taxonomies for decision models contributing to existing empirical research on decision making (for e.g. Langley et al. 1995, Sabherwal and King 1995, Chan and Reich 2007).

My evolutionary findings have implications for research in at least three areas; (1) empirical research on routines, (2) organizational learning, and (3) dynamic capabilities. First, I analyze a large collection of organizational planning decisions within one large organization over a consecutive, two-year period by adopting a rigorous inductive methodology which helps me systematically discover tacit decision making routines. I contribute to the empirical research literature on routines. In spite of extensive theoretical developments on organizational routines, few empirical studies have employed the organizational routine as the unit of analysis. My methodological approach enables me to systematically examine properties of organizational routines. Evolution of routines can be explained based on the characteristics of routines themselves (Pentland and Feldman 2005). I submit that the appropriateness of a routine is a key attribute that plays a central role in guiding this evolution of routines.

Second, my research has implications for organizational learning (March and Levitt 1988). Orlikowski (1996) maintained that perspectives on change such as the planned change (Burns and Stalker 1961), technological imperative (Smith and Marx 1994) and punctuated equilibrium (Sabherwal et al. 2001) perspective often neglect the emergent nature of change. Change and organizational learning can be emergent (Mintzberg and Waters 1985). Such change is not planned and choreographed, but it often occurs as a result of incremental adjustments in organizational action. Emergent change is thus realized in slow, constant, cumulative organizational action. Since actions taken by organizational members either reproduce existing routines or alter them; I propose two evolutionary mechanisms of change: (1) evolutionary paths

that challenge the status quo and (2) evolutionary paths that adopt or adapt existing routines. I proposed attributes of routines that are likely to guide the choice of either of these two evolutionary mechanisms. Often, as is the case for prioritizing and planning for large IT portfolios, routines employed by actors are often tacit and the "script" is not often written down for organizational actors to enact. I submit that it is the logic of appropriateness that serves as an *internal compass* guiding organizational learning especially when actions are guided by knowledge that largely remains tacit. I maintain that emergent change (Mintzberg and Waters 1985) can be characterized by systematic evolutionary patterns. March (1981, p. 564) states that: "change takes place because most of the time most people in an organization do about what they are supposed to do; that is; they are intelligently attentive to their environments and their jobs." I contribute to research on organizational learning by proposing that logic of appropriateness — organizational actors doing what they are supposed to do — serves as a key internal driving force in achieving a more effective repertoire of routines.

Third, my study has implications for research on dynamic capabilities. Teece et al. (1997) define dynamic capabilities as "the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (p. 516). Rapidly changing environments seem necessary for the existence of dynamic capabilities. Alternatively, Zollo and Winter define a dynamic capability as "a learned, stable pattern of collective activity through which an organization systematically generates and modifies its operating routines in pursuit of improvement effectiveness" (2002, p. 340). By avoiding the tautology of defining capability as ability, they identify routines as the object on which dynamic capabilities operate. Dynamic capabilities are structured and persistent. An organization that adapts to crises in a creative but disjointed way is not exercising a dynamic capability. Dynamic capabilities are

exemplified by an organization that adapts its operating routines through a stable process dedicated to improvements and learning investments.

Learning investments can offer payoffs over time. Argyres et al. (2007) examine the evolution of contracting and find that contingency planning and task-descriptions act as complements. This complementarity results from learning spillovers between these two contractual provisions. These investments suggest that organizations learn to improve the appropriateness of their contracts as they do so in their other internal activities. I examine learning investments in planning; a key internal managerial activity. Dynamic capabilities have been invoked (Malhotra et al. 2005, Banker et al. 2006, Rai et al. 2006), yet few studies have examined dynamic capabilities by focusing on routines. I discover routines and track the outcomes of their evolution over a two- year period. My research suggests that rules based on the logic of appropriateness serve as self-enforcing mechanisms; when internalization is incomplete, rule following is enforced by other actors. I highlight the role of appropriateness (compliance internalized as a part of identity) in guiding improvements in the effectiveness of planning. Based on the two mechanisms of change proposed in my research — (1) challenging the status quo and (2) adapting and adopting the status quo — actors can improve the effectiveness of their decision making.

I adopt an inductive methodology which helps me discover stable, learned patterns of evolution. An outcome of this rigorous methodological approach is Figure 7; which represents a consistent, evolutionary process. Figure 7 is a meta-routine and gives us the much needed visual vocabulary for articulating dynamic capabilities. To the best of my knowledge, my study is the first of its kind and gives us an intuitive understanding of the *anatomy* of dynamic capabilities.

4.4. FUTURE WORK

This dissertation research can be enriched and extended along several dimensions. First, challenges associated with research on formal planning revolve around choosing a suitable dependent variable. The anticipated outcome ultimately associated with successful IT planning is improved organizational performance. Such outcomes are causally distant from the decision making rationale employed during the planning. *Quality of the plans,* as a dependent variable, developed has a more direct causal relationship (Byrd et al. 1995). Investigation on how plans actually affect an organization's performance would require a separate study of the implementation process itself. Such a study could be an extension to the analyses conducted for this dissertation. In such a study, the quality of the plan would be a key independent variable, with organizational performance as a dependent variable.

Second, data from additional large multi-business organizations could enrich the findings presented in this dissertation. These additional steps could improve the generalizability of the findings presented in this dissertation.

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APPENDIX A: DETERMINATION OF THE STRATEGIC ORIENTATION

The multi-business subsidiary, I choose for this study, is in the manufacturing sector. The three business units, from this subsidiary, considered in this study are developing fundamental technologies and serving industrial clients. This subsidiary has seven business units in total. Only three business units were chosen for this study as they could be successfully classified using the Defender-Prospector-Analyzer typology.

The strategic orientations of business units within this subsidiary were identified by using a two-stage process. (1) Analysis the annual reports of this organization and (2) further validation based on semi-structured interviews with key informants within the organization.

The two strategic orientations, Defenders and Prospectors, are most distinct and represent ends of the spectrum. They differ systematically across three dimensions: (1) the entrepreneurial, (2) engineering and (3) administrative dimension. Content themes for characterizing the differences along these dimensions across Defenders and Prospectors were developed based on prior research (Kabanoff and Brown 2008). The annual report of this organization was studied to investigate the presence of these content themes to guide my classification. For instance, the frequency with which these content themes appeared (when describing the strategic orientation of different business units) is an effective indicator of the systematic differences in strategic orientation across different business units (Kabanoff and Brown 2008).

Key informants in this organization (i.e. Vice President and CIO of this large multi-business subsidiary, and five senior business executives in the CIO office) validated this

classification for me. As a validation step, semi-structured interview questions were developed

based on related prior research (Sabherwal and Chan 2001). Interviews with these informants

revealed corroborating evidence for my classification for one business unit as a Defender *"...in*

spite of being a large business, over 80% of our revenues were generated primarily based on one

product, which we developed based on a stable, proven technology...[demonstrating high

defensiveness and limited emphasis on new product development]*".*

Corroborating evidence for the classification of another business unit as a Prospector was

obtained from the annual report and validated in my interviews. *"...we have been working*

feverishly to globalize this business..." *"...close to 50% of our orders now come from outside*

the U.S." *..."new customers in Country A, B, C are now buying our products..."* *..."We have*

new market of $4 billion in global opportunities..." *..."we have effectively doubled the market*

for this great business... [indicating high-risk taking tendencies and very high proactiveness]."

My classifications were validated relying on additional measures (size and R&D intensity)

presented in prior research (Sabherwal and Sabherwal 2007). As an additional validation step,

size of the Defender was ascertained to be larger than that of the Prospector; where as the R&D

intensity of the Prospector is expected to be higher than that of the Defender.

Based on the presence of mixed content themes in the annual reports, one business unit

within this subsidiary was classified as an Analyzer. Longitudinal data spanning a consecutive

two-year period were obtained from this business unit. This longitudinal data were analyzed for

the second study. Executives in this business place a heavy emphasis on analysis of factors

external/internal sources of uncertainties *(indicating high analysis)*. This business, in the past has

produced innovations that have fundamentally changed their industry and now are choosing to explore new opportunities with caution *(indicating high risk aversion)*. My informants had worked in this business and were familiar with the operations of this business. My evaluation of this business, as an Analyzer, was unanimously validated by all my informants.