

PATTERNS IN INFORMATION SYSTEMS PORTFOLIO PRIORITIZATION: EVIDENCE FROM DECISION TREE INDUCTION

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Appendix A

Theory Development: Decision Rationale Profile for Firms that Adopt Dual IS Conservative- and IS Innovator-Like Strategies

Some firms adopt dual (IS-conservative-like and IS innovator-like) strategies. The behavior of firms that adopt a dual IS strategy is associated with the following characteristics: they (1) adhere to dual goals with a simultaneous emphasis on efficiency improvements and cautious exploration of new opportunities, (2) adopt a relatively formal decision-making structure, and (3) are inherently risk averse. Dual goals are likely to exert a conflicting influence on the behavior of firms that adopt both IS conservative- and IS innovator-like strategies.

Balancing dual goals can be cognitively demanding and thus we maintain that the complexity of the decision rationale applied by such firms is likely to be high. Thus, the communicability of this decision rationale is likely to be low. The consistency with which decision rules are applied by such firms in the process of managing these dual conflicting goals is likely to be low as applying the same rule with a high consistency would imply that *one* of the dual goals is most likely not being sufficiently addressed. Acting appropriately, decision makers with a low-risk appetite are expected to approve high-risk initiatives only after ensuring that risk mitigation mechanisms have been designed to lower the likelihood of failures (Boynton and Zmud 1987; March and Shapira 1987; Straub and Welke 1998). In summary, the decision rationale applied by firms that adopt dual IS conservative- and IS innovator-like strategies is likely to be complex, applied with a low consistency, and likely to focus on the *assessment/mitigation of risks*.

Proposition 3: The decision rationale used by firms that adopt dual IS conservative-like and IS innovator-like strategies for IS portfolio prioritization is likely to be difficult to communicate, applied with low consistency and focused on risk assessment/mitigation.

Appendix B

Identifying the IS Strategy

Semi-structured interviews with key informants within different business units at the research site revealed several recurring themes which enabled us to determine their adopted IS strategies.

IS Conservative Classification: Interviews revealed that executives within one business unit at our research site place a high emphasis on adopting a *safe and stable approach* to running their business, as one executive noted, “[a] significant portion of our revenues were generated primarily based on a set of stable, proven, technologies.” The approach they adopt toward investment in IS tends to be very safe and stable. They largely invest in proven, safe IS and perceive IS as a vehicle to support their business operations in a stable manner. Informants also revealed that they are extremely *conservative* and *risk averse* when it comes to investments in IS. Given their conservative approach to investing in IS, this firm is not in any hurry to adopt new, emerging IS. They only invest in IS that is proven to be a stable, predictable technology in their industry. Informants also revealed an emphasis on *intensive planning* and a *top-down formal structure for decision making* within their firm. Their conservativeness enables them to ensure that all of their investment is geared toward stable and proven IS that systematically improves the efficiency of their business operations. Given the prevalence of such strong themes, this firm was classified as an IS conservative. This research choice was unanimously validated for us by the informants at our research site.

IS Innovator Classification: Interviews revealed that executives within another business unit at our research site place a high emphasis on the necessary experimentation for their continual growth and perceive IS as a vehicle for their experimentation/growth. Corroborating evidence for this emphasis on continual growth was also obtained from the annual report:

[We] have been working feverishly to globalize this business....[A] significant fraction of our orders now come from outside the U.S....[New] customers in Country A, B, C are now buying our products....We want to take advantage of a new market of \$4 billion in global opportunities....[We] have effectively doubled the market for this great business.

Informants revealed that they are focused on experimentation and *take risks* when it comes to investments in IS. Given their innovative approach to investing in IS, this firm is more likely to quickly respond to signals from their external dynamic environment to adopt new, emerging IS. Informants revealed their reliance on a less *formal, more bottom-up approach to decision making* within their firm. Given the prevalence of such strong themes emphasizing experimentation with IS for growth, this firm was classified as an IS innovator. This research choice was also unanimously validated for us by the informants at our research site.

Dual IS Strategy Classification: Finally, interviews with executives at *another* business unit at our research site revealed the presence of both the IS conservative- and IS innovator-like behavior, described above, in their philosophy in the use of IS. This firm was classified as having dual IS strategies. (Theoretical development for this IS strategy is discussed in Appendix A; data are presented in the fourth section of Appendix C; results are presented in Appendix D. Finally, we discuss the managerial implications of this IS strategy in the subsection, “Mediating Role of the Decision Rationale Profile,” of the main paper.)

Appendix C

Sample Selection Criteria, Characterizing Initiatives (Information Attributes)

Elimination of Initiatives

To account for various confounding factors, prior research has suggested focusing on only one kind of portfolio (e.g., Earl 1989; Sabherwal and Chan 2001). In accordance with this recommendation, we employed a rigorous selection process to retain only initiatives pertaining to business applications of IS.

Regulatory compliance related proposals (e.g., Sarbanes-Oxley Act) were eliminated.

A key decision maker at the research site commented on this elimination step as follows:

Managers who really need funds to finish off their older initiatives will sometimes pitch “new” initiatives and say that these are SOX initiatives ...expecting us to readily agree...but SOX initiatives are very different and different forces guide those choices....There always is this dark side to planning effort and I am glad you excluded SOX initiatives from your analysis.

Such discussions with key decision makers at the research site provided validation for our sampling criteria.

Next, proposals strictly pertaining to IT infrastructure, identified for us by the decision makers, were also eliminated. In this research study, we intend to examine the influence of the strategic orientation of an organization on the decision rationale it uses for IT governance. At our research site, the IT infrastructure portfolio was governed as an enterprise-wide, shared capability. The theoretical justification for governing IT infrastructure portfolio as an enterprise-wide centralized capability, at our research site, is discussed next.

As multibusiness organizations have to make a choice between granting autonomy to their separate businesses (or business units) and extracting synergies across their businesses (or business units), prior work has framed this choice as a tradeoff (Weill and Ross 2004). In the context of the portfolio of IT investments, we find that organizations can enjoy the benefits of both of these paradigms if they leverage these different mechanisms for *different kinds of IT portfolios*. At our research site, we found that the IT infrastructure portfolio was relatively standardized and there were significant synergies to be extracted across various businesses on the IT infrastructure portfolio. From the IT governance standpoint, given the high levels of standardization within the IT infrastructure, this IT infrastructure portfolio was managed as an enterprise-wide capability. With regard to these IT infrastructure components, a standardized approach was leveraged across the entire organization to derive synergies from this IT infrastructure portfolio.

IT infrastructure components are systematically different from business applications of IS in three ways. First, approvals for certain IT infrastructure initiatives do not require comprehensive search (decision) processes (Boonstra 2003). For instance, typically, the decision to use Microsoft Office as the office productivity software does not require elaborate search processes. Second, IT infrastructure components are often used in this organization, across the entire enterprise, almost in a “plug-and-play” manner with very little or no customization. Business applications of IS, on the other hand, required systematic customization depending on the various different business needs across individual businesses or business units within the organization. Third, IT infrastructure initiatives enjoy extensive scale advantages such that the licensing fees for these hardware/software components that are used in a plug-and-play/standardized manner across the entire enterprise *significantly decrease* with increasing scales/volumes. Typically, standardized vendor contracts kick in and large organizations can get better deals and services as they purchase multiple licenses in larger volumes. Centralization of such IT infrastructure capabilities has some strong advantages in the form of significant cost savings and an enterprise-wide shared capability approach also leverages technology expertise across the company while permitting large and cost-effective contracts with hardware/software vendors. Governing the IT infrastructure portfolio as an enterprise-wide, shared capability was especially considered better at this particular large organization as it operated in multiple countries and continents and the senior management believed that standardization of the IT infrastructure would significantly reduce coordination costs (Weill and Ross 2004). Given these theoretical reasons, we excluded IT infrastructure initiatives from our consideration set and, in accordance with prior research (e.g., Earl 1989; Sabherwal and Chan 2001), exclusively focused only on one portfolio pertaining to the set of proposals that systematically described business applications of IS.

Information Attributes

Characterizing Benefits

Our key informants indicated that although managers proposing new initiatives were required to richly characterize the benefits associated with their initiatives, *quantifying* these benefits with a number was not a requirement. In other words, IT governance decisions did not depend on a *numeric* measure of benefits. Arguably, a rigorous quantification of benefits associated with initiatives (with a return-on-investment measure) would be a desirable decision-making aid. But often, arriving at such a numeric measure is extremely difficult given the bounded rationality of the economic actors involved in planning (Simon 1955). Detailed discussions with the decision makers revealed numerous challenges associated with quantifying the benefits associated with proposed initiatives. Discussions with the CIO, senior management, and members of the top management teams revealed that *especially in the early planning stages*, ROI metrics were not *exclusively* used as decision-making criteria.

These insights revealed that decisions on proposed initiatives are often made on a tacit level by relying on *qualitative information* on the types of benefits proposals are designed to deliver. Based on our understanding of the pertinent literature (e.g., Broadbent et al. 1999; Sabherwal and Chan 2001), five kinds of benefits that initiatives could potentially offer were used to create five variables to comprehensively characterize

benefits associated with initiatives. The comprehensiveness of these five variables was validated for us by the key decision makers at the research site. Initiatives were designed such that they could offer multiple types of benefits and thus these five different kinds of benefits associated with proposals were *not* mutually exclusive.

Although all of the initiatives we examine in this study (annual planning cycle for investments spanning the 2006–2007 time period) were of high substantive significance to the organization, not all these initiatives offered *strategic* benefits. Some of these initiatives were designed specifically with *efficiency improvements* in mind. Based on several consultations with members of the CIO's office and the metrics within this organization, such initiatives were classified as initiatives that offered only efficiency improvements and not as initiatives that offered strategic benefits. Such proposals were crafted very differently, highlighting the strategic benefits offered by their initiatives, and it was thus very easy for us to identify such initiatives (in consultation with the members of the metrics groups at the research site) which offered strategic benefits and efficiency improvements. Discussions with the members of the CIO's office and the metrics group within this organization guided us to systematically classify benefits and helped us validate these nuanced distinctions/classifications. Given the dark side to the planning effort, senior executives feared that there would be a tendency for every manager to claim that all initiatives offered *strategic* benefits so as to warrant approval and funding. Senior management cautioned managers that all the initiatives claiming to offer strategic benefits could warrant additional scrutiny. Thus, we do not find evidence to suggest that managers were claiming benefits that were not genuinely built into the design of their initiatives.

1. **Efficiency improvements:** Certain initiatives were designed so as to develop IS that replaced, digitized, or automated manual tasks or business processes (Camillus and Lederer 1985; Philip 2007). These initiatives, focused on exploitation (e.g., March 1991), helped managers automate various business activities and thus operate with higher efficiency.
2. **Marketing benefits:** Certain initiatives were designed to develop IS that enabled businesses to create, promote, and better position new products/services. These initiatives helped managers to effectively market their products (Sabherwal and Chan 2001).
3. **Strategic benefits:** Certain initiatives were designed to develop IS which were deemed strategic. These initiatives helped managers to develop strategic capabilities to enable them to achieve some strategic advantages (Piccoli and Ives 2005).
4. **Efficient interorganizational business processes:** Certain initiatives were designed to develop IS that improved the efficiency of interorganizational business processes including critical supplier-, customer-facing processes (e.g., Kumar and van Dissel 1996).
5. **Cycle Time Reductions:** Certain initiatives were designed to develop IS that had the potential to offer business process improvements, specifically aimed at reducing the business cycle implementation times associated with certain business processes (Broadbent et al. 1999).

Characterizing Risks

Risk assessment is critical for IT governance (Iversen et al. 2004; McFarlan and Nolan 2005). Based on the recommendations from prior work (Lyytinen et al. 1998), we adopt McFarlan's (1981) approach for assessing the risk of proposed initiatives, resulting in these three measures.

6. **Initiative Size:** This attribute was measured based on the estimated investment required to implement the initiative. Risk associated with an initiative increases with its size (McFarlan 1981). This variable was assigned the following three values: low size (investment less than U.S. \$100,000), medium size (investment greater than U.S. \$100,000 but less than U.S. \$1,000,000), and high size (investment greater than U.S. \$1,000,000). These anchors for the size measure were validated for their suitability based on inputs from the senior management and the CIO at the research site.
7. **Initiative Structure:** Some initiatives by their very definition are well-defined and have high clarity and certainty in terms of their expected inputs and outputs. Thus, the corresponding organizational tasks required to implement such initiatives are relatively straightforward (Eisenhardt 1985). Initiatives whose inputs/outputs are vulnerable to change have low structure. Initiatives of high structure are less risky when compared to initiatives of low structure (McFarlan 1981). This variable was assigned two values: high structure (well-defined objectives for the initiative) and low structure (initiative with relatively fluid objectives). The vulnerability to change and the extent of clarity of the objectives, which separates low-structured, high-risk initiatives from high-structured, low-risk initiatives, was ascertained by the managers proposing initiatives and validated for us by the members of the senior management and the CIO at the research site.

This variable was assigned only two values. The decision makers indicated that, from an IT governance standpoint, such a measurement scheme was satisfactory as it helped them to identify and separate the high-structured, low-risk initiatives from the high-

risk, low-structured initiatives. Although in theory the degree of inherent structure in a project is a continuous variable, this use of a two-category variable demonstrates satisficing behavior from the boundedly rational decision makers involved in IT governance tasks.

8. **Prior Experience:** As the familiarity of an organization with a technology increases, the likelihood of encountering technical problems reduces. The higher the prior experience with technologies used in the execution of initiatives, the lower the risk associated with such initiatives (McFarlan 1981). 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 very familiar to the organization).

The design of this variable also provides evidence of the satisficing behavior of the decision makers. Values at the ends of the spectrum for this variable were very easy to identify. Managers had worked with certain mature technologies in the past and delivered successful projects. Some technologies were nascent and emerging, and managers had not yet adopted these technologies within the organization. Identifying initiatives with high/low prior experience with technologies was relatively straightforward, and thus identifying the technologies for which the prior experience was neither high nor low was *also* easy. From a decision-making standpoint for IT governance, the design of this three category variable was deemed satisfactory.

Characterizing Risk Mitigation Mechanisms

Diverse kinds of risk mitigation mechanisms are critical for successful implementation of business initiatives that depend on IS (e.g., Iversen et al. 2004; Nolan and McFarlan 2005; Piccoli and Ives 2005; Sherer and Alter 2004). Prior research points to at least three kinds (e.g., Baskerville 1993), including (1) *internal risk mitigation mechanisms* pertaining to software and technological capabilities (e.g., Baskerville 1993), (2) *process risk mitigation mechanisms* pertaining to the management of software development processes and methodologies (Ramasubbu et al. 2008; Sherer and Alter 2004), and (3) *external risk mitigation mechanisms* concerning the business process redesign implications of new initiatives (Broadbent et al. 1999). Variables on these categories of decision criteria,¹ used for managing risks associated with these initiatives are described next.

Internal Risk Mitigation Mechanisms

9. **Employ in-house software:** Software applications developed in-house potentially embed organizational knowledge (e.g., Earl 1993; Mitchell and Zmud 2006; Saarinen and Vepsalainen 1994) and thus their use in the execution of proposed initiatives can be viewed as a risk mitigating factor. Since in-house software applications embed organizational process knowledge, this familiarity with the technological solution to an organizational process problem makes it relatively easy to redeploy this solution in the context of a new initiative. 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.
10. **Internal Maturity:** Managers who have managed certain initiatives in the past (e.g., an e-commerce website to solve some business problem in the past) are likely to develop mature plans² for future initiatives. So although the development work for the subsequent initiatives is not done, it is easy to see how the proposals for these subsequent initiatives are likely to be considered mature and thus perceived to be less risky (Boonstra 2003). Risks associated with an initiative decrease as the maturity associated with the proposed initiative increases (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 lifecycle (SDLC) maturity phases. In other words, a proposal or plan of an idea that is more developed and further along the SDLC maturity phases

¹One decision criterion (a risk criterion) in most organizations during planning is that of resource availability. For our research site, given the large organization size and the availability of a sufficiently large pool of resources at their offshore implementation centers, we observed that the resource availability criterion was not a limiting factor.

²For instance, managers at a municipality introduced an Internet application facility for the payment of dog licenses. After the decision to approve the first initiative was taken, for subsequent initiatives that are arguably more mature as they were similar to the first initiative, decisions on the related initiatives followed relatively easily, which led to a wide range of Internet-enabled facilities (Boonstra 2003).

is likely to be less risky.³ 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 clearly defined), and high (several different future contingencies have been envisioned and controls have been systematically developed to manage those risks by crafting a complete, mature proposal). In other words, the proposals for some initiatives are more mature and less risky than others as managers proposing these initiatives can build on some similar initiatives they have implemented in the past, so the internal maturity of such proposals is relatively high. These plans, given their high maturity, are likely to be perceived as being less risky.

Process Risk Mitigation Mechanisms

Exploiting potential business opportunities that critically depend on IS involves several organizational tasks in addition to just deploying the software. Process capabilities are often deemed critical in delivering successful initiatives. The CIO and other members of the top management teams we interviewed validated that the likelihood of success is critically dependent not only on the maturity of the initiative proposals but also on the teams (collaborations between the internal and external partners) assembled to manage and implement the initiatives. Potential business opportunities that critically depend on IS often have a significant impact on the business processes of an organization. Such initiatives which critically depend on IS can either constrain or facilitate business process redesign (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.

11. **Business process redesign completed:** Before starting initiatives that critically depend on IS, envisioning process changes, and redesigning work flow activities, exerting effort and planning for such BPR tasks is critical to minimizing process risks (Broadbent et al. 1999). This variable was assigned a value of 1 when BPR planning tasks were completed and these controls were systematically presented in the proposal and a value of 0 when the BPR planning tasks were not described in the proposal.
12. **Resources for process redesign committed:** Identifying organizational resources and committing them for undertaking BPR planning tasks before starting initiatives can be a critical risk mitigation factor (Lambert 1986). For the successful delivery of these new business initiatives that critically depend on IS, the early involvement of the right resources that systematically understand the business process implications and ramifications of these initiatives is critical. 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.

External Risk Mitigation Mechanisms

13. **Employ consultant knowledge:** Specialized external consultants/partners can add value to large IT initiatives and integrating these external sources of knowledge with internal expertise can mitigate risks. Consultants can offer expertise in specific areas and, in particular, their exposure of several different organizational contexts on similar initiatives can be helpful in minimizing the likelihood of project failure (Ko et al. 2005). For each initiative, this variable was assigned a value of 1 when managers identified and proposed leveraging capabilities from external consultants and a value of 0 otherwise. The identification of external partners who have worked on similar initiatives in the past is a nontrivial task and managers are required to exert significant effort to systematically identify such external partners.⁴ In the context of this large organization, proposals from managers that identified such pertinent, external partners that have worked on similar initiatives in the past were considered less risky.
14. **Utilize specialized software applications:** Organizations can potentially manage successful delivery of large initiatives by procuring specialized software products. These partial solutions to specialized organizational problems can potentially expedite initiative progress and improve likelihood of success (McFarlan 1981). Given the large size of this organization, managers within all the business units could exert significant bargaining power to attract very competitive contracts from multiple software vendors. Given the high bargaining power of this large organization, risks of vendor opportunism were relatively easy to mitigate. This identification of vendors early on in the process of designing an initiative helped managers systematically manage risks and understand how these building blocks, in the form of specialized software applications, could be leveraged to expedite the development of their initiatives.

³It is critical to point out that we are referring to the maturity of the plan. It is not as if the work on the initiative has been done, but that experienced managers are often able to envision future contingencies (problems they might encounter during development/deployment of the initiative) and develop *ex ante* controls for those risks by crafting mature proposals.

⁴This mechanism relies on external partners who can introduce new risks by acting opportunistically. However, given that this organization is a large, Fortune 50 enterprise, they had a history of developing extensive contracts with well-designed safeguards to mitigate the risks of opportunistic behavior on external partners. At the same time, this organization has also been able to craft contracts that incentivize their external partners to excel at their tasks.

This variable was assigned a value of 1 if the initiative proposed the procurement of specialized software and a value of 0 otherwise.

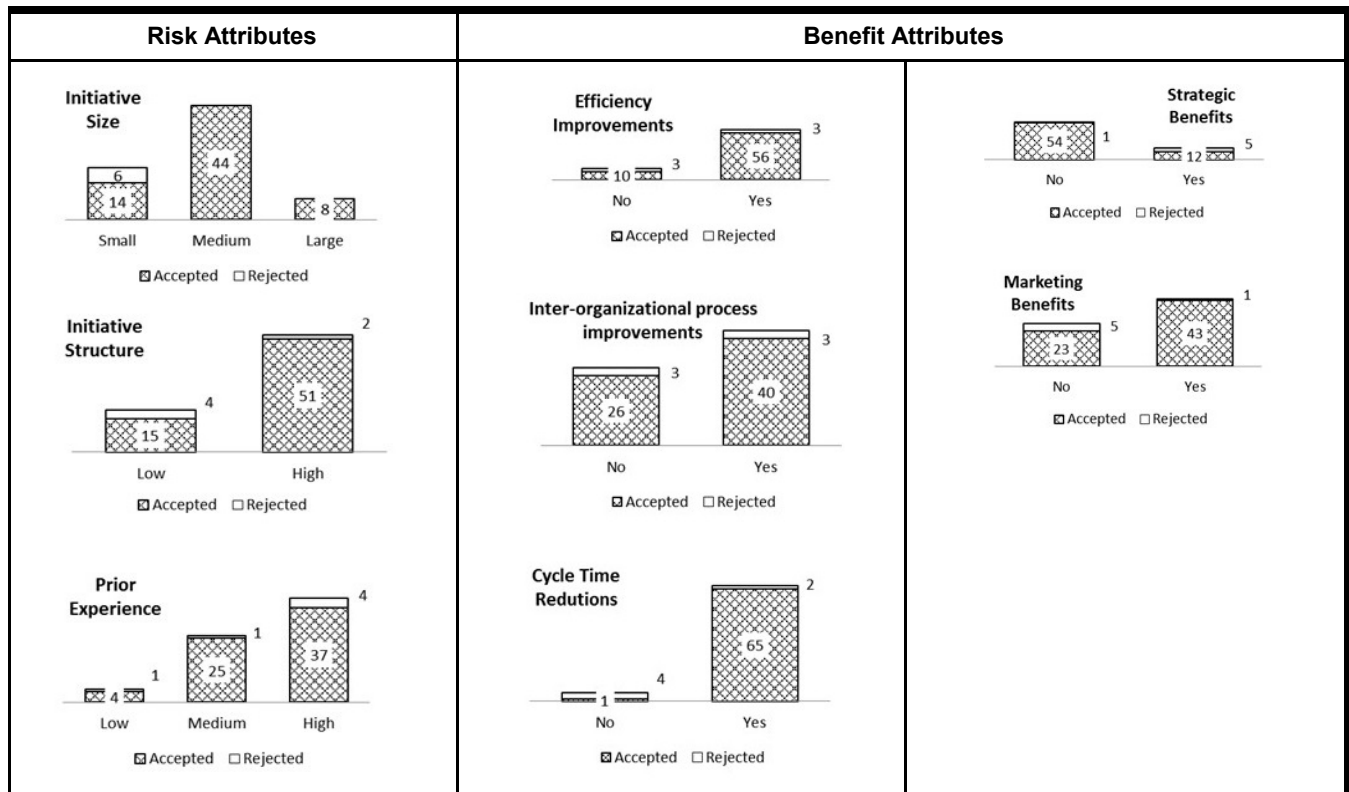
15. **Leverage third-party solutions:** Executives can also potentially manage successful delivery of large initiatives by leasing third party technologies (e.g., McFarlan 1981) solutions as building blocks. Third party applications model best practices and thus can expedite the delivery of proposed initiatives, simultaneously improving likelihood of success. This variable was assigned a value of 1 if the proposed initiative recommended leveraging third party software applications and a value of 0 otherwise.

This risk mitigation mechanism is conceptually similar to the purchase of specialized software solutions from external vendors. In the event of the purchase of licenses, these software components would need to be hosted within the organization and would necessitate additional maintenance effort over the duration of the initiative. The lease of third party applications would free the organization from the burden of hosting software applications as a part of the internal IT infrastructure. Barring these minor differences, both of these risk mitigation mechanisms demonstrated that managers proposing new initiatives had exerted significant effort to identify vendors, craft preliminary contract/service level agreements, and negotiate preliminary price quotes to systematically manage the risks associated with their initiatives. Both of these mechanisms depended on external vendors, but given the large size of this organization, the likelihood of opportunistic behavior on behalf of the vendors was deemed very low. In essence, both of these mechanisms were considered risk mitigating as they demonstrated that managers proposing new initiatives, while managing the threat of opportunistic behavior on the part of the external vendors, had exerted significant effort to leverage partial solutions as building blocks to assuage the risks associated with their initiatives.

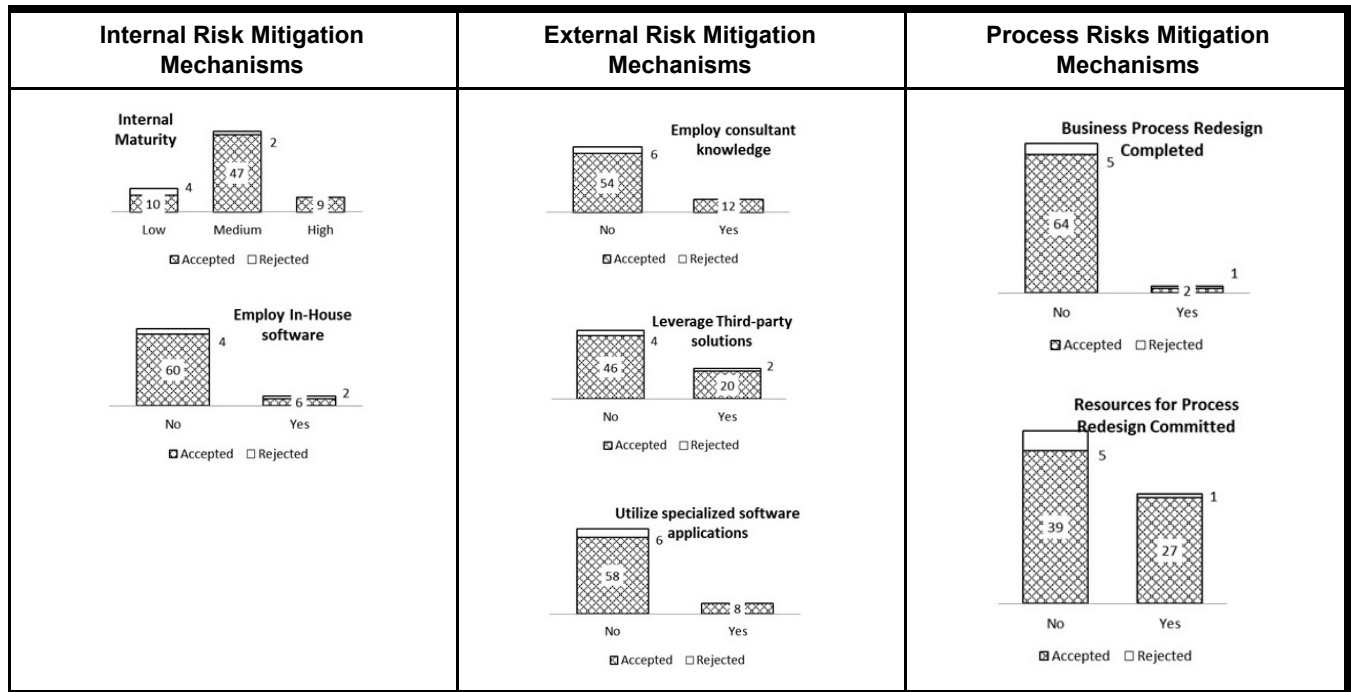
Measure definitions for these 15 attributes were consistently enforced across all proposal submissions before the commencement of planning. Portfolio data analyzed in our study was subjected to at least two rounds of validation before decision making started.

Summarized Views of Portfolio Data

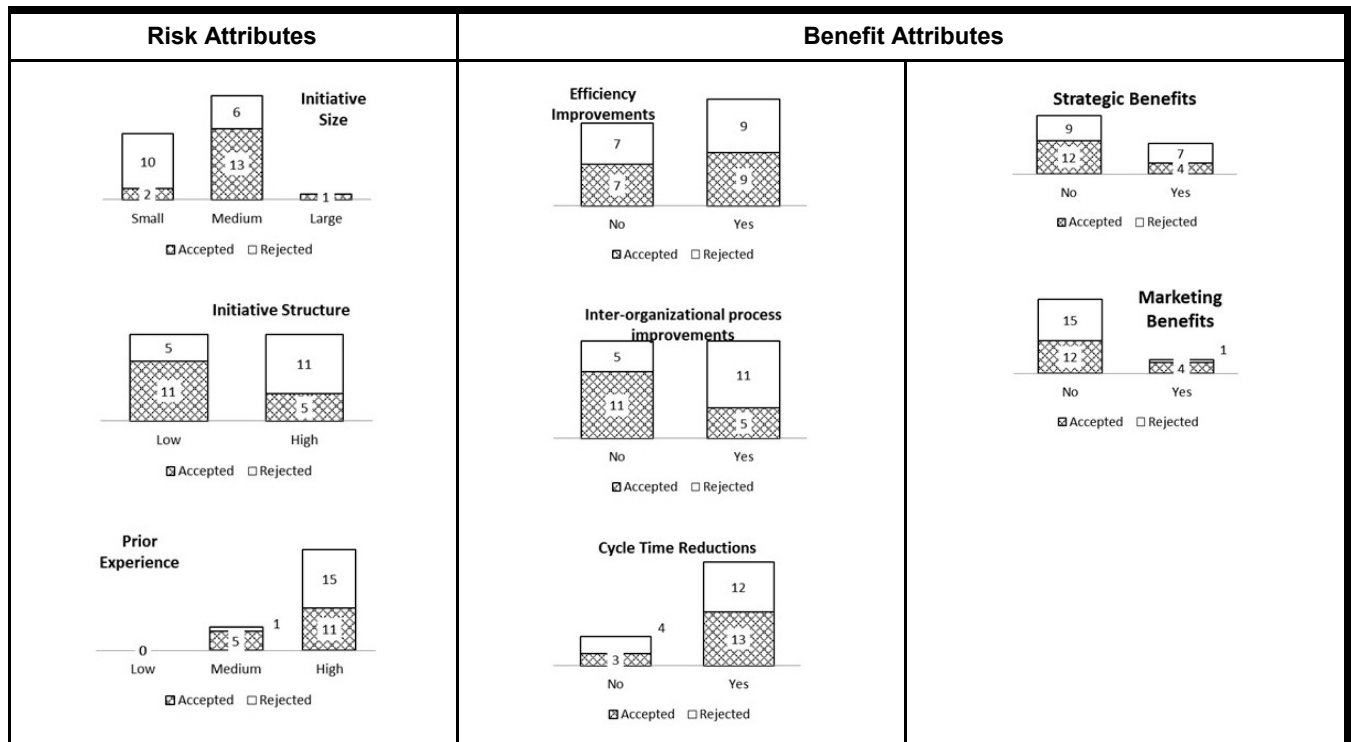
IS Conservative’s Portfolio (Total Number of Initiatives = 72)



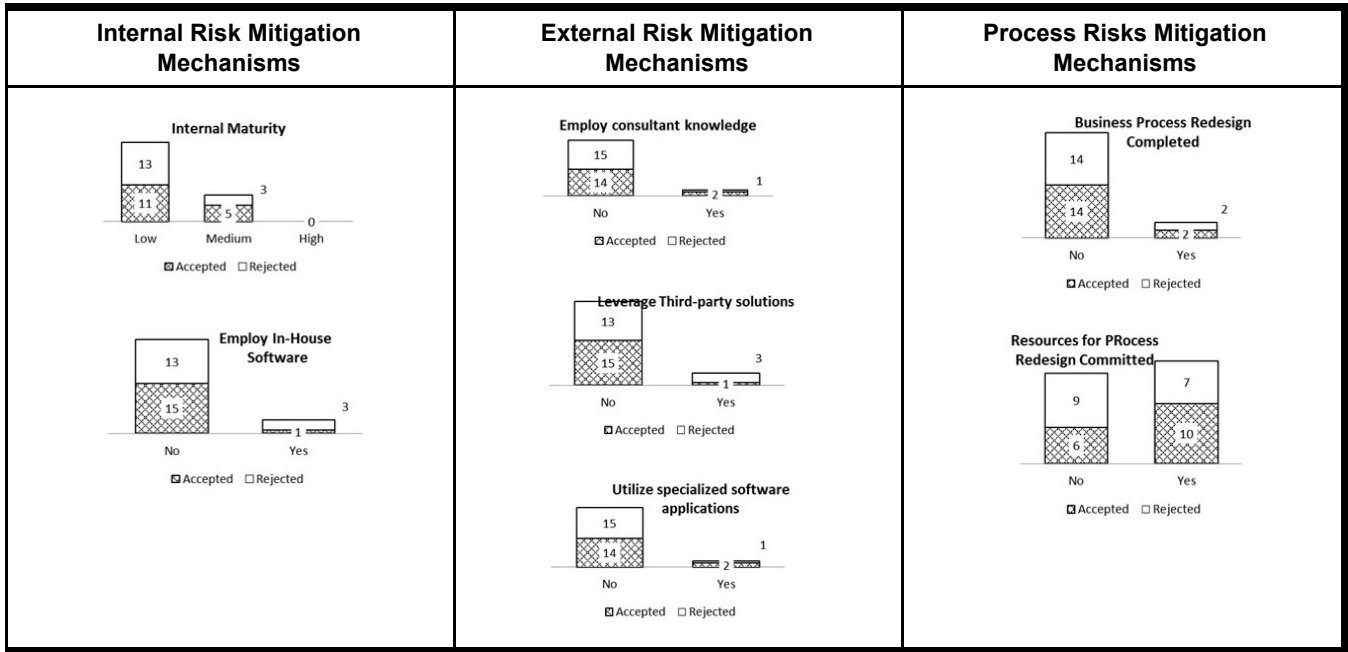
IS Conservative's Portfolio: Risk Mitigation Attributes (Total Number of Initiatives = 72)



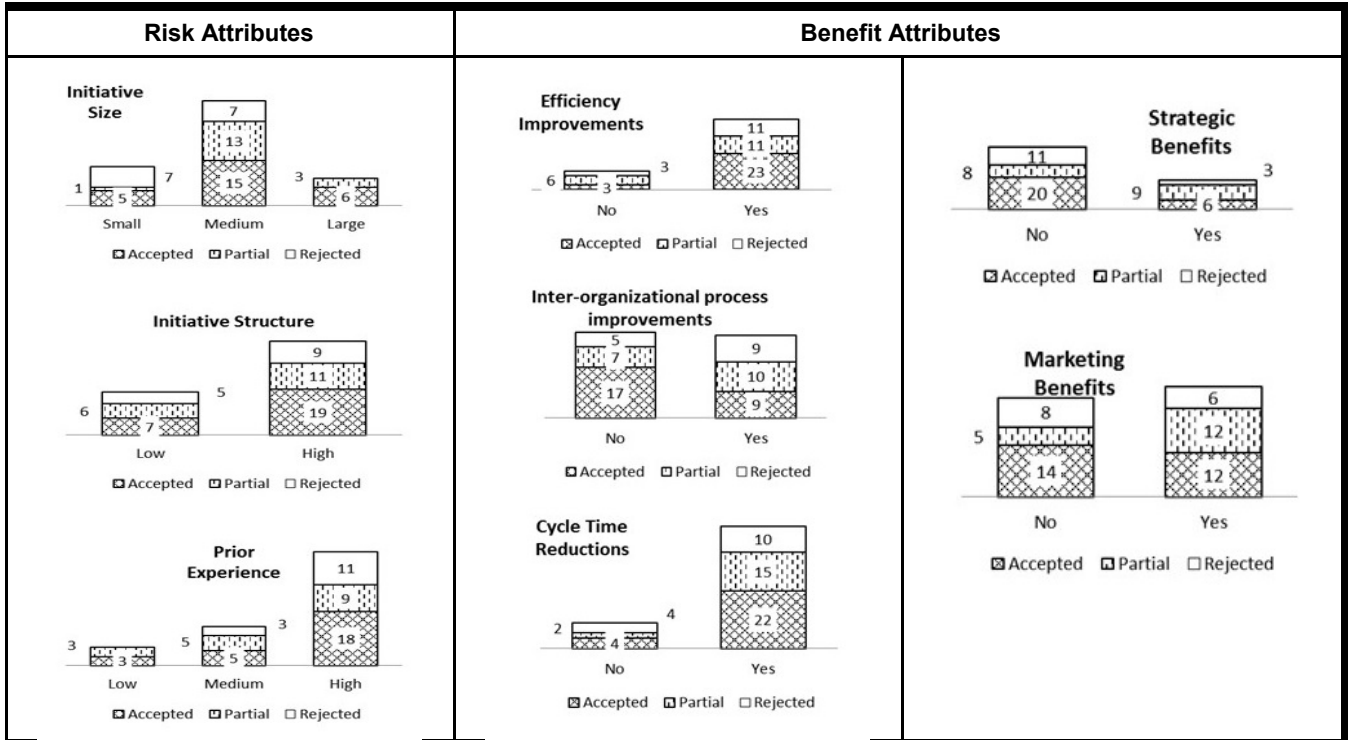
IS Innovator's Portfolio (Total Number of Initiatives = 32)



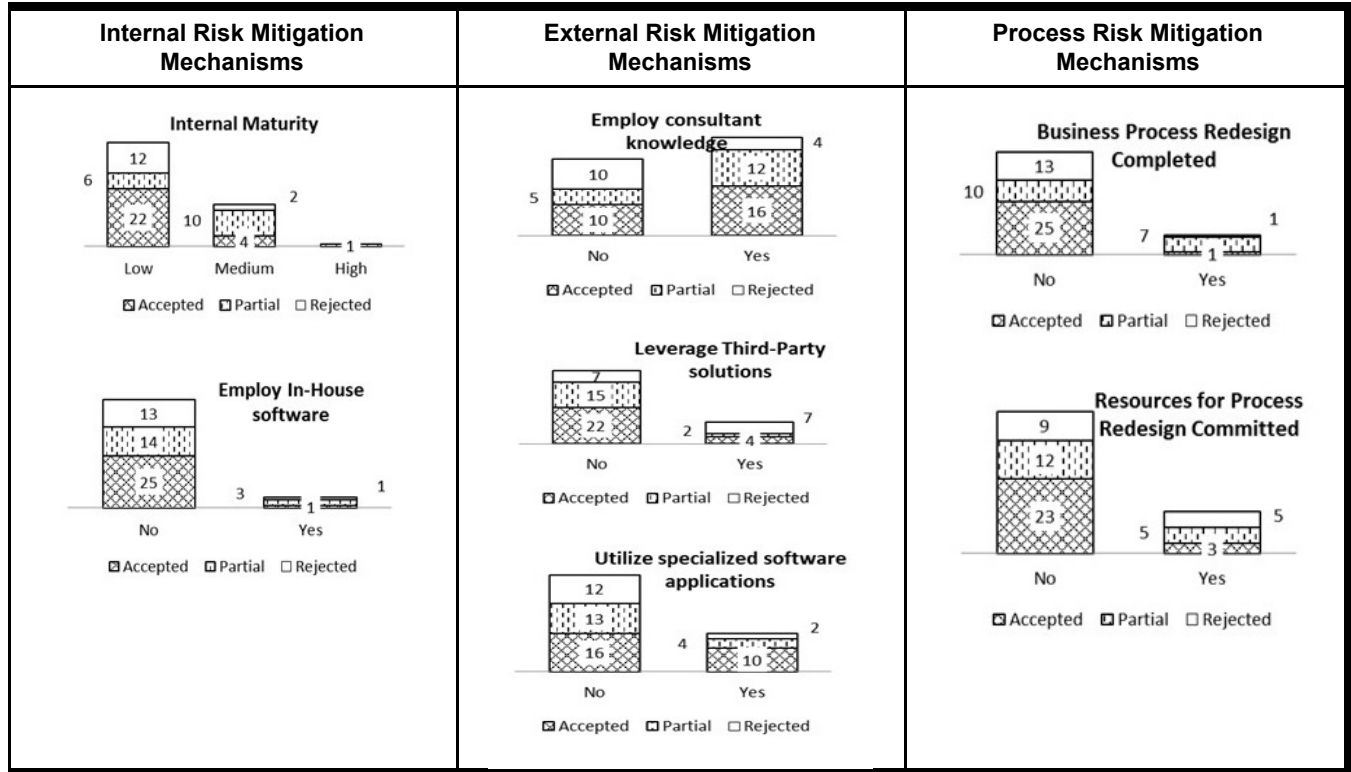
IS Innovator's Portfolio: Risk Mitigation Attributes (Total Number of Initiatives = 32)



Portfolio of a Business Unit with a Dual IS Conservative- and IS Innovator-Like Strategy (Total Number of Initiatives = 57)

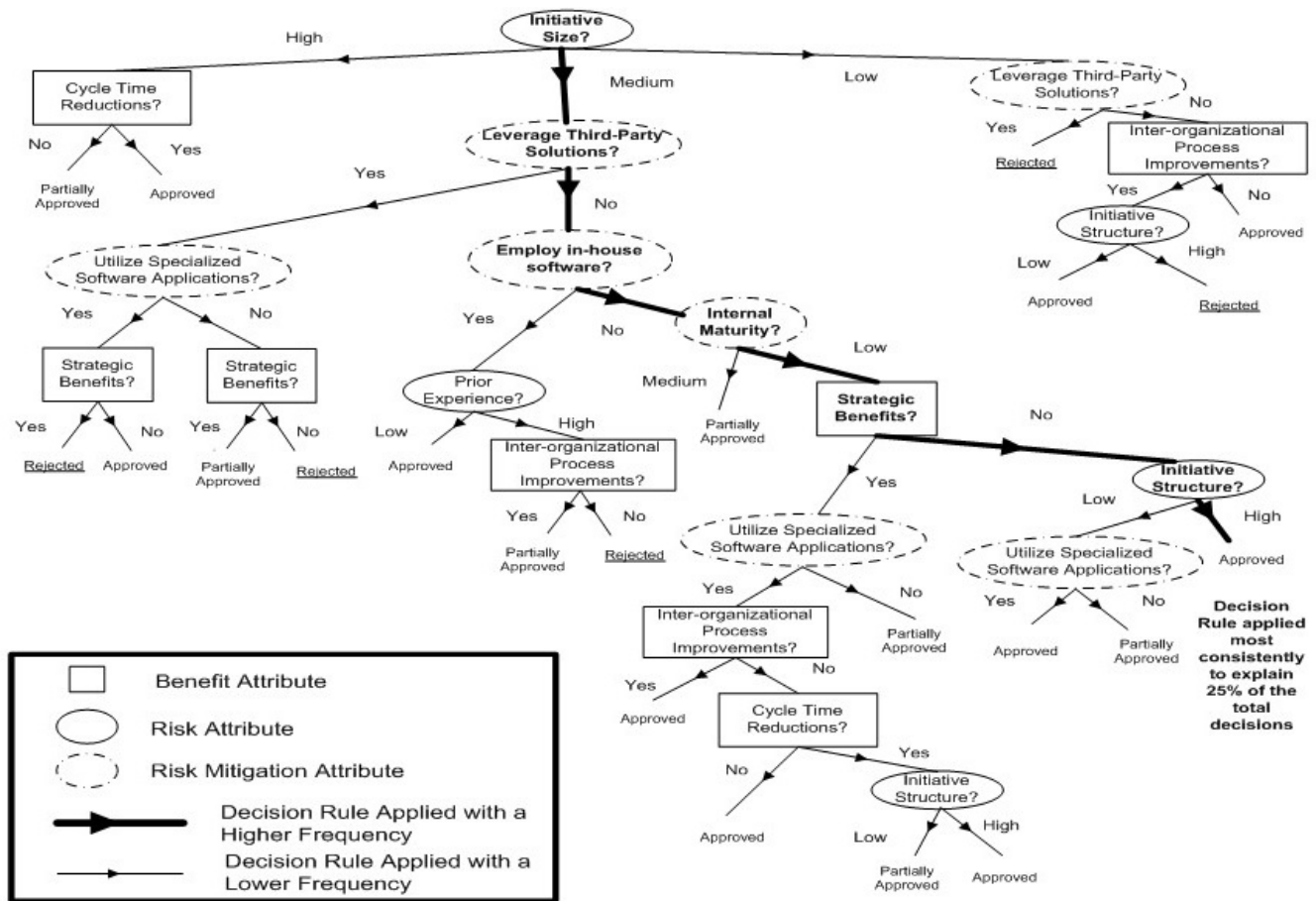


**Portfolio of a Business Unit with a Dual IS Conservative- and IS Innovator-Like Strategy
(Total Number of Initiatives = 57)**



Appendix D

Decision Tree for Business Unit that Adopted Dual IS Conservative- and IS Innovative-Like Strategies



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