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IT GOVERNANCE AND PORTFOLIO MANAGEMENT: AN EXPLORATION OF THE SUPERIOR IT PROJECT INVESTMENT PORTFOLIOS

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Abstract

In this study, we explore the characteristics with the IT project investments for improving the IT portfolio superiority. Our methodology is based on the computational modeling approach. The preliminary findings implicate that a firm could manage to improve on the selectivity, heterogeneity, and scalability in the IT project investments for portfolio selection.

Keywords: IT governance, IT portfolio, Computational modeling, Computational experiment

1 INTRODUCTION

The concerns of IT governance have led the trend of adopting the portfolio-based approach to harness IT spending in firm. Many organizations, including the US Office of Management and Budget (OMB)1, are implementing the IT portfolio management (ITPM) practices (e.g., the practices in COBIT) for taming the notorious IT spending. In prior literature, the portfolio-based approach is also taken as one critical component in IT governance (Weill & Ross 2004; Jeffery & Leliveld, 2004; Maizlish, 2005; Kumar et al. 2008).

IT investment can account for a very large share of IT spending in recent years (Berghout & Tan 2013). Traditionally, firms used to treat all the cost related to IT as spending (i.e., a cost center perspective). Nowadays, there are numerous businesses to be enabled by IT. From the Electronic Commerce (EC) to the Cloud Service (CS), IT has become no doubt one critical value driver, consistently enabling and creating businesses in firms. In this regard, IT can enable not only cost reduction, but also value capturing and creation. Recently, many firms have managed to govern their IT from an investment center perspective.

The investment in IT projects can be one major IT investment in firm (Kaplan 2004). Although its exact definition is maybe arguable, IT project investment can be easily identified almost everywhere in business. For example, a firm can invest in IT project for developing new systems, enhancing network securities, adopting the innovative technologies, etc. More importantly, such investments are all made for achieving firm business objectives. Conventionally, if an IT project is not proposed for fulfilling certain "must-do" requirements (e.g., law compliance) or maintaining operational routines (e.g., office automation), it is of the nature of capital investment (Bacon 1992)2. Considerable IT projects can be proposed and considered investments in a firm, especially in an enterprise. If we view the overall selected IT project investments as a portfolio, the IT portfolio could strongly influence the performance of IT investment in a firm. In recent literature, it is already shown that, on average, IT spending would be significantly and inarguably associated with the firm performance in a positive way (Mithas et al 2012). Nonetheless, the knowledge regarding the firm IT investment performance remains very lacked. Particularly, very few studies attempt to address such issues at the portfolio level. Among the very limited IT portfolio research, one main theme is the exploration of IT portfolio characteristics. For example, Weill and Ross (2009) analyse the ex-post IT asset portfolios in a hundreds firms and summarize their characteristics. While the extant research has yielded a great deal of understanding in the area, it has been not very clear that how the ex-ante IT project investments could influence the ex-post IT portfolio performance.

Accordingly, we have the following questions. Are some IT portfolios superior to others? Moreover, what characteristics within a set of IT project investments are favorable for composing superior IT portfolios? From our understandings, the similar questions were already faced by many enterprises. In our research site, for instance, enterprise top management periodically review the IT project investments for portfolio selection. These IT project investments are essentially the business initiatives that depend on IT projects to implement (IT-business cases) 3. They are mainly proposed by each autonomous business division, in order to achieve the objectives of improving process efficiency, customer satisfaction, and etc.4. Basically, all of these IT project investments have passed through the division-level screening processes and qualified for selection. The final review focuses on the enterprise-wide resource analysis, benefit analysis, risk analysis, etc. Once getting approval, the IT

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1 IT Dashboard (2012). PortfolioStat, retrieved from https://www.itdashboard.gov/portfolio_stat [Last accessed 12-13-2014].
2 In a way, the nature our defined IT project investment is close to the IT-dependent strategic initiative (Piccoli and Ives, 2005).
3 The business case is a recently very popular format in practice for evaluating the feasibility of IT investment. The details of the use of IT investment business case can be found in the study of Berghout and Tan (2013).
4 Our research site has another centralized MIS division in charge of the IT infrastructure, office support, and R&D for the entire enterprise.

project investment (the IT-business case) would be selected into the portfolio and ready for being "sequentialized". However, our research site has long been puzzled by how superior an IT portfolio could be and how to improve the superiority by managing the IT project investments.

Our preliminary findings suggest that the selectivity, heterogeneity, and scalability with a set of IT project investments in portfolio selection would all be associated with the superiority of IT portfolio. We conjecture that the three characteristics can have impact on firm's potentialities of selecting superior IT portfolios. We thus expect that this study will make several contributions to research and practice in the near future.

2 THEORETICAL BACKGROUND

2.1 The IT Portfolio Superiority and Modern Portfolio Theory

In this study, we see a superior IT portfolio as a superior combination of IT project investments. Hence, the portfolio alternatives can be the key to the IT portfolio superiority. In a firm, the portfolio selection from a set of IT project investments often would generate an overwhelming number of alternatives. For example, if assuming that each IT project could provide only two investment options (e.g., invest or not), we could have more than one billion combinations as alternatives (i.e., 2^30) from simply 30 IT project investments for portfolio selection. Many firms thus often consider selecting those top IT project investments into portfolio, resulting in the portfolio composition that might not best fit. For example, if most of the top IT project investments are very profitable as well as risky, the portfolio that is only composed of the top ones might not fit with a firm that has a conservative risk-taking strategy. In other words, the selected IT project investments underlie a superior portfolio must interdependently complement each other for fitting firm IT investment strategies.

Moreover, we reason that a superior IT portfolio can be an IT portfolio that involves better return/risk efficiency, according to the modern portfolio theory (MPT) (Markowitz 1959). In prior literature, many theories in finance are grounded on the return/risk criteria. In the IS literature, many studies also adopt the similar concept for evaluating IT investment performance (Dewan et. al. 2007; Dewan & Ren 2011). Seemingly, a firm is thus able to simply rely on the return/risk ratio to sort out the "best" portfolio. In the reality, nevertheless, the portfolio that can involve the least risk but the greatest return has been too rare to capture. Even if the condition could allow a firm to have the portfolio for selection, the time would be transient. In most cases, there is no such a "best" portfolio to select for a firm. Accordingly, the modern portfolio theory (Markowitz 1959) defines all the portfolios by either the efficient ones or the inefficient ones. An efficient portfolio is always superior to an inefficient portfolio, because of better return or risk. For example, if the return of one portfolio can be greater than the return of the other portfolio and the both involves the same level of risk, the portfolio is better than the other. In the same vein, if the return of one portfolio can be greater than the returns of other portfolios, and all of them involve the same level of risk, the portfolio could dominate others. The portfolio is called efficient and the others are inefficient. Moreover, the modern portfolio theory (Markowitz 1959) indicates that, if taking into consideration the overall levels of risk, we would have a series of efficient portfolios. Namely, at each level of risk, there would be a corresponding efficient portfolio. Visually, we can present these equally-efficient portfolios in the coordinate of return and risk (e.g., x: risk, y: return) – the Markowitz portfolio efficient frontier (Markowitz 1959).

We thus define that the superiority of IT portfolio can be taken as, within the level of risk that a firm plans to take, the best return of the combination of IT project investments. The modern portfolio theory (MPT) (Markowitz 1959) implicates that any prudent investor should be able to locate the most preferred portfolio by traversing along the Markowitz portfolio efficient frontier, until arrive at the point where the investor is unwilling to take more risk for improving return. In other words, the point could refer to the risk tolerance level, a conceptual return/risk equilibrium where the investor can hardly adjust the portfolio composition more profitably, without tolerating more risk. In prior literature, the similar concept of risk tolerance level is intertwined with the risk attitude and often comprised in the decision theories across fields (Markowitz 1959; Pratt 1964; Arrow, 1974; Kahneman & Tversky 1982; Howard 1988). Conventionally, if a firm sets up a higher risk tolerance level, we could reason that it would tend to consider trading more risk for return. With a lower risk tolerance level, a firm would tend to consider trading less risk for return. Overall, the return and risk that are yielded by the IT portfolio, and the planned risk-taking strategy for the IT portfolio (i.e., risk tolerance level) can be the three main factors in IT portfolio superiority for a firm.

3 METHODOLOGY

In this study, we basically apply the computational approach (Harrison et al. 2007) for addressing our research questions. In prior literature, the similar approaches have been applied in many studies that focus on the exploration and analysis (Sikora & Shaw 1988; Bapna et al. 2003 & Green et al. 2010). Moreover, we focus our model on what are essentials for meeting our research needs and keeping as fewer variables as possible. We are thus able to make the direct inferences from our analysis results.

3.1 Computational Models

In order to explore the characteristics of IT project investments and their impacts, we model the optimal IT portfolio choices that a firm could consider as alternatives in portfolio selection. Firstly, we model an IT portfolio as a combination of IT project investments.

$$P = \{ x_1, x_2, \ldots x_i \} \quad (1)$$

, where x_i is the selected IT project investment and *P* is an IT project investment portfolio.

Moreover, we reason that a firm concerns the return of IT portfolio. We model the return using NPV. NPV is a method of discounting all estimated cash flows for a project to estimate its benefit and widely used in firm capital budgeting. Our research site, for example, depends on the financial experts to factor in the decreased training time, the reduced working time, etc. to evaluate the NPV on the IT project investments. Other possible factors could include the reduced accidents, the improved frequency of sales/service calls, etc. (Ives & Learmonth 1984) (Bacon 1992).

$$V(P) = \max \sum_{i=1}^{n} v_i x_i \quad (2)$$

, where v_i is the NPV associated with IT project investment *i*, *V(P)* is the IT portfolio NPV; all other notations have the same meaning as the aforementioned equations.

We then reason that a firm concerns the risk of IT portfolio. We model the risk of IT portfolio by the overall impact of the unwanted outcome under uncertainty. In prior literature, the definition of risk varies across fields. In finance, for example, risk can be modeled as the volatility of the historical stock prices (Markowitz 1959). In engineering, risk could be modeled as a gap between the realized outcome and the objective outcome (Browning et al. 2002). Many firms also adopt the similar concept for defining the risk of their IT project investments. In our research site, for example, the managers evaluate the risk of IT project investment based on the possibly negative impact of their outcomes. In other words, the risk is analogous to a function of the magnitudes and odds of the negative consequences.

In this study, we use the scoring method to develop the risk metrics. The scoring method has been largely used for project risk evaluation in practice. The method has many merits including the simplicity and transparency for demonstrating the reality (i.e., a white box approach). It is particularly very effective when the failure impact is hard to be evaluated monetarily (Bacon 1992). By the method, the risk score is the sum of the weighted scores of the overall risk factors. Namely, the risk score of an IT project investment is the estimate of the failure impact and the possibility. Our research site, for example, assigns a score 90 of 100 to a very risky IT project investment. The main reason is that, although the outcome of the investment is very critical to the firm, the investment is dependent on the IT project that has to run on a sunset platform (e.g., visual small talk[5]). For other IT project investments, our research site could consider the risk factors, such as the size, the prior experience, and the units involved in coordination. Overall, these factors would be all due to the firm specific risks, competition risks, and technological risks, which all would influencing the outcome of IT project investment (McFarlan 1982; Jiang & Klein 1999; Wallace & Keil 2004, Gallaugher 2014).

Next, we model firm risk tolerance level as the overall risk score threshold. The PMI (Project Management Institute 2012) has defined the firm risk appetite as an internal tendency to take risk in a given situation. The risk appetite can reflect the organizational risk culture and the individual risk propensities of key stakeholders. By applying the similar concept, we view the risk tolerance level as a control threshold that a firm can consider to ensure the proper level of risk to be taken.

$$R(P) = \sum_{i=1}^{n} r_i x_i \le R_0 \tag{3}$$

,where r_i is the risk score associated with IT project investment *i*, *R(P)* is the IT portfolio risk score, R_0 is the IT portfolio risk tolerance level as a score threshold; all other notations have the same meaning as the aforementioned equations.

Lastly, we reason that a firm concerns the resource to be consumed by IT portfolio. We use the cost to model the resource. For example, our research site considers the labor costs, the management costs, the equipment (e.g., hardware and software) cost, the maintaining cost, the training cost, etc. for estimating the needed resource for implementing IT project investment. The similar cost factors could also be found in many IS studies (Kumar et al. 2008; Project Management Institute, 2012; Gallaugher 2014). We also assume that a firm could have a cost acceptance level as a cost threshold.

$$C(P) = \sum_{i=1}^{n} c_i x_i \le C_0 \tag{4}$$

,where c_i is the cost associated with IT project investment *i*, *C(P)* is the IT portfolio cost, C_0 is the IT portfolio cost acceptance level as a cost threshold; all other notations have the same meaning as the aforementioned equations.

[5] Visual small talk is a windows-based platform, but no more support will be available and no more products will be released from its vendor.

3.2 Pilot Experiment

After developing the models, we computationally simulate firm selection of IT portfolios. Our instruments are mainly based on personal computers, modeling software, and a set of real-world IT project investments. Our objectives are to analyze the result of testing the following conjectures.

Our first conjecture is that the variations in the firm investment unit for IT project could affect IT portfolio alternative scalability, resulting in the variations in IT portfolio superiority. In a firm, some IT project investments could be analogous to the investment in the financial movable assets (e.g., stock), whereas some of them could be alike the investment in the financial immovable asset (e.g., real-estate). For example, if the investment in one outsourced IT project is for acquiring cloud services, such as the Amazon EC2, the investment unit could be very flexible and thus the investment could be scalable. One feature of the cloud services is the elastic pricing, meaning the investment in the IT project could be adjusted in a very scalable manner. In this situation, the IT project investment unit could be compared to the share of the investment in financial stock. If the investment in one in-house IT project is for migrating enterprise systems, such as VB to J2EE, the investment unit could be very rigid and thus the investment could rarely be scalable. Such an IT project investment probably could offer very few investment alternatives (options) for a firm. In this situation, the IT project investment could be compared to the investment in financial real-estate. Thus we can infer that, for a set of scalable IT project investments and a set of non-scalable ones, it is reasonable that the scalable ones could generate more scalable IT portfolio alternatives. A firm could thus have greater opportunities to capture superior IT portfolios to select.

Our second conjecture is that the variations in the resource restraint could affect the IT portfolio alternative selectivity, resulting in the variations in IT portfolio superiority. The firm resource supply is consistently limited, whereas its impact on the IT portfolio selection could vary. For example, if the budget plan could allow a firm to take simply a minority of IT project investments into consideration, the resource restraint would be relatively stringent. On the contrary, if the budget plan could allow a firm to take a majority of IT project investments for consideration, the resource restraint would be relatively easing. If more IT project investments could be considered, the IT portfolio alternatives should be richer. This means the selectivity of IT portfolio alternatives could be greater, leading to greater opportunities to capture superior IT portfolios to select.

Our third conjecture is that the variations in the variety of IT project investments could affect the IT portfolio alternative heterogeneity, resulting in the variations in the superiority of IT portfolio. In a firm, it is possible to select a portfolio from a set of similar IT project investments, while it is likely to select one from a set of different IT project investments. For example, if the majority of IT project investments are associated with one IT asset class, such as the transactional, they could be associated with the similar values in their estimated attributes. On the other hand, they would differ a lot, if spreading among several classes, such as the transactional, the informational, and etc. In other words, the resultant IT portfolio alternatives would be relatively more diversified and thus heterogeneous. Moreover we can infer that, with the investment context full of contingencies, a firm has more heterogeneous IT portfolio alternatives would more likely capture superior IT portfolios to select.

Moreover, we test the conjectures by designing the scenarios. Overall, we construct eight scenarios for the experiments. In each scenario, we depict a set of IT project investments by the combinations of these characteristics including Hs-Hl-Hh, Hs-Hl-Lh, Hs-Ll-Hh, Hs-Ll-Lh, Ls-Hl-Hh, Ls-Hl-Lh, Ls-Ll-Hh, and Ls-Ll-Lh (high scalability: Hs, low scalability: Ls, high selectivity: Hl, low selectivity: Ll, high heterogeneity: Hh, low heterogeneity: Lh). For testing the first conjecture, we employ two kinds of the planned budgets, the tight one and the easing one, to reflect the selectivity variation degrees. We assume that, if the majority in the set of IT project investments could be considered for portfolio selection, the budget would be easing. In such a situation, we reason that the set of IT project investments would involve high selectivity (Hl). On the contrary, if the minority in the set of IT project investments could be considered for portfolio selection, the budget relatively would be tight and the selectivity would be low (Ll). For testing the second conjecture, we employ two kinds of value dispersions, the wide one and the narrow one, to reflect the heterogeneity variation degrees. We assume that, if a firm has the set of IT project investments with very different returns, risks, and costs, the set relatively could have wider value dispersion and thus more heterogeneous (Hh). Contrarily, if the set would be associated with very similar returns, risks, and costs, the set relatively could have narrower value dispersion and thus more homogenous. We use the variance to evaluate the dispersions (Lh). We thus would numerically populate the two sets of IT project investment with the NPV of narrow or wide value dispersions, if we feed the statistics into a computer to render them. For testing the third conjecture, we simulate the contexts where a firm would select a portfolio from sets of IT project investments with the scalability variations, because of the differences in the investment units. We employ two kinds of the decision units of the investment in IT project, the arbitrary one and the binary one, to reflect the scalability variation degrees. We assume that, if a firm has a set of IT project investments and could arbitrarily select any unit of it to invest, the set relatively would have high investment flexibility and thus very scalable. For example, a very scalable IT project investment could enable a firm to select shares of it to invest (Hs). Contrarily, if a firm has a set and could decide only Yes or No to invest in each IT project investment in the set, the set relatively would have low investment flexibility and thus very non-scalable (Ls).

To implement the scenarios, we collect a real-world data set from our research site (a fortune-500 enterprise in the United States). The data is a set of strategic IT business cases. These cases were proposed between in 2009 and 2010. They were submitted for the IT portfolio selection review in our research site. For example, there is a case called KMC in our collection. Simply put, the objective of KMC is to improve the capability of knowledge management for our research site. It is proposed in KMC that the current knowledge management systems in the call centers need to be enhanced. Accordingly, certain investment estimates associated with the KMC case are presented in the case for review. Thus, we utilize such estimates to conduct our experiments.

4 DISCUSSION AND CONCLUSION

Through the pilot experiment results, we summarize our preliminary findings and their implications as follows.

The selectivity with the IT project investments could be a key factor in firm selection of superior IT portfolios. If we conceptually regard the selectivity as a contextual characteristic of the IT project investment in portfolio selection, and further define it as degree to which a set of IT project investments could provide portfolio alternatives, our preliminary results indicate that the characteristic is very likely to influence the portfolio superiority. In prior literature, many related studies have the same implications (Keil 1995; Lacity et al., 1998; Lee et al., 2004; Levin & Milgrom 2004). Our inference is thus that the IT project investment selectivity would be significantly associated with the richness of IT portfolio alternatives, in turn influencing whether a firm could capture superior IT portfolios to select.

The heterogeneity with the set of IT project investments could be a key factor in firm selection of superior IT portfolios. Similar to the selectivity characteristic, the heterogeneity could be a contextual characteristic of the IT project investment in portfolio selection. If define it as degree to which a set of IT project investments could provide portfolio alternatives, our preliminary results indicate that the heterogeneity characteristic is very likely to influence the portfolio superiority. According to the classical economic theories, the concept of diminishing marginal utility implicates that a set of heterogonous components could have the greater opportunities of improving the overall utility of a portfolio, as compared with a set of homogenous components (Marshall 2004). Our inference is thus that the IT project investment heterogeneity would be significantly associated with the redundancies of IT portfolio alternatives, in turn influencing whether a firm could capture superior IT portfolios to select.

The scalability with the set of IT project investments could be a key factor in firm selection of superior IT portfolios. Similar to the mentioned characteristics, the scalability could be a contextual characteristic of the IT project investment in portfolio selection. Moreover, our preliminary results indicate that it is very likely to influence the portfolio superiority, if we define the scalability as the degree to which a set of IT project investments could provide the flexible portfolio alternatives. Specifically, these flexible portfolio alternatives could be contracted or expanded on their investment funds. According to the classical resource-based theory, the indivisibility can be one common characteristic of firm resources. This resource characteristic could preclude a firm from attaining the equilibrium, a status where a firm can hardly use its resource in a better way. (Penrose 1959; Teece 1989). This is many because the resource indivisibility would largely limit the resource allocation alternatives. However, firm investment in IT projects can hardly be all indivisible. Our inference is thus that the IT project investment scalability would be significantly associated with the investment options (choices) of IT portfolio alternatives, in turn influencing whether a firm could capture superior IT portfolios to select.

It is acknowledgeable that this study is yet to complete. First, the current findings only provide limited new thoughts about IT investment. Second, there should be more theoretical supports to justify the findings, and more discussion about the insights of the IT portfolio selection model. For example, the proposed IT portfolio heterogeneity characteristic might be confused with the portfolio diversity characteristic in finance. Overall, these issues should be carefully addressed for the future research.

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