

## RISK IN INFORMATION TECHNOLOGY PROJECT PORTFOLIO MANAGEMENT

**JOHN R. DRAKE, Louisiana Tech University**

Department of Management & Information Systems, PO Box 10318, Ruston, LA 71272, Phone: (318) 257-2809,  
Fax: (318) 257-4253, Email: [jdrake@latech.edu](mailto:jdrake@latech.edu)

**TERRY ANTHONY BYRD, Auburn University**

Department of Management, Lowder Business Building, Suite 401, Auburn, AL 36849, Phone: (334) 844-6543,  
Fax: (334) 844-5159, Email: [byrdter@auburn.edu](mailto:byrdter@auburn.edu)

### ABSTRACT

*This study synthesizes previous research on risks in various reference disciplines into integrated typology of risk factors and offers unique propositions for IT project portfolio management. The paper examines and synthesizes research in strategic information systems planning, IT governance, IT project management, financial portfolio management, and product development. The synthesis resulted in an emergent typology of five categories of risk of relevance to the IT project portfolio manager and 13 unique propositions establishing the relationship between specific risk factors and the overall portfolio risk levels. This typology offers a way to analyze portfolio risks through generic categories, simplifying the assessment portfolio risk in the portfolio management process. Both CIOs and portfolio managers could find this research beneficial in their assessment of portfolio risk, portfolio health, and the project selection and review process.*

### 1. INTRODUCTION

As the growth of information technology (IT) projects ballooned over the decades, the corresponding growth in the scope and breadth of these projects has frustrated executives in the management of their investments. Translating strategic goals into successful projects would help ensure that IT investments resulted in increased business performance. Research into business-IT alignment answered some of the questions about how to translate IT investments in business to business performance (Bergeron,

Raymond, and Rivard 2004; Bruce 1998; Burn and Szeto 2000). Now executives are implementing organizational structures that support strategic alignment, IT governance, and project selection and prioritization. This structure, IT project portfolio management, bridges the gap between project management and strategic management. Its function is to analyze strategic objectives and organization competencies in order to structure information systems for the corporation to communicate and store information effectively and efficiently. Traditionally, Strategic Information System Planning (SISP)

Marcus Rothenberger acted as the senior editor for this paper.

Drake, J. R. and T. A. Byrd, "Risk in Information Technology Project Portfolio Management," *Journal of Information Technology Theory and Application (JITTA)*, 8:3, 2006, 1-11.

performed this function, which at best involved a periodic review of project selection to ensure proper strategic alignment.

IT portfolio management consists of two functions. The first is the planning of new projects and migration to new systems. The planning phase may begin with SISP, which is “the process of identifying which computer based applications that will assist an organization in executing its business plans and realizing its business goals” (Lederer and Sethi 1988). Once identified, a portfolio of projects should be chartered to satisfy gaps in strategic objectives and information needs.

The second function of IT portfolio management is the re-assessment on-going projects and systems to determine if they are still meeting their objectives within the constraints provided, budgetary or otherwise. Project management needs a comprehensive examination from the portfolio level (Kearns 2004). As the size and complexity of IT departments increase, so does the size and complexity of the projects they undertake. It takes a portfolio level analysis to determine the progress and relevance of these projects.

Portfolio management, ideally designed, incorporates a continuous process of alignment. Elements of IS Governance are used to ensure that policy, control and reporting are consistent across the IT organization (Rau 2004).

To understand better how the management of a portfolio should proceed, an assessment of risk is required. Risk is the measure of probability and magnitude of an unwanted event happening. In risk management, identification of risks helps managers prevent and/or mitigate the effects of those risks. At the portfolio level, managers need to identify what unwanted events can affect the success of the projects in that portfolio. By preventing or mitigating the effects of risks, managers increase the health of the portfolio. Portfolio health is defined by the success of the projects in that portfolio in satisfying business needs.

While researchers have made major strides in identifying and quantifying project risk factors, few have done the same for portfolio risk. McFarlan (1981) addressed

## CONTRIBUTION

This study makes several contributions to IT research. First, this study identifies relevant reference disciplines in the study of IT project portfolio management and explains how and why they apply to risk assessment and risk management. While several research efforts have looked at single reference disciplines in this regard, this effort compares and contrasts several reference disciplines to form a more holistic and integrated view of risk management in a portfolio.

Second, we identify a typology of five categories of risk, based on prior research, in which to classify the risk types. Further, this study develops a list of important risk factors within these five categories that managers should consider when managing an IT portfolio.

From this research, we expect researchers interested in IT project management and portfolio management to test the propositions and validate the nature of these risks in the management of IT portfolios. With a better understanding of the risks that affect portfolio management, researchers can devise better tools for measuring the health of a portfolio. Furthermore, IT managers will find this list helpful in identifying shortcomings in their portfolios.

some risk factors with respect to identifying a risk profile of corporations. Shoval and Giladi (1996), while discussing the implementation order for IS projects, recognized several portfolio level risks. Likewise, Jiang and Klein (1999a) measured various IS project selection criteria that senior management felt were important when facing a new project portfolio. Some of these criteria explicitly recognized project risk, but merely hinted at the risks involved at the portfolio level. The purpose of this study is to explore academic literature for appropriate reference disciplines, compile a list of important risk factors that IT portfolios face, and categorize them according to an emergent typology. From this list, it is hoped that a framework can be developed for

identifying, measuring, and mitigating risks at the portfolio level.

## 2. REFERENCE DISCIPLINES

An IT project portfolio is similar to a financial portfolio in several ways. Several researchers (Benko and McFarlan 2003; Jeffery and Leliveld 2004) have noted that projects are investments the company makes in its future, just like stocks are an investment in the future. The financial concept of portfolio management is derived in part from the Modern Portfolio Theory, first proposed by Markowitz (1959), which among the key principles are:

- An optimal portfolio generates the highest possible return for a given level of risk.
- Expected risk has two sources: 1) investment risk – the risk of the stock itself (unsystematic) and 2) relationship risk – the risk derived from how a stock relates to the other stocks in a portfolio (systematic).

Defined broadly, the expected risk of an IT portfolio is similar to a financial portfolio in that there is risk in individual projects and risk in how projects relate to one another. Relationship risk (also called “Market risk”) refers to risk that affects the entire portfolio. These risks cannot be diversified away because the entire portfolio is affected by outside influences. Relationship risk is slightly more complicated in project portfolios than in financial portfolios because, besides having systematic risk, projects can, by design, directly influence the success or failure of other projects. This is particularly evident when projects are dependent on the completion of other projects before they can begin, such as upgrading the operating systems in order to support a new application. When this is the case, there is a relationship risk acting in a distinctly unsystematic way. Yet, this unsystematic risk does not apply to one single investment as it does in financial portfolios. We can conclude from this, that when defining the optimal project portfolio with risk/reward expectations, there are three broad areas of risk to consider:

1. The risk of the projects themselves

2. Risk from the relationships between projects

3. Risk to the whole of the portfolio

Of these three areas, the risk factors of projects have been thoroughly addressed in several research efforts (Barki, Rivard, and Talbot 1993; Jiang and Klein 1999b; Rainer, Snyder, and Carr 1991; Schmidt, Lyytinen, Keil, and Cule 2001; Wallace, Keil, and Rai 2004). Because project risk factors appear to be well established, the focus on our efforts will be on the last two areas, risk in the relationship between projects and risk to the whole portfolio.

Although the modern portfolio theory provides a starting point for evaluating portfolio risk, there are limitations to the application of financial portfolios to IT portfolios, just as there are with applying financial portfolios to product portfolios. Cardozo and Smith (1983) reported the first empirical study of the application of financial portfolios to product portfolios. Several researchers (Devinney, Steward, and Shocker 1985; Leong and Lim 1991; Lubatkin and Chatterjee 1994) have identified some weaknesses to this approach. These limitations include the assumption that “returns are at least weakly stationary” so that rapid product growth is not a factor, the assumption that products can be added or dropped with minimal transaction costs, the assumption that individual investment decision do not affect the overall returns and risks, and the assumption that correlations between products is not synergistic.

These same limitations apply when financial measures are used to predict IT portfolio success (Kearns 2004; Shoval and Giladi 1996). Indeed, product portfolios share many more similarities with IT portfolios than financial portfolios. Nambisan (2003) went as far as to propose that IS should be a reference discipline for new product development. She noted that the reverse is also true - new product development can be a reference discipline for IS. Cooper, Edgett, and Kleinschmidt (1998) define product portfolio management as:

*“...a dynamic decision process, whereby a business’s list of active new product*

*projects is constantly updated and revised. In this process, new projects are evaluated, selected, and prioritized; existing projects may be accelerated, killed, or deprioritized; and resources are allocated and reallocated to the active projects. The portfolio decision process is characterized by uncertain and changing information, dynamic opportunities, multiple decision-makers and locations.”*

If we merely switch the word “product” for “information system”, it is instantly recognizable to the IS field (Lederer and Sethi 1996; Shoval and Giladi 1996). The nature of portfolio management is very consistent between new product development and IT project development. Many of the risk factors that are true with product portfolios are also true of IT portfolios.

### 3. RISK FACTORS

As mentioned above, McFarlan (1981) provided a start of the of a list of risk factors that influence risk profiles of project portfolios. While reviewing this list, it became apparent that there were three types of risk mentioned (figure 1), risks from strategic alignment issues, risks of an organizational or management nature, and risks with the cultural and/or climate. Strategic alignment risks deal with the IS group’s relation to the rest of the company, specifically the alignment between IS and the business strategy. It evaluates such things as whether IS is critical to delivery of current corporate services, IS is important decision-support aid, IS is critical to delivery of future corporate services, and IS is critical to future decision-support aid. Organizational and management risk captures the qualities and traits of individuals in the IS development department, such as the stability of the group, the experience of the group, and the experience of the management team. Cultural and climate risks deals with perception related risks to the environment where development takes place, such as perceived quality of IS group, major fiascos in the past two years, and the company perceived as backward.

The three types of risks identified so far are all systematic risks, affecting the whole portfolio. However, as argued previously, there are risks in the relationships between

projects. These types of risk affect more than a single project, but may not affect the portfolio as a whole. They can include dependency issues, alternate project issues, and knowledge sharing issues. Relationship risk represents the fourth type of risk.

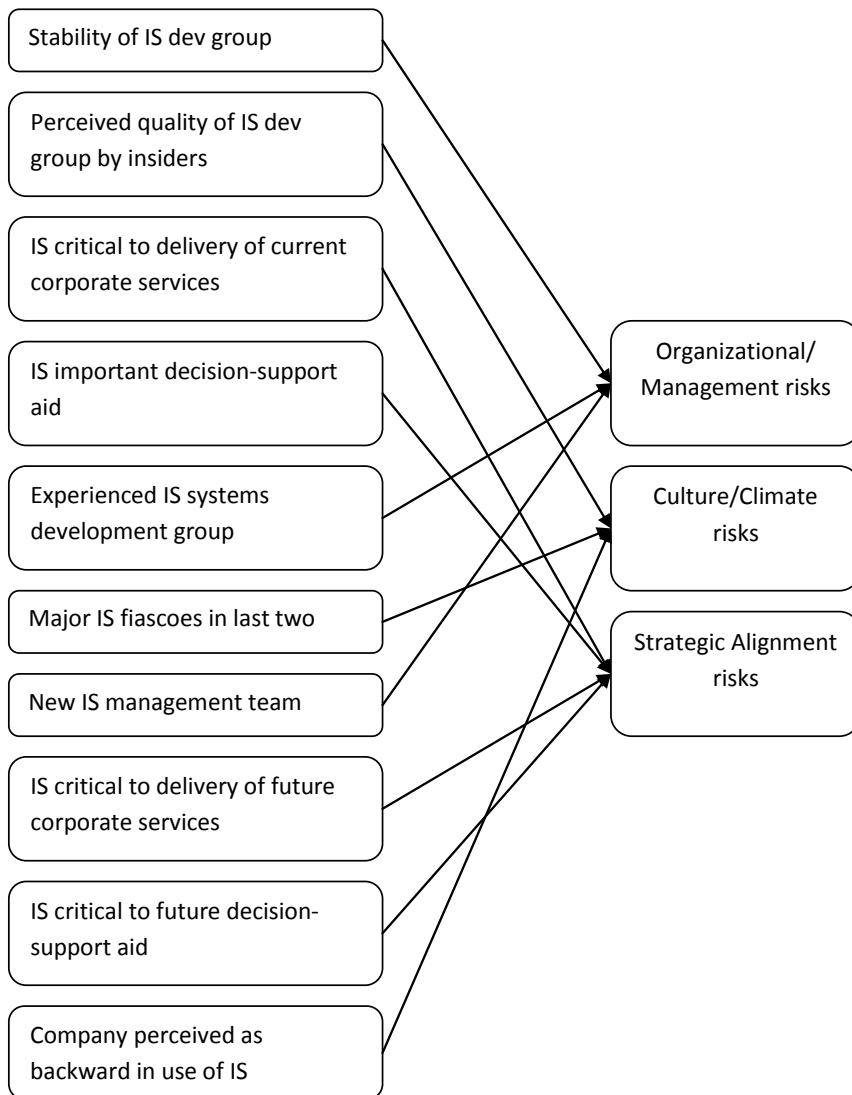
A fifth type of risk stretches across all three of the broad areas of risk: from individual projects, to relationships between projects, to the whole portfolio. These risks deal with the inherent shortcomings in the use of specific monetary measures for evaluating projects and portfolios. Most common financial measures of project importance ignore relationships between projects and the portfolio as a whole (Shoval and Giladi 1996). These five types of risk are explored in detail below.

#### 3.1. Strategic Alignment Risks

Applying strategic objectives in IT portfolio management requires a systematic procedure to ensure relevance and accuracy. SISP has a long history in academic research as such a mechanism. Its relationship to business strategy is well understood (Henderson and Sifonis 1988). Within the context of portfolio management, SISP is the process for selecting and prioritizing projects that further strategic goals.

In project portfolios for product diversification, Ansoff (1965), over 40 years ago, identified the risk of projects being out of alignment with strategic objectives. Cooper and colleagues (1998) reiterated this risk in the portfolio management of new products. Without alignment, the portfolio as a whole is at risk of pursuing projects that the organization is ill equipped to handle. IT portfolios carry this risk as well. It requires portfolio-level scrutiny to identify which capabilities and technologies are truly critical for strategic success (Jeffery and Leliveld 2004; McFarlan 1981). Jeffery and Leliveld found that the benefit most valued by CIOs practicing IT portfolio management was improved business-strategy alignment. This alignment is valued because it decreases the risk in the portfolio as a whole.

**Proposition 1.** IT Portfolio risk will increase when alignment between business-strategy and IT projects decrease.



**Figure 1. McFarlan’s list of portfolio risks**

Strategic objectives often are designed to develop a competitive advantage in certain core competencies. IS can play two roles with core competencies, they can facilitate other core competencies within the firm (Lindgren, Henfridsson, and Schultze 2004; Post 1997), or they can become a core competency in their own right (Muller 1995; Powell 2001). The risk to portfolio management is that these core competencies are ignored during the planning phase. Worse yet, projects selected could potentially hinder a competency.

**Proposition 2.** IT Portfolio risk will increase when core competencies are ignored in a project selection and prioritization.

**3.2. Organization and Management Risks**

In the context of product portfolios, Cooper and colleagues (1998) said that portfolio management, besides selecting projects based on strategic objectives, is about resource allocation in the firm. This again holds true for IT portfolios. Allocating the proper staff resources is dependent on the

competencies the firm has already acquired (Jiang and Klein 1999a; McFarlan 1981; Shoval and Giladi 1996). Obviously, when there is a large gap between portfolio needs and staff competency, the organization begins to look outside itself to find these resources, whether in new hires or through outsourcing. The risks inherent in the search and acquisition of new staffing resources manifest themselves in the portfolio's overall risk (Aron, Clemons, and Reddi 2005).

**Proposition 3.** IT Portfolio risk will increase if the appropriate staffing resources are not available within the organization.

Lack of stability of your IT staff produces a new risk associated with the loss of knowledge from old staff to new (McFarlan 1981). There are many reasons why IT staff intends to switch employment (Hsu, Jiang, Klein, and Tang 2003). Regardless of their reasons, the loss of a few key personal can greatly hamper several projects if they happen to be working in critical areas on those projects.

**Proposition 4.** IT Portfolio risk will increase when there is high IT staff turnover.

Another potential concern is IT management turnover. Top management support has been recognized as essential to project success (Jiang and Klein 1999a). In fact, maintaining key people is the most widely cited reason for success in project planning (Lederer and Sethi 1996). To our knowledge, the direct effects of management turnover on a portfolio have not been measured, but Longenecker and Scazzero (2003) found that the biggest impact of IT manager turnover is difficulty in achieving performance goals. By extension, we can assume this would also apply to portfolio success.

**Proposition 5.** IT Portfolio risk will increase when there is high IT management turnover.

Sweda (2005) observed that an ineffective project selection and review process leads to portfolio problems. He had seen multiple instances where a lack of a formal process and a lack of a Project

Management Office (PMO) led to large projects floundering and poor quality projects being pursued. This lack of project visibility allowed other projects to fall between the cracks. CIOs had no way of knowing what projects their organizations were pursuing or how those projects were doing. Cooper and colleagues (1998) also recognized the negative impacts from ineffective process to product portfolios. A bureaucratic management style and political tensions are two mechanisms that directly affect the project selection and review process (Jiang and Klein 1999a; Kearns 2004). One solution, IT governance, makes use of cultural strengths and nurtures cultural weaknesses (Hefner 2003). With the help of an IT governance council, project selection and review becomes better organized while simultaneously providing a platform for various interested parties to participate in the process.

**Proposition 6.** IT Portfolio risk will decrease by implementing an IT governance council.

### 3.3. Culture and Climate Risks

The business culture can affect the risk of a portfolio in multiple ways. In cultures that accept change, projects that initiate new technologies are nurtured and supported. Hoffman and Klepper (2000) proposed that the cultural dimensions of sociability and solidarity affect the acceptance of new IT systems. McFarlan (1981) noticed that perceived IS criticality directly affects the amount of IT portfolio risk an organization was willing to endure. He further noticed that when a major IT fiasco occurs in an organization, the culture shifts to become highly suspicious of the IT staff and its ability to complete a project. It creates an environment difficult to work in and where risk is shunned.

**Proposition 7.** IT Portfolio risk will increase in an organizational culture adverse to change.

Communication and hence the sharing of knowledge between IT and business people is of utmost importance (Jeffery and Leliveld 2004). Without this communication, there is a risk that the needs of the business people will not be met or that unrealistic expectations may

be set for projects. Scopes expand out of control and systems are delivered that do not satisfy business needs. This is often a cultural issue. When the culture encourages communication between business and IT staff, many of these issues resolve themselves. When there is a lack of communication, portfolio managers and project managers cannot make decisions effectively.

**Proposition 8.** IT Portfolio risk will increase when communication is hindered between IT and business staff.

### 3.4. Project Relationship Risks

Some projects are only undertaken for the prospect of future dependent projects. The value of these dependent projects confuses a measurement the initial project's worth. If not done appropriately, managers risk missing high value and/or critical dependent projects during the project selection and prioritization phase (Dillon and Pate-Cornell 2001). Some of the financial measures are designed to minimize this risk, but still may miss dependent projects of strategic nature. When dependent projects are ignored, the portfolio as a whole suffers. Complex correlations and dependencies must be managed within the portfolio (Blau, Pekny, Varma, and Bunch 2004). The allocation of scarce resources should be determined by these correlations and dependencies.

**Proposition 9.** IT Portfolio risk will increase when there are complex dependencies between projects.

Not only do dependencies need to be carefully managed to avoid risk, project alternatives also pose a risk if those alternatives are incompatible with each other (Fernandes and Valdiviezo 1997). Looking at projects from just their own perspective will miss this potential issue. It requires a portfolio level view to see all the alternatives for all the projects and to assess if those alternatives will be compatible with each other.

**Proposition 10.** IT Portfolio risk will increase when there are complex project alternatives.

In project management, knowledge that is ineffectively managed during a project lifecycle is lost or devalued (Owen, Burstein,

and Mitchell 2004). Since projects tend to share many similar characteristics, methodically capturing and reusing knowledge gained on one project helps produce success in future projects. Reusing knowledge in a portfolio of projects delivers not just one but a succession of successful project. Successful projects, especially those without much executive support, have the most to gain from external knowledge generation (Fedor, Ghosh, Caldwell, Maurer, and Singhal 2003). It is this ability to share knowledge, often facilitated by a knowledge management system, that increases the chances of success by sharing ways to mitigate risks.

**Proposition 11.** IT Portfolio risk will decrease as knowledge sharing increases.

Technology reuse, whether code reuse or infrastructure reuse, presents an additional mechanism of reducing risk of a portfolio. While the debate on the reuse effectiveness and strategies continues (Nazareth and Rothenberger 2004; Ravichandran and Rothenberger 2003), code reuse has been identified as producing higher quality applications (Frakes and Succi 2001). As reuse becomes more pervasive, IT portfolios will be able to share high quality work among its own projects and hence reduce risk to the overall portfolio.

**Proposition 12.** IT Portfolio risk will decrease as technology reuse increases.

### 3.5. Financial Risks

Use of the financial portfolio theory can only be applied to a limited extent in analyzing IT portfolios. Until recently, determining the value of a portfolio was largely dependent on the value of each individual project. This was calculated by such measures as return on investment, return on net assets, benefit/cost ratio, rate of return, growth rate, payback period, and net present value (Jiang and Klein 1999a; Shoal and Giladi 1996; Vanhoucke, Demeulemeester, and Herroelen 2001). These measures fail to account for the complexity of dependent projects, synergies developed between projects, and intangibles that some projects bring to the organization.

Real options analysis has been proposed and tested as a one financial measure

that overcomes some of these limitations (Bardham, Bagchi, and Sougstad 2004; Huchzermeier and Loch 2001; Kumar 2002). Real options analysis is a means of hedging risks during project prioritization based on the concept of budgetary slack that can be moved around to different projects as needed in the future. Real options analysis provides additional flexibility to recognize that a project with current negative NPV or ROI can have positive financial expectations when future value-added services are considered. Some financial measures, like real options techniques, are able to account for the complex dependency of projects, and, therefore, assess the value of including a project holistically rather than in isolation.

**Proposition 13.** IT Portfolio risk will increase when financial measures of projects fail to capture the interrelationships between projects.

#### 4. PORTFOLIO HEALTH

Understanding potential IT project portfolio risks (figure 2) allows us to promote a healthy portfolio. Risks deal with the potential for some threat to affect the success of a project or portfolio in the future, whereas portfolio health represents the current level of success a portfolio is having in solving business information needs. The relationship between these two concepts is that risks that are unsuccessfully mitigated will negatively affect the health of a portfolio. Risk management is not distinct from project and portfolio management, but an extension of it

(Heemstra and Kusters 1996). Weill and Vitale (1999) suggest that to determine portfolio health, we should look retrospectively back at the risk. This may be appropriate if no risk management system is in place, but after the initial diagnosis, the portfolio risks need to be managed in an ongoing process. This will ensure that new risks that appear due to changing conditions do not adversely affect the portfolio health.

In order to measure the amount of risk, various measures have been proposed. Traditional financial measures such as ROI, Cost-Benefit graphical (CBG) method, and NPV focus exclusively on the financial aspects but ignore the intangibles, like strategic objectives and cultural biases. To overcome this limitation, several multi-criteria decision making methods have found some use in measuring risk. These methods include analytic hierarchical process (AHP) (Kearns 2004; Muralidhar, Santhanam, and Wilson 1990), risk management matrix (Datta and Mukherjee 2001), balanced scorecard (VanDerZee and DeJong 1999), and an advanced programmatic risk analysis method (APRAM) (Dillon and Pate-Cornell 2001).

These methods are still in their infancy in their application to IT portfolios and need to be studied in more depth. Once the risk factors and their relations to one another in portfolio management are better understood, the best method for measuring risk and applying it to project selection and prioritization will hopefully emerge.

Project Portfolio Risks				
<b>Strategic Alignment risks</b> * Projects not tied to strategic objectives or goals * Core competencies are ignored	<b>Organization &amp; Management risks</b> * Available skilled staff * Turnover of staff * Turnover of management * Ineffective or no formal process	<b>Cultural &amp; climate risks</b> * Business staff afraid of change * Lack of communication between IT staff and business leaders	<b>Project relationship risks</b> * Critical dependent projects ignored * Alternative projects incompatible * No knowledge management * No re-use of technologies, code, etc.	<b>Financial risks</b> * Project synergies missed in financial measures

Figure 2. Risk Factors in IT Project Portfolio Management



## 5. CONCLUSION

From this study, we found that there are five types of risk that should be considered when measuring portfolio risk. These five are strategic alignment risk, organizational and management risk, culture and climate risk, project relationship risk, and financial risk. Besides these categories of risk, we have identified 13 important risks that researchers should investigate further. We have also discussed a means for assessing portfolio risk and its impact on portfolio health.

These risks should be verified through empirical testing. Verifying the risks and their relationships at this point should be highly

exploratory, using an approach such as multiple case studies or Delphi studies of senior IS managers. Construct development efforts (Lewis, Templeton, and Byrd 2005) may help to refine the dimensions of portfolio risk and provide a means of measuring risk and assessing its impact on portfolio health.

One of the limitations of this study is that risks external to the corporation, such as geopolitical issues, have been largely ignored. While these risks certainly are relevant to portfolio managers, there is little that can be done to control these risks. Those risks internal to the firm provide at least the potential for control.

## 6. REFERENCES

- Ansoff, H. I., *Corporate strategy*, New York: John Wiley & Sons, 1965.
- Aron, R., E. K. Clemons, and S. Reddi, "Just right outsourcing: Understanding and managing risks," *Journal of Management Information Systems*, 2005, 22:2, 37 - 55.
- Bardham, I., S. Bagchi, and R. Sougstad, *A real options approach for prioritization of a portfolio of information technology projects: A case study of a utility company*, Paper presented at the Hawaii International Conference on System Sciences, Hawaii. 2004,
- Barki, H., S. Rivard, and J. Talbot, "Toward an assessment of software development risk," *Journal of Management Information Systems*, 1993, 10:2, p. 203-226.
- Benko, C., and F. W. McFarlan, *Connecting the dots: Aligning project with objectives in unpredictable times*, Boston, MA: Harvard Business School Press, 2003.
- Bergeron, F., L. Raymond, and S. Rivard, "Ideal patterns of strategic alignment and business performance," *Information & Management*, 2004, 41:8, p. 1003 - 1020.
- Blau, G. E., J. F. Pekny, V. A. Varma, and P. R. Bunch, "Managing a portfolio of interdependent new product candidates in the pharmaceutical industry," *Product Innovation Management*, 2004, 21:4, p. 227-245.
- Bruce, K., "Can you align IT with business strategy," *Strategy & Leadership*, 1998, 26:5, p. 16 - 21.
- Burn, J. M., and C. Szeto, "A comparison of the views of business and it management on success factors for strategic alignment," *Information & Management*, 2000, 37:4, p. 197 - 216.
- Cardozo, R. N., and D. K. Smith, "Applying financial portfolio theory to product portfolio decisions: An empirical study," *Journal of Marketing*, 1983, 47:2, p. 110-119.
- Cooper, R. G., S. J. Edgett, and E. J. Kleinschmidt, *Portfolio management for new products*, Reading, MA: Addison-Wesley, 1998.
- Datta, S., and S. K. Mukherjee, "Developing a risk management matrix for effective project planning - an empirical study," *Project Management Journal*, 2001, 32:2, p. 45-57.
- Devinney, T. M., D. W. Steward, and A. D. Shocker, "A note on the application of portfolio theory: A comment on Cardozo and Smith," *Journal of Marketing*, 1985, 49:4, p. 107-112.
- Dillon, R. L., and M. E. Pate-Cornell, "APRAM: An advanced programmatic risk analysis method," *International Journal of Technology, Policy and Management*, 2001, 1:1, p. 47 - 65.
- Fedor, D. B., S. Ghosh, S. D. Caldwell, T. J. Maurer, and V. R. Singhal, "The effects of knowledge management on team members' ratings of project success and impact," *Decision Sciences*, 2003, 34:3, p. 513 - 539.
- Fernandes, E., and L. E. Valdiviezo, "Total cost management of interdependent projects," *International Journal of Technology Management*, 1997, 13:1, p. 15 - 24.
- Frakes, W. B., and G. Succi, "An industrial study of reuse, quality, and productivity," *The Journal of Systems and Software*, 2001, 57:2, p. 99 - 106.

- Heemstra, F. J., and R. J. Kusters, "Dealing with risk: A practical approach," *Journal of Information Technology*, 1996, 11, p. 333-346.
- Hefner, R., *Aligning strategies: Organization, project, individual*, Paper presented at the Hawaii International Conference on System Sciences, Hawaii. 2003,
- Henderson, J. C., and J. G. Sifonis, "The value of strategic IS planning: Consistency, validity, and is markets," *MIS Quarterly*, 1988, 12:2, p. 187-200.
- Hoffman, N., and R. Klepper, "Assimilating new technologies: The role of organizational culture," *Information Systems Management*, 2000, 17:3, p. 36 - 42.
- Hsu, M. K., J. J. Jiang, G. Klein, and Z. Tang, "Perceived career incentives and intent to leave," *Information & Management*, 2003, 40:5, p. 361-369.
- Huchzermeier, A., and C. H. Loch, "Project management under risk: Using the real options approach to evaluate flexibility in R&D," *Management Science*, 2001, 47:1, p. 85-101.
- Jeffery, M., and I. Leliveld, "Best practices in it portfolio management," *MIT Sloan Management Review*, 2004, 45:3, p. 41-49.
- Jiang, J. J., and G. Klein, "Project selection criteria by strategic orientation," *Information & Management*, 1999a, 36:2, p. 63-75.
- Jiang, J. J., and G. Klein, "Risks to different aspects of system success," *Information & Management*, 1999b, 36:5, p. 236 - 272.
- Kearns, G. S., "A multi-objective, multi-criteria approach for evaluating it investments: Results from two case studies," *Information Resources Management Journal*, 2004, 17:1, p. 37-62.
- Kumar, R. L., "Managing risks in IT projects: An options perspective," *Information & Management*, 2002, 40:1, p. 63-74.
- Lederer, A., and V. Sethi, "The implementation of strategic information systems planning methodologies," *MIS Quarterly*, 1988, 12:3, p. 444-461.
- Lederer, A., and V. Sethi, "Key prescriptions for strategic information systems planning," *Journal of Management Information Systems*, 1996, 13:1, p. 35-62.
- Leong, S. M., and K. G. Lim, "Extending financial portfolio theory for product management," *Decision Sciences*, 1991, 22:1, p. 181-193.
- Lewis, B., R., G. F. Templeton, and T. A. Byrd, "A methodology for construct development in MIS research," *European Journal of Information Systems*, 2005, 14:4, 388 - 400.
- Lindgren, R., O. Henfridsson, and U. Schultze, "Design principles for competence management systems: A synthesis of an action research study," *MIS Quarterly*, 2004, 28:3, p. 435-472.
- Longenecker, C. O., and J. A. Scazzero, "The turnover and retention of IT managers in rapidly changing organizations," *Information Systems Management*, 2003, 20:1, p. 59-65.
- Lubatkin, M., and S. Chatterjee, "Extending modern portfolio theory into the domain of corporate diversification: Does it apply?" *Academy of Management Journal*, 1994, 37:1, 109 - 138.
- Markowitz, H. M., *Portfolio selection: Efficient diversification of investments*, Oxford, UK: Basil Blackwell Ltd, 1959.
- McFarlan, F. W., "Portfolio approach to information systems," *Harvard Business Review*, 1981, 59:5, p. 142-150.
- Muller, N. J., "Managing desktop assets: An emerging core competency," *Information Systems Management*, 1995, 12:3, 81.
- Muralidhar, K., R. Santhanam, and R. L. Wilson, "Using the analytic hierarchy process for information system project selection," *Information & Management*, 1990, 18:2, p. 87-95.
- Nambisan, S., "Information systems as a reference discipline for new product development," *MIS Quarterly*, 2003, 27:1, p. 1 - 18.
- Nazareth, D. L., and M. A. Rothenberger, "Assessing the cost-effectiveness of software reuse: A model for planned reuse," *The Journal of Systems and Software*, 2004, 73:2, p. 245 - 255.
- Owen, J., F. Burstein, and S. Mitchell, "Knowledge reuse and transfer in a project management environment," *Journal of Information Technology Cases and Applications*, 2004, 6:4, p. 21 - 35.
- Post, H. A., "Building a strategy on competences," *Long Range Planning*, 1997, 30:5, 733.

- Powell, S. D. a. M. L. a. P., "Information systems strategies in knowledge-based SMEs: The role of core competencies," *European Journal of Information Systems*, 2001, 10:1, 25.
- Rainer, R. K., C. A. Snyder, and H. H. Carr, "Risk analysis for information technology," *Journal of Management Information Systems*, 1991, 8:1, p. 129-147.
- Rau, K. G., "Effective governance of it: Design objectives, roles, and relationships," *Information Systems Management*, 2004, 21:4, p. 35 - 42.
- Ravichandran, T., and M. A. Rothenberger, "Software reuse strategies and component markets," *Communications of the ACM*, 2003, 46:8, p. 109 - 114.
- Schmidt, R. C., K. Lyytinen, M. Keil, and P. E. Cule, "Identifying software project risks: An international Delphi study," *Journal of Management Information Systems*, 2001, 17:4, p. 5-35.
- Shoval, P., and R. Giladi, "Determination of an implementation order for IS projects," *Information & Management*, 1996, 31:2, p. 67-74.
- VanDerZee, J. T. M., and D. DeJong, "Alignment is not enough: Integrating business and information technology management with the balanced business scorecard," *Journal of Management Information Systems*, 1999, 16:2, p. 137 - 156.
- Vanhoucke, M., E. Demeulemeester, and W. Herroelen, "On maximizing the net present value of a project under renewable resource constraints," *Management Science*, 2001, 47:8, p. 1113-1121.
- Wallace, L., M. Keil, and A. Rai, "Understanding software project risk: A cluster analysis," *Information & Management*, 2004, 42:1, p. 115-125.
- Weill, P., and M. Vitale, "Assessing the health of an information systems applications portfolio: An example from process manufacturing," *MIS Quarterly*, 1999, 23:4, p. 601 - 624.

## AUTHORS



**John R. Drake** is a visiting instructor in CIS at Louisiana Tech University and a PhD candidate in MIS at Auburn University. His current research interests focus on portfolio management, on trust and ethics in information technology, and on online auction decision making. His research has appeared in *International Journal of Integrated Supply Management*, *Encyclopedia of Information Ethics and Security*, and various conference proceedings at both the regional and the national levels. Prior to his PhD work, he was an IT developer and consultant. He earned his BS in Physics from Southern Illinois University at Edwardsville.



**Terry Anthony Byrd** is Professor of MIS in the Department of Management at the College of Business, Auburn University. He holds a BSEE from the University of Massachusetts at Amherst and a Ph.D in MIS from the University of South Carolina. His research has appeared in *MIS Quarterly*, *Journal of Management Information Systems*, *European Journal of Information Systems*, *Decision Sciences*, *OMEGA*, *Interfaces* and other leading journals. His current research interests focus on the planning, management, implementation, usage, diffusion, and infusion of information technology in facilitating a variety of individual, group, organizational and societal behaviors and initiatives to achieve positive results.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.