An Exploratory Study of Risk Factors for Implementing Service-Oriented IS Projects

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Abstract. For IS project managers, how to implement the projects successfully is always a challenge. Further, as more and more enterprises start to develop service-oriented IS projects, it is essential to assess the sources and impacts of relevant risks. This research aimed at identifying risk factors related to service-oriented IS projects and analyzing the impact of these risk factors. Applying the SIMM (service integrated maturity model) proposed by IBM, customer service systems were selected to justify the research framework. Result showed that the risk factors influencing the adoption of service-oriented systems were insufficient technology planning, lack of expertise, ineffective project governance, and organizational misalignment, listed in the order of strength of influence. The findings of this research is expected to assist managers realize the risks and the importance of these risks that have to be noticed and controlled when making decisions on service-oriented systems adoption.

Keywords: Risk management, Service-orientation, IS project management, Service integration, Customer service Systems.

1 Introduction

Failure of IS projects is common despite efforts for improvement. For example, a survey of more than 600 organizations in 22 countries showed that 49% of these organizations have experienced at least one IS project failure [1]. Also, a PIPC survey in 2005 found that 31% of IS projects failed to deliver on time and another 31% failed to deliver within budget [2]. Industrial efforts have been carried out to deal with the IS project risks. Examples include the COBIT (Control Objectives for Information and related Technology) framework proposed by the Information Systems Audit and Control Association (ISACA) and the IT Governance Institute (ITGI) [3], and the guidelines published by the Project Management Institute to define the project risk management methodology for project management [4]. Researchers have also proposed frameworks or methods for risk management and control [5][6][7][8].

Such issue becomes even more complex and important nowadays as more and more companies start to focus on the strategy of on-demand business [9], or so-called

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service-oriented enterprise (SOE) to respond to the increasing business dynamics, changing customer preferences, and disruptive technological shifts [10]. To achieve these goals, the integration between IT and the management processes needs to be assured. That is, the focus of IS projects should transform from simply replacing manpower to a higher level of integration of processes, technologies and the people managing and acting upon them. In this paper, we call these IS projects that focus on supporting SOE as "service-oriented IS projects."

Implementing these service-oriented IS projects however are not easy and involve a lot of risks [11]. Organizations need to handle challenges not only in technology but also in the business. These challenges may occur in processes, strategies, and workforces. This study therefore aims at developing a risk assessment framework for implementing service-oriented IS projects. Such framework is expected to create value for project managers in managing and running service-oriented IS projects, as well as for CEOs and top mangers in transforming their businesses into a SOEs. The research objectives are (1) to develop a risk assessment framework for service-oriented IS projects, and (2) to prioritize the risk factors that can differentiate adopters from non-adopters of service-oriented IS for better management of service-oriented IS projects.

2 Conceptual Background

2.1 IS Project Risks

Over the past few decades, a number of studies have discussed the concept of "risk" in IS projects and categorized the factors into different types or models. Ewusi-Mensah and Przasnyski proposed the three dimensions of risk (economic, organizational, and technological) and discussed the influence of each of these dimensions on the failure of IS projects [7]. Keil et al. categorized software project risks into a framework consisting of four quadrants (customer mandate, scope and requirements, execution, and environment) and two dimensions (perceived relative importance of risk and perceived level of control) [8]. Moreover, Wallace and Keil discussed the relationship between software project risks and project performance by investigating a proposed model containing six primary dimensions of risks [12]. Based on a review of 46 articles, Alter and Sherer conceptualized risk as (1) composed of different types of negative outcomes; (2) leading to loss or source of risk factors; (3) probability of negative outcomes (sometimes weighted by loss); (4) difficulty in estimating outcome; and (5) undefined or discussed using a different term such as problem or threat [13]. This study follows the description of risk as "leading to loss or source of risk factors" and more detailed description of the definitions and operationalizations will be provided below.

2.2 IS Projects and Service-Oriented Enterprises

According to Wikipedia, service-orientation (SO) is defined as a design paradigm that specifies the creation of automation logic in the form of services. Service-oriented architecture (SOA) is often viewed as an enabler of service orientation and is an architectural style based on which existing or new functionalities are grouped into atomic services. These services communicate with each other by passing data from one service to another, or by coordinating an activity between one or more services. Past researchers have discussed similar concepts of "service orientation" such as customer orientation, market orientation, and on demand (e.g., [11][14][15]). IBM consolidated these concepts and proposed the "On Demand Business Architecture" in 2004. According to IBM, on demand business refers to an enterprise whose business processes are integrated across the company and with key partners, suppliers and customers, enabling it to quickly respond to any customer demand, market opportunity or external threat [9].

To enable service orientation, companies need to develop a business strategy framework that focuses on the decisions of service strategy formulation [15][16]. To support these service strategies, an understanding of the actual business processes and underlying IT infrastructure is needed [10][17][18]. The investment of service-oriented IS projects therefore focuses on the integration of IT and business processes to enable the availability of data for decision makings. Moreover, these projects need to consider the development in connectivity, automation, and technology integration to enable extensible enterprises and dynamically reconfigure business relationships in response to market changes and business relationships [10]. It is expected that these investments have profound influence on those who work for such companies and the way their works get structured. Human capital management and optimization therefore also become a critical issue while investing these service-oriented IS projects [11][16][19].

IBM has proposed the Service Integration Maturity Model (SIMM) [20], depicting the levels of maturity of service-oriented systems. The seven levels are explained below.

- Level 1: *Data Integration*. The organization starts from proprietary and ad-hoc integration, rendering the architecture brittle in the face of change.
- Level 2: *Application Integration*. The organization moves toward some form of EAI (Enterprise Application Integration), albeit with proprietary connections and integration points.
- Level 3: *Functional Integration*. The organization componentizes and modularizes major or critical parts of its application portfolio, exposing functionality in a more modular fashion. The integration between components is done through the interfaces and contracts between them.
- Level 4: *Process Integration*. The organization embarks on the early phases of SOA by defining and exposing services for consumption internally or externally by business partners.
- Level 5: *Supply-Chain Integration*. The organization extends its influence into the value chain and service eco-system. Services form a contract among suppliers, consumers, and brokers who can build their own eco-system for on-demand interaction.
- Level 6: *Virtual Infrastructure*. The organization now creates a virtualized infrastructure to run applications after decoupling the application, its services, components, and flows. The infrastructure externalizes its monitoring, management, and events (common event infrastructure).
- Level 7: *Eco-System Integration*. The organization now has a dynamically re-configurable software architecture. It can compose services at run-time using externalized policy descriptions, management, and monitoring.

Based on our definition of service orientation, service-oriented IT projects are defined as those that aim to achieve level 4 of service integration or even higher level.

3 Research Model and Hypotheses Development

3.1 The Initial Research Model

Based on the review of relevant literature and the discussion above, the initial research model of this study was proposed as shown in Figure 1.

The independent variables were economic risks, organizational risks, and technological risks. Table 1 below provides a more detailed description of the three kinds of risks.

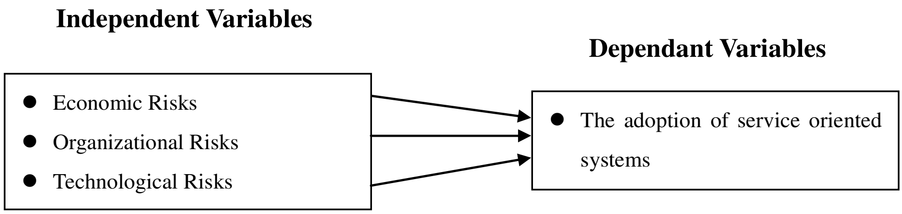

Fig. 1. Initial Research Model

Table 1. Risk Hierarchy of Service-Oriented Projects

Risk Category	Factor	In Service-Oriented IS Projects
Economic Risk	Size Risks	• IT planning becomes more long-term oriented [15][17]
	Resource Risks	• Lack of technology resources to support service-oriented IS projects [21]
Organizational Risk	Extent of Change Brought	• Lack of supply chain flexibility [10]
		• Lack of supportive processes [10][11][14][22]
		• Lack of supportive organization structure [11]
		• Lack of organizational responsiveness [23]
		• Lack of the modulization of user tasks [16]
		• Lack of user capability [15][23]
	Intensity of Conflicts	• Lack of high cohesion and morale in service development activities [16]
		• Lack of specific executive as the service owner for each logically connected set of services [18]
	Environmental complexity	• Lack of close communication within the new service project group [16]
		• Lack of close communication with customers [16]
		• Insufficient information sharing that coordinates new service/products development activities [16]
Technological Risk	Lack of Expertise	• Lack of knowledge in standardization [10][16][18]
		• Lack of knowledge in modualization [10][17][18]
		• Lack of IS Team knowledge in new services and products [16]
		• Lack of the ability to leverage managerial IS knowledge in the customer service processes [21]
	User Risks	• Lack of user involvement [8]
		• Lack of developing market learning and service climate knowledge for users [15][16][19][21][24]

3.2 Pretest and Revised Research Model

In preparation for the large-scale data collection, three interviews were conducted during early April 2008. The three companies selected were implementing service-oriented IS projects, with their company background shown in Table 2. Two issues were identified from the interviews following by the Delphi method: (1) Various definitions of SO systems exist among the three companies, and (2) most companies that declared to have service-oriented systems only reached the basic level of service integration. After intensive discussion, the research model was revised as shown in Figure 2 to reflect the features of service orientation.

The revised risk factors are shown in Table 3. Compared with the risk hierarchy of Table 1, size risk, resource risk, and insufficient staffing risk were consolidated and renamed "Resource insufficiency." The extent of changes and intensity of conflicts were grouped into "Organizational misalignment." Environmental complexity, environmental uncertainty, lack of commitment, and user risk were also consolidated and renamed "Ineffective project governance." Moreover, lack of expertise and inappropriate staffing were consolidated under the new name "Lack of expertise," and Technology complexity was renamed "Insufficient technology planning."

3.3 Hypotheses Development

Resource risks are associated with resource availability. If the project is not allocated sufficient resources, the project may not be accomplished in time. Therefore, Hypothesis 1 was proposed as follows.

H1: Resource insufficiency risk will negatively affect the adoption of service-oriented systems.

Since supply chain processes are derived from the integration of enterprise processes, lack of supply chain flexibility means there is neither internal enterprise flexibility nor flexibility of the connections, adding difficulties to dynamic information flows [10].

Table 2. Company Profile

Company	Role of SO	No. of Employee	**Capital** (NT Million$)
Company A	Solution Provider	65	65
Hospital T	Customized	4000	N/A
Corporate I	Solution Provider	1700	360

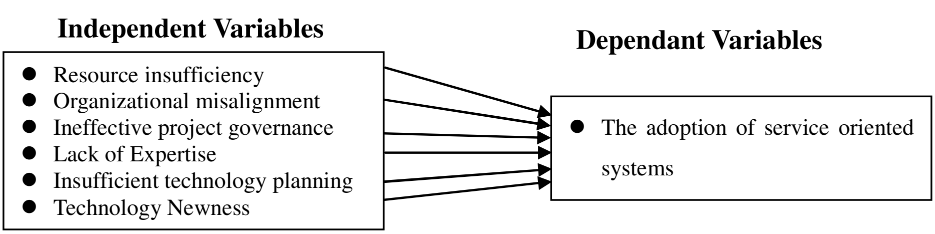

Fig. 2. Revised Research Model

Table 3. Revised Risk Factors

Risk Factor	Description
Resource insufficiency	• Can't perceive the value • Resource insufficiency in project time, staffing, budget, hardware, software
Organizational misalignment	• Lack of flexibility • Lack of supportive process • Lack of supportive organization structure • Lack of organizational responsiveness • Lack of the modulization of user tasks • Lack of user capability
Ineffective project governance	• Lack of specific executive as the service owner for each logically connected set of services • Lack of close communication within the new service project group • Lack of close communication with customers • Top management commitment • Commitment among development team members • User involvement • User attitude and user commitment
Lack of Expertise	• Lack of knowledge in standardization • Lack of knowledge in modualization • Lack of IS team knowledge in new services and products • Lack of IS team knowledge in service-oriented systems • Lack of the ability to leverage managerial IT knowledge in the customer service processes
Insufficient technology planning	• Number of links to existing systems • Number of links to future systems • Difficulty in defining the inputs and outputs of the system • Number of users outside the organization
Technology Newness	• Software newness • Hardware newness

Similarly, companies need to develop processes to support market-sensing and customer-orientation [10][11][14][22]. Moreover, service-oriented IS projects require horizontal and network-like structure based on service consumer-service provider relationship [11]. To support service-oriented IS projects, organizations need to be responsive to customer needs and competitors' actions [23]. To support modularization of service components, user tasks should be re-designed as well [16]. Besides, users within the organizations that are related to the services of the service framework need to be market responsive and able to process market information [15][23]. Lack of user capability may cause risks because there is no sufficient user knowledge to design and implement services. Therefore, H2 was proposed as shown below.

H2: Organizational misalignment risk will negatively affect the adoption of service-oriented system.

To enable service orientation, it is critical to specify an executive to supervise each logically connected set of services, and his/her responsibility is aligned with the overall enterprise governance [18]. It is also important to have close and clear communication within the new service project group when designing new services [16]. If the communication is not good enough, conflicts, misunderstandings, and unfamiliarity may cause serious risks. It is also of equal importance to have close communication with customers. Therefore, H3 was proposed.

H3: Ineffective project governance risk will negatively affect the adoption of service-oriented systems.

Lack of knowledge in modularization is also risky [10][17][18]. Modularization refers to the process of designing and packaging services into modules. Each related functions will be reorganized by usage and purpose of the services and user requirements. Without being properly modularized, these functions tend to be tightly coupled with each other, putting the competitive advantage of flexibility in peril. Lack of IS team knowledge in new services and products may also incur risks [16]. IS teams need to have the knowledge about the process, the workflow, the users, the new services, and the innovation of the tasks. Moreover, risks may occur when IS teams lack the ability to leverage managerial IT knowledge in customer service process [21]. More specifically, every industry has its unique domain knowhow, and for that reason there exist different concerns to design the new services as well as the IT infrastructures. H4 was therefore proposed.

H4: Lack of expertise risk will negatively affect the adoption of service-oriented systems.

Integration with existing systems involves implementation issues such as how to link with legacy systems, how to run the new systems without affecting the old ones, and which existing functions should remain unchanged [6] [12]. Improperly dealing with these issues may cause risks. H5 was thus proposed as follows.

H5: Insufficient technology planning risk will negatively affect the adoption of service-oriented systems.

The concept of service-oriented architecture is new, and the technology to implement it is new as well. Since the IS project involves new hardware, software, and technology, more efforts are needed to overcome the technological problems. It therefore requires more time and resources and brings about more risks than the projects using existing technologies. Based on the argument above, H6 was therefore proposed as follows.

H6: The technology newness risk will negatively affect the adoption of service-oriented systems.

4 Data Analysis

4.1 Data Collection

To test our hypotheses, we target at the companies whom have applied the concept of service integration in implementing their customer service system project. Developed upon IBM SIMM described in Section 2, four levels of service integration for customer service systems are proposed: data integration (level 1), application and functional integration (level 2), process integration (level 3), and eco-system integration (level 4). The detail definition of each level is shown in Table 4. A Web survey was conducted for data collection. The URL of a Web questionnaire was sent to 300 professionals within organizations that have implemented customer service systems. A total of 107 responses were received out of which 105 were valid.

The average number of employees in the firms was 405, capital 0.37 NT billion dollars, and annual sales 1.68 NT billion dollars. The areas covered various industries to which the complete list is available on request from the authors. For the customer service system project that has implemented in these responding companies, 44 companies have expressed that their project belongs to level 1, and 19 companies have the project belonging to level 2. Based on our definition, these companies haven't adopted service concept in there IS project, and thus we label these companies as Non-SO group. The data also shows 24 respondents have implemented the project that belongs

Table 4. Definition of Service Integration Level for Customer Service Systems

Level	Description
Data integration	The organization owns a basic enterprise website for customers to send comments and complaints. The website has an independent member system, from which customers can browse the website to join member, subscribe company e-paper, search information about the products and services, apply for services, or give comments. There is no direct connection between the website's member system and the company's inner CRM system. The employees of the customer service have to manually transform the data of the website's member system and import the data into the CRM system for further processing the requests for the customers.
Application and functional integration	The enterprise website has connections to the internal (e.g. CRM, ERP) and external (e.g. SCM) systems of the organization. There are standardized format of transformation (e.g. XML). The transformation can be scheduled as automatically executed tasks within a certain period by batch, or be designed as synchronized tasks to import data synchronously into other related systems of the organization without manual operations. The automation only refers to those data interchange with no flows (e.g. receive order form or add new member). For the processes which are involved with flows or complicated logistics should rely on manual operation or other process to be accomplished.
Process integration	For enterprise the interaction between internal/external systems becomes more automatic. It not only makes customers register the services on line and transfers data into the internal system automatically but also disposes the processes of business knowledge (e.g., identify a form which the departments belong to, understand how to dispose in different situation). For example, when a user makes an order, the system will activate the processes to fulfill the order needs automatically, if the order involves the cooperation of external factories and stores, system will sends the order information to them in order to reach the best route planning and fast to fulfill the order needs.
Eco-system integration	Any service component is modulized and independent. To fulfill customer needs, the system is able to recombine different service components to form a new one. For example, customer service system can be divided into the following service components: member service, order service, and distribution service. User can selects the service which he needs and makes the service join to his systems or processes.

to level 3, and 18 belongs to level 4. These companies are treated as adopters of service-oriented systems; we label them as SO group.

4.2 Instrument Validation

Factor analysis was conducted to assess the construct validity, using principal component analysis for factor extraction and Varimax for rotation. 13 Items with factor loadings under 0.5 was discarded, and the Cronbach's α value of the six risk factors ranged from 0.769 to 0.932. Besides factor analysis, the correlation matrix of the measurement items was inspected to assess the convergent validity. The smallest within-factor correlations were all significantly different from zero, providing positive evidence for convergent validity. Further, the between- and within-factor correlations also supported the discriminant validity of the instrument.

4.3 Mean Value Analysis

The comparison of mean values of the risk factors between Non-SO and SO groups revealed that four of the six risk factors (ineffective project governance, lack of expertise, insufficient technology planning, and organizational misalignment) were able to discriminate the adoption behavior while the other two were not (see Table 5).

Table 5. Mean Value Analysis

Risk Measure	Non-SO (N=63)	SO (N=42)	Mean Difference	Significance
Ineffective project governance	3.57	2.73	0.84	0.000
Lack of expertise	4.00	2.88	1.12	0.000
Insufficient technology planning	4.24	3.08	1.15	0.000
Resource insufficiency	4.40	4.45	-0.04	0.877
Organizational misalignment	3.62	2.90	0.72	0.002
Technology newness	4.41	4.14	0.27	0.339

As shown in Table 5, the means of the Non-SO group were higher than those of the SO group. Such finding was consistent with the hypotheses of this study. In addition, both groups showed higher-than-average resource insufficiency (4.40 for Non-SO and 4.45 for SO) and technological newness (4.41 for Non-SO and 4.14 for SO), meaning that both groups perceived high risks in these two categories.

4.4 Regression Analysis

The research hypotheses were analyzed using binary logistic regression. The result of the binary logistic regression is shown in Table 6. From the result in Table 6, ineffective project governance, lack of expertise, insufficient technology planning, and organizational misalignment were found to be significant and negatively related to the adoption of service-oriented systems, while resource insufficiency and technology

Table 6. Summary of Binary Logistic Regression Analysis

	B	S.E	Wald	Rank	df	Sig.	Exp(B)
Ineffective project governance	-0.585	0.258	5.145	3	1	0.023	0.557
Lack of expertise	-0.831	0.270	9.453	2	1	0.002	0.436
Insufficient technology planning	-0.966	0.271	12.654	1	1	0.000	0.381
Resource insufficiency	0.087	0.249	0.123	6	1	0.726	1.091
Organizational misalignment	-0.503	0.250	4.056	4	1	0.044	0.605
Technology newness	-0.126	0.248	0.259	5	1	0.611	0.881
Overall model fit	chi-square = 33.151 (p=0.000) Hosmer & Lemeshow = 12.147 (p=0.145)						

Table 7. Classification Result

		Model		
		Predicted Group		
Actual Group	Number of Cases	Non-SO	SO	Percentage. Correct.
Non-SO	63	49	14	77.8%
SO	42	18	24	57.1%
Overall	105			69.5% Correct

newness were not. The reason these two factors were insignificant may be due to the fact that adoption of service-oriented systems was a challenge per se for the companies. The technology was a new concept and most companies do not have required resources. Therefore these two factors were unable to explain the difference between adoption and non-adoption. Table 7 shows how well the regression model classified SO from Non-SO groups. As shown in the table, the hit ratio of the regression model was 69.5%. As there were 63 Non-SO and 42 SO companies, the classification accuracy by random guess was $(63/105)^2 + (42/105)^2 = 52\%$ (the maximum chance criterion). Thus, it could be concluded that this model could be considered a valid predictor of the adoption of service-oriented systems. The results therefore supported four of the six hypotheses proposed (H2, H3, H4, H5), while rejecting the other two (H1 and H6).

5 Conclusion

Two major findings arose from this study and are discussed in this section.

1. *Four risk factors influencing the adoption of service-oriented systems were identified. These factors included insufficient technology planning, lack of expertise, ineffective project governance, and organizational misalignment.*

First, according to the Wald statistics in Table 6, the most influential risk factor to the adoption of service-oriented systems was "insufficient technology planning." Since service-oriented systems require integration among business, technology, process, and workforce, huge efforts are needed. Integration for service-oriented systems requires the development and deployment of integration platforms and interfaces to existing systems. The efforts to enhance the integration of service-oriented systems can be more complicated and costly than the integration of traditional information systems. This also means that well-designed adoption plan is essential to the successful of adoption. Second, developing the knowledge of technologies such as J2EE, .NET platform, WSDL, XML, and SOAP is expensive and acquiring professionals with qualified skills is also a challenging task. Even if the company chooses to outsource to software vendors, how much the vendor knows about service-oriented technology is questionable and thus needs to be evaluated. Third, due to the newness and large scale of the service-oriented concept and technology, managing a serviced oriented system project is more difficult than managing a traditional one. And since service orientation is not a purely technical problem, supports from top managers and key users are essential. Well governance and communication to realize the benefits are required. In a business environment, it is common that key users own the power to the decision of implementing a system, and the IS professionals are responsible for identifying requirements and the implementation work. A successful project is impossible without proper governance and communication structure in the business. Fourth, organizational alignment is also required because the success of the systems depends on how process, workforces, strategies, and technologies move toward the same direction. To ensure the alignment, the company structure may need to be reorganized, business processes modularized, and alternative service groups organized to make the goals consistent. If related parties are not aligned together (e.g., each department managers has their own conceptualizations on how to use IT to improve customer service), the existing processes may not be able to support customers' changing requirements. The companies may therefore encounter difficulties in collecting market and competitors' information, making it more difficult to adopt service-oriented systems successfully.

2. *Although resource insufficiency and technology newness were not essential risk factors to the adoption of service-oriented systems, they both were valued high in terms of risk.*

From the mean value analysis of Table 5, the Non-SO and SO groups rated resource insufficiency (4.40, 4.45) and technology newness (4.41, 4.14) higher than average. Although the two risk factors were not significant according to the binary logistic regression analysis shown in Table 6, the result showed that both groups perceived these two factors as high risk.

With the new technology and insufficient resource, companies who chose to implement service-oriented systems might want to build competitive advantages after successful implementation. In other word, facing the challenges of insufficient resources and technology newness, companies still decided to implement the systems in order to follow industrial trends or to sustain competitive advantages. Decision makers, however, need to proceed with implementation with great care to control the scale, budget, human resource, or functions.

Limitations exist and need to be noted though cautious steps had been taken. First, the participants of the survey were limited to IS department staff with experiences in planning/implementing customer systems, and only one participant per company was accepted. Under such strict conditions, qualified participants were hard to find and therefore small sample size was unavoidable. To mitigate this problem, we contacted as many sources of targets as possible and offered monetary rewards. Second, because no unified and agreed-upon definition of "service-oriented systems" was available, this study followed IBM's SIMM and industrial interviews and proposed four maturity levels of customer service systems. The definition of each maturity level is suggested to be further refined for future studies. Moreover, this study only considered the risks of adopting service-oriented IS projects, leaving risk control issues untouched [8]. It is also a suggested direction for future studies.

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