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以 RM-BSC 方法發展 B2B 網路銀行之關鍵風險指標

Developing Key Risk Indicators for B2B International Internet Banking: A RM-BSC Approach

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摘 要

企業網路銀行已經成為銀行維持競爭優勢的利器，跨組織網路交易的各種風險也成為銀行風險管理之重要議題。本論文提出一個 RM-BSC 整合架構與作法，調查參與 C 計畫之銀行放款專業人員或高階主管的認知，以初步 AHP 先找出關鍵風險因子，再依風險管理策略規劃步驟，延展成為重點風險指標，再以進一步 AHP 評估這些關鍵風險因子構面與因子本身之相對重要順位。建議在組織環境中採用 PDCA 作法，週期性的重新認定關鍵風險因子及其相對重要順位。最後採用 SEM 方法進行模型統計顯著性檢定，結果顯示問卷問項具良好的收斂確實性、內部一致性、各構面具有足夠的分辨力，進一步作路徑分析也辨識出若干串連 4 構面關鍵風險因子之顯著路徑。

【關鍵字】階層分析程序法、風險管理、平衡計分卡

Abstract

Business-to-business international internet banking (B2B IIB) has emerged as one of the key drivers in sustaining a bank's competitive advantage and the related risk management issues are getting important. This paper proposes an integrated RM-BSC framework and approach to incorporate key risk factors and then elaborate these risk factors along with the risk management (RM) strategy to establish key risk indicators. The risk factors and their rankings are identified through the two-step Analytical Hierarchy Process (AHP) conducted by surveying the bank representatives who joined the government-sponsored C-plan (TMEA, 2004) to develop B2B IIB. A suggested PDCA approach for periodical assessment and elaboration of key risk factors and its implication for risk management in the dynamic B2B IIB environment are also discussed. The validation of the risk factor associations in the RM-BSC framework were conducted based on the SEM testing with statistical significance. The results exhibit a good convergent validity, an adequate internal consistency, a good discriminating validity, and a proper structural model. The further path analysis identifying the important paths from Learning and Growth perspective to financial perspective might imply the causal-effect relationships along with the Strategy map consisted of the risk factors.

【Keywords】analytic hierarchy process, risk management, balanced scorecard

1. Introduction

The internet has grown considerably during the past decade; particularly with respect to the use of tools for communication, entertainment, and marketplace trading (Miyazaki & Fernandez, 2001). The Internet provides a common platform not only for a company's internal activities, but also for connections with operations throughout the entire supply chain (Vakharia, 2002). Successful e-commerce should define goals including: reduced transaction costs, reduced transaction risk, increased productivity, enhanced opportunities for reengineering towards supply chain communications, and enhanced capabilities for leveraging competitiveness in the global marketplace (Pathak, 2004). As a result, business-to-business international internet banking (B2B IIB) has emerged as one of the key drivers in sustaining a bank's competitive advantage. Therefore, after the successful stories of A-pan and B-plan which encourage the internet-based supplier chain management, the TMEA (2004) fostered the C-plan to encourage the domestic banks to develop B2B IIB.

In the B2B IIB environment, banks support center factories and provide suppliers with financial services. The center factory transfers bills to banks through e-channel and banks recognize these bills and allow fund transfer for suppliers. According to the Businesses need process efficiency and lower transaction cost in trading, and thus induce the popularity of internet-based payments. In the market evolution dynamics, the risk management of relationships among banks, center factories, and suppliers have inevitably become critical issues (Basel, 1999, 2001). According to Basel (1998), the provision of retail and small value banking products and services through electronic channels would run on the gamut from direct deposits, ATMs, credit and debit cards, electronic bill payments, to web-based banking. However, there is no formal mechanism to verify the relationship risks, risk control strategies, and key risk indicators for B2B IIB. The links between risk-related strategic objectives and performance measures of the B2B IIB are weak. Therefore, the research regarding the identification of key risk factors for B2B IIB and their impacts for adjusting key risk indicators associated with risk control strategies of the B2B IIB is important. In this study, we aim at developing a risk-control strategic framework and associated risk indicators for the B2B IIB sector by adapting the BSC model (Kaplan & Norton, 1996) to be incorporated with risk management concepts and dimensions of COSO ERM (COSO ERM, 2004; Moeller, 2007). The reasons for adopting the BSC model to deal with the risk factors and the associated risk indicators along with the B2B IIB risk-control strategies are twofold. Firstly, the BSC provides the essential concept of balancing the attentions between financial and non-financial measures, internal and external factors, leading and lagging indicators, as

well as current outcomes and future performances. Secondly, the BSC is adaptable to be integrated with the concept and framework of the COSO ERM. The integrated risk-control strategic framework originated from the combination of risk concepts and perspectives between the COSO ERM and the BSC is denoted as RM-BSC (the Risk Management on BSC) to be used to address the multi-perspective considerations in the risk management of B2B IIB. In our research, the risk factors are collected from the literature and practitioners to be elaborated along the risk-control strategy based on the proposed RM-BSC framework. The AHP approach (Saaty, 1980) is conducted to identify and prioritize the relative importance of risk factors addressed in the RM-BSC framework. Finally, a PDCA model is adopted for implementation to periodically review the key risk factors and the associated indicators in the B2B IIB environment. The iterative process of the identification, elaboration, ranking, and implementation for these key risk factors and indicators are concluded as the RM-BSC approach.

2. Literature Review

2.1 Balance Scorecard Framework

Balanced Scorecard (BSC) is a performance measurement framework that provides an integrated look at the business performance of a company by a set of financial and non-financial measures (Kaplan & Norton, 1992, 1993, 1996). The BSC uses four perspectives determined by organizational visions and strategies to measure the integrated total performance. Kaplan and Norton (1996) explain the four perspectives as follows and stress the importance of adhering to three principles: maintaining cause-and-effect relationships, comprising sufficient performance drivers, and keeping a linkage to financial measures. (1) Financial perspective: The highest level in the hierarchy is the financial perspective. The financial perspective contains outcome measures that result from achievement of objectives in the lower perspectives. Companies improve shareholder's values through a revenue growth strategy. (2) Customer perspective: The Objectives of this perspective is to focus organizations on the external environment and induces firms to understand, discover, and emphasize customer needs. Customers are the source of business profits; hence, satisfying customer needs is the objective pursued by companies. Management determines the expected target customers and market segments for operational units and monitors the performance of operational units in these target segments. Some examples of the core or genetic measures are customer satisfaction, customer retention, new customer acquisition, market position and market share in targeted segments. (3) Business process perspective: A

generic view of the internal business process perspective encompasses the entire internal value chain, which Kaplan and Norton (2001) decompose into four processes common to all firms: innovation, customer management, operational, and regulatory and environmental. (4) Learning and growth Perspective: In this perspective, managers define the employee capabilities and skills, technology, and corporate climate needed to support a strategy (Kaplan & Norton, 2001). Outcome risk measures of the Learning and Growth Perspective are fundamental and support indicators of the outcomes of each of the three perspectives above it in the hierarchy.

In BSC literature, Zahra (1999) suggests the need for composite balanced scorecard approach over traditional approaches to measure investments. Banker, Chang, Janakiraman, and Konstans (2004) analyzes BSC performance metrics in the US telecommunications industry. Shankar and Tiwari (2005) analyzes for end-of-life computers by an analytic network process and BSC model. Chang, Wu, and Lin (2008) proposes the Balance Scorecard (BSC) model to construct a framework for solar photovoltaic industry.

2.2 COSO Enterprise Risk Management

The Committee of Sponsoring Organizations of the Treadway Commission (COSO) issued Internal Control-Enterprise Risk Management (ERM) to help businesses and other entities assess and enhance their internal control systems. ERM is a process which is effected by an entity's board of directors, management and other personnel, applied in strategy setting across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives (COSO ERM, 2004; Moeller, 2007). ERM consists of eight interrelated components: Internal Environment, Objective Setting, Event Identification, Risk Assessment, Risk Response, Control Activities, Information and Communication, Monitoring. They are integrated to be implemented in various levels of units to meet objectives in four categories-strategic, operations, reporting, and compliance (COSO ERM, 2004; Moeller, 2007). Among the eight interrelated components, Internal Environment, Objective Setting, Event Identification, Risk Assessment, Risk Response, and Control Activities are key points to be fully addressed during the Risk Policy setting process. The value maximization of various levels of organization units can be aggregated as the value maximization of shareholders. The achievement of objectives in the four categories would lead to the enhancement of overall competitiveness. Therefore, the risk management dimensions in our research are simplified as Information and Communication (COSO ERM,

2004), Monitoring (COSO ERM, 2004), Risk Policy (COSO ERM, 2004), Max of Shareholder's Values (COSO ERM, 2004), and Competitiveness (COSO ERM, 2004), to be incorporated with four BSC strategic performance perspectives: Financial, Customer, Business Process, Learning and Growth. Tseng and Chiang (2006, 2008) propose to use COSO ERM framework as a guiding reference framework to build information systems for risk management. The framework includes cross-functional risks across the corporate enterprise and provides a common understanding of terminology and concepts (Moeller, 2007). From the viewpoint of internal control, the COSO-ERM provides the risk-oriented model framework which would help enhance the competitiveness of enterprises and promote the enterprise's performance (Huang, Yen, Hung, Zhou, & Hua, 2009). In IT security management, Yue, Metin, Ryu, and Liu (2007) also consider COSO-ERM as a valuable reference framework for the enterprise to establish the definitions on control measures and compliance procedure to fulfil the risk management spirit.

2.3 Research Issues in E-commerce Risks

The important E-commerce risk related literatures are reorganized and compiled as Table 1.

Table 1 Summary of e-commerce risk related literature

Author (Year)	Research Objective	Literature Type
William (1997)	Suggests e-business entities to comply with the CPA WebTrust seal, which includes business practices policy, transaction integrity and information protection.	E-commerce risk
Karahannas (1999)	Suggests performance measures used to enforce monitoring and technical control in e-business.	E-commerce audit
Vinten (2001)	Suggests to use e-commerce system control to enhance internal control and reduce the implementation costs.	E-commerce audit
Elliott (2001)	Develops e-business Web of assurance model relationships with other organization	E-commerce model
IFAC (2001)	Proposes e-commerce of internal auditing standard focusing on transaction integrity, transaction security, and process alignment.	E-commerce audit
Sutton and Hampton (2003)	Proposes a B2B e-business risk model consisted of three level: (1) the application level (2) the business level (3) the technical level.	E-commerce risk

Warren and Hutchinson (2003)	Proposes a security method to evaluated and ensure the risk control of information system	E-commerce risk
Champlain (2003)	Emphasizes on dealing with e-business and outsourcing effects on organization's business risk.	E-commerce risk
Alter and Sherer (2004)	Uses the nine elements of the work system framework to organize the hundreds of risk factors in the IS projects.	E-commerce risk
Yue et al. (2007)	Analyzes the security risk management and optimizes allocation of security resources (investments) in protecting every system in an organization.	E-commerce risk
Lee and Rao (2007)	Analyzes the relationships between various risks, beliefs, and behavioral intentions for citizens' use of anti-/counter-terrorism websites.	E-commerce risk
Cazier, Jensen, and Dave (2008)	Analyzes the advantages and disadvantages of residual RFID from the perspective of consumer's privacy risk.	E-commerce risk
Du (2009)	Proposes an automatic e-tendering system for different risk preferences (such as risk neutrality, risk aversion, or risk proneness) and degrees of negotiating power.	E-commerce risk

Source: compiled by the authors

As exhibited in the literature review on E-commerce risks, very few integral research papers have been focused on the risk management with multiple perspective considerations, as exhibited in BSC. This invokes the research motivation for this paper

2.4 Review of the Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) was first introduced by Saaty in 1971 to solve the scarce resources allocation and planning needs for the military (Saaty, 1980). As a multicriteria decision analysis technique, AHP aims at choosing from a number of alternatives by their comparative rating based on a chosen set of qualitative and quantitative criteria (Saaty & Vargas, 2006; Schniederjans, Hamaker, & Schniederjans, 2003). AHP structures the decision problem into a hierarchy that reflects the value recognition, goals, objectives, and desires of the decision-makers. The main advantage of using AHP approach is to integrate different measures associated with different criteria into a single utility measure. Several elements are used by AHP as the inputs, such as: evaluation criteria, relationships between the criteria (importance), relationships between the alternatives (preference), and the judgments of the decision makers about the alternatives. Since its

introduction, the AHP has become one of the most widely used multiple-criteria decision-making (MCDM) methods and has been used to solve unstructured problems in different areas of human needs and interests, such as political, economic, social, and management sciences (Kang & Lee, 2006). Some examples of using AHP in information science are: budget allocation for maintaining and enhancing the security of an organization's information system (Bodin, Gordon, & Loeb, 2005), selection of a vendor for a telecommunications system (Tam & Tummala, 2001), importance measurement of intranet functions for a virtual organization (Kim, 1998). Several MCDM methods and their comparison are exhibited in Table 2.

Table 2 Characteristics of several multiple-criteria decision-making methods

AHP	ANP	Delphi	Decision tree	Simulation
● Having direct and interactive communication and decision formulation process. ● Being more structural and independent in nature.	● Solving problem among dimensions that are dependent. ● Providing a general framework for dealing with decisions without generating assumptions about the independence between levels as a hierarchy. ● Modeling complex decision environments.	● Taking more time to reach a compromise and is therefore more difficult to get hold of the opportunity. ● Holding communication in a hidden way without face to face contact. ● Making decision process dominated by the coordinator.	● Having simple structure and is more welcomed by decision makers. ● Being easily influenced by the subjective value recognition of the decision maker.	● Having scientific and economical characteristics. ● Being more difficult in model construction and program simulation. ● To know fully the real situations so as to construct appropriate model architecture.

Source: modified from Tseng and Huang (2003)

Among the above MCDM methods, AHP is chosen for this research due to the following reasons: (1) The risk factors associated with four BSC perspectives may be related, but not obviously dependent. (2) Risk factors can be relatively easy to be evaluated by the banking experts without the subjective perception established by the coordinator. (3) Although the risk control environments can involve various scientific and economical

characteristics, it seems too early to involve complex model construction at the stage of identifying critical risk factors. Therefore, this paper uses AHP to help identifying the key risk factors from the perceptions of banking experts.

2.5 The Collected Risk Factor and Literature References

Table 3 describes the risk factors involved in B2B IIB from the literature.

Table 3 The descriptions of risk factors

Perspective	Risk factor	Description	Ref.
Customer	Trust risks (TUR)	HC1: The risks casused by failing to maintain the partner trust among the bank, the center factory, and suppliers.	A
	Integration risks (IGR)	HC2: The risks caused by failing to integrate and coordinate AP to AP infomation operation among the bank, the center factory, and suppliers.	E, F
	Communication risks (COR)	HC3: The risks caused by failing to communicate via appropriate channel among the bank, the center factory, and suppliers.	X
	Liquidity risks (LIR)	HC4: The risk caused by failing to make in-time payment due to the fund shortage of ceter factory or suppliers.	G
	Privacy risks (PIR)	HC5: The risks caused by failing to have good protection for customer data.	H
	Reputation risks (RER)	HC6: The risks caused by failing to promote professional services of the bank.	C, K
Learning and growth	Leadership risks (LER)	HL1: The risks caused by fast turnover of employees for dissatisfaction of work environment.	O
	Management risks (MAR)	HL2: The risks caused by low quality employee for disorderly management.	M
	Intellectual property risks (IPR)	HL3: The risks caused by plagiarism of business activity or patent pirot by competitors.	V
	Moral risks (MOR)	HL4: The risks caused by misconduct of employees, such as stealing, shirking, etc.	W

Business process	Technology risks (TER)	HI1: The risk caused by the underestimated complexity of information technology.	EX
	Information risks (INR)	HI2: The risks caused by failing to process in-time confirmation for some customer orders.	M
	Competitive risks (CER)	HI3: The risks caused by failing to reduce unvalued business activities in some important process.	N
	Culture risks (CUR)	HI4: The risks caused by failing to establish regulated international agreements for multi-national business transactions.	M
	Service risks (SVR)	HI5: The risks caused by complex business process to induce customer inconvenience.	M,L,EX
	Transactional risks (TAR)	HI6: The risks caused by too many incomplete transactions.	M
	Security risks (SER)	HI7: The risks caused by defect of system security.	K, EX
	Operational risks (OPR)	HI8: The risks caused by inadequate or failed internal business processes.	J
	Transition Risks (TRR)	HI9: The risks caused by delayed project development progress to affect the in-time system transition.	EX
Financial	Credit risks (CRR)	HF1: The risks caused by default of customer debt.	EX
	Profitability risks (PRR)	HF2: The risks caused by failing to achieve profitability goal in the budget.	T
	Natural risks (NAR)	HF3: The risks caused by normal and abnormal natural disasters, such as earthquake, epidemic disease, etc.	EX
	Legal risks (LAR)	HF4: The risks caused by commercial disputes to incur legal costs.	M, EX
	Strategic risks (STR)	HF5: The risks caused by failing to formulate the strategic use of the financial resources.	U
	Cost risks (CTR)	HF6: The risks caused by the incurred IT cost of new financial products.	M

A: Doney and Cannon (1997), C: Auger and Gallaugher (1997), E: Basel (1999), F: Saunders (1998), G: Mitusch and Nautz (2001), H: Berghel (2000), J: Basel (2001), K: Jagdish (2003), L: McNamee and Chan (2001), M: COSO ERM (2004), N: Amit and Zott (2001), O: Robbins (2004), T: Porter (1980), U: Smith, McKeen and Staples (2001), V: Kauffman and Walden (2001), W: Chen (2003), EX: Expert opinion, X: Li and Liao (2007)

3. Identifying Key Risk Indictors Using RM-BSC Framework

The RM-BSC approach is illustrated as follows: (1) Collect the risk factors from literature and practitioners. (2) Identify and the key risk factors using the initial AHP. (3) Elaborate the key risk factors along with RM planning steps based on the RM-BSC framework, to generate the associated key risk indices. (4) Prioritize the key risk factors using the second AHP. (5) Periodically review and implement the key risk factors for B2B IIB using PDCA. The activities of RM-BSC approach are illustrated in the following sections.

3.1 The Steps of Risk Factor Evaluation Using AHP

We used a survey method with the analytic hierarchical process (AHP) to construct the weights of risk factors. Initially, we invited 153 bank loan officers to participate the research through responding to a questionnaire. All the respondents were assured that their responses would be kept confidential. A total of 43 questionnaires were returned with response rate 28.1% (43/153) and 6 questionnaires invalid (CR>0.1). The weight is scaled from 1=extremely unimportant to 5 = extremely important. The following steps are used in AHP analysis for evaluating the weights of risk factors :

Step 1. Form a matrix, called Matrix A, using the weights allocated to risk factors in pairwise comparison.

$$A = \begin{bmatrix} 1 & . & a_{1j} & . & a_{1n} \\ . & . & . & . & . \\ a_{i1} & . & a_{ij} & . & a_{in} \\ . & . & . & . & . \\ a_{n1} & . & a_{nj} & . & 1 \end{bmatrix}_{n\times n} = \begin{bmatrix} w_1/w_1 & . & w_1/w_j & . & w_1/w_n \\ . & . & . & . & . \\ w_i/w_1 & . & w_i/w_j & . & w_i/w_n \\ . & . & . & . & . \\ w_n/w_1 & . & w_n/w_j & . & w_n/w_n \end{bmatrix}_{n\times n}$$

Among them, the ratio of weight of w_i and w_i/w_j in Matrix A is obtained from the decision-maker's pairwise comparison. The matrix has three attributes, $a_{ij} = 1/a_{ji}$, $a_{ij} = w_i/w_j$, and $a_{ij} = 1$, *for* $i = j$. After each element were compared, the matrix were formed as shown in Table 18 in the Appendix. The full names and definitions for the risk factor abbreviation are referred in Table 3.

Step 2. Calculate the eigenvalue and the eigenvector

$$W=\begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix},\ w_i=\frac{\sum_{i=1}^{n} a_{ij}}{n}, W'=AW=\begin{bmatrix} w_1' \\ w_2' \\ \vdots \\ w_n' \end{bmatrix},\ for\ i=1,2,.....,n,\ \lambda_{\max}=\frac{1}{n}\left(\frac{w_1'}{w_1}+\frac{w_2'}{w_2}+\frac{w_3'}{w_{31}}\cdots+\frac{w_n'}{w_n}\right)$$

where W is the eigenvector, w_i is the eigenvalue (priority weight) for the i[th] risk factor, and λ_{max} is the principal eigenvalue used for the consistency test of the AHP approach. Table 4 presents the results of the eigenvector for 25 risk factors collected from literature and practitioners.

Table 4 The eigenvector for the risk factors evaluation in the initial AHP

Risk factor	W	Risk factor	W	Risk factor	W	Risk factor	W	Risk factor	W	
TUR	0.042	RER	0.042	TER	0.017	TAR	0.043	PRR	0.041	
IGR	0.052	LER	0.045	INR	0.045	SER	0.046	NAR	0.018	λ_{max}=26.17
COR	0.012	MAR	0.049	CER	0.042	OPR	0.042	LAR	0.057	
LIR	0.041	IPR	0.043	CUR	0.047	TRR	0.051	STR	0.042	
PIR	0.037	MOR	0.011	SVR	0.036	CRR	0.047	CTR	0.045	

Relatively speaking, the eigenvalues for Communication risk, Moral risk, Technology risk, and Natural risk were much lower than those for other risk factors.

Step 3. Check the Consistency Index (CI)

In order to make sure the current run of AHP approach is acceptable, the consistency test is started by calculating the consistency index (CI) of the overall AHP approach.

$$CI=(\lambda_{max}-n)/(n-1)$$
$$=(26.17-25)/(25-1)=0.048$$

Step 4. Compute the Consistency Ratio (CR)

The consistency test is then completed by observing and evaluating the consistency ratio (CR):

$$CR=CI/RI$$

where RI is from Saaty's (1980) suggestions for a set of RIs with each corresponding to each total number of factors participating the pairwise comparisons, as shown in Table 5. He

also suggests the acceptance criterion for the consistency test to be CR ≤ 10%. If the CR > 10%, we need to redo the AHP process where more clarified questionnaire can be delivered to the respondents so that they can revise the subjective judgments to be more consistent.

$$CR = 0.048 / 1.58 = 0.030$$

Table 5 Random index table

no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R.I.	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.58

Source: Saaty (1980)

After eliminating four risk factors with low eigenvalues, this paper identifies 21 risk factors as the key risk factors, and elaborates them along with the RM planning steps based on the RM-BSC framework, to generate corresponding key risk indices.

3.2 The Integrated RM-BSC Framework

In the RM-BSC framework, the risk-control strategy is the backbone for embedding enterprise risk management into the organizational culture: As business strategy provides direction for the company's entire management activities, risk-control strategy provides direction for the company's risk-management activities (KPMG, 2005). Before developing a new risk management strategy, a few things about the organization need to be made clear including organizational current operations, goals, and objectives. Then, risk exposures relating to every dimension of the company's risk factors and associated indicators can be efficiently and effectively measured. The key elements of the risk-control strategy include governance and regulations, guiding policies, procedures and objectives for risk control, and its linkage to business planning and operation environment. Based on the COSO-ERM framework, the risk management dimensions in our research are simplified as four dimensions: Information and Communication, Monitoring, Risk Policy, Max of Shareholder's Values and Competitiveness. By considering the risk management (RM) dimensions along with the four BSC strategic performance perspectives including Financial (F), Business Process (B), Customer (C), as well as Learning and Growth (L) (Kaplan & Norton, 2001), we propose an integrated RM-BSC framework as shown in Figure 1.

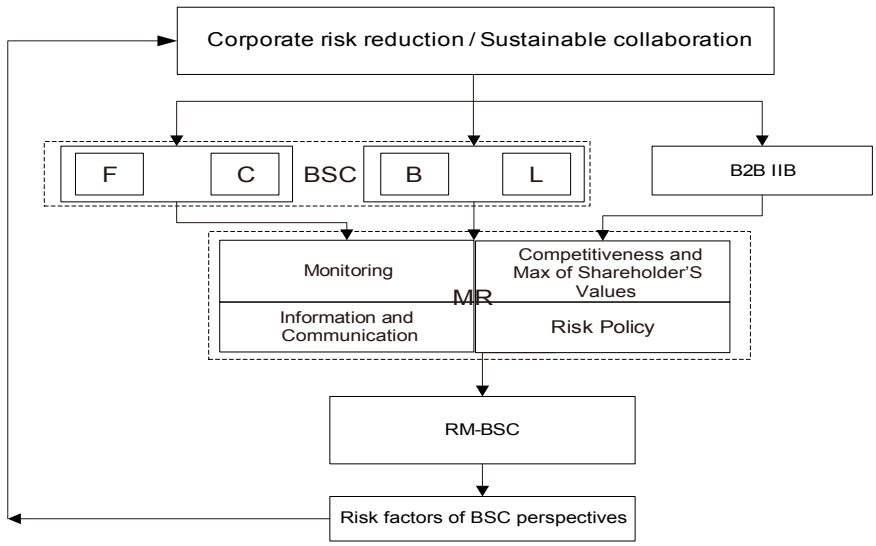


Figure 1 The integrated RM-BSC framework for B2B IIB

The steps for RM planning corresponding to four COSO-ERM dimensions are shown in Figure 2. In the planning steps, the risk management mission and strategies, risk control objectives, and the associated risk factors and indicators are to be specified for further management and control.

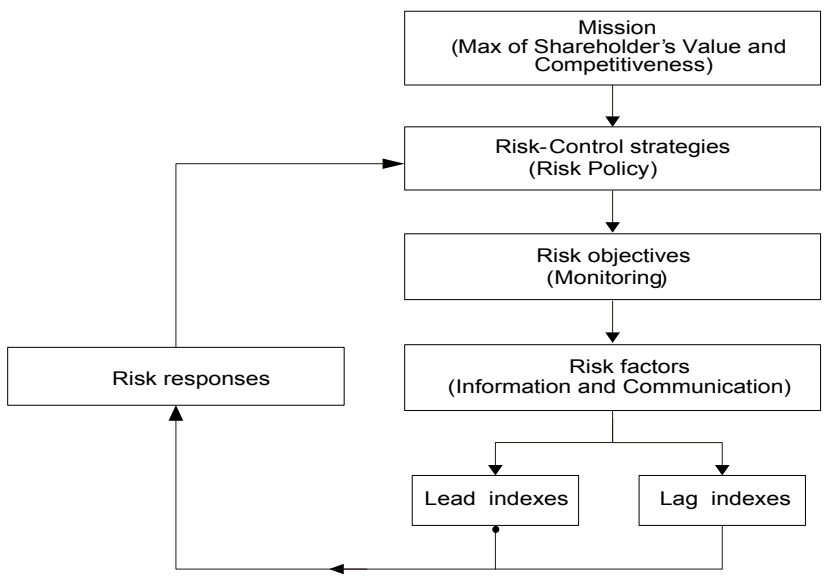


Figure 2 The RM planning steps corresponding to COSO ERM dimensions

The risk factors involved in the RM-BSC framework are aligned with risk adjusted performance activities of the business enterprise. Values are sustained by controlling and reducing the risks. Therefore, this RM-BSC approach is similar to the value-creation process in BSC approach, where each perspective contains outcome measures that are drivers of the other perspectives in the model (Kaplan & Norton, 1996). In Figure 3, risk factors are classified in the RM-BSC framework. Considering the RM planning steps (Figure 2) along with the value sustaining perspectives, the outcome measures from the risk factors classified in one perspective can influence outcome measures in all other perspectives.

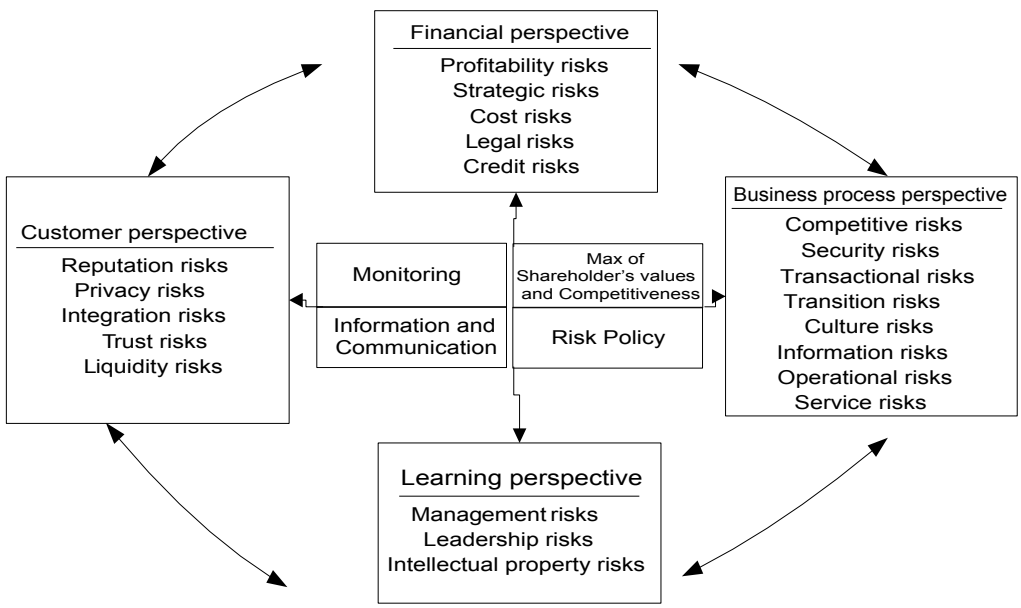


Figure 3 The risk factors in the RM-BSC framework for B2B IIB

3.3 The RM-BSC Scope

In order to align the risk factors along with the business strategy and make it controllable in the organization environment, we try to arrange them by the RM planning steps corresponding to COSO ERM dimensions. The strategic RM planning scopes for the four BSC perspectives are illustrated in Table 6.

Table 6-1 The RM-BSC scope for Learning and Growth perspective

Learning and Growth				
Risk mission	To maintain the employee's productivity, and enhance the company's competitiveness			
Risk-control strategies	● To retain the high quality employees and the generated intellectual properties, and establish the related policies ● To convert the low quality employees to be more productive by training or encouragement, and establish the related policies			
RM objectives	Risk factors	Lead indexes	Lag indexes	Risk responses
To reduce Employee turnover	Leadership risks	● Employee satisfaction index	Employee turnover rate	To improve leadership strategy
To reduce the low quality staff	Management risks	● Number of training hours ● Number of mismanagement counts	● performance evaluation ● Employment Cost	To improve the learning organization setting (Senge,1990)
	Intellectual property risks	● Innovation capability index ● Number of patents	Patent pirate rates	To improve the reward policy for innovation

Table 6-2 The RM-BSC scope for Business Process perspective

Business Process				
Risk mission	To maintain the integrity of the internal process, and enhance the company's competitiveness			
Risk-control strategies	● To avoid ineffective or inefficient workflows of the internal process, and establish the related policies			
RM objectives	Risk factors	Lead indexes	Lag indexes	Risk responses
To reduce defect decision due to information lag	Information risks	Realtime confirmation mechanism for loan payments	Unpayable loan report	To revise the information lagging problem to avoid the incurred defect decision
To reduce unvalued activities	Competitive risks	Activity-Based Costing analysis	Number of unvalued activities	To revise the business process to modify or remove the unvalued activities. (COSO ERM, 2004)

To reduce unregulated operations (COSO ERM, 2004)	Culture risks	Standardized agreements for foreign customers	Number of OBU remittances	To improve the policy and process for more regulated international agreements
To reduce customer inconvenience	Service risks	● Convenience Index ● Number of inconvenience complaints	● Reduced Customer Number ● Reduced Trading Volume	To investigate the customer's request for service improvement
To reduce incomplete transactions	Transactional risks	Setting of transaction check points	Number of Incomplete Transactions	To revise the transaction logging policy
To reduce defects of system security	Security risks	Violateions of e-transaction security rules	● Number of fake cases ● Inadequate authorization mechanism for IT resources	To improve the security control mechanism
To reduce inadequate operations	Operational risks	Establishment of e-auditing procedures	Number of violations of operation rules	To improve the operation monitoring by continuous auditing
To reduce unsuccessful project implementation (COSO ERM, 2004)	Transition Risks	Institutionalized project management process	Number of delayed project progress	To improve the capability or maturity level for the project management process

Table 6-3 The RM-BSC scope for Customer perspective

Customer				
Risk mission	To keep long-term relationship with the customers, and eventually maximize the shareholder's values			
Risk-control strategies	● To avoid customer dissatisfaction by high quality products and services, and establish the related policies			
RM objectives	Risk factors	Lead indexes	Lag indexes	Risk responses
To retain customer confidence	Trust risks	● Number of litigations ● Higher loan amount ● Lower loan rate	Number of loosing customers	To improve the customer service mechanism
To avoid customer's controversy	Integration risks	Number of failing transactions	Number of system integration problems	To improve the function of system integration framework
To avoid the bad brand effect	Reputation risks	● Maturity of Professional advertisement ● Maturity of Professional service capability	● Number of customers ● Number of customer service defects	To improve the function of public relation affairs
To reduce customer's shortage of fund	Liquidity risks	Fund turnover rate of customers	Financial gap report of customer	To improve the customer fund management mechanism
To reduce disclosing customer's data	Privacy risks	Degree of data security for private customer data	Number of Complaints about data security problems	To ensure customer data security disciplines

Table 6-4 The RM-BSC scope for Financial perspective

Financial				
Risk mission	To maintain the cost beneficial status, and eventually maximize the shareholder's values			
Risk-control strategies	● To monitor and maintain the acceptable financial status, and establish the related policies			
RM objectives	Risk factors	Lead indexes	Lag indexes	Risk responses
To reduce customers debt	Credit risks	● Customer Credit rating ● Customer deposit	● Uncollectible loan (bad debt)	To periodically plan or assess for bearable risks
To reduce profit loss	Profitability risks	● Market value ● Conversion rate ● Turn over rate of account receivable	● Acid Ratio ● Transaction fees ● Transaction amount ● Payback rate for E- cost	● To plan for financial procedure for external economic environment ● To plan for pricing negotiation procedure
To reduce unused asset	Strategic risks	Net Present value of investments	● E-finance market share ● E-finance returns on capital	● To plan for annual budget and regular tracking of financial goal ● To plan for the returns on capital after risk adjustment (RAROC) task
To reduce dispute cost	Legal risks	● Delayed payment	● Number of disputes ● Amount of compensation	To plan for mortgage policy from center factory
To reduce operation cost	Cost risks	● Fixed IT cost ● Total IT expenses	● Rate of cost reduction ● Rates of reduction of capital cost	To plan or design new E-finance products with reducing cost

3.4 AHP for RM-BSC

The initial AHP was conducted for the 153 bank loan officers with 43 of them responding to the questionnaire. There are some shortages in the initial AHP:

1. The risk factors arranged in the initial AHP was arranged in one layer, not in hierarchical structure.
2. Saaty (1980) suggests the consistency test based on the assumption that the factors of the same comparison level should be equal or smaller than 15. But our initial AHP compared 25 risk factors collected from the literature and practitioners, which is higher than the suggested limit.
3. Some respondents (bank loan officers) of the initial AHP suggested to disregard four un-important risk factors, COR, MOR, TER, NAR. They all have obviously lower eigenvalues.
4. Although the 43 correspondents are all bank loan officers, only a few of them are at high level positions. The high level managers are assumed to have better judgment for evaluating the risk factors.

After eliminating these risk factors with low eigenvalues, this paper identifies 21 key risk factors and classify them by four BSC perspectives. A second AHP is then conducted by interviewing the selected 7 bank loan experts with high level management authority for answering the revised questionnaire.

(A) The approach of the second AHP evaluation

Identifying key risk factors in RM-BSC for B2B IIB is a typical multiattributes multi-criteria problem. As shown in Figure 4, after management objectives are defined, the AHP process starts with identifying pertinent factors. These factors are then structured into a hierarchy descending from an overall objective to various importance criteria and sub-criteria in successive levels. In the AHP, risk factors in the hierarchy serve two purposes:

1. to provide an overall view of the complex risk relationship inherent in the B2B IIB situation.
2. to help decision makers assess whether the issues in each level are of the same order of magnitude, so that the homogeneity in comparisons is preserved.

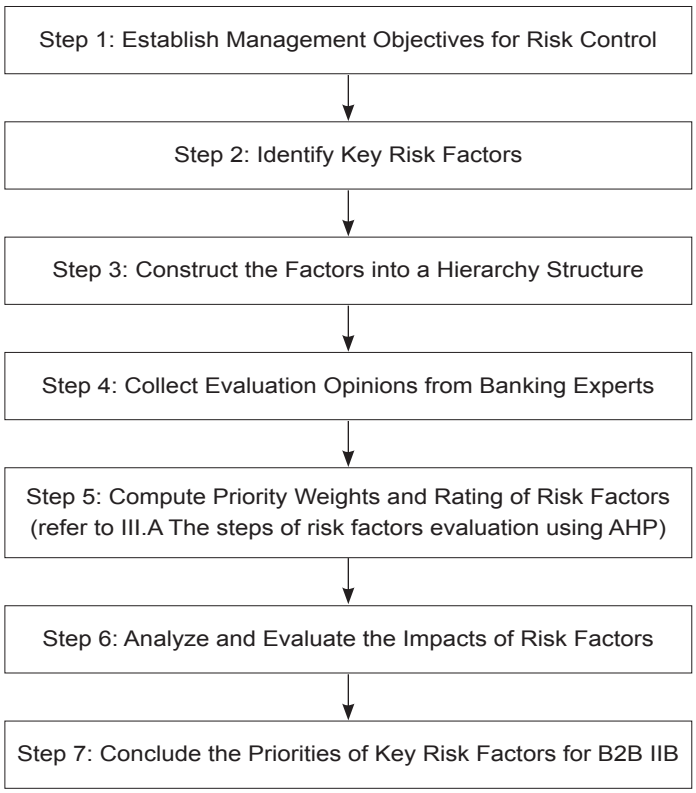


Figure 4 The planning steps of the AHP process

(B) Key risk factor ranking in the second AHP

Figure 5 shows a three-level (L1~L3) decision hierarchy incorporating these criteria and their sub-criteria. A group of seven banking experts were interviewed for evaluating these criteria (four BSC perspectives) and sub-criteria (key risk factors). We invited these experts, as shown in Table 7, to participate the research through responding to a questionnaire. All the respondents were assured that their responses would be kept confidential.

All interviews involved personal visits. During the interview, specific terminology of decision criteria and sub-criteria was explained to evaluators if necessary. Special care was taken to avoid the pitfall of leading questions when requesting evaluators to conduct the rating. The length of the interviews had been limited to 60 min. In the first stage, evaluators were requested to compare the four-decision criteria (corresponding to four BSC perspectives) pairwisely using a nine-point scale of intensity (Table 8). For example, if an evaluator decided that "customer perspective" was moderately important over "financial

perspective" then the former would be rated as "3" and the later would be rated as "1/3" (Saaty, 2000). As a result, a matrix of rating was obtained after the competition of all comparisons. The complete process is illustrated in III.A: The steps of risk factors evaluation using AHP.

In the second stage, evaluators were requested to use absolute measurement to rate the risk factors, i.e. to rate each sub-criterion (key risk factor) (as shown in level 3 of Figure 5) against the corresponding criterion's (level 2 of Figure 5) own intensity set (Saaty, 2000). The intensities within each set represent different weights as shown in Table 9. These weights were calculated by setting the intensities to have an equal distinction from one another (Liberatore, Nydick, & Sanchez, 1992; Tam & Tummala, 2001). The major reason for using this absolute measurement rather than pairwise comparison at this stage is to avoid inconsistent judgment by evaluators. As humans are only able to compare seven to nine things accurately at a time, therefore, the number of sub-criterion to be evaluated by pairwise comparison should be limited to less than nine (Saaty, 1980). Absolute measurement is, therefore, an appropriate means for rating the 21 risk factors in our RM-BSC framework. The results of absolute measurement were then multiplied with the weights of the decision criteria as obtained in the top level comparison, and the consequent results would be the weights of the risk factors.

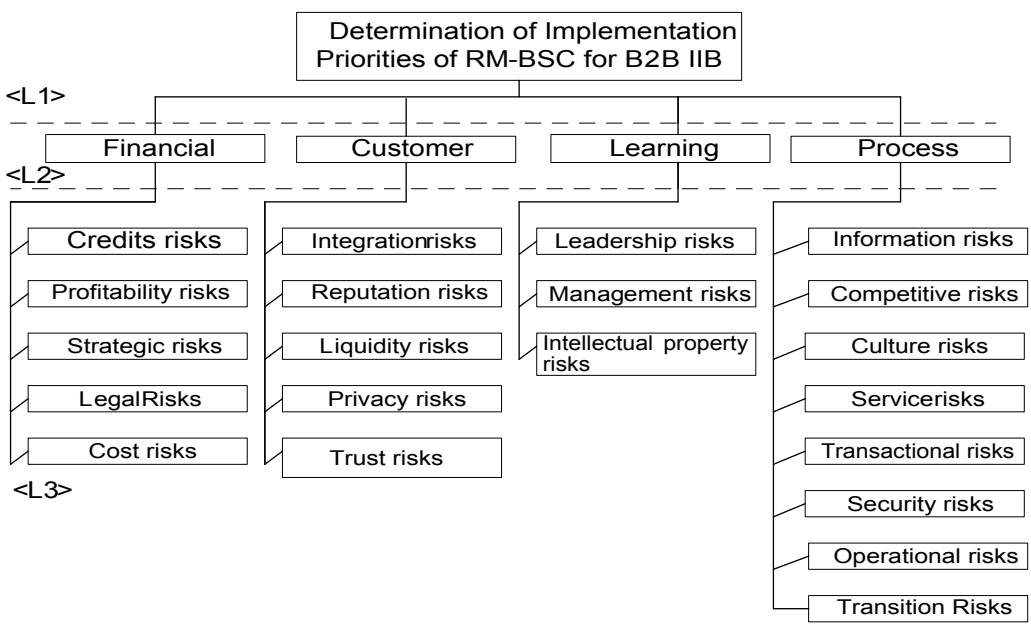


Figure 5 The decision hierarchy model for the AHP

Table 7 Background of banking experts invited

Evaluator	Organization	Position	Banking Experiences
Expert 1	Bank 1 (Loan department)	Deptment Manager	10 Years
Expert 2	Bank 2 (Loan department)	Deptment Manager	11 Years
Expert 3	Bank 3 (Information department)	Deptment Manager	16 Years
Expert 4	Bank 4 (Information department)	Deptment Manager	13 Years
Expert 5	Bank 5 (Bank branch)	Branch Manager	13 Years
Expert 6	Bank 6 (Bank branch)	Branch Manager	11 Years
Expert 7	Bank 7 (Bank branch)	Branch Manager	10 Years

Table 8 Intensities of relative importance for pairwise comparison

Intensity	Definition
1	Equal important
3	Moderate importance of one over the other
5	Essential or strong importance of one over the other
7	Demonstrated importance of one over the other
9	Extreme importance of one over the other
2,4,6,8	Intensities values between the two adjacent judgments

Source: Saaty (1980)

Table 9 Weights of intensities used in the AHP

Rating	Weight obtained from relative comparison (local weight)	Weight divided by the highest value
Always	0.513	1.000
Usually	0.261	0.509
Sometimes	0.129	0.251
Rarely	0.063	0.123
Never	0.033	0.064

Source: Liberatore et al. (1992); Tam and Tummala (2001)

4. Analysis of Results

4.1 Evaluation of Decision Criteria by Four BSC Perspectives

Risk weights of criteria and the consistency ratio of pairwise comparisons from the participating experts (each represent one bank) are given in Table 10. Their consistency ratio was less than the 0.10 criterion and was therefore acceptable (Saaty, 2000). The evaluation processes of decision criteria were identical for Bank1 to Bank7 (B1-B7). By the overall ranking, the top criterion is "Financial perspective". B1, B2, B5 and B7 treat it as the top priority weight, followed by B3, B4, B6 as the second priority weight. The second top criterion is "Process perspective". The statistic of Kendall's test is presented at Table 11 which shows that all of responses are significant in variables p, W, and χ^2. In other words, the representing experts significantly perceive Financial Perspective as the 1st criterion, Process (Business Process) as the 2nd criterion, Customer as the 3rd criterion, and Learning (Learning and Growth) as the last criterion, to be considered for first level decision criteria comparison.

Table 10 The risk priority weights (eigenvalues) of decision criteria

Perspective/Banks	B1	B2	B3	B4	B5	B6	B7	Avg
Financial	0.476 (1)	0.417 (1)	0.332 (2)	0.382 (2)	0.398 (1)	0.398 (2)	0.454 (1)	0.406 (1)
Customer	0.240 (3)	0.153 (4)	0.251 (3)	0.217 (3)	0.294 (3)	0.401 (1)	0.301 (2)	0.253 (3)
Process	0.311 (2)	0.307 (2)	0.435 (1)	0.459 (1)	0.388 (2)	0.275 (3)	0.271 (3)	0.349 (2)
Learning	0.133 (4)	0.205 (3)	0.178 (4)	0.179 (4)	0.143 (4)	0.192 (4)	0.175 (4)	0.172 (4)
Consistency ratio	0.06	0.07	0.07	0.08	0.07	0.08	0.07	

Table 11 The statistic of Kendall's test by the decision criteria

Variables	B1	B2	B3	B4	B5	B6	B7
P	0.033	0.028	0.042	0.038	0.035	0.024	0.036
W	0.51	0.47	0.41	0.46	0.38	0.40	0.39
χ^2	28.86	26.55	27.69	26.02	29.62	28.17	27.72

4.2 Evaluation of Sub-criteria by Key Risk Factors

Table 12 shows the perceived priorities of the key risk factors in RM-BSC as the results of conducting AHP with seven banking experts. As shown in Table 13, the Kendall's coefficient of concordance shows that the degree of agreement of these priorities is high (Kendall's W =1; χ^2 =29.956; p =0.038) for the average. The top of important risk factor is "Credit risks", rated first by B1, B6, followed by "Profitability risks", rated first by B4, B7.

As shown in Table 13, "Financial perspective" is most important with the 1st "Credit risks" and the 2nd "Profitability risks" in the average of the 7 experts. The "Process perspective" is also important, with the 3rd "Security risks", 5th "Service risks", 6th "Competitive risks", 7th "Transactional risks", 8th "Operational risks" in the average. Comparably, "Customer perspective" and "Learning and Growth perspective" are perceived less important except the 4th "Leadership risks".

Table 12 The risk priority weights (eigenvalues) of risk factors in the RM-BSC framework

No	Criteria	Risk factors	B1	B2	B3	B4	B5	B6	B7	Avg.
1	Customer	TUR	0.442 (11)	0.267 (17)	0.364 (15)	0.375 (14)	0.396 (9)	0.343 (14)	0.213 (21)	0.342 (10)
2		IGR	0.291 (19)	0.215 (21)	0.295 (17)	0.287 (15)	0.317 (13)	0.274 (13)	0.315 (11)	0.284 (16)
3		RER	0.315 (16)	0.287 (15)	0.275 (19)	0.262 (17)	0.276 (16)	0.215 (18)	0.224 (20)	0.264 (19)
4		LIR	0.275 (20)	0.254 (18)	0.267 (20)	0.258 (18)	0.235 (20)	0.192 (21)	0.233 (17)	0.244 (20)
5		PIR	0.301 (17)	0.278 (16)	0.375 (11)	0.364(8)	0.324 (12)	0.253 (15)	0.304 (12)	0.314 (13)
6	Learning	MAR	0.379 (12)	0.357 (11)	0.352 (13)	0.352 (9)	0.305 (14)	0.285 (12)	0.295 (13)	0.290 (15)
7		IPR	0.295(18)	0.342 (12)	0.281 (18)	0.246 (19)	0.245 (19)	0.247 (16)	0.273 (15)	0.275 (17)
8		LER	0.463 (2)	0.445 (3)	0.452 (1)	0.387 (6)	0.374 (5)	0.365 (4)	0.352 (4)	0.405 (4)
9	Process	CUR	0.216 (21)	0.243 (19)	0.251 (21)	0.237 (20)	0.212 (21)	0.193 (20)	0.235 (19)	0.226 (21)
10		INR	0.387 (9)	0.361 (10)	0.347 (8)	0.347 (8)	0.298 (9)	0.263 (8)	0.285 (7)	0.326 (12)
11		SVR	0.416 (8)	0.435 (4)	0.388 (7)	0.442 (2)	0.363 (8)	0.354 (9)	0.347 (5)	0.392 (5)
12		TAR	0.405 (7)	0.383 (8)	0.315 (9)	0.332 (7)	0.436 (2)	0.386 (5)	0.363 (6)	0.374 (7)
13		SER	0.425 (4)	0.413 (6)	0.397 (6)	0.415 (4)	0.458 (1)	0.447 (2)	0.437 (2)	0.427 (3)
14		OPR	0.431 (6)	0.395 (7)	0.407 (5)	0.325 (9)	0.352 (9)	0.374 (6)	0.335 (10)	0.372 (8)
15		TRR	0.365 (13)	0.315 (13)	0.338 (12)	0.317 (12)	0.335 (11)	0.298 (11)	0.416 (3)	0.340 (11)
16		CER	0.392 (10)	0.372 (9)	0.432 (3)	0.407 (5)	0.407 (4)	0.417 (3)	0.247 (9)	0.382 (6)
17	Financial	STR	0.351 (14)	0.233 (20)	0.303 (16)	0.273 (16)	0.258 (18)	0.203 (19)	0.268 (16)	0.270 (18)
18		LAR	0.340 (15)	0.295 (14)	0.317 (14)	0.212 (21)	0.263 (17)	0.237 (17)	0.385 (14)	0.292 (14)
19		CTR	0.432 (13)	0.453 (1)	0.325 (13)	0.325 (13)	0.294 (14)	0.312 (10)	0.374 (18)	0.360 (9)
20		PRR	0.458 (3)	0.427 (5)	0.447 (2)	0.451 (1)	0.387 (6)	0.395 (7)	0.448 (1)	0.430 (2)
21		CRR	0.471 (1)	0.450 (2)	0.413 (4)	0.437 (3)	0.415 (3)	0.462 (1)	0.397(8)	0.435 (1)

Table 13 The statistic of Kendall's test by risk factors

Variables	B1	B2	B3	B4	B5	B6	B7
P	0.029	0.017	0.032	0.018	0.020	0.031	0.027
W	0.43	0.51	0.45	0.54	0.41	0.39	0.43
χ2	27.91	25.95	26.79	25.28	27.82	27.18	27.22

4.3 Advocates of a Risk-performance Based Approach in the B2B IIB Environment

In the B2B IIB environment, banks support center factories and provide suppliers with financial services. The center factory transfers bill to banks through e-channel, and banks recognize these bills as the collateral and approve the loan for the suppliers. During the trading process, businesses need higher fund raising efficiency and lower transaction costs and thus internet-based payments should benefit both banks and businesses. However, the bank investing on B2B IIB may loose in this new competitive market due to the poor service reputation (Customer perspective), poor IT service capabilities (Learning and Growth perspective), inefficient operation process (Process perspective), or ineffective cost beneficial arrangement (Financial perspective). The bank is therefore exposed to the risks on the IT investment of B2BIIB in terms of four BSC perspectives.

To avoid the risks and enhance the success opportunity for the IT investment in B2B IIB, we suggest to incorporate the RM-BSC concepts into the PDCA cycle (Deming, 1986) for routine evaluation of risk factors and the associated risk indices, as illustrated in Figure 6. The design of PDCA activities is illustrated below.

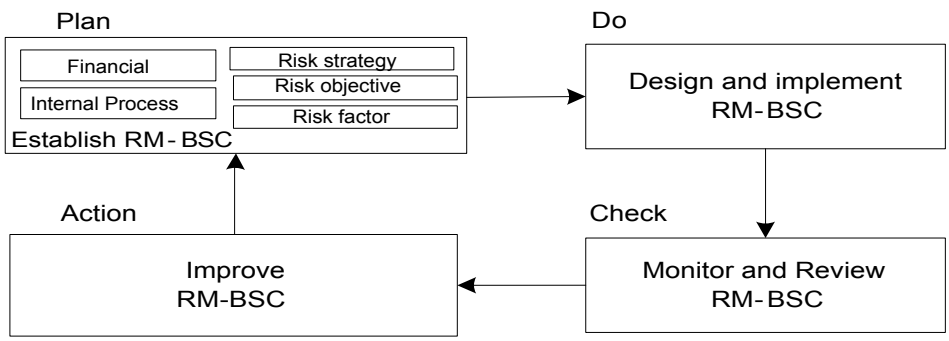


Figure 6 A PDCA model of RM-BSC approach for B2B IIB

(A) Plan: Make the overall plan for risk management, such as:
  (1) establish the decision criteria and sub-criteria for the AHP based on the RM-BSC framework to collect the evaluation of the BSC perspectives and key risk factors from the outside perceptions.
  (2) determine the overall risk appetite (COSO ERM, 2004) for the banks.
  (3) elaborate the key risk factors along with RM planning steps based on the RM-BSC framework to generate the associated key risk indices, based on the inside perceptions.

(B) Do: Develop the action approaches of risk management based on the above plan to achieve the risk control objectives, such as:
  (1) establish an enterprise risk management organization,
  (2) build the risk control knowledge base,
  (3) assess the risk events (COSO ERM, 2004),
  (4) treat and respond to the risk events appropriately, and
  (5) arrange the supervisory and periodical review (COSO ERM, 2004).

(C) Check: Develop the monitoring process to ensure if the risk control mechanism is appropriately implemented, such as:
  (1) whether the policies along with procedures and other entity directives, in response to risk events, are appropriately carried out (COSO ERM, 2004),
  (2) whether the policies along with procedures and other entity directives, are appropriately carried out throughout the organization, at all involved departments and functions (COSO ERM, 2004),
  (3) whether the information technology involved in risk control application is appropriately adopted and implemented (COSO ERM, 2004).

(D) Action: Develop action mechanism to ensure the improvement of risk management, including:
  (1) adopt the important key risk factors and associated risk indices to support the risk-adjusted performance management,
  (2) establish critical control systems and risk management process operations.
  (3) erform the internal controls for important key risk factors and the associated indices.
  (4) provide advices in the design and improvement of control systems and risk mitigation operations.

By the iterative process of the above PDCA cycle, we implement the important features in COSO-ERM to deal with four perspectives of the BSC model, as addressed in the

RM-BSC framework. In the overall RM-BSC approach, risk factors are collected from the literature and bank loan officers, classified by BSC perspectives, elaborated along with RM planning steps, identified and prioritized by the AHP, and finally implemented by the periodically review via the PDCA cycle.

5. Validation for the RM-BSC Framework

5.1 Questionnaire and Sample

To validate the association relationships among 21 risk factors and 4 BSC perspectives as organized in the RM-BSC framework in Figure 3, we developed a questionnaire with 7-point Likert scale question which hypotheses of risk factors association along with the RM-BSC framework is shown in Table 14. The questionnaire was refined by 7 senior managers as shown in Table 7, and then delivered to 512 experienced loan and IT officers in the banking industry at Taiwan during the fall of 2009. A total of 456 responses were received. After eliminating incomplete and inappropriate responses, a total of 418 usable responses were collected for construct validation and hypothesis testing. More than 80% of the respondents were manager and near half (48%) of them had more than 10 years of banking experiences.

5.2 Exploratory Statistics

The exploratory statistics is based on the structural equation modelling (Hair, Anderson, Tatham, & Black, 1998). In the processes, we examined the construct validity by exploratory factor analysis (EFA). Cronbach's α was used to verify the reliability of the association recognition of each risk factor using 0.6 criterion as suggested by Hair et al. (1998). As for the validation of BSC perspectives, we used Fornell's composite reliability (CR) (Fornell & Larcker, 1981) with greater than the 0.7 to be considered adequate. As shown in Table 15, the results reveal that each risk factor's factor loading (by Cronbach's α) is greater than 0.6, indicating a good convergent validity for each risk factor. The composite reliabilities[1] (CR) of the risk factors in the construct are all higher than 0.7, indicating adequate internal consistency.

Principle components analysis and varimax rotation method were also used to further validate the association relationships. The results show that all the eigenvalues are greater than 1.0, and all the average variance extracted (AVE) values are higher than the commonly

[1] Composite reliability= $\left(\lambda i\right)^2 \operatorname{var} F / \left[\left(\lambda i\right)^2 \operatorname{var} F + \Theta ii\right]$

acceptable 0.50 criterion. All of the above validity analyses exhibit the adequacy of the association relationships among 21 risk factors and 4 BSC perspectives in the proposed RM-BSC framework. The descriptive statistics are listed in Table 15.

Table 14 Hypotheses of risk factors association along with the RM-BSC framework

BSC Perspectives	Risk Factors	Hypothesis
Financial Perspective	CRR	HF1: Based on the description in Table 3, the CRR factor is considered appropriate to be associated with the Financial Perspective.
	PRR	HF2: Based on the description in Table 3, the PRR factor is considered appropriate to be associated with the Financial Perspective.
	LAR	HF4: Based on the description in Table 3, the LAR factor is considered appropriate to be associated with the Financial Perspective.
	STR	HF5: Based on the description in Table 3, the STR factor is considered appropriate to be associated with the Financial Perspective.
	CTR	HF6: Based on the description in Table 3, the CTR factor is considered appropriate to be associated with the Financial Perspective.
Customer Perspective	TUR	HC1: Based on the description in Table 3, the TUR factor is considered appropriate to be associated with the Customer Perspective.
	IGR	HC2: Based on the description in Table 3, the IGR factor is considered appropriate to be associated with the Customer Perspective.
	LIR	HC4: Based on the description in Table 3, the LIR factor is considered appropriate to be associated with the Customer Perspective.
	PIR	HC5: Based on the description in Table 3, the PIR factor is considered appropriate to be associated with the Customer Perspective.
	RER	HC6: Based on the description in Table 3, the RER factor is considered appropriate to be associated with the Customer Perspective.

Business Process Perspective	INR	HI2: Based on the description in Table 3, the INR factor is considered appropriate to be associated with the Business Perspective.
	CTR	HI3: Based on the description in Table 3, the CTR factor is considered appropriate to be associated with the Business Perspective.
	CUR	HI4: Based on the description in Table 3, the CUR factor is considered appropriate to be associated with the Business Perspective.
	SVR	HI5: Based on the description in Table 3, the SVR factor is considered appropriate to be associated with the Business Perspective.
	TAR	HI6: Based on the description in Table 3, the TAR factor is considered appropriate to be associated with the Business Perspective.
	SER	HI7: Based on the description in Table 3, the SER factor is considered appropriate to be associated with the Business Perspective.
	OPR	HI8: Based on the description in Table 3, the OPR factor is considered appropriate to be associated with the Business Perspective.
	TRR	HI9: Based on the description in Table 3, the TRR factor is considered appropriate to be associated with the Business Perspective.
Learning and Growth Perspective	LER	HL1: Based on the description in Table 3, the LER factor is considered appropriate to be associated with the Learning Perspective.
	MAR	HL2: Based on the description in Table 3, the MAR factor is considered appropriate to be associated with the Learning Perspective.
	IPR	HL3: Based on the description in Table 3, the IPR factor is considered appropriate to be associated with the Learning Perspective.

Table 15 The results of EFA

Criteria	Sub criteria	Hypothesis	Eigenvalue	AVE	Cronbach's α	CR
Financial (α=0.814)	CRR	HF1	1.335	0.748	0.686	0.951
	PRR	HF2	2.014	0.751	0.871	0.917
	LAR	HF4	1.165	0.612	0.717	0.923
	STR	HF5	1.006	0.678	0.743	0.881
	CTR	HF6	1.153	0.812	0.901	0.805
Customer (α=0.746)	TUR	HC1	2.124	0.692	0.772	0.913
	IGR	HC2	1.548	0.665	0.692	0.804
	LIR	HC4	1.716	0.871	0.871	0.875
	PIR	HC5	1.691	0.875	0.805	0.852
	RER	HC6	1.802	0.603	0.713	0.911
Internal Process (α=0.834)	INR	HI2	2.027	0.761	0.817	0.904
	CTR	HI3	1.619	0.624	0.696	0.956
	CUR	HI4	1.297	0.659	0.901	0.907
	SVR	HI5	1.518	0.752	0.752	0.825
	TAR	HI6	1.387	0.622	0.622	0.826
	SER	HI7	1.471	0.816	0.816	0.851
	OPR	HI8	1.719	0.859	0.859	0.892
	TRR	HI9	1.693	0.733	0.733	0.863
Learning and Growth (α=0.786)	LER	HL1	2.011	0.702	0.791	0.907
	MAR	HL2	1.912	0.647	0.694	0.842
	IPR	HL3	1.365	0.698	0.713	0.918

5.3 Confirmatory Statistics

Since every Eigenvalue was above the acceptable level, all questionnaire items were retained for further analysis. In the confirmatory statistics, all the coefficients in the Pearson correlation matrix are lower than the acceptable 0.8 (Hair et al., 1998), as shown in Table 19

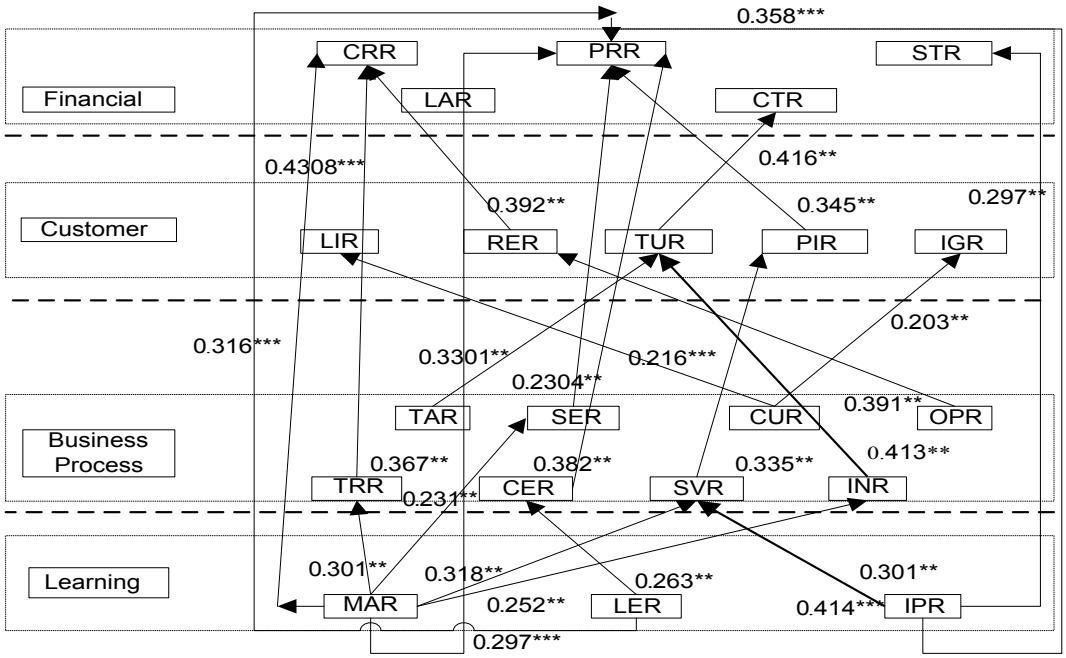
of the Appendix, indicating the good discriminating validity for all factors with no significant multicollinearity. Finally, we examined some important goodness-of-fit indexes. The results in Table 16 show that our research construct is a proper structural model.

Table 16 The results of Goodness-of-fit measurement

Fit statistic	Criteria	Results
Chi-square		386.03
df		145
Normed λ^2 index λ^2 (/df)	3	2.618
Chi-square significance	P<=0.05	<0.0005
Goodness-of-fit index (GFI)	>=0.9	0.952
Normed fit index (NFI)	>=0.9	0.951
Comparative fit index (CFI)	>=0.9	0.965
Root mean Square residual (RMR)	<=0.05	0.021
RMSEA	<=0.05	0.05
PCLOSE	>=0.5	0.65

Source: this research

In the BSC framework, Learning and growth perspective (LP), Business process perspective (BP), Customer perspective (CP), and Financial perspective(FP) are related positively and sequentially (Kaplan & Norton, 1996). They assert the fact that LP affects BP, BP affects CP, and CP affects FP. Based on the suggestion of Hair et al. (1998), we developed the path analysis for the RM-BSC framework. The path might imply the causal-effect relationships along with the strategy map consisted of the 21 risk factors. Figure. 7 and Table 17 shows a version of relationship that incorporates the standardized regression weights. By SEM, we used the Critical Value (C.R.), equal to the parameter estimate (or called beta coefficients) divided by its standard error (S.E.), and test the statistical significance. The parameter estimate named as Total effect is the sum of direct effect and indirect effect, and the indirect effect is the multiplication product of all the parameter estimates of the in-between paths. The results of the path analysis of the strategy map associated with the RM-BSC framework are illustrated as follows.



Notes: **significant level p<0.05; ***significant level p<0.01, RMSEA=0.038, chi-square = 68.67

Figure 7 Strategy map for the risk factors in the RM-BSC framework

(1) Two paths in Table 17, MAR → INR → TUR → CTR and OPR → RER → CRR, have low total effects without statistical significance. They may be due to the low risk priority weights of some involved risk factors, such as MAR (15th), INR (12th), and RER (19th), as shown in Table 12.

(2) The path from MAR → TRR → CRR has the highest total effect 0.541 and C.R. value 6.598 with statistical significance. It includes the direct effect as well as the indirect effect via the intermediate node TRR at BP. This highest total effect in the path analysis along with the highest risk priority weights of CRR (1st) in Table 12 echoes to Basel Committee's promotion in adequate and effective transparency of credit risk profiles by providing guidance to banks on useful credit risk disclosures and discussion to fulfill the supervisory information needs (Basel, 1999).

(3) The path from LER → CER → PRR has the second highest total effect 0.416 with statistical significance. The LER of LP would influences the CER of BP, which in term affects the PRR of FP. This reflects the common recognition of the profitability of internet business should be geared to the thorough compatibility involved in the BP based on the leadership established in the LP (Porter, 1980).

Table 17 Parameter estimates (AMOS report) representing the direct and indirect paths

Regression Weights							
No.	Path	Estimate			S.E.	C.R.	P-value
		Direct effect	Indirect effect	Total effect			
1	LER→CER→PRR	0.316	0.1004	0.416	0.092	4.522	0
2	MAR→TRR→CRR	0.4308	0.1104	0.541	0.082	6.598	0
3	MAR→INR→TUR→CTR	-	0.0432	0.0432	0.079	0.546	0.518
4	MAR→SER→PRR	0.297	0.0532	0.3178	0.084	3.783	0
5	MAR→SVR→PIR→PRR	0.297	0.0367	0.3337	0.071	4.700	0
6	IPR→SVR→PIR→PRR	0.358	0.0347	0.405	0.078	5.192	0
7	IPR→STR	0.297	-	0.297	0.051	5.823	0
8	TAR→TUR	0.3301	-	0.3301	0.034	4.038	0
9	CUR→LIR	0.216	-	0.216	0.081	5.407	0
10	CUR→IGR	0.203	-	0.203	0.069	4.942	0
11	OPR→RER→CRR	-	0.1532	0.1532	0.061	2.511	0.097

As illustrated above, the validation of the risk factor associations in the RM-BSC framework based on the SEM includes the exploratory statistics, confirmatory statistics, and the statistics involved in the path analysis (Hair et al., 1998). The exploratory statistics shows a good convergent validity and adequate internal consistency for each risk factor. The confirmatory statistics indicates the good discriminating validity for all factors with no significant multicollinearity. Finally, the overall goodness-of-fit indexes reveal the appropriateness of the structural model in our research. Path analysis was used to identify the import and unimportant paths form LP to FP to make further statistical validation. The results of path analysis are compared with the earlier AHP analysis and risk management concerns as well as strategic considerations in the real world.

6. Discussion and Conclusions

The primary profit of banking industry depends on the acceptance of risk appetite. When a bank makes profits from the capital or stock, it would be simultaneously faced with

the risk of deficit or loss. Therefore, the performance management and evaluation indexes should involve the concept of risk management. Typical BSC addresses the strategic performance measurement which doesn't involve the concepts of risk management (assessment). Standard risk management focuses on risk control activities in response to event identification and risk assessment and doesn't address the impact on the performance evaluation. This paper aims to integrate the concepts of performance evaluation and risk control on behalf of both the researchers and practitioners. The similar economic capital concept has been developed to the Risk-Adjusted Return on Capital (RAROC) as a newer performance index (Chapelle, Crama, Hübner, & Peters, 2008). However, the RAROC addresses the financial aspect only. The contribution of this paper is to further elaborate the risk factors along with the four perspectives of BSC and analyze their possible causal effect relationships. The BSC model could help to translate the risk-control strategies into a linked set of objectives and indexes for evaluating the achievements of objectives set to implement the risk-control strategies.

This paper has discussed characteristics of risk factors of the B2B IIB and considered that a balanced scorecard approach seemed well suited as a risk-control strategy development instrument as it holds the potential for incorporating various kinds of risk factors. However, the risk-control strategy development aspects of the balanced scorecard may be rather weak at accounting for the B2B IIB environments. The spirit of COSO ERM provides a useful reference to be incorporated into our proposed RM-BSC framework for the complex settings in theB2B IIB environment. The integrated RM-BSC framework gives valuable and diverse information by setting up the risk control objectives and associating the important key risk factors with the necessary indices in response to appropriate risk management strategies to reach the risk control mission.

The AHP approach is adopted for initial identifying and later prioritizing key risk factors in RM-BSC for B2B IIB. It provides a systematic way to enables banking experts to determine decision criteria and risk factors involved in the RM-BSC . As key risk factors are rated independently in absolute measurement, the model enables decision maker to introduce new factors or delete old factors without affecting the weights of existing factor priorities.

This paper conducts the AHP survey twice. The initial survey identifies 21 applicable key risk factors and the following survey ranks the relative priorities of the selected 21 risk factors. The analytic hierarchy is structured by the four major perspectives of the BSC model: Financial, Customer, Internal Business Process, Learning and Growth, with each

followed by the related risk factors. The results show that Financial (0.406) and Internal Business Process (0.349) have higher risk weights. This indicates that inducing cost beneficial arrangement and promoting internal business process improvement for B2B IIB are considered more risky by banking experts. For the associated risk factors, "Credit risks" (0.435), "Profitability risks" (0.430) and "Security risks" (0.427) are the most important factors to be focused on. An implementation approach for periodically assessing the key risk factors along with risk management strategies and the associated risk indices in the dynamic B2B IIB environment are also discussed.

In the overall RM-BSC approach, the collection of risk factors from the literature and practitioners and their identification/prioritization by the AHP represent the emphasis of risk consensus from outside sources. The classification of risk factors by BSC perspectives and the elaboration along with RM planning steps represent the emphasis of risk considerations from the inside of organization. The suggested implementation by the PDCA model represents the action plan with periodical review to consolidate the external perceptions and internal considerations for effective risk management.

The validation of the risk factor associations in the RM-BSC framework were conducted based on the SEM testing with statistical significance. The exploratory statistics shows a good convergent validity and adequate internal consistency. The confirmatory statistics indicates the good discriminating validity with no significant multicollinearity. The overall goodness-of-fit indexes reveal the appropriateness of the structural model. Path analysis identifying the important paths form LP to FP might imply the causal-effect relationships along with the strategy map consisted of the risk factors. The analysis can therefore make better management implications for both academia and practitioners. A tool like QPR ScoreCard tool (QPR, 2008) can be developed for the important risk factors to monitor the routine operation of B2BIIB to control the possible risk exposures.

This research focuses mainly on the risk factors in the RM-BSC framework in B2B IIB. Future research could further elaborate the risk factors to find the lead indexes and lag indexes and the associated risk responses. Furthermore, the study could extend the applicability of the RM-BSC approach to other enterprises and SMEs, separately or collectively. Similar to the empirical information collected in this paper for banking industry, comparative evaluations of various decision criteria and sub-criteria can be conducted across various industry sectors to reveal industry-specific characteristics. The research can also be extended to adopt other evaluation instruments to replace the complicated evaluation approach of the AHP.

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Appendix

Table 18 The pairwise comparison matrix for risk factors evaluation in the initial AHP

No	Risk factors	TUR	IGR	COR	LIR	PIR	RER	LER	MAR	IPR	MOR	TER	INR	CER	CUR	SVR	TAR	SER	OPR	TRR	CRR	PRR	NAR	LAR	STR	CTR
1	TUR	1	1/2	3	1/2	2	4	3	1	3	3	4	1/3	2	1/4	3	2	1/6	1/7	1/3	2	1/3	3	1/2	2	3
2	IGR	2	1	4	2	3	2	1/5	4	1/7	7	8	1/4	1/3	7	8	5	1/6	6	7	6	3	7	3	4	5
3	COR	1/3	1/4	1	1/5	2	1/5	1/7	2	1	1	2	3	1/5	1/7	1/4	3	1/5	1/6	1/7	1/8	1/7	2	1/8	1/6	1/7
4	LIR	2	1/2	5	1	1/3	1/4	5	1/7	1/6	5	7	1/5	6	5	7	4	6	1/3	5	1/6	1/7	6	1/2	1/4	1/6
5	PIR	1/2	1/3	1/2	3	1	1/3	1/6	5	4	1/8	1/9	6	7	5	8	1/5	1/8	6	1/7	3	4	1/8	7	1/5	1/6
6	RER	1/4	1/2	5	4	3	1	1/2	3	4	3	1/8	1/4	3	6	7	5	8	1/2	1/4	3	8	1/4	1/3	5	8
7	LER	1/3	5	7	1/5	6	2	1	5	7	1/6	1/5	3	1/2	1/3	4	1/7	1/6	5	8	1/2	1/5	3	7	1/4	1/5
8	MAR	1	1/4	1/2	7	1/5	1/3	1/5	1	6	4	3	2	1/2	1/3	4	7	5	1/2	1/3	1	2	7	4	1/3	5
9	IPR	1/3	7	1	6	1/4	1/4	1/7	1/6	1	1/2	4	1/3	1/2	1/7	3	5	7	4	1/2	1/3	1/6	1/7	1/2	1/3	3
10	MOR	1/3	1/7	1	1/5	8	1/3	6	1/4	2	1	1/3	1	1/4	2	1/5	3	1/4	1/6	1	1/4	1	1	3	1/2	1/4
11	TER	1/4	1/8	1/2	1/7	9	8	5	1/3	1/4	3	1	1/5	1/6	1/2	1	1/2	1/3	1	2	1/7	1/6	1	1/4	2	3
12	INR	3	4	1/3	5	1/6	4	1/3	1/2	3	1	5	1	3	2	1/7	1/4	2	1/2	3	1/2	1/3	1	2	1	1/4
13	CER	1/2	3	5	1/6	1/7	1/3	2	2	2	4	6	1/3	1	4	8	1/3	2	1/4	6	1/7	5	3	7	4	2
14	CUR	4	1/7	7	1/5	1/5	1/6	3	3	7	1/2	2	1/2	1/4	1	1/2	1/7	2	3	5	1/4	1/7	3	1	2	4
15	SVR	1/3	1/8	4	1/7	1/8	1/7	1/4	1/4	1/3	5	1	7	1/8	2	1	6	1/3	5	1/2	1/4	1/6	7	8	4	1
16	TAR	1/2	1/5	1/3	1/4	5	1/5	7	1/7	1/5	1/3	2	4	3	7	1/6	1	4	3	1	1/5	2	1	3	4	2

17	SER	6	6	5	1/6	8	1/8	6	1/5	1/7	4	3	1/2	1/2	1/2	3	1/4	1	1/2	1/3	1	7	4	1	2	3
18	OPR	7	1/6	6	3	1/6	2	1/5	2	1/4	6	1	2	4	1/3	1/5	1/3	2	1	4	1	1/2	3	1	1/2	1/3
19	TRR	3	1/7	7	1/5	7	4	1/8	3	2	1	1/2	1/3	1/6	1/5	2	1	3	1/4	1	1/8	2	1	6	1/5	3
20	CRR	1/2	1/6	8	6	1/3	1/3	2	1	3	4	7	2	7	4	4	5	1	1	8	1	4	1	2	1/5	1
21	PRR	3	1/3	7	7	1/4	1/8	5	1/2	6	1	6	3	1/5	7	6	1/2	1/7	2	1/2	1/4	1	7	2	1/4	3
22	NAR	1/3	1/7	1/2	1/6	8	4	1/3	1/7	7	1	1	1	1/3	1/3	1/7	1	1/4	1/3	1	1	1/7	1	3	1	1/2
23	LAR	2	1/3	8	2	1/7	3	1/7	1/4	2	1/3	4	1/2	1/7	1	1/8	1/3	1	1	1/6	1/2	1/2	1/3	1	7	1/3
24	STR	1/2	1/4	6	4	5	1/5	4	3	3	2	1/2	1	1/4	1/2	1/4	1/4	1/2	2	5	5	4	1	1/7	1	2
25	CTR	1/3	1/5	7	6	6	1/8	5	1/5	1/3	4	1/3	4	1/2	1/4	1	1/2	1/3	3	1/3	1	1/3	2	3	1/2	1

Table 19 The results of Pearson correlation matrix

Risk factors	TUR	IGR	LIR	PIR	RER	LER	MAR	IPR	INR	CER	CUR	SVR	TAR	SER	OPR	TRR	CRR	PRR	LAR	STR	CTR
TUR	1																				
IGR	0.353*	1																			
LIR	0.461**	0.613**	1																		
PIR	0.528*	0.324	0.418*	1																	
RER	0.426**	0.361**	0.464**	0.313**	1																
LER	0.398*	0.412*	0.115	0.425*	0.352*	1															
MAR	0.503**	0.153	0.303*	0.131	0.338*	0.410**	1														
IPR	0.429*	0.393*	0.493*	0.336*	0.293	0.361*	0.431*	1													
INR	0.547**	0.417**	0.204	0.473**	0.547**	0.432**	0.579**	0.221	1												
CER	0.304*	0.249	0.317*	0.292	0.376*	0.323*	0.362*	0.332*	0.311*	1											
CUR	0.492*	0.523*	0.425*	0.531*	0.155	0.514*	0.256	0.549*	0.406*	0.590*	1										
SVR	0.523**	0.434**	0.387*	0.448**	0.374*	0.185	0.343*	0.457**	0.271	0.475**	0.317*	1									
TAR	0.601**	0.516**	0.461*	0.562**	0.413*	0.526**	0.437*	0.565**	0.415*	0.185	0.451*	0.557**	1								
SER	0.394*	0.451*	0.402*	0.216	0.421*	0.467*	0.414*	0.478*	0.413*	0.487*	0.131	0.476*	0.314*	1							
OPR	0.396*	0.603**	0.196	0.632**	0.261	0.628**	0.316*	0.686**	0.318*	0.668**	0.381*	0.185	0.512*	0.615**	1						
TRR	0.435*	0.531*	0.435*	0.519*	0.450*	0.599*	0.405*	0.591*	0.409*	0.119	0.490*	0.594*	0.509*	0.493*	0.490*	1					

CRR	0.496*	0.546*	0.496*	0.565*	0.469*	0.550*	0.496*	0.509*	0.194	0.590*	0.449*	0.503*	0.189	0.430*	0.493*	0.340*	1				
PRR	0.508**	0.258	0.508**	0.487**	0.588**	0.271	0.581**	0.418**	0.585**	0.481**	0.558**	0.412**	0.452**	0.318**	0.326**	0.384**	0.620**	1			
LAR	0.412*	0.428*	0.212	0.280	0.427*	0.401*	0.147	0.416*	0.472*	0.461*	0.427*	0.610*	0.372*	0.104	0.278	0.453*	0.518*	0.354*	1		
STR	0.309*	0.495*	0.309*	0.453*	0.396*	0.432*	0.369*	0.225	0.367*	0.452*	0.375*	0.123	0.472*	0.439*	0.229*	0.495*	0.398*	0.546*	0.281	1	
CTR	0.503**	0.456**	0.503**	0.464**	0.135	0.443**	0.558**	0.434**	0.559**	0.443**	0.195	0.437**	0.651**	0.378**	0.486**	0.387**	0.465**	0.375**	0.453**	0.354**	1

Notes: *Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed)

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