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Full Length Research Paper

Solutions for conflicts between variant product strategies and their performance evaluation

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Although lots of recent publications address customer management and supply chain management within production networks, critical success factors (CSFs) of new product development (NPD) still have no one solution. In addition, most firms also suffer from the inconsistency between strategic objectives (newly emerging strategies) and final performance (implementing the current strategy). In order to solve the aforementioned problems, the paper first discusses CSFs of NPD within production network, and then finds that CSFs are different between strategic objectives and performance indicators. Basically, the difference is larger in radical product strategies because their composite are more complicated and dynamic, but smaller in incremental product strategies. Accordingly, in order to solve the inconsistency for all product strategies, firms are suggested to adopt the model consisting of two sets of casual analysis to timely cascade strategic formation process with extracted CSFs, and then extracted CSFs with performance evaluation indices.

Key words: Product strategies; project management; critical success factors (CSFs), performance evaluation

INTRODUCTION

Companies need to have successful new product development (NPD) to confront fast changing technologies, shortening product life cycles and increased global competitions. Considerable effort has been made in the past several years to help organizations make better decisions in NPD project selection (Ringuest et al., 2004; Lawson et al., 2004). These studies attempted to identify the factors that were necessary for the success of NPD. Although lots of recent publications address customer management and supply chain management within production networks, critical success factors (CSFs) of NPD still have no one solution (Helble and Lee, 2004; Grant and Baden-Fuller, 2004; Luo et al., 2007). Different methodologies were used, and similar, inconsistent or even contradictory results were found (Sun and Wing, 2005). Therefore, in order to obtain objective results about CSFs of NPD under production network, a comprehensive literature review and data collection were carried out by the authors. Then, extensive questionnaires and statistical analysis were applied in order to obtain meaningful extracted CSFs. In addition, the empirical operations and scholarly literature always suffer from the fact that strategic objectives (newly emerging strategies) and performance evaluation indices (implementing the current strategy) cannot be in accord (Simons, 1995; Veen-dirks and Wijn, 2002; Chaganti, et al., 2008). Accordingly, the paper first discusses CSFs of NPD within production network, and then finds that CSFs are different between strategic objectives and performance indicators. Basically, the difference is larger in radical product strategies because its market and technology are more complicated and dynamic, but smaller in incremental product strategies. Accordingly, in order to solve the aforementioned inconsistency for all product strategies, firms are suggested to adopt the model consisting of two sets of casual analysis to timely cascade strategic formation process with extracted CSFs, and then extracted

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CSFs with performance evaluation indices (Aworemi and Ilori, 2008).

The rest of the paper is organized as follows. A hierarchy for facilitating NPD is constructed in section 2. Consistency between strategic objectives and performance evaluation indices are studied in section 3, and case studies adopting the proposed methodology for different product strategies are presented in section 4. Some conclusions and future research directions are addressed in the last sections.

HIERARCHY FOR FACILITATING NPD IN PRODUCTION NETWORKS

The concept of network capability was first introduced by Ritter (1999). With diversified and complex network structures, forms and categories, scholars have not reached an agreement on the definition of network capability. Generally speaking, network capability can be explained from two perspectives. One is the capability of the network at strategic level, that is, knowledge and capability of developing overall network opinion and prediction on potential evolutionary direction (Ritter and Gemunden, 2004). In order to reach the strategic objective of maintaining competitive in long term, a firm needs to select suitable product strategies through a list of potential candidates under network cooperation (Chen et al., 2006). Hence, strategic network capability means to develop product strategies and new products under production network, and this must timely take four aspects of network cooperation into accounts including technological capability, market capability, organizational relationship capability, and integrated capability of manufacturing resources (Sivadas and Dwyer, 2000; Trott, 1998; Kale et al., 2002). The other perspective is the capability of the network at execution level, that is, a company's capability to promote its position and to build a good relationship within the network. This is the capability to gain competitive advantages by initiating, maintaining and utilizing commercial relationship and network (Ritter and Wilkinson, 2002). In order to reach the executive objective of maintaining competitive and utilizing the resources under production network, a firm needs to closely execute, monitor, and evaluate selected projects to which established objectives are met (Chen et al., 2006).

In this research, a hierarchy with five stages is constructed. Developing new projects with innovation and effectiveness under production network is the strategic objective at the highest hierarchy, and the items for achieving strategic objectives, which consist of capabilities of organizational relationship, marketing, technology, and resources integration, are developed in the second stage. The CSFs of NPD under production network are searched in the third hierarchy, while performance evaluation items including financial, customer, internal process and innovation perspectives are in the fourth stage (Kaplan and Norton, 1992). The final stage is the performance target. The first three stages simplify the complexity of strategic product selection under production network, and the last three stages simplify the complexity of project performance evaluation. The strategic formulation process offers a platform to select strategic projects in response to dynamic market needs and technology changes, while performance evaluation examines the executing efficiency of the strategically selected projects. Though causally linked, CSFs of NPD, strategic product objectives and performance evaluation indices are different. Thus, the authors study from two perspectives: one, project evaluation study (the strategic perspective); and two, performance evaluation of the strategically selected projects (the execution perspective). The major purpose of strategic formulation process is to examine whether the project timely responds to dynamic market needs and technological changes. Performance evaluation of execution is to examine execution performance, such as customer satisfaction, standardization rate of developing process, meeting of performance objectives.

Accordingly, the paper first builds up strategic product objectives of an enterprise (strategic network capability) by means of four aspects of product strategies (Strategic objectives), and then list extracted CSFs of NPD under production network after an extensive research and statistical analysis (Critical success factors (CSFs) and finally introduce the modified balanced scorecard for performance evaluation (Balanced scorecard for performance evaluation) in the subsequent sub-sections.

Strategic network capability

Meyer et al. (1986) pointed out that the growth of a firm must be based on the decisions on exploiting or exploring NPD and on market characteristics, and then on the so-called product strategy. In order to find the best product strategy, patterns and activities including exploitation, exploration (Lee and Lee, 2003; Lee and Ryu, 2002), multi-products (Padmanabhan et al., 1997; Bhattacharya et al., 1998) and family products (Meyer and Lehnerd, 1997; Krishnan and Gupta, 2001) used to be considered. Exploratory migration keeps the network on leading technologies, and exploitative migration satisfies customer's individual needs. A good product strategy needs to keep firms competitive, stable and innovative at the same time. Nobeoka and Cusumano (1997) studied the relationship among product strategy, product structure factors and operation process, and performance of product development, and concluded the following: (1) NPD is a strategic process, and a firm must set the strategy and objectives; (2) NPD process and organization structure affect the setting of development strategy; (3) NPD strategy, process and performance are

causally related. The theoretical basis of this paper is constructed under these concepts.

Strategic objectives

Strategic objectives for NPD under production network should cover the following items:

Network's technological capability

Cooperative competence in network means mutual adjusting capability among organizations that participate in innovation, especially technological complementary capability of innovation among organizations (Sivadas and Dwyer, 2000; Langlois and Robertson, 1995);

Network's market capability

Market capability of network means an organization's capability of uniting consumers and binding channels in a network (Trott, 1998).

Network's organizational relationship capability

Relational capability in network means the capability of winning competitive advantages by forming, developing and governing partnership among network organizations or the capability of gaining, developing and maintaining mutual benefit relationship (Dyer and Singh, 1998).

Network's integrated capability

Network alliance capability is a firm's mechanism and process, which provides integrated capability to accumulate, store, integrate and transmit knowledge and resources among individuals and organizations (Kale et al., 2002).

Critical success factors (CSFs)

Critical elements should receive constant and careful attention from management because they drive the organization to focus attention on the success of the project in hand (Asrilhant et al., 2006). Empirical studies showed that there is no best CSFs of NPD under production networks since CSFs change along with product complexities, chosen technologies, size and structure of an organization, project characteristics and enterprise's own circumstances (Danilovixc and Winroth, 2005). Therefore, an extensive research is applied in order to obtain objective results and finally 47 CSFs are collected (Table 1) (Montoya-Weiss and Calantone, 1994; Cooper and Kleinschmidt, 1995; Hart et al., 2003; Nzomoi, et al., 2007).

Balanced scorecard for performance evaluation

Balanced scorecard (BSC) is a strategic management tool that transforms a firm's operation strategy (not the strategically selected projects) into practice. Its contents comprise of four management dimensions: financial perspective, customer perspective, internal business perspective and innovation and learning perspective (Kaplan and Norton, 1992). BSC evaluates NPD performance as follows:

Financial perspective

It contains market share, return of investment, and market potential, etc.

Customer perspective

It consists of reduction of the number of complaints, complaint handling time, and new customer sales growth, etc.

Internal business perspective

It contains developing time, process capability, and procedure standardization rate.

Innovation and learning perspective

It consists of technology promotion, employee satisfaction, and cooperation with other factories, etc.

Even though the relationships among strategic objectives, CSFs, and performance evaluation indices are not directly related, they are causally related and time sequenced, as shown in Figure 1. Therefore, this paper first analyzes possible CSFs and uses factor analysis to simplify CSFs. Causal analysis is then carried out diachronically to determine the casual relationship between strategic objectives and extracted CSFs, and between extracted CSFs and performance evaluation indices.

CONSISTENCY BETWEEN STRATEGIC OBJECTIVES AND PROJECT PERFORMANCE

By adopting BSC for performance evaluation, the past emphasis on solely financial data can be shifted to a comprehensive consideration of technological improvement together with a firm's policy and organizational development.

Table 1. Critical success factors of variant products in production network.

Mutual trust and commitment	Cooperation rate with other factories	Previous manufacturing experience
Fair and rational rewarding system	Market openness	Processing capability
Competitive advantage	Predictable market demand	Process standardization rate
Organization structure	Complementarities of operation policy	Reputation of inventor
Compatible management team	Expected net value	Consumer complaint handling speed
Social-cultural communication	Financial state	Number of engineering changes
Flow speed of R&D results	Reasonable profit allocation	Reduction of consumer complaints
Size of market	Substitutability	Easy imitation of technology
Adequate manufacturing resources	Quality reliability	Technological complexity
Past technological experience	Joint efforts to reduce manufacturing cost	Technology replacement
Potential market growth	Manufacturing facilities and supporting assets	Low setup cost
Relative scale with respect to market share and sales volume	Integrated management of up-stream and down-stream manufacturers	Technology improvement rate
Complementarities between technology and resources	Early-development advantage	Superiority of product functionality
Regional distance	Global logistic capability	Sustainable R&D capability
Core technology	Flexibility in quality and delivery	New or breakthrough technology
Design of sales channel	Capability of major competitors	

Though Kaplan and Norton (1992) stressed that BSC is a strategic management tool that transforms strategy into practice, many researchers held that BSC cannot feedback real operation results to strategic level, not to say to affect the establishment of strategies (Simons, 1999; Norreklit, 2000). Besides, some scholars pointed out that many evaluation results of BSC are irrelevant to the success of strategies, and thus, the method may cause distortions (Otley, 1999). There exists the tension between strategy formulation and strategy implementation (Veen-dirks and Wijn, 2002). In addition, it may imply “the more dynamic and complicate the strategic objective, the more distant the difference between strategic objectives and final performance” (Chaganti, et al., 2008). Accordingly, in order to distinguish different levels of strategies for BSCs and CSFs, management control can be divided into three successive dimensions including (1) diagnosis control, monitoring differences between real values and planned values continuously; (2) interacted control, examining the uncertainty of strategy regularly; (3) strategic control, examining or reconstructing strategy. A detailed comparison of the three dimensions is shown in Table 2.

With years of study and research, Simons (1995) and Veen-dirks and Wijn (2002) concluded the following:

(a) BSC belongs to diagnosis control and interacted control, while CSFs belong to strategic, interacted and diagnosis control.

(b) If a firm is in a traditional industry, it may not face a problem even if it does not have strategic control. Although interactive control needs more time and cost, it can still feedback or examine part of the strategies. However, for a high technology company, without a strategic control is highly risky.

(c) For a firm that is technology-oriented, its strategic control should prevent the occurrence of technologic causal dependence. For a firm that is market-oriented, its

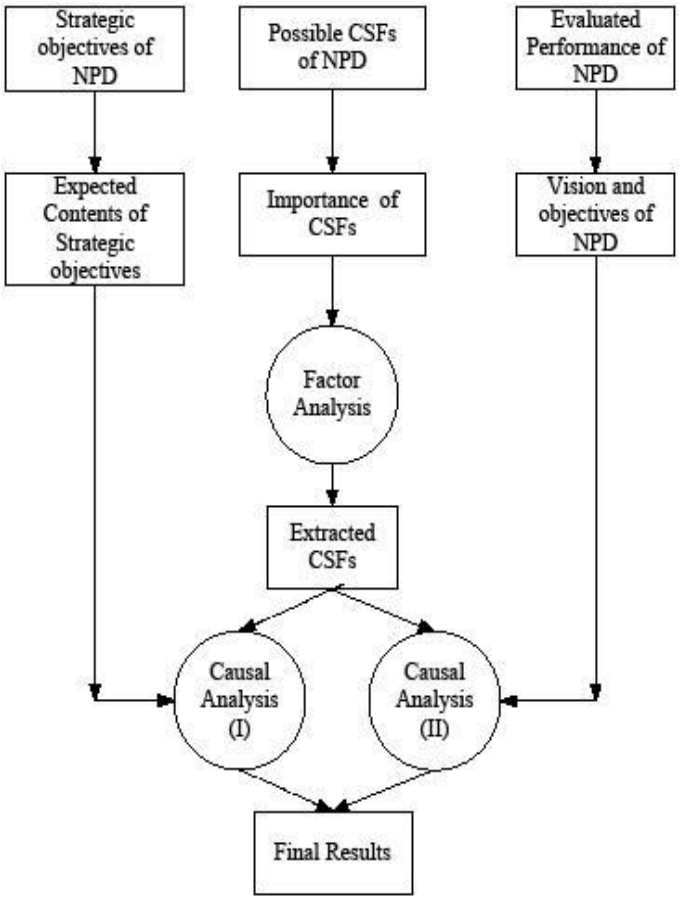

Figure 1. The causal relationship among strategic objectives, CSFs and performance evaluation indices.

Table 2. The comparison of management controls under different dimensions.

	Diagnosis control	**Interacted control**	**Strategic control**
Goal	Provide direction of goal and motivations	Promote communication and organizational learning	Provide direction of goal and motivations continuously
Objective	Continuous monitoring	Innovative research	Expectation/changes
Analysis complexity	Deduction	Generalization	Deduction and generalization
System complexity	Complex	Simple	Complex but systemized
Time frame	Now and past	Now and future	Now and future
Object	Fixed	Periodic evaluation	Based on external environment
Feedback	Negative	Positive	Negative or positive
Correction	Input or procedure	Double loop learning	Continuous correction
Communication	Reduce unnecessary communication	Provide normal communication	Provide external environment conditions

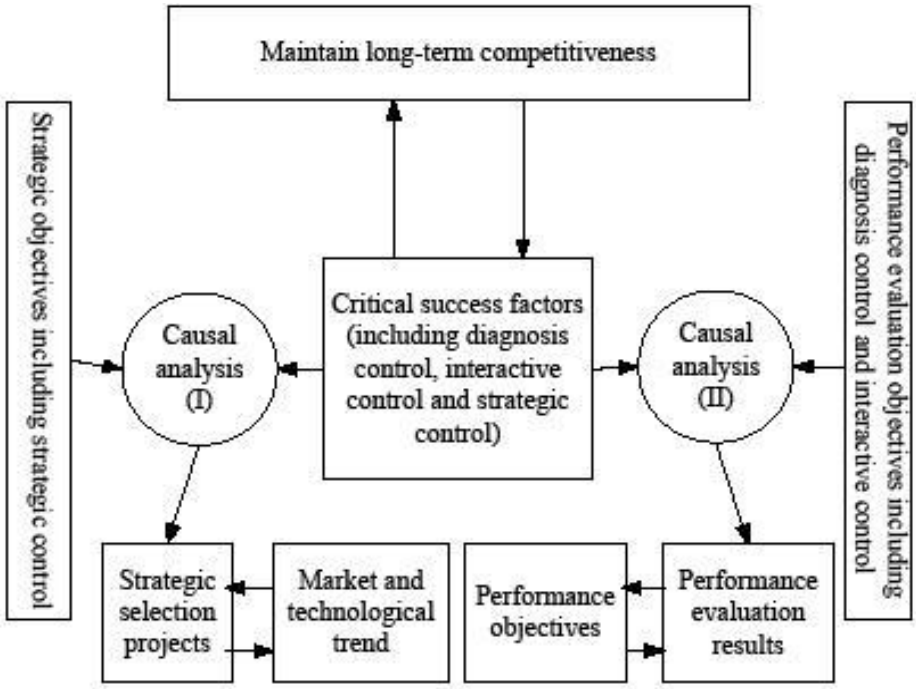

Figure 2. The relationship among strategic objectives, CSFs and performance objectives

strategic control should focus on market demand changes.

(d) The way Kaplan and Norton (1992) put CSFs in the lower hierarchy of BSC is not appropriate since BSC belongs to strategic execution hierarchy, not strategic forming hierarchy.

A complete strategic framework should be able to handle long-term and short-term strategies, strategy formation and execution, diagnosis control, interacted control and strategic control all together. Accordingly, this paper proposes a framework that combines strategic objectives, CSFs of NPD under production network, and performance evaluation objectives, as shown in Figure 2. This paper first uses factor analysis to extract simplified CSFs from 47 possible CSFs, and then proposes methods to avoid the "possibility of distortion" (Simons, 1995; Veen-dirks and Wijn, 2002). The distortion may be:

(1) inconsistency between performance evaluation indices and strategically selected projects; (2) irrelevance between strategic objectives (strategy formulation) and strategically selected projects. To solve the first problem, we adopt causal analysis to find out the causal relationship between extracted CSFs and project performance, as shown in Figure 1. To solve the second problem, we adopt causal analysis to find causal relationship between extracted CSFs and strategic objectives, also as shown in Figure 1. In addition, a firm should continuously examine whether strategically selected projects depart from strategic objectives, that is, strategically selected projects should conform to dynamic market demand and technological development trend.

Oppositely, a firm should also continuously examine whether performance evaluation results depart from expected performance objectives. The relationship among CSFs, BSC and strategic objectives is shown in Figure 2. With such a design, by solving the two problems, consistency between strategic objectives and project performance can be met. Meanwhile, we can also observe whether the strategy deviates from market demand and technological trend, whether the firm stresses long-term or short-term strategy, and whether it takes account of financial and non-financial factors. Only in this way can a firm keep itself competitive perpetually.

CASE STUDIES

In this section, an exploration research is done to study CSFs of NPD in production networks, and the relationship of CSFs with strategic objectives and project performance indices. Because most items evaluated in the questionnaire are subjective recognition that cannot be evaluated directly or quantified, this research adopts factor analysis and causal analysis to solve such a problem.

Sample selection

The content of the questionnaire was set based on literature review and interview with experts. The purpose of the questionnaire was to examine the importance of each

Table 3. Reliability coefficients at different stages of questionnaires

Research stage	Aspect of variable	Number of question	Cronbach α
Decision stage	Four strategic objectives	4	0.8236
Operation stage	Critical success factor	47	0.7309
Evaluation stage	Four perspectives of evaluation	4	0.8120

factor to a firm's long-term competitive performance. The questionnaire consisted of 55 items in total, among which were 4 strategic product objectives, 47 possible CSFs of NPD, and 4 NPD performance evaluation factors. In order to examine the practicality of the proposed model many producers from high technology industry and conventional industry were studied. Questionnaires were targeted at participants of the firms' present and future cooperation firms. In order to ensure validity of survey data, normal post mails supplemented with direct communication was used to track individuals. A total of 3151 questionnaires were sent out, and 1104 questionnaires were received, with a returning rate of 35.03%. Statistical analysis of the returned questionnaires shows that reliability coefficient of questionnaires at different stages was above 0.7, meaning that the reliability of returned questionnaires was acceptable, as shown in Table 3.

Factor analysis

There were 47 possible CSFs for consideration. Thirteen CSFs with eigenvalues larger than one were extracted as common factor dimensions through factor analysis and varimax rotation method by SPSS software. Kaiser-Meyer-Olkin (KMO) statistics was used to measure sampling adequacy, that is, if data were likely to factor well. Since the KMO statistic was 0.714, a value greater than the satisfactory value of 0.5, it was appropriate to proceed with factor analysis. In addition, Bartlett's test of sphericity tests the null hypothesis that the variables in the correlation matrix are uncorrelated. In the study, the observed significance level was 0.000, and it was small enough to reject the hypothesis. This also suggested that a factor analysis for the data could proceed. Table 4 lists the eigenvalues, variance and cumulative variance of the 13 selected CSFs, and these 13 CSFs can explain 79.64% of the variance in the original data sets. For the naming of extracted factors, this research chose a factor in each dimension with a loading larger than 0.45 as a reference for the name, and used a name that represented the aggregates of the observed factors. For the 47 CSFs of network capability, the extracted factor dimensions are as follows: product competitive advantage factors (dimension 1), human resource factors (dimension 2), market potential factors (dimension 3), technological characteristic factors (dimension 4), technology accumulation factors (dimension 5), manufacturing resource integration capability factors (dimension 6), surviving capability factors (dimension 7), market share factors (dimension 8), manufacturing capability factors (dimension 9), return of investment factors (dimension 10), organizational learning capability factors (dimension 11), customer satisfaction factors (dimension 12), and technological improvement capability factors (dimension 13).

Causal analysis

We propose a theoretical framework that assumes a time sequence and causal relationship among strategic product objective stage, CSFs stage and project performance stage. Precedent variables are exogenous variables, and subsequent variables are endogenous variables. Multiple linear regression analysis by gradual regression analysis is conducted to obtain the optimum predictor variable mix, and to examine the proposition hypothesis by causal analysis.

Radical product strategies (from 683 questionnaires)

Causal analysis was first applied to analyze the relationship between the four aspects of strategic product objectives and 13 extracted CSFs, and then the relationship between 13 extracted CSFs and 4 perspectives of project performance. The two causal analysis models were integrated last to form a complete evaluation model.

Causal analysis model (I)

Causal analysis of four aspects of strategic objectives and 13 extracted CSFs were carried out. The results are as shown in Table 5 and Figure 3 and are discussed as follows.

Promoting technological capability of network cooperation

The most important CSFs for NPD strategically selected projects are product competitive advantage factors (including superiority of product functionality, sustainable R & D capability, competitive advantage, core technology, new or breakthrough technology, early- development

Table 4. Factors, eigenvalues and cumulative variance in each dimension.

	Questions in the questionnaire	Eigen value	Variance (%)	Cumulative variance (%)
1.	Superiority of product functionality, sustainable R & D capability, competitive advantage, core technology, new or breakthrough technology, early-development advantage, and capability of major competitors	6.61	14.06	14.06
2.	Mutual trust and commitment, compatible management team, fair and rational rewarding system, organization structure, and social-cultural communication	5.26	11.19	25.25
3.	Size of market, reasonable profit allocation, potential market growth, predictable market demand, and customer complaint handling speed	4.86	10.34	35.59
4.	Easy imitation of technology, technology replacement, early-development advantage, technological complexity, and low setup cost	4.63	9.85	45.44
5.	Reputation of investor, adequate manufacturing resources, past technological experience, and complementarities between technology and resources.	2.75	5.85	51.29
6.	Global logistic capability, regional distance, manufacturing facilities and supporting assets, and integrated management of up-stream and down-stream manufacturers	2.43	5.17	56.47
7.	Capability of major competitors, substitutability, joint efforts to reduce manufacturing cost, quality reliability, and flexibility in quality and delivery	2.17	4.61	61.08
8.	Design of sales channel, complementarities of operation policy, market openness, relative scale, and complementarities between technology and resources	1.84	3.91	64.99
9.	Previous manufacturing experience, processing capability, process standardization rate, number of engineering changes, and manufacturing facilities and supporting assets.	1.76	3.74	68.73
10.	Expected net value and financial state	1.62	3.45	72.18
11.	Cooperation rate with other factories, and flow speed of R & D results	1.32	2.80	74.98
12.	Reduction of customer complaints	1.13	2.41	77.39
13.	Technology improvement rate	1.06	2.25	79.64

advantage and capability of major competitors), technological characteristic factors (including easy imitation of technology, early-development advantage, technology replacement, technological complexity, and low setup cost), and technology accumulation factors (including reputation of investor, adequate manufacturing resources, past technological experience, and complementarities between technology and resources).

Promoting marketing capability of network cooperation

The most important CSFs of NPD strategically selected projects are market potential factors (including size of market, reasonable profit allocation, potential market growth, predictable market demand, and customer complaint handling speed), market share factors (including

Table 5. Causal analysis between 4 strategic product objectives and 13 CSFs.

Dependent variables	Independent variables	Absolute and standardized relative coefficients	P value	Adjusted R^2
Dimension 1	Technological capability	0.416	0.000	0.378
Dimension 4	Technological capability	0.261	0.013	0.215
Dimension 5	Technological capability	0.217	0.021	0.184
Dimension 3	Market capability	0.265	0.017	0.196
Dimension 8	Market capability	0.252	0.012	0.294
Dimension 10	Market capability	0.176	0.029	0.216
Dimension 2	Organizational relationship capability	0.607	0.000	0.557
Dimension 6	Integrating capability of manufacturing resources	0.314	0.008	0.335
Dimension 7	Integrating capability of manufacturing resources	0.198	0.025	0.201
Dimension 9	Integrating capability of manufacturing resources	0.267	0.019	0.273

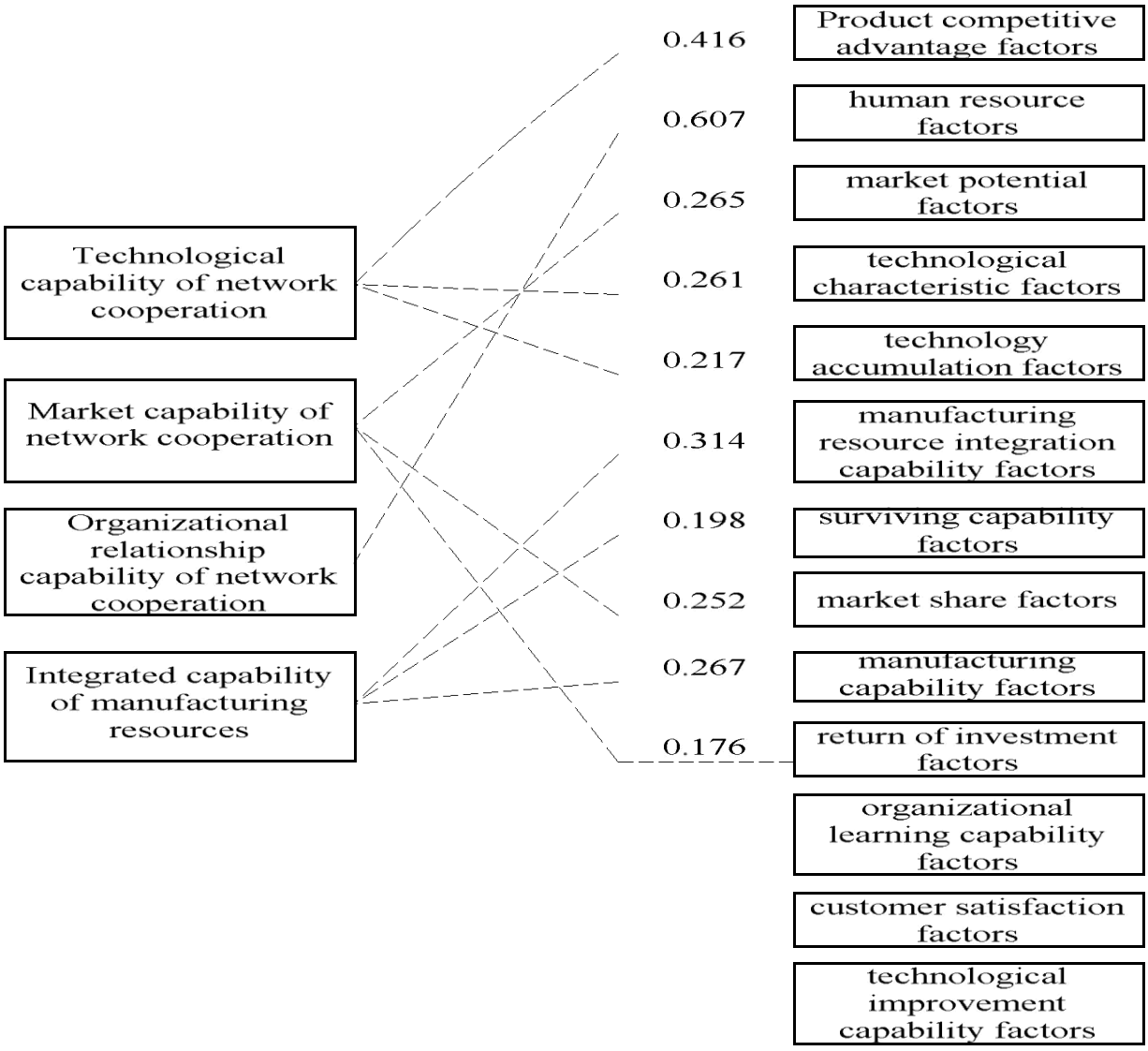

Figure 3. The relationship among 4 strategic product objectives and 13 CSFs.

Table 6. Causal analysis between 13 CSFs and 4 performance perspectives.

Dependent variables	Independent variables	Absolute and standardized relative coefficients	P value	Adjusted R^2
Financial perspective	Dimension 3	0.512	0.000	0.423
	Dimension 8	0.353	0.004	0.423
	Dimension 10	0.172	0.017	0.423
Customer perspective	Dimension 12	0.458	0.000	0.391
	Dimension 3	0.129	0.032	0.391
	Dimension 7	0.146	0.026	0.391
Internal business perspective	Dimension 6	0.164	0.021	0.276
	Dimension 7	0.291	0.011	0.276
	Dimension 9	0.342	0.005	0.276
Innovation and learning perspective	Dimension 11	0.385	0.004	0.329
	Dimension 13	0.338	0.008	0.329
	Dimension 2	0.167	0.022	0.329

(including design of sales channel, complementarities of operation policy, market openness, relative scale, and complementarities between technology and resources), and return of investment factors (expected net value and financial state).

Promoting organizational relationship capability of network cooperation

The most important CSFs of NPD strategically selected projects are human resource factors (including mutual trust and commitment, compatible management team, fair and rational rewarding system, organization structure, and social-cultural communication).

Capability of integrating capability of manufacturing resources

The most important CSFs of NPD strategically selected projects are manufacturing resource integration capability factors (including global logistic capability, regional distance, manufacturing facilities and supporting assets, and integrated management of up-stream and down-stream manufacturers), manufacturing capability factors (including previous manufacturing experience, processing capability, process standardization rate, number of engineering changes, and manufacturing facilities and supporting assets), and surviving capability factors (including capability of major competitors, substitutability, joint efforts to reduce manufacturing cost, quality reliability, and flexibility in quality and delivery).

Causal analysis model (II)

Causal analysis of 13 extracted CSFs and four perspectives of project performance were carried out. The results are as shown in Table 6 and Figure 4 and are discussed as follows:

Performance objectives of financial perspective

Extracted CSFs factors, including market potential, market share, and return of investment, are relevant to the success of financial performance objectives.

Performance objectives of customer perspective

Extracted CSFs factors, including customer satisfaction, surviving capability and market potential, are relevant to the success of customer performance objectives.

Performance objectives of internal business perspective

Extracted CSFs factors, including manufacturing capability, surviving capability and manufacturing resource integration capability, are relevant to the success of internal business perspective performance objectives.

Performance objectives of innovation and learning perspective

Extracted CSFs factors, including organizational learning

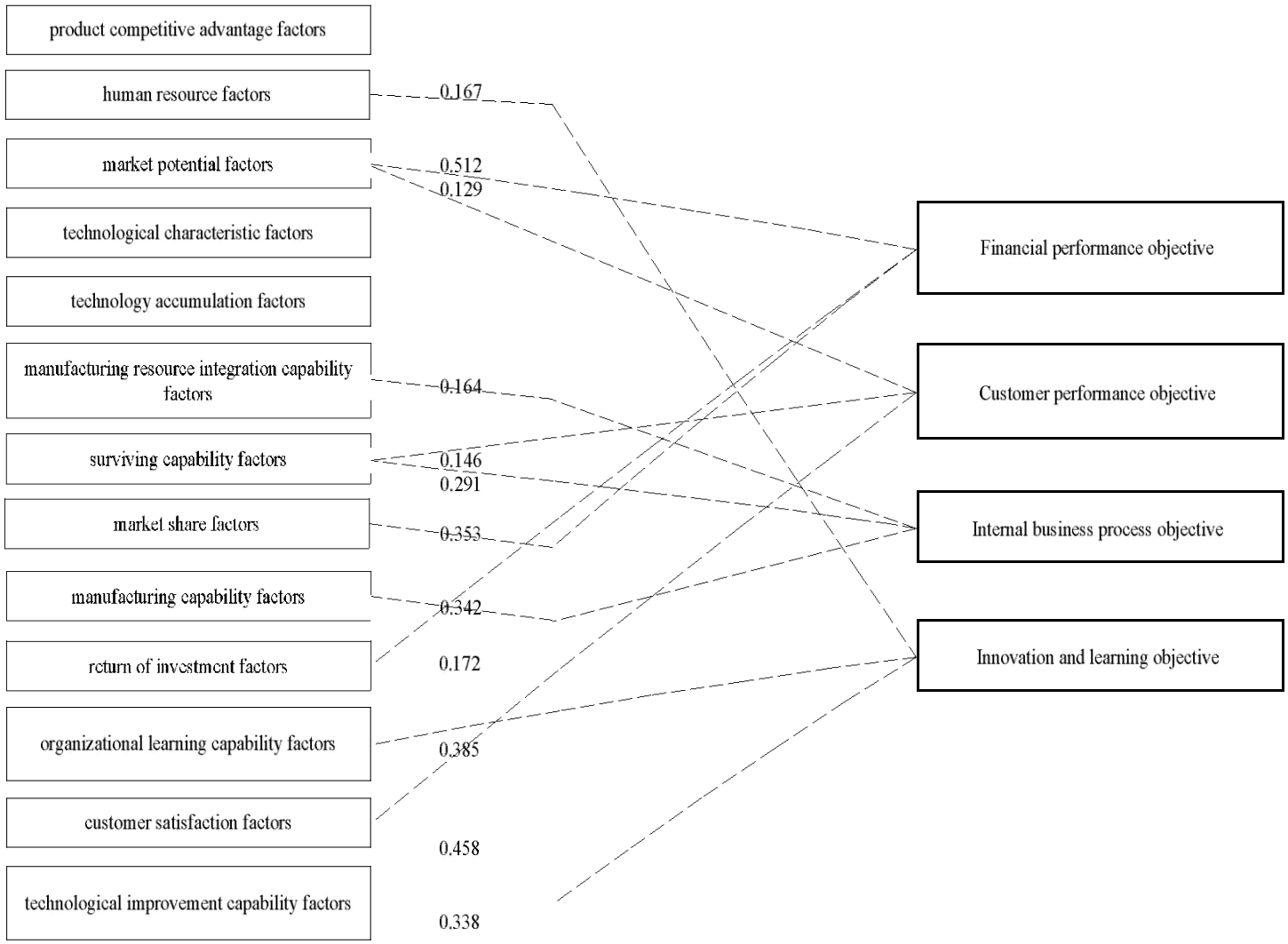

Figure 4. The relationship among 13 CSFs and 4 performance perspectives.

capability, technological improvement capability and human resources, are relevant to the success of innovation and learning performance objectives.

Cascading causal analysis model (I) and (II) together

By integrating the results of causal analysis model (I) and (II), we deduced that there are relationships in the stages among strategic objectives, CSFs and performance evaluation indices and that the relationships are relevant according to time sequence.

Incremental product strategies (from 421 questionnaires)

The same causal analyses were carried out and the results are obtained. Obviously, the useful extracted CSFs between strategic objectives and performance evaluation for radical product strategies and incremental product strategies are different. In radical product strategies (Figures 3 and 4), the affected extracted CSFs for strategic objectives are lack of organizational learning, customer satisfaction, and technological improvement, while those for performance evaluation indices are lack of product competitive advantage, technological characteristics, and technology accumulation. In incremental product strategies, the affected extracted CSF for strategic objectives is lack of technological improvement, while that for performance evaluation indices is lack of technological characteristics. Basically, the inconsistency of CSFs between strategic objectives and final performance is larger in radical product strategies than that in incremental product strategies. However, if firms utilize a model consisting of two sets of

casual analysis to timely cascade strategic formation process with extracted CSFs, and extracted CSFs with performance evaluation indices, the aforementioned inconsistency for all product strategies can be partly solved. Of course, as shown in Figure 2, we also observe whether the strategy deviates from market demand and technological trend, whether the firm stresses long-term or short-term strategy, and whether it takes account of financial and non-financial factors.

CONCLUSIONS AND FUTURE RESEARCH DIRECTION

The empirical operations and scholarly literature suffer from the fact that strategic objectives and performance evaluation indices cannot reach in accord. In this research, possible CSFs of NPD in production networks were first listed, and then condensed into meaningful extracted CSFs, which could be used in empirical analysis. This paper finds that the inconsistency between strategic objectives and performance evaluation indices is resulted from the dynamic change of critical success factors within different stage of NPD. Especially, the difference is larger for radical product strategies because their composite are more dynamic and complicated. Then, the extracted CSFs were utilized as intermediate variables to timely cascade the inconsistency between strategic objectives and the performance evaluation indices.

This paper screened out product development criteria and proposed a NPD hierarchical structure which could precisely implement and evaluate the strategic objectives of an enterprise. However, experts, such as senior managers of a firm, need to contribute their professional experience to identify criteria and detailed criteria that influence the decision. In order to incorporate the opinion and the expertise of decision makers, some mathematical methodology like the multi-criteria decision-making (MCDM) method needs to be developed in the future work to generalize subjective judgment of experts.

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