정보기술전략과 정보기술아키텍쳐: 설명적 상황이론 프레임워크

Information Technology Strategy and Architecture: An Explanatory Contingency Framework

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요 약

본 연구는 Ansoff의 "전략적 성공모델"에 의거하여 조직 정보기술전략의 도달 가능한 최고 성과는 경영환경의 역동성(turbulence)과 정보기술전략의 공격도(aggressiveness), 정보기술역량(capability)간의 일치에 의한다는 가설을 검증하였다. 정보기술전략의 공격도와 정보기술역량을 차별화하기 위하여 정보기술아키텍처라는 개념을 원용하였다. 즉, 정보기술전략의 공격도는 아키텍쳐를 의미하는데, 이는 정보기술역량이 경영자의 장래 정보기술에 대한 태도를 의미하는데 반하여 정보기술아키텍쳐는 현재 조직이 보유한 기술적 역량을 의미한다.

본 연구는 정보기술아키텍쳐와 경영환경의 역동성, 정보기술역량간의 수준의 일치가 조직성과에 유의미하다는 결론을 제공한다. 즉 경영환경의 역동성, 정보기술전략과 정보기술아키텍쳐의 일치는, 특히 경영환경이 역동적인 상황에서 더욱 조직성과에 유익한 결과를 가져올 수 있다는 근거를 통계적으로 증명한다.

키워드 : 정보기술전략, 정보기술아키텍처, 정보기술역량, 경영환경역동성, 상황이론

I. Introduction

Information technology is transforming the nature of products, processes, companies, industries, and even competition itself (Porter and Millar, 1985). The next level of information revolution is under way. However, it is not happening where information scientists, information executives, and the information industry in general, are looking for it. It is not a revolution in technology, machinery, techniques, software, or speed. It is a revolution in concepts of technology, applications of technology, and utilizations of technology.

Every leading firm in an industry has access to the most current, identical information technologies without difficulty these days (Keen, 1993). Organizations can insource or outsource telecommunications, computer hardware, workstations, software development, and information management tools from a wide range of vendors and system integration providers. The wide range of competitive organizational and economic benefits that companies gain from information technology thus rests on management and applications differences, but not on a technical one (Dutta, 1996; Bensaou & Earl, 1998). This means the IT architecture that is a logically consistent set of principles, policies and standards that guides the engineering of the organization's IT systems and infrastructure is gaining strategic importance for the organizational competitiveness. Con-

ventionally, IT architecture is an integrated framework for evolving or maintaining existing information technology and acquiring new information technology to achieve the organizational strategic goals and information resources management goals (Zachman, 1996). Some business leaders are somehow able to fit the pieces together better than others (Keen, 1993). By these reasons, the development of IT architecture increased the strategic significance of IT management and organizational capability to integrate IT into organizational processes.

Ⅱ. Theoretical Background

Strategy researches were initiated to explore external environmental change and adapt effectively to survive and prosper in the long run (Schendel & Hoffer, 1979). It has been conceptualized that the organizational capability to adapt to a change in environment is a key success factor (Thompson, 1967; Lawrence & Lorsch, 1969). Emery and Trist (1963) proposed that the environment is composed of several distinctive segments within the different levels of turbulence. Concerning the traditional contingency framework, Ansoff, Sullivan et. al, (1993: 193-194) presented the paradigmatic theorems for optimizing strategic behavior:

2.1 Behavior Driving Variable

The variable which determines the strategic behavior necessary for success is the turbulence level in the ESO's (environment serving organization) environment.

2.2 Strategic Success Formula

An ESO's performance is optimized whenever its strategic responsiveness (strategic aggressiveness plus organizational responsiveness) is aligned with the turbulence level of the ESO's environment.

Environmental turbulence is a driving contingent variable that determines the type of strategic behavior. It has been referred that any theory of corporate or business strategy must be, by definition, contingency-based (Hofer, 1975; Ginsberg & Venkatraman, 1985). A classic problem in the field of strategic management has been how to establish and maintain a match between expected external (environmental) demands and anticipated internal (organizational) resources (Fiegenbaum, et. al., 1996). Since the external environment is constantly changing, often in unpredictable ways, maintaining this match or alignment is no easy task, and usually involves the need to overcome particular internal deficiencies or build new capabilities over time (Barney, 1991).

Ginsberg and Venkatraman (1985) proposed that as the contingency approaches of strategy suggest, an optimal strategy exist for a certain set of organizational and environmental conditions. They also argued that studies that focus on the contingent relationships between independent or contextual variables and a dependent variable namely, the organization's strategic response or on the relationship between strategy and performance across different contexts are legitimate studies in the tradition (Ginsberg & Venkatraman, 1985). Itami (1987) captured the contingency requirement in depth with his concept of 'dynamic fit.' Itami proposed that the role of management in today's world should be to both create and destroy alignment with the environment. Itami asserted that management must work hard to send consistent messages to the environment, and align strategies, systems, and processes with the environment in order to achieve a high performance.

The managerial role has been even more critical in keeping up with the development of technology. New technologies may potentially have an impact on market characteristics as well as on the performance of individual firms. The technological breakthrough or innovations sometimes affect organizational life span and the rule of thumb in the market. However, most studies of innovation generally ignore the strategic issues that managers face when confronted by a new technology (Van de Ven, 1992). As an environmental development that has the potential to affect organizational performance, technological development is one of the most important strategic issues that the top managers must contemplate (Venkatraman, 1997).

As the field of strategic management has expanded, strategy researchers and practitioners have shown increasing interest in the role of information technology in strategy formulation, implementation, and in its impact on financial performance (Henderson and Venkatraman, 1992; Kettinger et. al., 1994; Powell and Dent-Micallef, 1997). As information technology has developed in an unprecedented way, IT strategy has gained its strategic significance in a critical way. In the similar vein, strategy research has begun to shift from a focus on 'tactical' difficulties surrounding the commercialization of new technology to 'strategic' problems of how technology can shape and support corporate strategy (Ginsberg & Venkatraman, 1992).

Even though the number of research concerning IT strategy has increased, the research were not satisfactory either in empirical or in case study approach. More importantly, "the literature is fragmented, far-flung, anddespite some recent advancesweighs heavily on case studies, anecdotes, and conceptual frameworks, with insufficient empirical work and minimal synthesis of findings" (Powell & Dent-Micallef, 1997: 375). Researchers however, also proposed that IT should be considered strategically, and that IT should be one of the most important parts of the current business environment.

Where IT environment is changing rapidly, many organizations do not seem to feel comfortable to handle this. Moreover, every organization does not enjoy the performance advantage from the state-of-the-art information technology infrastructure (Hatten & Hatten, 1997). There are contrasting results concerning the value of information technology compared to return on investment (Clemons & Row, 1991; Earl, 1993).

In order to fill the gap between IT strategy and organizational performance, this study proposes the concept of IT architecture. IT architecture is another terminology of IT capability. IT capability is a parallel concept of organizational capability that is demonstrated in Asnoff's strategic success formula. The study employs IT architecture as a substituting concept of IT capability. Because the conventional understanding of IT capability and IT aggressiveness has not been differentiated clearly as strategic aggressiveness organizational capability does.

Most difficulties for capitalizing IT investment to the performance advantage are attributed by the human side of technology. The technologies and systems are not fully meshed with people who actually utilize them. Moreover, the requirements from the system may not appropriate to the business model of the organization. IT architecture is a linking concept between two basic problem areas human side of technology and business model side of technology.

IT architecture is an integrated framework for evolving or maintaining existing information technology and acquiring new information technology to achieve the organizational strategic goals and information resources management goals. It also denotes that the characteristics of organizational members' mindset and

attitude to the new technology and desire to learn and adapt new information technologies. Human side of technology is considered mostly by the concept of IT architecture.

IT aggressiveness on the other hand, refers the technical side of IT strategy. IT strategy defines current set of systems and human resources that directly configure organizational information systems and information flows. The relationship between the business model and organizational IT technology of today is conveyed by IT aggressiveness.

The strategic success paradigm proposes that the essential performance variations lie in the alignment of strategy with environmental turbulence levels. In the similar vein, aligning IT strategy and IT architecture with environmental turbulence should give a performance advantage to the organizations.

Ⅲ. Methods

The study was conducted through a survey. The format and contents of the questionnaire were initially developed from an intensive literature review. While generating survey questions, informational interviews with 5 IT managers from different organizations were also conducted. The thorough literature reviews and interviews allowed the authors to establish content valid questionnaire items. After the questionnaire was developed, the survey was conducted through the MBA students of the prestigious university located in Seoul, Korea.

Utilizing MBA students for a survey has both pros and cons. The pros are such that students are knowledgeable enough to the relatively scholarly materials of the survey questionnaire and they have minimal level of confusions to the academic jargons in the questionnaire. Moreover, MBA students are all practicing managers currently. Utilizing MBA students can be a best alternative to the blind mailing survey.

However, the convenient sampling can be a source of bias in two perspectives. First, the respondents can answer the questions based on their academic knowledge but not based on the real experiences from their jobs. They may answer from the knowledge of textbooks and lectures not from the practical experiences. Second, they can answer the questions even though they really don't know. The respondents might be obliged to respond to the whole questions because the professor is waiting for answers.

Acknowledging those shortcomings, we advised students to answer what they really perceive and think but not to guess. Moreover, we did not distribute the questionnaires to the students who are not currently employed or the students who are not in the business field.

Ⅳ. Measurements of Research Variables

4.1 Environmental Turbulence

The measurement of turbulence has been conceptualized and empirical support reported by Ansoff (1979), Ansoff and McDonnell (1990), Ansoff, Sullivan et al., (1993) and a number of United States International University dissertation researchers (e.g., Hatziantoiou, 1986; Sullivan, 1987; Lewis, 1989; Jaja, 1989; Wang, 1991; Djohar, 1991; Chafie, 1992; Johannesson, 1994). These studies report empirical support for the reliability and validity of measurements of environmental turbulence, strategic aggressiveness, and organizational capability.

Environmental turbulence is a combined measure of the changeability and predictability of the organiza-

tional environment (Ansoff & McDonnell, 1990). Changeability is characterized by the complexity of the organizational environment and relative novelty of the successive challenges that the firm encounters in the environment. Predictability is characterized by the rapidity of change. Rapidity of change is the ratio of speed with which challenges evolve in the environment, to the speed of the organization's response.

4.2 IT aggressiveness

The nature of explanatory study captured the concept of IT aggressiveness in mutually exclusive components in 3 perspectives by factor analysis: current market oriented IT (market orientation), IT for current production process improvement (production process orientation), and information systems that enable strategic utilization (strategic information systems). These three components were utilized as variables for IT aggressiveness. The components of the measurements are presented at the <Table 1>.

The reliability of the measurement constitutes strong coherence of concepts of IT aggressiveness. The measurement was estimated by Cronbach alpha, and the alpha was 0.7798 <Table 2>.

The concept of IT aggressiveness was captured in two perspectives: the current point of IT investment direction and relatively short run oriented expectation from IT. The concept of strategic aggressiveness was based on "strategies currently employing." Following this concept, the variable of IT aggressiveness was also constituted as currently using strategies.

<Table 3> shows communalities of IT aggressiveness by factor analysis of variable components. <Table 4> presents total variance explained by three com-

〈Table 1〉 Rotated Components of IT aggressiveness

	Component		
	1	2	3
Making new niche market	.655	.229	-.064
New product development	.756	.391	.046
Information storing	.801	.000	.142
Exploring new market	.775	.078	.274
Quality improvement	.362	.745	-.062
Process globalization	.109	.728	.165
Manufacturing flexibility	7.593E-02	.760	.143
Customer information process	.234	-.108	.760
Supporting current organizational strategy	2.755E-03	.254	.738
Improving database system	5.325E-02	.139	.814

Extraction Method: Principle Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 5 iterations.

〈Table 2〉 Reliability Coefficient

Number of cases = 78	Number of Items = 10
Alpha = .7798	

〈Table 3〉 Communalities

	Initial	Extraction
Market orientation	1.000	.641
Production process orientation	1.000	.610
Strategic information systems	1.000	.385

Extraction Method: Principle Component Analysis

〈Table 4〉 Total Variance Explained

	Initial Eigen Values			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.636	54.530	54.530	1.636	54.530	54.530
2	.807	26.889	81.419			
3	.557	18.581	100.000			

Extraction Method: Principle Component Analysis

〈Table 5〉 Component Matrix(1 component extracted)

	Component 1
Market orientation	.801
Production process orientation	.781
Strategic information systems	.620

Extraction Method: Principle Component Analysis

ponents. The Eigen value that is higher than 1 was adopted as a critical factor. Only one factor was extracted. <Table 5> presents factor-loading scores. As <Table 5> shows, the factor loadings are not quite different. The relatively evenly loaded factor loadings allowed us to use the mean of each questionnaire item to establish a latent variable, IT aggressiveness.

4.3 IT architecture

IT architecture was also conceptualized by factor analysis. <Table 6> presents the components of IT architecture. Factor analysis generated three perspectives of IT architecture. The first factor is named as organizational IT infrastructure (IT infrastructure). The second factor is named as managerial expectation for future IT investment and competitive IT position (future IT capacity). The third factor is organizational culture to share the information (information sharing).

These components are differentiated with IT aggressiveness because it emphasizes organizational potential to develop the future IT competences. IT infrastructure defines the current investments of the system. The current amount of the investment is a strong predictor of future strategic IT position. Information sharing also articulates organizational culture and attitude to the IT. Future IT capacity mentions future competitiveness, competency and capability. All of these components are underpinning concepts for future information technology capability. <Table 7> shows the reliability of measurements. And <Table 8> shows communalities of IT capa-

〈Table 6〉 Rotated Component Matrix

	Component		
	1	2	3
Internal information gathering	**.651**	.275	4.585E-02
Market information sharing	**.815**	-.089	.079
Competitive information	**.867**	-.016	-.083
Strategic information	**.680**	.034	-.116
Strategic alignment	**.702**	.269	.093
Cost efficiency	.223	.410	**-.739**
IT strategy orientation	.199	.361	**.776**
Internal information sharing	.082	**.745**	-.120
Business process integration	-.087	**.747**	.125

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 4 iterations.

〈Table 7〉 Reliability Coefficient

Number of cases = 78	Number of Items = 9
Alpha = .7085	

〈Table 8〉 Communalities

	Initial	Extraction
IT infrastructure	1.000	.354
Information sharing	1.000	.603
Future IT capacity	1.000	.514

Extraction Method: Principle Component Analysis

〈Table 9〉 Total Variance Explained

	Initial Eigen Values			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.407	49.012	49.012	1.470	49.012	49.012
2	.866	28.865	77.877			
3	.664	22.123	100.000			

Extraction Method: Principle Component Analysis.

bility by factor analysis of variable components.

<Table 9> presents total variance explained by three components. The researcher adopted the conventional criteria of the Eigen value. The factors that have higher than 1 were adopted. As we expected, only one factor was extracted. As <Table

〈Table 10〉 Component Matrix (1 component extracted)

	Component 1
IT infrastructure	.595
Information sharing	.777
Future IT capacity	.717

Extraction Method: Principle Component Analysis.

9> shows, the first component explains 49% of variance. <Table 9> presents component matrix. We also used the mean values of the components in order to generate a latent variable IT capability.

4.4 Findings

The factor analysis of the variable components was performed in order to cluster the concepts of environmental turbulence, strategic aggressiveness of IT and organizational IT capability. The analysis successfully discriminated different concepts of the research variables. The analysis extracted 60.40% of total variance from 11 components. <Table 11> presents the result of factor analysis and <Table 12> presents correlation matrix of the research variables.

After conceptualizing and differentiating the research variables, the responses were recoded based on 'high' and 'non-high' labels based on their responses. High label denotes that the response is noted to be higher than average in all three latent variables such as environmental turbulence, IT aggressiveness, and IT architecture. This distinction allowed us to see the performance relationship between alignment organizations and not well-aligned organizations.

For example, if an organization noted to be high turbulence and high IT aggressiveness, but not high IT architecture, the organization is regarded as 'not-high' aligned organization. On the same side of coin, if an organization noted to be high turbulence and high IT architecture, but not high IT aggressiveness, the organization is also allocated to be 'not high' aligned organization.

The rational to differentiate only high level of environmental turbulence, IT aggressiveness and IT architecture lies below. The information revolution made most industries shift their static positions to the fierce competitions. The development of telecommunications and transportations urged organizations to be global competitors. Internet made most traditional industry definitions and boundaries useless. The level of environmental turbulence has shifted upward. Seeing these phenomena, studying organizational strategies in high turbulence will provide more significant contributions to both academia and practical field.

This process allowed us to determine how the alignment among all three latent variables such as environmental turbulence, IT aggressiveness, and IT architecture might give a performance advantage. We utilized ANOVA in order to evaluate the significant difference of means between well-aligned group and not-well-aligned group.

<Table 13> presents the ANOVA table. We discriminated the groups based on the means of each latent variable such as environmental turbulence, IT aggressiveness, and IT architecture. High profile organizations are the organizations that have higher value than the mean value of environmental turbulence, IT aggressiveness, and IT architecture. As <Table 9> presents higher profile organizations have significantly higher level of IT performance than the organizations are not higher than average at least one latent variable. This result can be inferred that the high profile orga-

〈Table 11〉 Total Variance Explained by Factor Analysis

	Initial Eigen Values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	2.285	32.637	32.637	2.285	32.637	32.627	1.811	25.870	25.870
2	1.115	15.922	48.559	1.115	15.922	48.559	1.374	19.622	45.493
3	1.045	14.924	63.483	1.045	14.924	63.483	1.259	17.990	63.483
4	.733	10.471	73.954						
5	.699	9.965	83.919						
6	.692	9.883	93.802						
7	.434	6.199	100.000						

Extraction Method: Principle Component Analysis

〈Table 12〉 Correlation Matrix of the Research Components

	Environ-mental Turbulence	Market orientation	Product orientation	Strategic information system	IT Infrastruc-ture	Information sharing	Future IT capacity	IT perfor-mance	Perfor-mance
Environmental Turbulence	1.00	.801**	.781**	.620**	.212	.273*	.381**	.314**	.317*
Market orientation		1.00	.441**	.266*	.089	.144	.400**	.179	.191
Product orientation			1.00	.232*	.153	.256*	.264*	.219	.207
Strategic information system				1.00	.251*	.212	.156	.321**	.327*
IT Infrastructure					1.00	.226*	.146	.470**	.436**
Information sharing						1.00	.323**	.313**	.323*
Future IT capacity							1.000	.139	.135
IT performance								1.000	.959**
Performance									1.000

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

〈Table 13〉 ANOVA

	Sum of squares	d.f.	Mean square	F	Sig.
Between groups	6.925	1	6.925	9.405	.003
Within groups	55.960	76	.736		
Total	62.885	77			

nizations that demonstrated higher level of IT aggressiveness and IT capability in a turbulence environment demonstrate significantly better performance than the organizations that are not aligned.

V. Conclusions

The study probed the conventional idea of strategic information technology and its applications for the performance advantage. The study instituted the concept of IT aggressiveness and architecture. The data has successfully discriminated the concepts of IT aggressiveness and IT architecture. The conventional wisdom of IT strategy and organizational performance were challenged by brining the concept of the contingency paradigm. This may also give a chance to consider strategic alignment of organizational IT architecture that is human side of IT and IT aggressiveness that is a technical side of IT.

The paradigm that we adopted here was initially developed by Ansoff (1990). The paradigm denotes that environment turbulence is the most critical contingent variable for organizational strategy and the level of alignment is a key factor for organizational performance.

This study has a contribution in two perspectives. First, the study successfully conceptualized and discerned organizational IT aggressiveness and IT architecture. This concept can be extended in depth for future research (e.g., Venkatraman, 1997).

Secondly, the study validated the significant relationships among IT aggressiveness and IT architecture for organizational performance especially in the turbulent environment. This result can be denoted that organizations that lie in the more turbulent environment need to apply IT strategy in two perspectives. Firstly, developing a concurrent organizational IT architecture is needed for competitive advantage. The managerial assessment of value of IT, organizational consensus for IT investment, and organizational position of IT leadership are some components of IT architecture. Secondly, as organization's environmental turbulence is getting higher, the organization should apply IT strategy in multiple scenarios. Preparing various IT usages may strengthen organizational capability for strategic challenges.

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Information Technology Strategy and Architecture: An Explanatory Contingency Framework

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Abstract

The study employs the conceptual framework of the strategic success paradigm developed by Ansoff (1990). The strategic success paradigm denotes that optimal performance will be attained when the level of environmental turbulence is aligned with the strategic aggressiveness and organizational capability. Based on the paradigm, authors developed the concept of IT (information technology) aggressiveness (IT aggressiveness henceforth) and capability (IT capability henceforth). In order to clarify the different concept of IT aggressiveness and capability, the author brought the concept of IT architecture. The difference of capability and architecture lies in the depth of technical considerations. Where capability refers attitudinal aspects of managers, architecture emphasizes technical capacity of the organization as a whole.

The study validated the need for alignment among IT architecture, environmental turbulence and IT aggressiveness. The imbalance between IT strategy and IT architecture (such as a higher level of IT aggressiveness but a lower level of IT architecture, or vice versa) has a marginal contribution to the organizational IT performance. The alignment among organizational environmental turbulence, IT aggressiveness, and IT architecture resulted in an optimal level of IT performance especially in a turbulent environment.

Keywords: ***Information Technology Strategy, Information Technology Architecture, Information Technology Capability, Contingency Theory***

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