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The Impact of Strategic Alignment of Accounting Information Systems on a Firm's Performance

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■ Abstract ■

Using structural equation modeling, this study empirically examined the causal relationships among the level of advanced manufacturing technology (AMT), facilitation of alignment, the degree of strategic alignment of management accounting information systems (MAIS), and the improvement of production performance. The causal relationships between MAIS strategic alignment and information characteristics of MAIS were also investigated. The results showed that the level of AMT has a significant and positive impact on alignment facilitation. A significant causal relationship between alignment facilitation and MAIS strategic alignment was also found. It was shown that under high degrees of MAIS strategic alignment, MAIS must provide broad-scope and integrated types of information. The causal relationships between MAIS strategic alignment and organizational performance were significant and positive. Thus, it is concluded that under high levels of AMT, a high degree of MAIS strategic alignment positively contributes to the improvement of production performance.

Keyword : MAIS Strategic Alignment, Alignment Facilitation, Production Performance, Information Characteristics of MAIS, Causal Relationships

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1. Introduction

Strategic alignment of information systems (IS) has become an important research topic. Thus, many studies (e.g., [5, 10, 16, 28, 38, 43, 44]) have suggested and investigated both the definition or types of IS strategic alignment and its impact on performance. Das et al. suggested a framework that links strategic IS planning and business strategy and relates it to company performance. Baets defined strategic alignment of IS as a collaborative process among business strategy, business organization, and IS infrastructure and strategy. King and Teo proposed four types (i.e., degrees) of alignment: administrative, sequential, reciprocal, and full integration. They also empirically examined and confirmed the positive effects of the degrees of alignment on organizational performance. Chan and Huff [9] and Chan et al. defined IS strategic alignment as the fit between business strategy and IS strategy. They partially demonstrated the positive impact of IS strategic alignment on business performance. Sabherwal empirically showed a circular relationship between IS strategic alignment and IS success that was measured by cost reduction, internal efficiency, and company reputation.

In investigating the effects of IS strategic alignment on performance, most prior studies did not consider the contingency variables that may influence strategic alignment of IS. Rather, they have focused on the alignment between IS strategy and business strategy without considering the causal factors of alignment. It is generally assumed that the advanced manufacturing technology (AMT) adopted by manufacturing firms requires a high level of the strategic alignment of management accounting information systems (MAIS) [19, 42]. However, the causal relationships among AMT, strategic alignment of MAIS, and organizational performance have not been empirically examined.

In examining the impact of IS strategic alignment on organizational performance, previous research has considered the whole IS. Thus, in most previous studies, only macro measures of organizational performance, such as market growth, return on sales, return on investment, and company reputation, were considered. However, the whole IS are composed of many types of sub-IS. There exist wide differences in the actual degree of strategic alignment according to types of sub-IS [47]. The level of strategic alignment of the whole IS seems to be the mixed results of the strategic alignment of various types of sub-IS. Accordingly, it may be more appropriate to investigate the impact of sub-IS strategic alignment on performance. In prior studies, the effects of sub-IS (i.e. MAIS) strategic alignment have never been examined.

In aligning IS with business strategy, there are many facilitating activities (i.e., alignment facilitation) [34]. Thus, using structural equation modeling, the current study empirically investigated and analyzed the causal relationships among AMT, MAIS strategic alignment, facilitation of alignment, and organizational performance. The present study also examined and identified relevant information characteristics of MAIS when the level of MAIS strategic alignment is high. Hence, the results of this study can answer the following research questions: Is the degree of MAIS strategic alignment different according to the level of AMT? ; Under a high level of AMT, does the high degree of MAIS strate-

gic alignment really lead to increased performance? ; What are the roles of alignment facilitation when the level of AMT is high? ; What are relevant information characteristics of MAIS when the degree of MAIS strategic alignment is high?

2. Theoretical Underpinnings and Hypotheses

2.1 AMT and MAIS strategic alignment

AMT relates to the physical hardware of the manufacturing process and is defined as consisting of technological advancements in automation that are used in the production process [24]. AMT allows an organization to obtain production systems with many forms of flexibility [39]. Because of these forms of flexibility, AMT brings various strategic benefits, such as quality improvement, economies of scope, and shortened lead and delivery times. AMT, which provides diverse tangible and intangible benefits, is regarded as the premiere competitive weapon to achieve manufacturing and business goals [15]. Since manufacturing capabilities are more central to determining the strategic position of a firm, the strategic importance of AMT is also enormous [35]. This strategic consequence requires the consideration of AMT as a key variable in the formulation and implementation of business strategy. The adoption and configuration of AMT must be closely aligned with manufacturing and business strategy.

In implementing AMT, the planning, control and evaluation of production activities through the provision of information are the most important roles of MAIS [7]. MAIS collect, classify, summarize, and report information to managers to assist them in their control of production activities. To adopt only AMT does not guarantee higher production performance. According to the complementary theory, the successful implementation of AMT requires complementary MAIS [33]. The MAIS that are not compatible with AMT are likely to cause poor production performance. The notion of complementarity implies that MAIS can interact with AMT to produce higher performance than would be achieved by AMT alone [40].

Sim and Killough developed a formal optimizing model in which AMT, business strategy and MAIS assist firms to maximize their expected profits. The essential element of their thesis is that profitability is maximized when strategy, AMT and MAIS are clustered in a way that exploits potential complementarities between them. They predict that profitable firms develop linkages among business strategy, AMT and MAIS to include: Flexibility or differentiation strategy, high levels of AMT and strategically aligned MAIS. They claim that there are synergies in employing complementary choices of strategy, AMT and MAIS, which enhance profitability. They point out that firms failing to achieve complementary relationships among strategy, AMT and MAIS are likely to encounter serious economic losses.

MAIS must be complementary to AMT to realize the strategic benefits of AMT and to attain higher production performance [33, 40]. MAIS must fit with the strategically important position of AMT. Thus, MAIS should also be linked to the goals and strategies of business or manufacturing. To support and evaluate the achievement of the strategic advantages of AMT, the design and development strategy of MAIS must

be aligned with the firm's strategy set, such as business strategy, mission, and objectives. In conclusion, MAIS have to serve the implementation of AMT as well as business strategy. MAIS, which are designed in that way, can be used to encourage employees to behave in accordance with a firm's business strategies.

For example, it has been argued that financial performance measures, which are one design element of MAIS, lack relevance in AMT in that they do not reflect and are inconsistent with the strategic factors of quality, flexibility and dependability of supply. To support and evaluate the realization of the strategic benefits of AMT, MAIS must provide non-financial performance information that reflects and is aligned with strategic goals. Prior researchers [24, 40] empirically confirmed that the non-financial performance measures, which match well with the AMT's strategic integration, can improve a firm's production performance.

Accordingly, a high level of AMT, which generally demands a large amount of investment and which is strategically more important than a low level of AMT, may require a closer integration or alignment with the business strategy. As a result, under a high level of AMT, a high degree of integration between MAIS planning and business strategic planning may be also needed. However, when the level of AMT is low, since the strategic consequence of AMT is trivial, the degree of MAIS strategic alignment may be low. Based upon these arguments, Hypothesis 1 is formulated as follows :

Hypothesis 1 : The level of AMT adoption has a positive effect on the degree of MAIS strategic alignment.

2.2 MAIS strategic alignment and alignment facilitation

To achieve the alignment of MAIS with business strategy, we can refer to means of IS strategic alignment. Nath [34] surveyed many firms to investigate the critical factors which are thought to influence the alignment of IS with strategy. Based on the responses of the IS and general managers, he suggested five important factors. They include educating upper managers, upper managers' commitment to IS, business objectives about IS, IS manager involvement in strategic planning process and educating IS management of business goals. Broadbent and Weill [6] also empirically reported the organizational policies and practices, which contribute to the alignment. They comprise the firm's experience of IS planning, the clarity and consistency in strategic orientation, the interaction between business and IS managers and the IS understanding of the business managers.

For the alignment of MAIS with business strategy, the mechanisms composed of similar elements, which were suggested by Nath, and Broadbent and Weill, are needed. The alignment with strategy is a collaborative process between business strategy and organization and the components of MAIS (i.e. MAIS architecture) [5]. The participation of management accountants in the strategic planning process, the clarity of business strategic orientation, the management accountants' collective understanding about business goals and the education of management accountants about the business and manufacturing strategy and so forth may be primary ways to attain alignment. These facilitating activities enhance and contribute to the alignment of MAIS

with business strategy. The success of aligning MAIS with business strategy is dependent on the conditions of this facilitation [17, 37]. Therefore, it is likely that to attain successful MAIS strategic alignment, the facilitation must be arranged first according to the level of AMT.

When the level of AMT is high, facilitation of alignment must be well-coordinated to obtain a high degree of MAIS strategic alignment. If the facilitation is poorly prepared, strategic MAIS planning process may not proceed. Hence, conditions of alignment facilitation may be a proxy indicator of the degree of alignment. However, under a low level of AMT, since the degree of MAIS strategic alignment is also low, well-coordinated facilitation may not be required. Based upon this reasoning, Hypotheses 2 and 3 are formulated as follows :

Hypothesis 2 : The level of AMT adoption positively influences the alignment facilitation.

Hypothesis 3 : The alignment facilitation has a positive impact on the degree of MAIS strategic alignment.

2.3 Strategic alignment and information characteristics

In most IS design research (e.g., [11, 12, 14]), three information dimensions (i.e., information scope, timeliness, and integration) are considered the key design variables of IS. Narrow-scope information tends to be concerned with events within the organization, and results in data that are financial and historic. Alternatively, broad-scope information includes external, non-financial, and future-oriented material. Timeliness is usually specified in terms of the ability to provide information on request and the frequency of reporting. Information integration deals with a variety of ways to collect or sum the data within periods of time or areas of interest, such as responsibility centers or functional areas.

Information characteristics of MAIS that is aligned with business strategy can be inferred from the information characteristics of strategic IS. Since business strategic planning causes highly uncertain and complex tasks, to support strategic planning process, timely and aggregated types of information are required [41]. Therefore, to influence and support the formulation and implementation of a business strategy, IS must provide broad-scope, aggregated, and non-periodic types of information [22]. Fisher [20] and Chong [13] empirically confirmed a positive relationship between highly uncertain tasks and the broad-scope, timely and integrated types of information. Kirs et al. [29] empirically demonstrated that IS which is integrated with business strategy provides external, future-oriented, aggregated, and broad-focused types of information.

Hence, it is likely that when the degree of MAIS strategic alignment is high, to support the implementation of manufacturing or business strategy and the achievement of strategic goals, MAIS also must provide broad-scope, timely, and integrated types of information. However, under a low degree of MAIS strategic alignment, since MAIS does not assist in the formulation and implementation of business strategy, MAIS may not necessarily produce broad-scope, non-periodic, and aggregated types of information. Based upon these arguments, Hypothesis 4 is proposed.

Hypothesis 4 : The degree of MAIS strategic alignment positively influences the provision of the broad-scope, timely, and integrated types of information.

2.4 Impact on organizational performance

Aligning IS with business strategy is a means that appropriately considers business objectives or strategies in strategic IS planning [25, 31]. IS strategic alignment helps to ensure that IS function supports organizational goals and activities at every level by identifying critical applications for development and ensuring that adequate resources are allocated to critical applications. Therefore, it is a way for a firm to secure competitive advantages from IS applications. Das et al. also argued that the fit between IS planning and business strategy creates synergy through the coordination of different functions, leading to competitive advantage and, ultimately, to superior performance.

Floyd and Wooldridge [21] empirically showed the positive effects of the strategy and IS alignment on return on assets (ROA). Chan and Huff [9], and Chan et al. empirically demonstrated that IS strategic alignment has a positive effect on market growth and innovation, but a negative impact on company reputation. Teo and King also confirmed that organizational performance is different according to the degree of IS strategic alignment. Sabherwal found a circular relationship between IS strategic alignment and IS success (i.e., business performance). He argued that aligning IS with business strategy improves organizational performance and, conversely, that increased performance contributes to achieving high degrees of IS strategic alignment.

Accordingly, if MAIS planning is not coordinated with manufacturing or business strategy, it is likely that it will be very difficult for MAIS to support business strategies and to contribute to the achievement of strategic goals. It is assumed that the degree of MAIS strategic alignment also has a positive impact on organizational performance. Based upon this reasoning, Hypothesis 5 is formulated.

Hypothesis 5 : The degree of MAIS strategic alignment has a positive effect on organizational performance.

3. Research Methods

3.1 Sampling

Data for this study were drawn from a survey of the current status of MAIS used in Korean manufacturing firms. 450 organizations were randomly selected from a population of approximately 1,000 firms that are listed on the Korean stock market. The manufacturing firms listed are medium to large in size and consequently are likely to have more experience with MAIS and AMT applications than are smaller firms. Data were collected by a survey questionnaire administered to chief factory accountants. Only chief factory accountants were selected as respondents, since they understand both the degree of MAIS strategic alignment and the firm's AMT level and performance.

An initial letter was sent to the chief factory accountant of each firm explaining the nature and purpose of the research. About 1 week later, a questionnaire with a cover letter was mailed

<Table 1> Sample characteristics

Type of industry	Chemical industry	Machine industry	Auto-mobile	Electronic industry	Textile	Food	Paper & pulp	Non-metal	Metal industry	Furnit-ure	Total
No. of firms	21	8	14	26	6	7	9	8	7	1	107

No. of employees	Below 300	300~500	500~1,000	1,000~5,000	5,000~	Total
No. of firms	36	16	26	24	5	107

to each respondent. A self-addressed stamped envelope was included with the questionnaire to ensure anonymous responses. 111 responses were returned. However, four responses were excluded from the study because of incomplete data. Finally, 107 usable data were collected yielding a response rate of 23%. <Table 1> summarizes the sample characteristics according to the industrial type of the firms.

3.2 Measurements

3.2.1 The level of AMT adoption

Since the level of AMT is closely related to the degree of automation, the current study measured the degree of automation in the production systems to obtain the AMT measurement. Meredith and Hill [32] suggested a four-stage model to assess the degree of automation. Based on Meredith and Hill's model, a seven-stage model was developed : partially automated stand-alone equipment, some automated stand-alone equipment, a greater number of automated stand-alone equipment, low level of integration, high level of integration, linked islands, and full integration. Since low-automated manufacturing firms in Korea are very dissimilar in the number of stand-alone equipment employed [30], the first stage (i.e., the stand-alone stage) was subdivided into three stages according to the number of pieces of unitary equipment. In the second step (i.e., the cells stage), the level of integration was divided into low and high [32]. Hence, the second step was also subdivided into two stages in accordance with the level of integration. With the seven-stage model, respondents were asked to select the stage that best corresponds with the state of automation in their manufacturing systems.

3.2.2 Degree of MAIS strategic alignment

Degree of MAIS strategic alignment is defined as the degree of the integration of MAIS planning with business strategic planning [28]. Teo and King developed a four-stage model of MAIS strategic integration: administrative, sequential, reciprocal, and full integration. In the present study, this four-stage model was used to measure the degree of MAIS strategic alignment. This study also measured the degree of the fit between MAIS planning and business strategic planning with two questionnaire items to prove the external validity of the four-stage model. Two question items are : the degree of the fit between MAIS planning and business strategic planning, and the degree of the reflection of MAIS planning in business strategic planning. The degree of fit was measured on a seven-point Likert-type scale.

3.2.3 Information characteristics

Of various characteristics, orientation, time

horizon, frequency, focus, aggregation, financial/non-financial, quantitative/qualitative, and periodic/non-periodic were specifically selected. Orientation determines whether data items report primarily internal or external facts. Time horizon defines whether data items are ex-post, reporting what has happened, or ex-ante, reporting what is expected to occur. Frequency represents how many times the reports are produced in a given period. Focus shows whether data items are broad and diffuse or specific and narrow. Aggregation shows whether the reports contain too little or too much detail. Financial information is expressed in monetary terms. Quantitative information is expressed in numeric terms. Periodic/non-periodic addresses whether data items are to be reported periodically, or at any undetermined time. In this study, actual information characteristics of MAIS were measured on a seven-point Likert-type scale.

3.2.4 Alignment facilitation

In measuring facilitation of alignment, nine factors that enhance and contribute to alignment were considered [34]. These were: MAIS manager's understanding about business strategy, MAIS manager education of business goals and objectives, MAIS manager involvement in business strategic planning, upper management's understanding about MAIS strategy, upper management education of MAIS strategy, user participation in MAIS planning, upper management commitment to MAIS, ability of MAIS management to keep up with advances in information technology, and MAIS responsiveness to user needs. Using these factors, nine questions were developed and measured on a set of seven-point Likert-type scale.

3.2.5 Organizational performance

Benefits of MAIS strategic alignment are multidimensional. Since MAIS strategic alignment contributes to the realization of strategic advantages of AMT, this study measured the improvement in production performance through AMT and the financial performance using two variables : (1) return on assets (ROA) and (2) return on sales (ROS). Using the 19 questionnaire items developed by Vickery et al. [46] and Agarwal [1], the degrees of improvement in production performance were measured on a seven-point Likert-type scale that ranged from 'Not improved, worse' to 'Highly improved.'

19 items comprise the improvements in four dimensions, such as cost, quality, flexibility and dependability of supply, which are the core elements of production performance in AMT. The 19 items were: new product, product volume, speed in new products, product changeover and R&D (five items for flexibility), lead time, delivery, production lead time and customer requirements (four items for dependability of supply), product performance, product durability, specifications, design and engineering, product features and perception of quality (six items for quality), production cost, material cost, labor cost, and overhead cost (four items for cost). Accounting data to compute ROA and ROS were collected from the firms' balance sheets and income statements for 2003, which were provided in the Korean annual report of listed companies.

4. Results

4.1 Reliability and validity test

The questionnaire items measuring research

variables had been used in previous empirical studies. However, the construct validities of these items were questionable. We employed two types of factor analysis : Principal component and confirmatory factor analysis. Principal component analysis with varimax rotation was used to determine if all items measuring a construct cluster together or not. That is, whether all items measuring a construct load onto a single factor (i.e. construct) or divide into multiple factors (constructs). Confirmatory factor analysis was adopted to assess the strength of measurement between the question items and associated constructs created by principal component analysis. To execute factor analysis, the number of sample must be four or five times of the question items used in survey [23]. In this study, 36 questionnaire items were utilized. When the number of sample is smaller than four or five times of the question items, separate joint factor analysis can be employed [27]. Two separate joint factor analyses for alignment facilitation, information characteristics and production performance were carried out to acquire a more stable solution by increasing the ratio of the sample size to the number of items.

Using the 0.4 criterion for significant item loading on a factor, the results show that in the cases of information characteristics and production performance, three factors with eigen

〈Table 2〉 Factor loadings of research variables (Varimax rotation)

Production performance	Factor			Alignment facilitation	Factor			
	1	2	3		1	2	3	4
1			0.84	1	0.59			
2			0.61	2	0.84			
3			0.80	3	0.73			
4			0.75	4	0.79			
5			0.69	5	0.84			
6	0.68			6	0.77			
7		0.66		7	0.85			
8	0.82			8	0.72			
9	0.89			9	0.82			
10	0.81			Information				
11	0.70			characteristics				
12	0.63			1		0.73		
13	0.69			2		0.81		
14		0.84		3		0.70		
15		0.73		4				0.81
16		0.87		5				0.86
17		0.80		6			0.90	
				7			0.88	
Eigen value	8.9	1.7	1.4		6.0	2.0	1.4	1.1
% of variance	52.3	10.2	8.4		38.5	12.5	9.0	6.6

Note) Factor loadings below 0.4 were not presented.

〈Table 3〉 Construct validity using Confirmatory Factor Analysis (a : p≤0.01)

Construct	Items	Factor loading	C.R.	Variance	Construct reliability	Measures of model fit
Alignment facilitation	MAIS manager's understanding	0.61	-	0.528	0.93	χ^2/df = 2.8
	MAIS manager education	0.85	5.5[a]			RMR = 0.06
	Upper manager's understanding	0.75	5.2[a]			GFI = 0.92
	Upper manager education	0.86	5.5[a]			AGFI = 0.88
	Upper manager commitment	0.85	5.5[a]			NFI = 0.94
	Ability of MAIS management	0.64	4.8[a]			IFI = 0.96
	MAIS responsiveness	0.82	5.4[a]			CFI = 0.96
	MAIS manager involvement	0.68	4.9[a]			
	User participation	0.74	5.1[a]			
Information scope	Quantitative/qualitative	0.77	-	0.804	0.78	χ^2/df = 1.6
	Financial/non-financial	0.68	3.7[a]			RMR = 0.05
	Orientation	0.62	3.0[a]			GFI = 0.94
Information timeliness	Frequency	0.99	-	0.870	0.79	AGFI = 0.90
	Periodic/non-periodic	0.69	5.7[a]			NFI = 0.89
Information integration	Focus	0.89	-	0.842	0.86	IFI = 0.94
	Aggregation	0.62	4.9[a]			CFI = 0.93
Quality & dependability of supply	Delivery reliability	0.76	-	0.553	0.92	χ^2/df = 2.2
	Product performance	0.91	10[a]			RMR = 0.06
	Product durability	0.88	9.6[a]			GFI = 0.90
	Conformance to specifications	0.78	8.3[a]			AGFI = 0.86
	Design & engineering quality	0.77	8.3[a]			NFI = 0.91
	Product features	0.68	7.1[a]			IFI = 0.93
	Quality	0.74	7.8[a]			CFI = 0.93
Cost reduction	Production lead time	0.78	-	0.650	0.91	
	Production cost	0.90	10[a]			
	Material cost	0.71	7.7[a]			
	Labor cost	0.86	9.7[a]			
	Overhead cost	0.82	9.1[a]			
Increased flexibility	New product	0.85	-	0.562	0.88	
	Product volume	0.74	8.6[a]			
	Speed in new product	0.81	9.8[a]			
	Product changeover	0.77	9.0[a]			
	R&D	0.68	7.6[a]			

values greater than one were extracted, respectively. However, in terms of information characteristics, item 4 (time horizon) of factor 1 was confounded with the item of factor 2. Item 4 was removed and the factor analysis was repeated. In this second factor analysis, the items of each-factor were not confounded with the items in the other factors. Factor 1 comprises quantitative/qualitative, financial/non-financial and orientation. Thus, its title is information scope. Factor

2, which is composed of focus and aggregation, represents information integration. Factor 3, which includes frequency and periodic/non-periodic, entails information timeliness.

In the case of production performance, in factor 1, items 6 (lead time) and 8 (customer requirements) were confounded with the items of factor 2. Thus, items 6 and 8 were removed. In the second factor analysis, no item was confounded. Factor 1 (delivery, product performance, product durability, specifications, design and engineering, product features, and quality) is quality and dependability of supply. Factor 2 (production lead time, production cost, material cost, labor cost, and overhead cost) represents cost reduction. Factor 3 (new product, product volume, speed in new product, product changeover, and R&D) shows increased flexibility. The results of our final factor analysis are presented in <Table 2>. <Table 3> shows the results of confirmatory factor analysis. From these results, it is confirmed that the construct validities of each variables are very high.

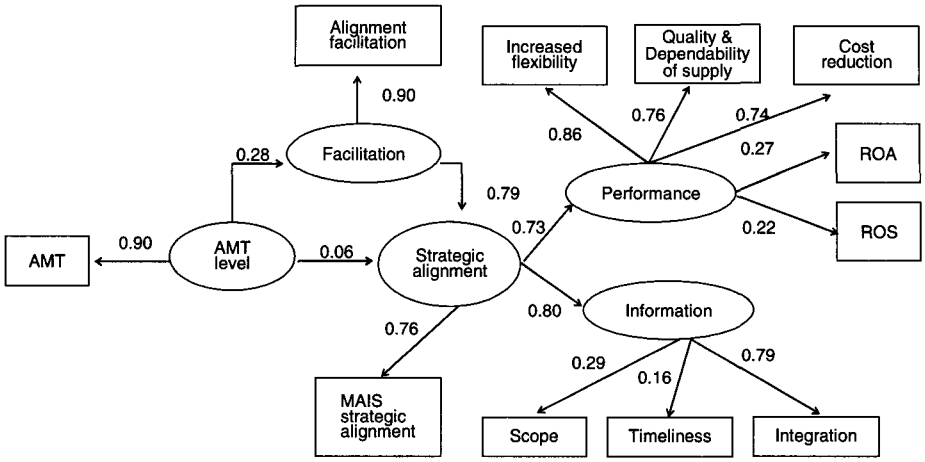
To prove the external validity of the four-stage model (i.e. the measure of the degree of MAIS strategic alignment), we employed Pearson correlation analysis. The correlation coefficient between the four-stage model and the degree of fit (i.e. the fit between MAIS planning and business strategic planning) was 0.56 ($p = 0.00$). Thus, it is concluded that the instrument for the degree of MAIS strategic alignment has external validity. A single scale for the research variable was created by averaging a respondent's scores over the items measuring each variable. The values of mean and standard deviation for the research variables were calculated and are summarized in <Table 4>.

4.2 Analysis of causal relationships

This study employed a structural equation modeling technique to analyze causal relationships among research variables. AMOS 4.0 was utilized as the analytical tool to estimate the measurement and theoretical models [4]. So theorized, distinct causal paths from AMT level, alignment facilitation and MAIS strategic a

〈Table 4〉 Summary statistics of research variables

Variables	Mean	Standard deviation	Median	Minimum	Maximum
Level of AMT	3.5	1.7	4.0	1.0	7.0
MAIS strategic alignment	2.3	0.8	3.0	1.0	4.0
Information scope	2.7	0.9	2.6	1.0	5.0
Information timeliness	3.1	1.2	3.0	1.0	7.0
Information integration	4.5	1.3	4.5	1.0	7.0
Alignment facilitation	4.6	1.1	4.7	1.0	6.3
Quality and dependability of supply	5.2	0.8	5.2	3.2	7.0
Cost reduction	5.1	0.9	5.2	2.6	7.0
Increased flexibility	4.8	0.7	5.0	2.4	6.8
Return on assets (ROA, %)	19.5	18.8	15.1	-25.0	58.8
Return on sales (ROS, %)	18.5	14.4	16.4	-21.8	66.9



[Figure 1] Structural path estimates

lignment predict alternative outcomes with respect to both organizational performance and information characteristics. [Figure 1] displays both the theoretical model structure corresponding to the hypotheses and the measurement model. [Figure 1] also presents individual structural path estimates. In [Figure 1], ellipse and box represent the unobserved variable (theoretical variable) and the observed variable (measurement variable), respectively.

The observed χ^2 for the theoretical model was 149.83 (df = 53 ; p = 0.00). Although the significance (p - value) of χ^2 indicates relatively poor fit between the model and the sample data, goodness of fit cannot be judged by χ^2 value alone. Since the p - value of χ^2 is sensitive to sample size, a ratio of χ^2 to degrees of freedom (χ^2 value/degrees of freedom) can be employed as fit index [8]. The χ^2 to degrees of freedom ratio in the range of 3 to 1 indicates an acceptable fit between the theoretical model and the sample data.

The ratio of χ^2 to degrees of freedom was 2.8. Other indices of fit for the theoretical model are GFI (goodness of fit index) = 0.87, AGFI (adjusted goodness of fit index) = 0.78, NFI (normed fit index) = 0.78, IFI (incremental fit index) = 0.80, CFI (comparative fit index) = 0.79 and RMR (root mean square residual) = 0.07. GFI and RMR reflect the relative amount of the variances and covariances jointly accounted for by the model. However, there is no basic standard with which to evaluate them because their distributions are unknown [26]. Although GFI value above 0.9 indicates a very good fit, GFI values around 0.8 also indicate an acceptable fit [3, 36]. Therefore, the theoretical model in [Figure 1] is judged to provide a moderate fit for the observed covariances.

Hypothesis 1 suggested that AMT level positively affects the degree of MAIS strategic alignment. However, contrary to this prediction, the path estimate between AMT level and MAIS strategic alignment is non-significant (0.06, $p > 0.4$). Thus, Hypothesis 1 is disconfirmed. Hypothesis 2 is supported by a significant and positive relationship (0.28, $p < 0.1$) between AMT level and alignment facilitation. Hypothesis 3 concerns the outcome resulting from the impact of align-

ment facilitation. Consistent with Hypothesis 3, the path predicting a relationship between alignment facilitation and MAIS strategic alignment is significant and positive (0.79, $p < 0.00$). Hence, high levels of AMT require well-coordinated alignment facilitation and, subsequently, well-coordinated alignment facilitation positively contributes to the attainment of high degrees of MAIS strategic alignment. <Table 5> shows these path estimates.

Hypotheses 4 and 5 proposed the direct effects of MAIS strategic alignment on information characteristics and organizational performance. Hypothesis 4, predicting positive impact of MAIS strategic alignment on information characteristics, is supported by a corresponding path estimate of 0.8 ($p < 0.1$). Thus, under high degrees of MAIS strategic alignment, broad-scope and integrated types of information must be provided. The path estimate representing Hypothesis 5 (0.73, $p < 0.00$) is also consistent with prediction suggesting that the degree of MAIS strategic alignment positively contributes to improvement of performance.

4.3 Fit among AMT, facilitation and strategic alignment

In structural equation modeling, the causal relationship between level of AMT and MAIS strategic alignment was not confirmed. Thus, we examine effects of the fit among AMT, facilitation and strategic alignment on organizational performance. Through this examination, we can show that if a level of AMT is high, both well-arranged facilitation and high degree of strategic

〈Table 5〉 Path coefficients of the theoretical and measurement models

Model	Path flow	Regression weights			Standardized
		Estimate	C.R.	p value	regression weights
Theoretical model	Facilitation ← AMT level	0.11	1.82	0.06	0.28
	Strategic alignment ← AMT level	0.02	0.74	0.40	0.06
	Strategic alignment ← Facilitation	0.51	7.95	0.00	0.79
	Information ← Strategic alignment	0.21	1.66	0.09	0.80
	Performance ← Strategic alignment	0.69	5.81	0.00	0.73
Measurement model	AMT ← AMT level	1.0*			0.90
	Alignment facilitation ← Facilitation	1.0*			0.90
	MAIS strategic alignment ← Strategic alignment	1.0*			0.76
	Scope ← Information	1.0*			0.29
	Timeliness ← Information	1.19	1.26	0.20	0.16
	Integration ← Information	6.19	1.69	0.09	0.79
	Quality & dependability of supply ← Performance	1.0*			0.76
	Cost reduction ← Performance	1.08	7.09	0.00	0.74
	Increased flexibility ← Performance	1.02	7.97	0.00	0.86
	ROA ← Performance	8.28	2.51	0.01	0.27
	ROS ← Performance	5.23	2.07	0.03	0.22

Note) * : Regression weight was set in 1

alignment can lead to improved performance. As it were, we indirectly analyze the relationships between AMT, facilitation and strategic alignment to attain a high performance.

Van de Ven and Drazin [45] outlined three approaches to analyze data based on alternative definitions of fit. They include: Selection, interaction and systems. Researchers have been critical of the selection and interaction approaches, arguing that they only provide partial depictions of relationships between variables of interest and fail to consider the fit of the whole system. The systems approach takes a holistic view of fit by considering the internal consistency among multiple variables. In this study, a systems approach is employed because there are various combinations of the level of AMT, facilitation and the degree of strategic alignment to enhance or decrease organizational performance.

Van de Ven and Drazin emphasized that there is no dominant method for operationalizing the systems approach. However, in recent years, a range of cluster analysis methods has emerged to offer a more sophisticated means of determining the way in which variables combine. In the current study, cluster analysis provides the clusters of companies that are similar in levels of AMT, conditions of facilitation and degree of strategic alignment. In the cluster analysis, this study used the hierarchical agglomerative method for forming the clusters because it generates non-overlapping clusters and has been the dominant method [2]. As the sorting or linkage rules, Ward's method was chosen since this technique optimizes the minimum variance within clusters [18]. We also used the squared Euclidean distance as the proximity measure.

Based on the values of the level of AMT, facilitation and the degree of MAIS strategic alignment, cluster analysis was performed to produce clusters of organizations. Additionally, the average organizational performance was calculated for each cluster. A critical issue in cluster analysis is to determine the optimal number of clusters. While there are formal decision rules to guide this process, heuristics are commonly used. A formal approach to determining the most appropriate number of clusters is to examine the distance coefficient.

The distance coefficient is shown in <Table 6>. The points at which the distance coefficient suddenly jumps indicate suitable stages in the clustering sequence for analysis [2]. In <Table 6>, the distance coefficient increases greatly at two points - between the sixth and seventh clusters and between the fourth and fifth clusters. This implies that the five-cluster and seven-cluster solutions may be appropriate points for analysis. However, the seven-cluster solution is a little large in terms of the number of clusters. The five-cluster result provides sufficient data to examine the variations in performance, which were caused by the various combinations of the AMT level, facilitation and strategic alignment.

〈Table 6〉 Distance coefficient (Agglomeration schedule using Ward method)

Stage	98	99	100	101	102	103	104	105	106
Coefficient	50.6	57.2	64.3	77.3	90.8	118.3	154.2	250.1	376.3
Increasing rate	-	13.0%	12.4	20.2	17.4	30.2	30.3	62.1	50.4
No. of cluster	9	8	7	6	5	4	3	2	1

Therefore, the five-cluster solution was used in the analysis.

The mean ranks of variables within each cluster are presented in <Table 7>, along with Kruskal-Wallis test results (χ^2 values) for each clustering variable. The χ^2 values show that statistical differences exist for individual variables across clusters. However, they do not provide evidence that significant differences exist between clusters. In the case of C3, the level of AMT is the highest (i.e. ranked first), and both the score of facilitation and the value of strategic alignment are also high (i.e. ranked first). Thus, C3 is solid in terms of organizational performance. By contrast, in C5, though the level of AMT is relatively high (i.e. ranked second), the value of facilitation and the degree of strategic alignment are lower (i.e. ranked fourth).

In terms of facilitation, the difference between C3 and C5 was examined using the Mann-Whitney test and found to be significant at the 1% level. In terms of the degree of strategic alignment, the difference between C3 and C5 was also significant (i.e. the difference was examined using the Mann-Whitney test). As a result, the organizational performance of C5 seems to decrease. In terms of organizational performance, the differences between C3 and C5 were examined using the Mann-Whitney test and found to be significant at the 1% and 5% level. These results are presented in <Table 8>. These results confirm the fact that at a high level of AMT, a high degree of MAIS strategic alignment along with well-coordinated facilitation can increase the firm's performance. Hence, to achieve increased performance, high levels of AMT must lead to well-arranged facilitation as well as high degree of MAIS strategic alignment.

In the case of C1, the level of AMT is very low compared with the scores of facilitation and strategic alignment. The difference between AMT level for C1 and C4 was examined using the Mann-Whitney test and found to be significant at the 10% level. However, the rankings of strategic alignment and facilitation are considerably higher. In terms of strategic alignment and facilitation, the differences between C1 and C4 were significant at the 1% level. Because of the misfit among AMT level, degree of strategic alignment and facilitation, the organizational

〈Table 7〉 Mean ranks of variables within clusters

Cultural variables	Clusters					
	C1 (n = 27)	C2 (n = 21)	C3 (n = 18)	C4 (n = 24)	C5 (n = 17)	χ^2
Level of AMT	17.5(5)	46.9(3)	67.9(1)	28.9(4)	62.7(2)	56.8[a]
MAIS strategic alignment	44.0(2)	43.5(3)	52.3(1)	9.2(5)	12.5(4)	35.5[a]
Facilitation	38.3(3)	48.8(2)	59.2(1)	8.9(5)	12.5(4)	41.9[a]
Quality & dependability of supply	35.6(3)	46.8(2)	56.1(1)	11.3(5)	23.8(4)	28.9[a]
Cost reduction	34.2(3)	45.3(2)	61.3(1)	18.7(4)	16.7(5)	28.6[a]
Increased flexibility	32.3(3)	45.5(2)	59.5(1)	17.8(5)	19.4(4)	27.0[a]
ROA	38.2(2)	37.0(3)	41.2(1)	37.0(3)	27.4(5)	1.8
ROS	40.9(2)	32.4(4)	41.0(1)	38.2(3)	27.8(5)	3.5

Note) The numbers in parentheses are rankings of research variables across clusters. [a] : $p \leq 0.01$.

〈Table 8〉 Differences between clusters (Mann-Whitney test)

Cluster	C3 C5	C1 C4	C2 C3
AMT level	18 16 U = 85.0	22 30 U = 15.0[c]	12 26 U = 18.0[b]
MAIS strategic alignment	27 7 U = 0.0[a]	39 14 U = 11.0[a]	17 23 U = 26.5[c]
Facilitation	28 6 U = 30.0[a]	38 13 U = 22.5[a]	18 22 U = 28.5[c]
Quality & dependability of supply	24 8 U = 36.6[a]	36 16 U = 37.0[b]	16 23 U = 27.0[c]
Cost reduction	26 7 U = 28.5[a]	35 16 U = 26.0[b]	16 24 U = 26.5[c]
Increased flexibility	28 9 U = 27.0[a]	36 17 U = 24.5[b]	15 23 U = 23.0[c]
ROA	23 11 U = 39.0[b]	26 26 U = 12.5	19 19 U = 11.0
ROS	24 12 U = 34.5[b]	27 26 U = 16.5	17 23 U = 12.0[c]

Note) Numbers are mean ranks. [a] : $p \leq 0.01$, [b] : $p \leq 0.05$, [c] : $p \leq 0.1$.

performance of C1 is likely to be a little low. From these results, it is concluded that under a low level of AMT, if the degree of MAIS strategic alignment is excessively high and the facilitation is very well-arranged, the performance of a firm may decrease.

The AMT level of C2 is a little lower than that of C3 (i.e. the difference was significant at the 5% level). In the degree of strategic alignment and the facilitation, the scores of C2 are slightly lower than those of C3 (i.e. the differences were significant at the 10% level). In C2, there is proper match among AMT level, strategic alignment and facilitation. Thus, the organizational performance of C2 is moderately high (i.e. ranked second). From these results, we can put forth the following conclusion : according to the level of AMT, a proper degree of strategic alignment and proper conditions of facilitation must be attained and maintained all together to achieve a high degree of organizational performance.

5. Conclusion and Discussion

In investigating the impact of IS strategic alignment on a firm's performance, contextual variables, such as external environments and AMT, which affect the degree of IS strategic alignment, must be considered. If contextual variables of a firm do not require high levels of IS strategic alignment, a firm generally pursues defensive strategies based on high efficiency and cost effectiveness and thus, a high degree of IS strategic alignment in the firm, which provides opportunities of strategic IS applications, may be a costly luxury. Therefore, it seems that when contextual variables do not require high levels of strategic alignment, a high degree of IS strategic alignment cannot be related with the improvement of organizational performance. Since the whole IS of a firm are composed of various types of sub-IS, the level of strategic alignment

of the whole IS may reflect the mixed results of the strategic alignment of many kinds of sub-IS. Thus, some inconclusive results of prior studies (e.g. [9, 10]) may be caused by the consideration of the whole IS strategic alignment.

This study focused on the strategic alignment of such sub-IS as MAIS. Using structural equation modeling, this study examined causal relationships among AMT level, degree of MAIS strategic alignment, alignment facilitation, information characteristics of MAIS, and organizational performance. The results showed that there is no significant causal relationship between AMT level and MAIS strategic alignment. However, through cluster analysis, we confirmed the fact that at a high level of AMT, a high degree of MAIS strategic alignment along with well-coordinated facilitation can increase the firm's performance. In addition, we found that the level of AMT has a significant and positive impact on alignment facilitation. A significant causal relationship between alignment facilitation and MAIS strategic alignment was also found. Hence, to achieve increased performance, high levels of AMT must lead to well-arranged facilitation as well as high degree of MAIS strategic alignment. From these results, we can suggest that under high levels of AMT, well-coordinated alignment facilitations are required and, consequently, they contribute to the increase of the degree of MAIS strategic alignment.

According to the results of this study, it is concluded that under high degrees of MAIS strategic alignment, MAIS must provide broad-scope and integrated types of information. These types of information are required to support the formulation and implementation of business strategy and the realization of strategic goals. The causal relationships between MAIS strategic alignment and organizational performance were significant and positive. Thus, it is suggested that under high levels of AMT, a high degree of MAIS strategic alignment positively contributes to the improvement of production performance.

Manufacturing firms usually employ high levels of AMT to achieve strategic goals, such as cost reduction, high quality, economies of scope and customer satisfaction. These strategic goals are also reflected in business strategies : Cost leadership strategy, and product and market differentiation strategy. Thus, a high level of AMT can be considered as a means to support and stimulate the implementation of business strategies. Since MAIS can encourage the achievement of strategic goals through AMT, the design of MAIS must be aligned with business strategies. There are many design elements of MAIS into which business strategic objectives must be incorporated. They are comprised of overhead allocation, performance measure, investment appraisal, costing and others. Performance evaluation systems, which are designed to monitor how strategies are implemented, can contribute to the achievement of organizational goals. Traditional investment appraisal may impede the adoption of AMT by emphasizing short-term profitability and using excessively high hurdle rates. Therefore, the investment in AMT must be justified from a strategic perspective. Even product costing may be used to implement competitive strategies. To focus employees' attention on the factors managers deem most critical to success, an incorrect and biased costing system may be intentionally created.

The strategic application of a specific sub-IS

is likely to influence positively the improvement of particular performance of a firm [47]. Since the important role of MAIS is to provide information for the control and evaluation of production activities, high levels of MAIS strategic alignment can lead to the improvement of production performance and consequently, high financial performance. The indirect relationship between MAIS strategic alignment and organizational financial performance, such as ROA and ROS, can be confirmed with the results of partial correlation analysis.

The partial correlation coefficients between MAIS strategic alignment and financial performance after controlling production performance are 0.13 ($p = 0.18$) in ROA and 0.15 ($p = 0.13$) for ROS, respectively. These results can be compared with the initial zero-order correlations of 0.22 ($p = 0.04$) in ROA and 0.21 ($p = 0.04$) for ROS. The positive relationship between MAIS strategic alignment and financial performance becomes non-significant when production performance is controlled. However, the significant positive relationship between MAIS strategic alignment and production performance exists as before after controlling financial performance. Partial correlation coefficients are 0.32 ($p = 0.01$) in quality and dependability of supply, 0.25 ($p = 0.01$) in cost reduction and 0.35 ($p = 0.01$) for increased flexibility.

The limitations of the current research and directions of future research efforts include : This study only considered the level of AMT as contingency variable that affects MAIS strategic alignment. There are many other contextual variables, such as environment and organizational culture, which may influence the degree of IS strategic alignment. In future research, various contingency variables have to be included simultaneously to determine the key contingency variable that explains the variations in the degree of IS strategic alignment.

In measuring the level of AMT, we used the seven-stage model. The seven-stage model can be considered as an objective measurement. However, if the seven-stage model is the subjective measure of AMT level, its scale is near to ordinal scale, and thus, it cannot be utilized in parametric analyses techniques. Although, in prior studies, the seven-stage model has been used in parametric analyses techniques, there is a problem in the use of the seven-stage model. It is the limitation of our research to utilize the seven-stage model. In future study, objective measurement to measure AMT level must be developed.

The dimensions of organizational performance, which are influenced by sub-IS strategic alignment, may differ according to the type of sub-IS that is aligned with the business strategy. Therefore, in investigating the impact of sub-IS strategic alignment, various types of sub-IS must be empirically examined while considering the relevant performance dimensions. If the positive effects of the strategic alignment of a particular sub-IS on specific performance dimensions can be proven, ways to improve specific dimensions of organizational performance through the strategic alignment of IS can be proposed.

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