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The Effects of National Culture on the Design of Management Accounting Information Systems*

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This study empirically examined the impact of national culture on the amount of information provided by management accounting information systems (MAISs). Two very different cultures, the Korean and Australian cultures, were considered in our study. The results showed that more flexibility performance information is provided in Korean firms, while the amount of quality performance information and traditional cost control information (TCCI) produced in Australian firms is more than in Korean firms. We also investigated the effect of the three-way interactions among national culture, level of advanced manufacturing technology (AMT), and information on production performance. The results revealed a significant impact of three-way interactions on the improvement of production performance.

INTRODUCTION

Because of the accelerating globalization of business, the transferability of information systems' (ISs) design characteristics across nations has been considered to be an issue of critical importance. Prior studies have found that national cultures differ from one another and people of different cultural origins have different attitudes toward, or reactions to, the same IS design (e.g. Straub, 1994; Cooper, 1994; Robichaux & Cooper, 1998). These studies have shown

that a specific IS design which is effective in one country may be ineffective, or even dysfunctional, in another because of cultural differences. However, most previous research did not examine cultural effects on information characteristics (e.g. content, amount and format) of IS, which are also key IS design elements. National culture as shared norms and values of people naturally influences managers' preferences for specific information characteristics (Kumar & Bjorn-Andersen, 1990).

Management accounting information systems (MAISs) collect, classify, summarize, and report information to managers to assist them in their control of production activities (Bruggeman & Slagmulder, 1995). However, in the past decade, massive changes have taken place in the design of MAISs due to the adoption of advanced manufacturing technology (AMT) by manufacturing firms. Many researchers have empirically examined and proposed information characteristics of MAISs suitable for levels of AMT and the interaction effects of AMT and information on production performance (e.g. Harrison & Poole, 1997; Sim & Killough, 1998). Although prior studies have identified the types of information required for successful implementation of AMT, cross-national generalizability of their research results was not confirmed. Most research was conducted in the cultural settings of "western" nations such as U.S.A., U.K. and Australia. Considering that it is unlikely that all characteristics of MAISs are generalizable and transferable across nations (Tan et al., 1995), some useful information characteristics of MAISs under AMT may be different according to varied cultural settings.

In this study, we identify nation-specific factors which only influence the amount of information provided by MAISs and empirically examine differences in the amount of information according to cultural variations. To conduct this examination, data were collected from samples of the Australian and Korean firms, since Australian culture seems to be almost opposite to that of Korea (Hofstede, 1991). We also empirically show the effects of the interaction among national culture, AMT and information on organizational performance. Through interaction analysis, types of information which are both culturally appropriate and well-matched to AMT can be identified. Thus, the results of this study can answer the following research questions.

(1) Are there culturally appropriate types of management accounting information ?

(2) Is the amount of information provided by MAISs different according to cultural variations ?

(3) Is the amount of information required by AMT also different according to varied cultural settings ?

(4) Can the culturally appropriate information always fit with the AMT in that country and improve AMT performance ?

(5) What are types of information that are both culturally appropriate and compatible with the level of AMT ?

THEORETICAL UNDERPINNINGS

National Culture

Hofstede (1991) defined culture as the collective programming of the mind which distinguishes the members of one human group from another. Hofstede identified five work-related cultural dimensions along which countries differ. Hofstede's five dimensions are: individualism, power distance, uncertainty avoidance, masculinity and Confucian dynamism. Individualism (Collectivism) relates to people's self-concept: "I" or "we". Power distance relates to people's acceptance that power in institutions and organizations is distributed unequally. Uncertainty avoidance refers to the degree to which the members of a society feel comfortable with uncertainty and ambiguity. Masculinity (Femininity) reflects preferences for achievement and material success as opposed to emphases on relationships and the quality of life. Confucian dynamism refers to a long-term versus short-term orientation in life. As reported in Hofstede (1991), workers from Korea and Australia had different scores on these five cultural dimensions:

	Individualism	Power distance	Uncertainty avoidance	Masculinity	Confucian dynamism
Korea	18	60	85	39	75
Australia	90	36	51	61	31
Mean for 39 countries	51	51	64	51	46

Thus, Hofstede's results suggest that Australian culture is much higher on the individualism and masculinity dimension, while Korean culture is relatively higher on the other three dimensions (i.e. power distance, uncertainty avoidance and Confucian dynamism).

AMT and Information Characteristics of MAISs

AMT relates to the physical hardware of the manufacturing process and is defined as consisting of technological advancements in automation able to be used in the production process (Harrison & Poole, 1997). AMT allows an organization to obtain production systems with many forms of flexibility. Through these flexibilities, a firm can realize various strategic advantages, such as shortened lead and production turnaround times, and economies of scope (Malhotra & Ritzman, 1990). AMT provides the electronic integration of the production process both within functions (e.g. across different manufacturing

tasks) and across functions (e.g. among design, engineering and manufacturing) (Dean & Snell, 1991). Through integration, AMT can facilitate the planning and execution of products in real time. To fully capitalize on AMT's strengths in processing market information, engineering and production concurrently, a firm should employ a strategy of cooperation between its operations on the one hand and the external constituents relevant to product and process development (e.g. suppliers, equipment vendors and scientific community) on the other (Parthasarthy & Sethi, 1993).

The major functions of MAISs are to provide information for planning, control and evaluation of production activities (Scarbrough et al., 1991). However, planning is an ex-ante form of control (Flamholtz & Das, 1985), since it defines the performance goals and expectations in terms of budget or forecasts. Evaluation represents an ex-post control in that it involves assessing the performance of individuals or groups against pre-established goals and standards. Hence, the information produced by MAISs is a form of control information. The control information of MAISs can be classified into two types: accounting (financial) and nonaccounting (nonfinancial) (Abernethy & Brownell, 1997). A typical type of nonfinancial control information is nonfinancial performance information. Nonfinancial performance information refers to the nonmonetary and qualitative measures such as customer satisfaction, product quality and cooperation (Bledsoe & Ingram, 1997). Types of financial control information include financial performance information and cost control information. The kinds of cost control information provided by MAISs can also be grouped into the traditional and advanced cost control information. Traditional cost control information (TCCI) is produced by traditional management accounting techniques which are comprised of standard costing, variable costing and full costing (Chenhall & Langfield-Smith, 1998a, 1998b). Advanced cost control information (ACCI) is provided by newer techniques which include activity-based costing (ABC), product life cycle costing and cost of quality (McNair, 1990; Chenhall & Langfield-Smith, 1998a).

Under AMT, to manage the integration and collaboration within and across business functions, MAISs must produce a large amount of control and coordination information (Otley, 1994). When AMT is employed, the utilization of ACCI such as ABC and product life-cycle costing increases to control interrelated activities (McNair, 1990). AMT provides various strategic benefits such as quality improvement, economies of scope and shortened lead and delivery times. Accordingly, to support and evaluate the achievement of various strategic benefits provided by AMT, nonfinancial performance information is also required (Abernethy & Lillis, 1995). Although AMT requires both financial control information and nonfinancial types of information, under high levels of AMT, nonfinancial performance information and ACCI are relatively preferable to financial performance information and TCCI.

HYPOTHESES FORMULATION

The Impact of National Culture

The national culture of Korea is characterized by high scores in collectivism, uncertainty avoidance and Confucian dynamism, while low in masculinity (i.e. high feminity). Australian culture is characterized by high scores in individualism and masculinity, but low values in uncertainty avoidance and Confucian dynamism. If collectivism and feminity are high, an individual is motivated by group interests and people emphasize the maintenance of interpersonal harmony or relationships (Merchant et al., 1995). In a collectivist society, people view their actions as an important contribution to their group's well-being. Therefore, in a highly collective and feminine culture, to control employees' activities, team or group-based performance evaluations and work arrangements are demanded more often than individual-oriented evaluations (Awasthi et al., 1998). Team or group-oriented performance measurements are likely to cross departmental lines and, consequently, be comprised mainly of nonfinancial performance information. Based upon these arguments, the following Hypothesis 1 can be proposed.

Hypothesis 1: Overall, the amount of nonfinancial performance information provided in Korean firms is relatively much greater than in Australian firms.

In an individualistic culture, people look primarily after their own interests, needs and preferences (Brewer, 1998). In a highly masculine society, people also place more emphasis on their own success and achievement than relationships and modesty. Therefore, if individualism and masculinity are high, to control employees' behavior, individual-based performance evaluation and pay are preferable to team or group-oriented evaluation (Awasthi et al., 1998). Under high individualism, in order to measure individual performance and to establish individual worker accountability, financial performance measures are required. In a country with a strong uncertainty avoidance culture, people's intolerance for ambiguity and the demand for precision and formalization are very high (Hofstede, 1991). Ambiguous situations are those which cannot be adequately structured or categorized by an individual (McGhee et al., 1978). Individuals intolerant of ambiguity perceive ambiguous situations as a source of threat and behave in a manner to reduce this threat. Individuals intolerant of ambiguity attempt to reduce the threats inherent in ambiguous situations by manifesting a preference for readily interpretable information (i.e. financial information). Therefore, in a high uncertainty avoidance society, financial performance information is required more often. Australian culture is characterized by high individualism and high masculinity, while high uncertainty avoidance is characteristic of Korean culture. Hence, it seems that no difference exists between Korean firms and Australian firms in the amount of financial performance information provided. Based upon the above reasons, Hypothesis 2 is presented.

Hypothesis 2: Overall, no significant difference exists between Korean firms and Australian firms in the amount of financial performance information provided.

TCCI focuses on managing cost by means of standards, variances and measurements established at the individual unit or level (Miller, 1992). Under TCCI, the fundamental assumption is that maximizing individual performance will lead to organizational success (McNair, 1990). However, ACCI considers interrelationships among functions or activities in controlling cost. The focus of ACCI is not an individual unit, but the interrelated processes and activities (Miller, 1992). Hence, TCCI is more likely to be individualism-oriented information, while ACCI is regarded as collectivism-oriented information. TCCI was developed 70-80 years ago and has been used in manufacturing firms since then (Kaplan, 1984). If newly developed ACCI is employed in firms, ACCI replaces or supplements TCCI. Adoption of new management accounting techniques is an innovation and change process (Firth, 1996). Since low uncertainty avoidance and high masculinity are components of innovative activities, they have a positive impact on the adoption of advanced management accounting techniques (i.e. ACCI). However, a high uncertainty avoidance culture deters and delays the adoption of ACCI. Since Korean culture is characterized by strong uncertainty avoidance and low masculinity, many Korean firms may still depend on TCCI. However, TCCI is individualism-oriented information. Thus, the high individualism of Australian culture also seems to prefer and demand TCCI. Moreover, both high masculinity and weak uncertainty avoidance in Australian society can promote the adoption of ACCI. Based upon the above arguments, Hypotheses 3 and 4 are proposed as follows:

Hypothesis 3: Overall, no significant difference exists between Korean firms and Australian firms in the amount of traditional cost control information (TCCI) provided.

Hypothesis 4: Overall, the amount of advanced cost control information (ACCI) provided in Australian firms is relatively much greater than in Korean firms.

The Consideration of AMT

In the previous section, it was argued that nonfinancial performance measures are culturally appropriate information in Korean firms. Thus, provision of nonfinancial performance information in Korean firms seems to have a positive effect on organizational performance irrespective of levels of AMT. Also, it was argued that in Australian firms, nonfinancial performance information is not culturally appropriate. However, when the level of AMT in Australian firms becomes high, nonfinancial performance measures are required to improve production performance. It is likely that three-way interac-

tions exist among national culture, level of AMT and the amount of nonfinancial performance information affecting production performance. Hence, Hypothesis 5 is presented.

Hypothesis 5: There is an interaction among the level of AMT, national culture and the amount of nonfinancial performance information provided by MAISs affecting production performance.

According to Hypothesis 2, financial performance information seems to be preferred and demanded in both countries. However, because of the frequent changes of products and the new level of technology in AMT, a high level of AMT gives rise to a high degree of uncertainty (Sanchez, 1995). Therefore, when the AMT level in Korean firms is high, the strong uncertainty avoidance of Korean culture is likely to demand a large amount of financial performance information. On the contrary, since Australian culture is characterized by weak uncertainty avoidance, a large amount of financial performance information may not be required under a high level of AMT. Based upon the above reasons, Hypothesis 6 is suggested as follows:

Hypothesis 6: There is an interaction among the level of AMT, national culture and the amount of financial performance information provided by MAISs affecting production performance.

In Korean firms, because of high uncertainty avoidance and low masculinity, ACCI may not be properly employed. In this situation, Korean firms are likely to demand a large amount of TCCI irrespective of levels of AMT. However, ACCI shortage under a high level of AMT decreases the production performance of Korean firms. In Australian firms, TCCI is culturally appropriate and ACCI is not culturally preferred. The characteristics of Australian culture are low uncertainty avoidance and high masculinity. Thus, under high levels of AMT, a large amount of TCCI is not required and a proper amount of ACCI can be provided. It seems that in Australian firms, ACCI can be utilized for the improvement in performance under a high level of AMT. Based upon the above arguments, Hypotheses 7 and 8 are proposed as follows:

Hypothesis 7: There is an interaction among the level of AMT, national culture and the amount of traditional cost control information (TCCI) provided by MAISs affecting production performance.

Hypothesis 8: There is an interaction among the level of AMT, national culture and the amount of advanced cost control information (ACCI) provided by MAISs affecting production performance.

RESEARCH METHOD

Questionnaire Development

All questionnaire items for this study were developed in previous research. Thus, the instrument was first written in English and then translated into Korean by a translator familiar with both the language and the research area. The Korean questionnaire was translated back into English by an independent bilingual translator. Comparison of the original English version and the back translation revealed no significant differences.

Study Sample

Data were collected by a survey questionnaire administered to a chief production manager or plant manager in the Korean and Australian automotive manufacturing firms. The same industry (i.e. automotive industry) and function (i.e. production) were chosen to control the industrial and environmental effects. The number of firms in the Korean automotive industry is about twice that of the Australian automotive industry. Thus, 385 and 186 organizations were selected, respectively, from the Korean and Australian automotive industries. An initial letter was sent to the chief production manager of each firm explaining the nature and purpose of the research. About one week later, a questionnaire with a cover letter was mailed to each respondent.

For the Korean and Australian firms, 79 and 49 responses were returned, respectively. However, 5 Korean and 2 Australian responses were excluded from the study, either because of incomplete data or because the respondent did not meet both the country of birth requirement and the post conditions (i.e. chief production manager or similar duties). Finally, 74 (Korea) and 47 (Australia) usable data were collected yielding a response rate of 19% (Korea) and 25% (Australia), respectively. Table 1 summarizes the Korean and Australian subsample characteristics according to the number of employees in each firms.

Table 1
Subsample Characteristics

Nation	No. of employees	Below 100	100-500	500-1000	1000-	Total
Korea	No. of firms	16	43	9	6	74
Australia	No. of firms	20	22	2	3	47

Measurements

National culture. Based on the Hofstede's (1991) results, nation can be used as a proxy for culture in hypotheses testing. Korea is a proxy for a high collectivism, uncertainty avoidance and Confucian dynamism, but low masculinity culture. Australia is a surrogate measure for a high individualism and masculinity, but low uncertainty avoidance and Confucian dynamism culture.

Level of AMT. Generally, the level of AMT is measured with a 10-item scale assessing the extent to which a firm has implemented and integrated computer technologies for manufacturing (Dean & Snell, 1991). The 10 items are: MRP?, CAD, numerical control (NC), computer NC, direct NC, FMS, robotics, automated materials handling, computer-aided test and inspection and computer-aided process planning. The level of AMT was measured on a seven-point Likert-type scale.

Nonfinancial performance information and financial performance information. Thirteen nonfinancial performance pieces of information suggested by previous research (e.g. Abernethy & Lillis, 1995; Harrison & Poole, 1997) were utilized to measure nonfinancial performance information. They are: product defects, quality improvement, introduction of new products, the ability to vary product characteristics, number of product returns, set-up and changeover times, rate of material scrap loss, length of cycle time from order to delivery, on time delivery performance records, machine utilization and down time, number of customer complaints, customer satisfaction with product and degree of cooperation of production employees with other departments. Respondents were asked to indicate on a seven-point Likert-type scale, anchored by 'No amount of information, none supplied' and 'Very large amount of information, very high extent of provision', the extent or the amount of information that is provided to the production department. To measure types of financial performance information, six questionnaire items developed by prior studies (e.g. Harrison & Poole, 1997; Chenhall & Langfield-Smith, 1998b) were used. They include inventory turnover ratio, return on investment, divisional revenue, contribution margin of each product, return on sales and assets, and budget variance analysis. Types of financial performance information were measured on a seven-point Likert-type scale.

Traditional cost control information (TCCI) and advanced cost control information (ACCI). Typical traditional management accounting practices include standard costing, variable costing and full costing (Chenhall & Langfield-Smith, 1988a). Three questionnaire items were used to measure traditional cost control information. It was measured on a seven-point Likert-type scale. Cost of quality, ABC and product life cycle costing are contemporary management accounting techniques (Kaplan, 1994, Chenhall & Langfield-Smith, 1998b). Three questionnaire items were used to measure advanced cost control information. Respondents were asked to indicate, on a seven-point Likert-type scale, the amount of information which is produced by these newer techniques.

Production performance. The ultimate goals that can be attained through AMT are low cost, improved quality, increased flexibility and high dependability of supply (Boyer, 1999). These four variables compose the core elements of production performance in AMT. Therefore, to evaluate a firm's production performance, this study measured the degree of improvement in cost, quality, dependability and flexibility through AMT. According to the measures of Vickery et al. (1993) and Agarwal (1997), improvements in the four dimensions were assessed by asking respondents to indicate the extent of improvement experienced by their plants since introducing AMT. The degrees of improvement were measured on a seven-point Likert-type scale that ranged from 'Not improved, worse' to 'Highly improved'. 16 question items were utilized to measure cost reduction, quality improvement, increased flexibility and dependability of supply. The 16 items are: new product, speed in new products, product changeover and R & D (four items for flexibility), lead time, delivery, production lead time and customer requirements (four items for dependability of supply), product performance, design and engineering, product features and perception of quality (four question items for quality), production cost, material cost, labor cost and overhead cost (four items for cost).

Reliability and Validity Test

The questionnaire items measuring research variables were used in previous empirical studies. However, the construct validities of these items are questionable. Principal component analysis with varimax rotation was used to determine whether all items measuring a construct load onto a single factor or divide into multiple factors. Four separate joint factor analyses for AMT, nonfinancial performance information, financial performance information, TCCI, ACCI 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 showed that all items within each index, except for nonfinancial performance information and production performance, are represented by a single factor.

In the case of nonfinancial performance information, two factors with eigen values greater than one were extracted. However, Item 12 (customer satisfaction with product) was significantly loaded on two factors. Thus, Item 12 was removed and the factor analysis for nonfinancial performance information was performed again. In the second factor analysis, the items of each factor did not confound with the items in the other factors. Factor 1 is comprised of product defects, quality improvement, product returns, material scrap, on time delivery, machine utilization and customer complaints. Thus, its title is 'quality performance information'. Factor 2, which is composed of new products, product characteristics, set-up and changeover times, length of cycle time and degree of cooperation, represents 'flexibility performance information'.

For production performance, three factors with eigen values greater than one were extracted. Item 3 (product changeover) was also significantly loaded on two factors. Thus, Item 3 was removed. In the second factor analysis, no item was confounded. Factor 1, that includes lead time, delivery, production lead time, customer requirements, product performance and perception of quality, is 'quality and dependability of supply'. Factor 2, that comprises new product, speed in new product, R & D, design and engineering and product features, shows 'increased flexibility'. Factor 3, that is composed of production cost, material cost, labor cost and overhead cost, represents 'cost reduction'. The alpha coefficients for 8 research variables (i.e. financial performance information, TCCI, ACCI, quality and flexibility performance information, quality and dependability of supply, increased flexibility and cost reduction) in the pooled sample were calculated. All alpha coefficients were above 0.8 and thus, the reliability of the multi-item scales was satisfactory. Accordingly, a single scale for the research variable was created by averaging a respondent's scores over the items measuring each variable.

ANALYSIS AND RESULTS

Differences in the Amount of Information: H1-H4

To analyze differences between Korean firms and Australian firms in the amount of information provided (i.e. Hypotheses 1, 2, 3 and 4), t-test was employed. The results of the t-test are presented in Table 2. In terms of quality performance information and flexibility performance information, significant differences were found. However, in the case of quality performance information, the mean and t value in Table 2 show that this type of information is provided more often in Australian firms than in Korean firms. This result is contrary to our expectation; the amount of nonfinancial performance information produced in Korean firms is much more than in Australian firms (H1). Hence, Hypothesis 1 is partially supported.

Although the activities to improve a product quality are strong group or team-oriented management processes, quality improvement is a key determinant in the survival and growth of a firm (Reed et al., 1996). Thus, it seems that much more quality performance information is intentionally provided in Australian firms to reinforce the cooperation and interaction among functions for the realization of continuous quality improvement. This inverse cultural impact on the use of performance measures was found in the study of Awasthi et al. (1998). Awasthi et al. empirically suggested that U.S. subjects (high individualism) seem to select more team-based performance measures under a high level of task interdependence to complement their cultural drawback.

Table 2
Results of t-Test

	QPI	FPI	Financial performance information	TCCI	ACCI
t -value	-4.2[a]	3.67[a]	-0.24	-1.54[c]	1.09
Mean	Kr. Aus. 4.7 5.5	Kr. Aus. 4.7 3.9	Kr. Aus. 4.4 4.5	Kr. Aus. 4.1 4.6	Kr. Aus. 3.4 3.1

a: p<0.01, b: p<0.05, c: p<0.1 QPI: Quality performance information; FPI: Flexibility performance information; TCCI: Traditional cost control information; ACCI: Advanced cost control information.

In terms of financial performance information, there was no significant difference. Therefore, Hypothesis 2 is fully accepted. However, in the case of TCCI, the mean and significant t value in Table 2 represent that TCCI is produced more often in Australian firms than in Korean firms. This result is contrary to our expectation; there is no difference between Korean firms and Australian firms in the amount of TCCI provided (H3). Thus, Hypothesis 3 is rejected. In terms of ACCI, the result of no significant difference is also contrary to our expectation; the amount of ACCI provided in Australian firms is much more than in Korean firms (H4). Therefore, Hypothesis 4 is also rejected.

The unexpected result in TCCI must be explained with the analysis result of ACCI. ACCI is culturally collectivism-oriented information. However, this study proposed that high uncertainty avoidance and low masculinity in Korean culture may impede the adoption of ACCI in Korean firms. No cultural difference in the amount of ACCI means that Korean firms also employ and use almost the same amount of ACCI as Australian firms do. Recent globalization and intense competition, especially, in automotive industry, are apt to make all firms employ the identical best management practices (Ralston et al., 1997). Thus, it is likely that in Korean firms, the convergence effect of globalization and the high competition in automotive industry outweighs the deterring impact of strong uncertainty avoidance and low masculinity. If Korean firms adopt some amount of ACCI, ACCI replaces TCCI and then, the amount of TCCI provided by MAISs decreases. TCCI is culturally individualism- oriented information. Therefore, Australian firms are likely to prefer and require much more TCCI than Korean firms.

Three-Way Interactions among AMT, National Culture and Information: H5-H8

A multiplicative model was employed to test the interaction effects of AMT, national culture and information on production performance (i.e.

Hypotheses 5, 6, 7 and 8). This involved use of a multiple regression equation as follows:

$$Y = bo + b_1*I + b_2*A + b_3*N + b_4*I*A + b_5*I*N + b_6*A*N + b_7*I*A*N + b_8*size + e \quad (1)$$

where Y= production performance; bi = regression coefficient; I= type of information; A= AMT level; N= nation, coded 1 for Korea and 0 for Australia, proxying for culture; I∗A, I∗N, A∗N and I∗A∗N= the interaction of information, AMT level and nation; size= organization size (control variable, logarithm of number of employees).

To test for the possible effect of national culture, a dummy variable was created with respondents from Korea assigned a value of 1 and respondents from Australia assigned a value of 0. The use of a dummy variable is appropriate for dichotomous variables such as culture (Lau & Tan, 1998). In equation (1), if b7 is significant (i.e. b7 π0), the corresponding incremental R2 will also be statistically significant at the same probability level (Southwood, 1978). To provide information on whether the posited relationship is monotonic or not, the partial derivative can be used.

Analysis results of nonfinancial performance information: H5. Table 3 shows that in the case of quality performance information, there is no significant three-way interaction term. In Table 4, in terms of flexibility performance information, the three-way interaction term for quality and dependability of supply is significant, and the introduction of the three-way interaction term results in a slight increase in R2. The partial derivative of Eq. B for quality and dependability of supply over information is calculated as equation (2), below.

$\Delta Y/\Delta I = 1.246\text{-}0.168A\text{-}0.899N+0.165A*N$ (2 for flexibility performance information).

This function is then written separately for Korea and Australia using the coding of 1 for Korea and 0 for Australia. The function for Korea is shown as equation (2i), and that for Australia as equation (2ii).

$\Delta Y/\Delta I = 0.347\text{-}0.003A$ (2i for Korea). $\Delta Y/\Delta I = 1.246\text{-}0.168A$ (2ii for Australia).

For the zero value of equation (2i), the calculated value of AMT level (A) is 115. The value of 115 is not within the range observed in our sample, from 1.2 to 6.6. Thus, the effect of information on quality and dependability of supply is monotonic. In equation (2ii), the calculated value of A for the zero value of equation is 7.4. The value, 7.4, also is not within the range observed in our sample, from 1.7 to 6.1. Hence, in Australian firms, the impact of information on quality and dependability of supply is also monotonic. These results suggest that in the Korean and Australian firms, a large amount of flexibility performance information can contribute to the improvement of performance irrespective of levels of AMT. The results demonstrate that under various levels of AMT, the provision of a large amount of flexibility performance information can always improve quality and dependability of supply. Therefore, there are no

interaction effects of AMT, information and national culture. Thus, Hypothesis 5 is rejected.

Table 3
Regression Analyses of Quality Performance Information
(B Coefficients, N=121)

	Quality and dependability of supply		Increased flexibility		Cost reduction	
	Eq. A	Eq. B	Eq. A	Eq. B	Eq. A	Eq. B
(1) AMT	0.948[b]	1.46[b]	0.415	0.659	0.308	0.878
(2) QPI	0.573[b]	0.815[a]	0.253	0.368	0.108	0.377
(3) Culture	2.295[a]	5.504[b]	2.447[a]	3.971[a]	3.293[a]	6.865[b]
(1)*(2)	-0.081	-0.166[c]	0.009	-0.03	0.027	-0.067
(1)*(3)	-0.463[a]	-1.42[c]	-0.28[c]	-0.736	-0.357[c]	-1.422[c]
(2)*(3)	0.042	-0.575	-0.106	-0.401	-0.158	-0.846
size	-0.041	-0.038	-0.075	-0.073	0.107	0.11
(1)*(2)*(3)		0.176		0.083		0.195
F	8.6[a]	7.8[a]	9.9[a]	8.7[a]	8.9[a]	8.0[a]
R^2	0.36	0.37	0.39	0.4	0.36	0.37

a: p<0.01, b: p<0.05, c: p<0.1 QPI: Quality performance information

Table 4
Regression Analyses of Flexibility Performance Information
(B Coefficients, N=121)

	Quality and dependability of supply		Increased flexibility		Cost reduction	
	Eq. A	Eq. B	Eq. A	Eq. B	Eq. A	Eq. B
(1) AMT	0.622[a]	0.88[a]	0.216	0.319	0.062	0.218
(2) QPI	0.993[a]	1.246[a]	0.451[a]	0.551[b]	0.317	0.471[c]
(3) Culture	1.416[b]	4.166[a]	2.259[a]	3.343[b]	3.286[a]	4.959[b]
(1)*(2)	-0.101[b]	-0.168[a]	0.019	-0.006	0.049	0.008
(1)*(3)	-0.064	-0.803[c]	-0.151	-0.443	-0.263	-0.713
(2)*(3)	-0.262[b]	-0.899[b]	-0.325[a]	-0.576[a]	-0.359[b]	-0.747
size	0.037	0.024	-0.007	-0.012	0.161[c]	0.153[c]
(1)*(2)*(3)		0.165[c]		0.065		0.1
F	18.1[a]	16.5[a]	17.2[a]	15.1[a]	13.3[a]	11.7[a]
R^2	0.54	0.56	0.53	0.53	0.46	0.46

a: p<0.01, b: p<0.05, c: p<0.1 FPI: Flexibility performance information

Analysis results of financial performance information: H6. Table 5 shows that the three-way interaction terms for all performance measures are significant. The partial derivatives of Eq. B for all measures of performance over information are computed as equations (3), (4) and (5).

$\Delta Y/\Delta I = 0.573-0.199A-0.233N+0.183A*N$ (3 for quality and dependability of supply).

$\Delta Y/\Delta I = 0.463-0.187A-0.524N+0.222A*N$ (4 for increased flexibility).

$\Delta Y/\Delta I = 0.251-0.126A-0.664N+0.27A*N$ (5 for cost reduction).

The functions for Korea are presented as equations (3i), (4i) and (5i), and those for Australia as equations (3ii), (4ii) and (5ii).

$\Delta Y/\Delta I = 0.34-0.016A$ (3i for Korea). $\Delta Y/\Delta I = 0.573-0.199A$ (3ii for Australia).

$\Delta Y/\Delta I = -0.061+0.035A$ (4i for Korea). $\Delta Y/\Delta I = 0.463-0.187A$ (4ii for Australia).

$\Delta Y/\Delta I = -0.413+0.144A$ (5i for Korea). $\Delta Y/\Delta I = 0.251-0.126A$ (5ii for Australia).

In equations (3i), (4i) and (5i), the calculated values of A (AMT level) for the zero values of equations are 21 for quality and dependability of supply, 1.7 for increased flexibility and 2.8 for cost reduction. The values, 1.7 and 2.8, are within the range observed (i.e. the range from 1.2 to 6.6), and the value of 21 is not. Thus, the effects of information on increased flexibility and cost reduction are nonmonotonic. The nonmonotonic effects of information are positive under high levels of AMT (i.e. higher than 1.7 or 2.8). The impact of information on quality and dependability of supply is monotonic. These results demonstrate that in Korean firms, the provision of financial performance information under high levels of AMT can improve production performance.

Table 5
Regression Analyses of Financial Performance Information
(B Coefficients, N=121)

	Quality and dependability of supply		Increased flexibility		Cost reduction	
	Eq. A	Eq. B	Eq. A	Eq. B	Eq. A	Eq. B
(1) AMT	1.196[a]	1.657[a]	1.077[a]	1.635[a]	0.611[c]	1.293[a]
(2) QPI	0.268	0.573[b]	0.095	0.463[c]	-0.198	0.251
(3) Culture	1.171[c]	4.314[b]	1.361[b]	5.184[a]	2.037[a]	6.683[a]
(1)*(2)	-0.107[b]	-0.199[a]	-0.076	-0.187[a]	0.008	-0.126
(1)*(3)	-0.699[a]	-1.589[a]	-0.553[a]	-1.634[a]	-0.667[a]	-1.982[a]
(2)*(3)	0.443[a]	-0.233	0.297[b]	-0.524	0.337[c]	-0.664[c]
size	0.065	0.079	0.016	0.033	0.184[c]	0.205[b]
(1)*(2)*(3)		0.183[c]		0.222[b]		0.27[b]
F	8.1[a]	7.5[a]	9.8[a]	9.5[a]	9.9a	9.6[a]
R^2	0.34	0.36	0.39	0.43	0.39	0.42

a: $p<0.01$, b: $p<0.05$, c: $p<0.1$ FPI: Flexibility performance information

For equations (3ii), (4ii) and (5ii), the computed values are 2.8 for quality and dependability of supply, 2.4 for increased flexibility and 1.99 in cost reduction. All values are within the range observed (i.e. the range from 1.7 to 6.1). Therefore, the effects of information on performance are nonmonotonic. The nonmonotonic effects are negative under high levels of AMT (i.e. higher than 2.8, 2.4 or 1.99). This negative impact shows that in Australian firms, the provision of financial performance information under high levels of AMT can decrease the performance of a firm. From these results, it is confirmed that under high levels of AMT, the provision of a large amount of financial performance information increases performance in Korean firms, while it decreases performance in Australian firms. Thus, Hypothesis 6 is fully accepted.

Analysis results of TCCI and ACCI: H7 and H8. In Tables 6 and 7, the three-way interaction terms for all performance measures are significant. The partial derivatives of Eq. B for all performance measures over TCCI and ACCI are calculated as equations (6T), (6A), (7T), (7A), (8T) and (8A).

$\Delta Y/\Delta I = 0.525-0.16A-0.646N+0.249A*N$ (6T for quality and dependability of supply in TCCI).

$\Delta Y/\Delta I = 0.38-0.098A-0.548N+0.162A*N$ (7T for increased flexibility in TCCI).

$\Delta Y/\Delta I = 0.269-0.045A-0.697N+0.172A*N$ (8T for cost reduction in TCCI).

$\Delta Y/\Delta I = 1.017-0.149A-1.046N+0.244A*N$ (6A for quality and dependability of supply in ACCI).

$\Delta Y/\Delta I = 0.718-0.093A-1.047N+0.182A*N$ (7A for increased flexibility in ACCI).

$\Delta Y/\Delta I = 0.447-0.035A-0.88N+0.15A*N$ (8A for cost reduction in ACCI).

The expressions for Korea are shown as equations (6Ti), (7Ti), (8Ti), (6Ai), (7Ai) and (8Ai), and those for Australia as equations (6Tii), (7Tii), (8Tii), (6Aii), (7Aii) and (8Aii).

$\Delta Y/\Delta I = -0.121+0.089A$ (6Ti for Korea). $\Delta Y/\Delta I = 0.525-0.16A$ (6Tii for Australia).

$\Delta Y/\Delta I = -0.168+0.064A$ (7Ti for Korea). $\Delta Y/\Delta I = 0.38-0.098A$ (7Tii for Australia).

$\Delta Y/\Delta I = -0.428+0.127A$ (8Ti for Korea). $\Delta Y/\Delta I = 0.269-0.045A$ (8Tii for Australia).

$\Delta Y/\Delta I = -0.029+0.095A$ (6Ai for Korea). $\Delta Y/\Delta I = 1.017-0.149A$ (6Aii for Australia).

$\Delta Y/\Delta I = -0.329+0.089A$ (7Ai for Korea). $\Delta Y/\Delta I = 0.718-0.093A$ (7Aii for Australia).

$\Delta Y/\Delta I = -0.433+0.115A$ (8Ai for Korea). $\Delta Y/\Delta I = 0.447-0.035A$ (8Aii for Australia).

In equations (6Ti), (7Ti), (8Ti), (6Ai), (7Ai) and (8Ai), the computed values of AMT level (A) for the zero values of equations are 1.3 for quality and dependability of supply in TCCI, 2.6 for increased flexibility in TCCI, 3.3 for cost reduction in TCCI, 0.3 for quality and dependability of supply in ACCI, 3.7 for increased flexibility in ACCI and 3.7 for cost reduction in ACCI. Except for 0.3, all values are within the range observed, from 1.2 to 6.6. Except for quality and dependability of supply in ACCI, the effects of types of information on performance are nonmonotonic. The nonmonotonic effects of information are positive under high levels of AMT (i.e. higher than 1.3, 2.6, 3.3, 3.7 or 3.7). The impact of ACCI on quality and dependability of supply is monotonic. Hence, in Korean firms, the provision of TCCI and ACCI under high levels of

AMT can increase production performance.

For equations (6Tii), (7Tii), (8Tii), (6Aii), (7Aii) and (8Aii), the calculated values are 3.3 for quality and dependability of supply in TCCI, 3.8 for increased flexibility in TCCI, 5.9 for cost reduction in TCCI, 6.8 for quality and dependability of supply in ACCI, 7.7 for increased flexibility in ACCI and 12.7 for cost reduction in ACCI. The values, 3.3, 3.8 and 5.9 are within the range observed in our sample (i.e. the range from 1.7 to 6.1), and the values of 6.8, 7.7 and 12.7 are not. Thus, the effects of TCCI on performance are nonmonotonic. The nonmonotonic effects of TCCI are negative under high levels of AMT (i.e. higher than 3.3, 3.8 or 5.9). The impact of ACCI is monotonic. From these results, it is suggested that in Australian firms, the provision of TCCI under high levels of AMT can decrease the performance of a firm, while a large amount of ACCI can improve performance irrespective of levels of AMT. In the case of TCCI, the results demonstrate that when the level of AMT is high, the provision of TCCI improves performance in Korean firms, while it decreases performance in Australian firms. Therefore, Hypothesis 7 is fully supported. In terms of ACCI, from the results, it is confirmed that under high levels of AMT, the provision of ACCI increases performance in Korean firms, while it improves performance in Australian firms irrespective of levels of AMT. Thus, Hypothesis 8 is also fully accepted.

Table 6
Regression Analyses of TCCI (B Coefficients, N=121)

	Quality and dependability of supply		Increased flexibility		Cost reduction	
	Eq. A	Eq. B	Eq. A	Eq. B	Eq. A	Eq. B
(1) AMT	0.616[b]	1.405[a]	0.552[b]	1.062[a]	0.17	0.718[c]
(2) QPI	0.023	0.525[c]	0.056	0.38[c]	-0.078	0.269
(3) Culture	1.994[a]	5.812[a]	2.165[a]	4.655[a]	3.127[a]	5.778[a]
(1)*(2)	-0.00	-0.16[b]	0.005	-0.098	0.066	-0.045
(1)*(3)	-0.575[a]	-1.794[a]	-0.39[a]	-1.18[b]	-0.393[b]	-1.24[b]
(2)*(3)	0.171	-0.646[c]	-0.1	-0.548[c]	-0.129	-0.697[c]
size	-0.01	0.032	-0.052	-0.024	0.093	0.123
(1)*(2)*(3)	0.249[a]	0.162[c]	0.172[c]			
F	6.9[a]	7.0[a]	8.5[a]	7.9[a]	9.1[a]	8.4[a]
R^2	0.31	0.35	0.35	0.38	0.37	0.39

a: $p<0.01$, b: $p<0.05$, c: $p<0.1$ TCCI: Traditional cost control information.

Table 7
Regression Analyses of ACCI (B Coefficients, N=121)

	Quality and dependability of supply		Increased flexibility		Cost reduction	
	Eq. A	Eq. B	Eq. A	Eq. B	Eq. A	Eq. B
(1) AMT	0.589[a]	1.041[a]	0.318[c]	0.648[a]	0.162	0.44[c]
(2) QPI	0.462[b]	1.017[a]	0.312[c]	0.718[a]	0.106	0.447
(3) Culture	2.062[a]	5.064[a]	2.23[a]	4.466[a]	3.022[a]	4.87[a]
(1)*(2)	-0.05	-0.149[a]	0.011	-0.09[c]	0.053	-0.035
(1)*(3)	-0.361[b]	-1.183[a]	-0.167	-0.772[a]	-0.29[c]	-0.796[b]
(2)*(3)	-0.077	-1.046[a]	-0.316[a]	-1.047[a]	-0.284[c]	-0.88[b]
size	0.021	0.036	-0.02	-0.009	0.135	0.144
(1)*(2)*(3)		0.244[a]		0.182[b]		0.15[c]
F	8.1[a]	8.5[a]	11.5[a]	11.1[a]	10.3[a]	9.4[a]
R^2	0.34	0.39	0.43	0.46	0.40	0.42

a: $p<0.01$, b: $p<0.05$, c: $p<0.1$ ACCI: Advanced cost control information.

CONCLUSION AND DISCUSSION

ISs' design characteristics such as the information content and amount are heavily influenced by national culture. Considerable IS design research has been conducted by western researchers based on observations in western organizations. However, the results of IS design research in western society need not necessarily apply in other cultures. There exist some cultural differences in the preferred and required IS characteristics. This study empirically examined the effects of national culture on information characteristics of MAISs.

In this study we, first, investigated the cultural impact on the amount of information provided by MAISs. The results showed that much more flexibility performance information is produced in Korean firms, while the amount of quality performance information and TCCI provided in Australian firms is much more than in Korean firms. In the cases of financial performance information and ACCI, there were no significant differences between Korean firms and Australian firms. The large amount of flexibility performance information in Korean firms is likely related to the high collectivism and Confucian dynamism of Korean culture. The greater amount of quality performance information in Australian firms may be the result of an inverse cultural effect that complements a cultural drawback (i.e. high individualism). The large amount of TCCI in Australian firms seems to be related to the high individualism of Australian culture.

We also investigated the effect of the three-way interactions among national culture, AMT and information on production performance. According to the results of our study, it was shown that in the Korean and Australian firms,

a large amount of nonfinancial performance information can generally improve production performance under high levels of AMT. It was also found that in Korean firms, the provision of financial performance information under high levels of AMT can increase production performance. However, in Australian firms, it was found that when the AMT level is high, a large amount of financial performance information can decrease the performance of a firm. In the cases of TCCI and ACCI, the results demonstrated that in Korean firms, a large amount of TCCI and ACCI under high levels of AMT can improve production performance. However, in Australian firms, the results were mixed. In Australian firms, it was found that when the AMT level is high, the provision of ACCI can increase performance, while a large amount of TCCI can decrease the production performance of a firm.

Therefore, from these results, we suggest that under high levels of AMT, Korean firms need a large amount of types of information (i.e. financial and nonfinancial performance information, TCCI and ACCI) -based MAISs, while Australian firms require the ACCI and nonfinancial performance information-oriented MAISs to improve production performance. A large amount of information- based MAISs in Korean firms seem to be related primarily to both the high degree of uncertainty caused by AMT and the strong uncertainty avoidance in Korean culture. The ACCI and nonfinancial performance information-oriented MAISs in Australian firms seem to reflect the information requirements of AMT. These conclusions imply that different cultural settings prefer and require different information characteristics of MAISs under a high level of AMT.

NOTES

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