

DECENTRALIZATION, MANAGEMENT ACCOUNTING SYSTEM (MAS) INFORMATION CHARACTERISTICS AND THEIR INTERACTION: EFFECTS ON MANAGERIAL PERFORMANCE: A SINGAPORE STUDY

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INTRODUCTION

The application of contingency theory to the analysis and design of organizational control systems has generated a considerable amount of interest (Otley, 1980). In particular, management accounting system (MAS), which is considered a subsystem within the control system of the organization has been targeted for empirical studies. Chenhall and Morris (1986), for example, examine the effects of contextual variables and organizational structure (discussed in terms of decentralization) on the perceived usefulness of the MAS information characteristics (discussed in terms of scope, aggregation, integration and timeliness). A limitation of their study is that they failed to relate the important relationship of the effects of contextual and design variables on performance (Gul, 1991).

This study, therefore, examines the effects of a combination of control subsystems (MAS information characteristics and decentralization) on managerial performance. For example, the selection of a particular degree of decentralization affects the implementation of other control subsystems (such as MAS) that are also being implemented. By examining different sets of two-way interactions, it is possible to provide some insights into the possible configurations of the internal control subsystems factors that could affect managerial performance in an organization.

In addition, prior studies have examined MAS as a control subsystem in isolation and without due consideration for the interactions of other control subsystems which could impinge on managerial performance. Brownell (1987, p. 194) also observed that:

The challenge to accountants is to understand the nature of any activity over which

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control is sought and to make an appropriate selection from the broad range of available controls, both accounting and nonaccounting in nature, *matching* the characteristics or setting of the activity to be controlled with the controls actually chosen.

The difficulty in meeting this challenge is that we know little about the effects of *combinations* of controls. Some controls may reinforce others, or they may negate each other. (Emphasis in original.)

Thus, it is important that research examining the joint effect of '... combination of controls' is conducted. An example of a combination of such controls may be the relationship between the MAS (and its related information characteristics) and decentralization (Tiessen and Waterhouse, 1983).

Another motivation for the present study is that most of the contingency theory research in management accounting has studied organizations in industrially advanced countries. Very little has been conducted in developing countries. In Singapore, very few studies are conducted in the management accounting area (Chia, 1992). Thus, this study could provide information on the interactions of control sub-systems that could enhance managerial performance in organizations operating in developing countries.

THEORETICAL DEVELOPMENTS

MAS

Management accounting research using a contingency perspective has attempted to relate a range of contextual variables such as environmental uncertainty (e.g., Gordon and Narayanan, 1984; and Govindarajan, 1984), technological complexity (e.g., Daft and MacIntosh, 1978; and Chenhall and Morris, 1986), strategy (e.g., Govindarajan and Gupta, 1985; and Simons, 1987) with the design of MAS. The MAS is an organizational control mechanism which facilitates control by reporting and creating visibility in the action and performance of its members. The informational role of the MAS facilitates decision-making and control in the organization and should, therefore, be tailored to the organizational contextual variables and other control subsystems (e.g., the organizational structure). Indeed, the use of accounting performance measurement, which is derived from the MAS, as a control means for performance evaluation purpose has been advocated by several researchers (e.g., Demski and Feltham, 1978; Merchant, 1981; and Kaplan, 1982).

Organizational Structure — Decentralization

Organizational structure provides the basic foundation within which an organization functions. The important role of organizational structure in affecting performance (e.g., efficiency, effectiveness, morale) at the

organizational and subunit levels have also been highlighted by Van de Ven (1976) as well. However, as Dalton et al. (1980, p. 60) pointed out:

structure-performance relationship is among the most vexing and ambiguous in the field of management and organizational behaviour. Evaluations and generalizations concerning the nature and directions of these relationships are tenuous.

One of the structural parameters which has received a great deal of attention in organizational research is the one that defines the extent to which decision-making within the organization is centralized or decentralized. Decentralization is one type of organizational structure which refers to where decisions are taken within the organization, i.e., the level of autonomy that is delegated to managers for their decision-making. The higher the degree of decentralization, the lower the hierarchical level in the organization where the decisions are taken. Waterhouse and Tiessen (1978) have explored the notion that decentralization provides managers with greater access to information than is available to the corporate board. Hence, the relevance of decentralization is its impact on the design of the sophistication of each of the MAS information characteristics. Furthermore, through decentralization an organization is able to provide its managers with greater responsibility and control over its activities and also greater access to the required type of information (Waterhouse and Tiessen, 1978). As Galbraith (1973) argued, decentralization facilitates information processing at the source of an event that required decision-making. This implies that there is a need for a more sophisticated MAS¹ to provide more relevant information when the degree of decentralization is high. The degree of decentralization also affects how information, such as management accounting information and performance evaluation information, is gathered, processed and communicated in the organization (Gerloff, 1985).

Link Between Decentralization and MAS

MAS has also been referred to as a supportive mechanism which should be consistent with the structural set-up of an organization (Watson, 1975). The degree of MAS sophistication facilitates the provision of different types of relevant and timely information required in a decentralized organization where different sub-units' managers have different specific needs. This will enable the managers to decide effectively, thereby resulting in higher managerial performance. The effect of decentralization and each of the MAS information characteristics is discussed next. MAS information characteristic is seen in terms of broad scope, aggregation, integration and timeliness (Chenhall and Morris, 1986).

When there is a fit between the control subsystems of organizational structure and MAS, it is likely that a higher level of managerial performance will ensue. This is in recognition of the fact that the separate impact of organizational structure or information from the MAS, is insufficient to produce greater

managerial performance. Therefore, an appropriately structured organization will need to be complemented by the information from the MAS to produce a higher level of managerial performance. For example, in a highly decentralized organization, a more sophisticated MAS will contribute to higher managerial performance than a less sophisticated MAS. Thus, an appropriate fit between two of the possible control subsystems is envisaged to enhance managerial performance. Sathe and Watson (1987, p. 72) recognized this when they wrote that:

Not only does the accounting system act as an 'operating mechanism' to reinforce the organization's basic structure, but by measuring and evaluating performance, the accounting system assists the organization toward its goal of operating in a rational manner.

Broad Scope of MAS Information

The MAS information characteristic of broad scope covers the dimensions of focus, time horizon and quantification (Gordon and Narayanan, 1984). A MAS with an information characteristic of broad scope provides information that is both internal and external to the organization. The scope of the information covers a diverse range of areas such as economic (e.g., total market sales, organization's share of that market, GNP) and non-economic (e.g., technological advances, sociological changes, demographic developments) aspects of the environment. Estimates of the likelihood of future events occurring are also covered in the broad scope as well. To the sub-unit managers operating in a decentralized organization, the broad scope of the MAS caters for their diversity of informational needs in their decision-making. For example, this information characteristic of broad scope is useful and relevant to the specific needs of the various sub-units on matter such as product pricing, inventory management and marketing. The ability of the MAS to meet the information needs of the sub-unit managers will improve the quality of their decisions, thereby enhancing managerial performance. Therefore, the greater the degree of decentralization in an organization, the greater is the need for a more sophisticated scope of MAS information to meet the diversity of informational needs of the sub-unit managers in order to enhance their managerial performance. This suggests hypothesis 1:

- H₁: The greater the degree of decentralization (X_1), the greater is the positive impact of the sophistication of MAS information characteristic of broad scope (X_2) on managerial performance (Y).

Aggregation of MAS Information

The MAS information characteristic of aggregation concerns the application of either formal decision models or analytical models on summated information

onto functional areas or over different time periods. There are three possible reasons why aggregated information is needed in a decentralized organization. Firstly, aggregated information helps in the reduction of potential information overload of the sub-unit managers (Iselin, 1988). Secondly, if the information is appropriately aggregated the information can serve as meaningful inputs in the decision-making process. There will be less time required to evaluate the aggregated information compared to the situation of the information in its raw and disorganised form. Hence, decisions using the aggregated information are optimized. Thirdly, aggregated information can further the interests of the sub-unit managers by appropriately portraying their respective areas of responsibility (Horngren, 1982; and Chenhall and Morris, 1986). Appropriately aggregated information reflecting the areas of responsibility of the sub-unit managers will be viewed as equitable when it is used in the performance evaluation process.

Therefore, the need for a more sophisticated MAS information characteristic of aggregation is greater in an organization where the degree of decentralization is higher than in one where the degree of decentralization is low. Furthermore, a more sophisticated MAS information characteristic of aggregation will enhance the performance of the managers who use the aggregated information from the MAS, thus suggesting hypothesis 2:

- H₂: The greater the degree of decentralization (X_1), the greater is the positive impact of the sophistication of MAS information characteristic of aggregation (X_2) on managerial performance (Y).

Integrating Characteristic of MAS Information

Integrated information from the MAS provides a means of coordination between the segments of a sub-unit and between the sub-units. The integrated information covers aspects such as stipulation of targets or activities to be accounted for in the interaction process of segments within the sub-unit, and between sub-units in an organization. The complexities and interdependencies among the sub-units will be reflected in the integrated information from the MAS (Ferrara, 1964; and Horngren, 1982). Thus, the greater the number of segments in a sub-unit and/or the greater the number of sub-units in an organization, the greater will be the need for more sophistication in the MAS information characteristic of integration. In fact, organizational theory posits that with decentralization, decision-making is delegated and the problem of control loss surfaces (Williamson, 1970). This will necessitate the implementation of integrative devices (Lorsch and Allen, 1973) such as more sophisticated standardised management accounting procedures, to facilitate decision-making and ex-post control. Thus, integrated information provides a coordinating role in the control of the diversity of decisions in a highly decentralized organization.

Sub-unit managers will find the integrated information useful when making decisions that impact on other sub-units. Integrated information is also seen to be morale-boosting to the sub-unit managers if performance evaluation measures include the consideration of integration between sub-units (Ansari, 1979). The discussion has indicated that integrated information is favoured by sub-unit managers (Pick, 1971; and Chenhall and Morris, 1986) and therefore should contribute to their performance. This reasoning suggests hypothesis 3:

- H₃: The greater the degree of decentralization (X_1), the greater is the positive impact of the sophistication of MAS information characteristic of integration (X_2) on managerial performance (Y).

Timeliness of MAS Information

The timeliness of information from the MAS is:

... usually specified in terms of the provision of information on requests and the frequency of reporting systematically collected information (Chenhall and Morris, 1986, pp. 20–21).

The timing of information refers to the length of time it takes between the request and the availability of the information from the MAS to the requesting party. Frequency of reporting is concerned with the length of the reporting cycle.

A key consideration in addressing the timeliness of information is the desirability of reporting the implications and effects of 'critical' events to an organization at a time preceding the next scheduled reporting date. It also affects the timely feedback on decisions that were made in order for corrective action to be taken whenever necessary. The timeliness of information affects the ability of managers to make timely decisions in response to any event or problem. Timely information should, therefore, ensure that the information is available for use before it loses its capacity to influence decisions. A further reason for the importance of timely decisions is provided by Iselin (1988, p. 149) who argued that the '... decision time has an opportunity cost in practice, since faster decision-making enables managers to move on to other revenue producing activities'.

The need for timely information becomes more acute in an organization which is highly decentralized. Therefore, it would seem that timely information is positively related to the performance of managers as they are able to respond more quickly to any event with the updated reports from the MAS. This suggests hypothesis 4:

- H₄: The greater the degree of decentralization (X_1), the greater is the positive impact of the sophistication of MAS information characteristic of timeliness (X_2) on managerial performance (Y).

RESEARCH METHODOLOGY

The questionnaire is developed from existing studies, where possible, to enhance the validity and reliability of the variable measures. Due to the sensitivity nature of some of the information requested, it is felt that the response rate would drop if the survey questionnaire does not provide for the anonymity of the respondents. However, respondents are provided with the option of identifying their companies in the questionnaires. The responses are measured using a Likert-type scale.

Measurement of Variables

Sophistication of MAS Information Characteristics

The instrument for measuring the sophistication of MAS information characteristics is from the instrument developed by Chenhall and Morris (1986) who used the instrument to measure the perceived usefulness of the MAS information characteristics by the respondents. The measurement of perceived usefulness does not provide for the link between the MAS and managerial performance which is the objective of this study. What is perceived as useful information may not be what is available from the MAS to the user. Hence, the MAS instrument for this study measures the perceptions of the respondents regarding the information received/obtained from the MAS. The extent of the quantity and variety of information received/obtained measures the sophistication of the MAS in terms of the information characteristics of broad scope, aggregation, integration and timeliness.

In the questionnaire, the twenty questions for the four information characteristics are randomized to minimize the potential problem of order and learning effects.

Organizational Structure — Decentralization

The instrument for measuring organizational structure — decentralization, is adapted from the questions on a similar variable found in Gordon and Narayanan (1984). Five questions are used to measure the degree of decentralization of decision-making, namely, the development of new products or services, the hiring and firing of managerial personnel, selection of large investments, budget allocations and pricing decisions.

Performance

The measurement of performance used in this study is the personal performance evaluation measure developed by Mahoney, Jerdee and Carroll (1963). The reasons for adopting this instrument are:

- (a) The measure provides eight sub-dimensions of managerial performance

and a ninth dimension of an overall rating. This is a reasonable number of ratings for the participants to perform. It has been recognized that too many dimensions (after an [unknown] optimum number) would cause the efficiency of the performance measure to decrease (Landy and Farr, 1980).

- (b) This measure has been used in accounting-related studies (e.g., Brownell, 1982; Brownell and Hirst, 1986; and Gul, 1991).

Following the approach adopted by Brownell (1982 and 1985) and Govindarajan (1986), a regression of the overall global rating on the eight dimensions gives an R^2 (R -square, i.e., the coefficient of determination) value of 0.68. This is consistent with the R^2 values of 0.61 obtained in Brownell (1985). The results indicate a substantially greater connection between the global measure and its eight subdimensions than that found by Mahoney et al. (1963) who claimed that the eight subdimensions should account for about 55% of the variance of the overall global rating with the balance of about 45% being job-specific.² Hence, the hypothesis tests are based on the overall global rating.

Method

One hundred companies were randomly selected from the Business Listing 1990 of the Telecommunications Authority of Singapore. Each company was sent the questionnaire with a covering letter and a self-addressed prepaid envelope. Recognising the sensitive nature of some of the information requested, the covering letter provided a statement assuring the respondents of the anonymity of their companies in the final report. The covering letter also offered the respondent the choice of a summarized copy of the final results after the data had been analysed. This served as an incentive to the respondent to respond to the survey. There were fifty-one returned questionnaires of which three were not usable. Forty-eight questionnaires were used in the final analysis. This response rate compared favourably to '... the expected rate of 25 percent for most postal surveys' (Seah, 1991, p. 12) conducted in Singapore. Senior management level staff were approached to participate in the study as they were the most appropriate personnel with the experience and charged with the responsibility of the performance of their organizations.³ The average time spent by the respondents in their companies was three and a half years.

DATA ANALYSIS AND RESULTS

The measures of the various variables for regression analysis are subjected to factor analysis to confirm their theoretical groupings (construct validity) (Kerlinger, 1964; and Chenhall and Morris, 1986). Orthogonal rotation (i.e., varimax rotation) is applied to arrive at the final selection.⁴ The results of factor analysis are shown in Table 1.

Table 1

Summary of Results of Factor Analysis and Cronbach Alpha Coefficients for Decentralization and MAS Information Characteristics

<i>Variables</i>	<i>Number of Factor Groupings</i>	<i>Kaiser's MSA Value</i>	<i>Cronbach Alpha Coefficient</i>
Decentralization	1*	0.68	0.66
Broad Scope	2***	0.76	0.80 (0.76)**
Aggregation	2***	0.84	0.88 (0.81)**
Integration	1	0.65	0.70 (0.73)**
Timeliness	1	0.76	0.78 (0.71)**

Notes:

* One item which has a factor loading of <0.40 for the variable was excluded in the final analysis.

** Values from the Chenhall and Morris (1986) study which measured the usefulness of the MAS information characteristics. N.B. This is not meant for comparison but for general information.

*** The two factor groupings account for 100% of the total variance for the variable. The approach of aggregating those items which have factor loadings of 0.40 and above in the two factor groupings for final analysis has been applied by Bourgeois (1985) and Govindarajan (1986).

The Kaiser's MSA values of the variables are all above the acceptable level of 0.50 required for the test of appropriateness of the respective set of data for factor analysis (Kaiser and Rice, 1974) and also indicate the construct validity of the respective variables. The Cronbach alpha coefficients for the internal reliability of various variables are all at an acceptable level of above 0.60 (Nunnally, 1978).

The measures in the regression models are evaluated for any presence of multicollinearity by the computation of variance inflation factors. In this study, the variance inflation factors of the variables are found to be less than ten, thus indicating that multicollinearity is not a problem (Neter, Wasserman and Kutner, 1985).

Descriptive Statistics of the Variables

Table 2 presents descriptive statistics for the various variables that have been examined.

Multiplicative Model

The empirical model for hypothesis testing indicates that the dependent variable is a function of the interaction of the other two preceding variables. Following the approach adopted by Govindarajan and Gupta (1985), the results are mathematically reflected as in equations (1) and (2):

Table 2

Descriptive Statistics for Variables in the Model Under Study

<i>Variables *</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Range</i>
MAS information characteristics:			
Scope (SSE)	3.21	1.52	1.00–6.50
Aggregation (SAE)	3.75	1.52	1.00–6.19
Integration (SIE)	3.87	1.56	1.00–6.33
Timeliness (STE)	4.09	1.45	1.00–6.25
Organizational structure:			
Decentralization (DEC)	4.05	1.50	1.00–7.00
Overall global rating for personal performance evaluation (PPE1)			
	5.15	0.71	4.00–7.00

Note:

• Abbreviations in parentheses will apply to all subsequent tables.

Two-way Interaction Models Equation to Predict Performance

$$Y = b_1X_2 + b_2X_2 + e \quad (1)$$

$$Y = b_1X_1 + b_2X_2 + b_3X_1X_2 + e \quad (2)$$

where:

Y = dependent variable of overall global rating of managerial performance,

b_1, b_2, b_3 = regression coefficients,

X_1 and X_2 = the independent variables of decentralization and MAS respectively,

X_1X_2 = the interaction of X_1 and X_2 ,

e = error term.

The inclusion of a product term in a multiple regression is an acceptable way of testing for interaction (e.g. Allison, 1977; and Schoonhoven, 1981). For this study, the interaction approach aims at explaining the variations in managerial performance from the interaction of the two independent variables in the empirical model. Therefore, as mathematically proven by Southwood (1978) and applied empirically by Schoonhoven (1981) and Govindarajan (1986), the main effects of the respective independent variables on the dependent variable are uninterpretable.⁵ The focus is on the significance and nature of the impact of interaction between the two independent variables on the dependent variable in equation (2).

If b_3 is significant and positive (i.e. $b_3 > 0$), the corresponding incremental R^2 will also be statistically significant at the same probability level (Southwood, 1978). This means that the introduction of the term X_1X_2 in equation (2) adds significantly to the variance explained.

As suggested by Schoonhoven (1981), testing for the existence of contingency versus universalistic interaction effect, of the two independent variables (X_1 and X_2) on the dependent variable (Y), can be performed by examining the partial derivative from the larger regression equation, that is, equation (2). This will determine if a nonmonotonic or symmetrical effect is present. The partial derivative of equation (2) is shown as equation (3) below:

$$\delta Y / \delta X_2 = b_2 + b_3 X_1 \quad (3)$$

The existence of nonmonotonic effects could provide information on where in the range of the contingent variable a change in the direction of a slope occurs (Schoonhoven, 1981).

Discussion of Results

Support for hypotheses 1 to 4 can be seen from Table 3. This is indicated by the statistically significant ($p < 0.10$) F -ratios of the regression models for managerial performance.⁶ There are significant interaction effects between decentralization and each of the MAS information characteristics, on managerial performance as indicated by the interaction coefficients, all of which are statistically significant ($p < 0.025$) as shown in Table 3. Therefore, the results (from equations (2a) to (2d)) indicate that decentralization significantly interacts with each of the MAS information characteristics to positively enhance performance.

To test for the presence of nonmonotonic relationship on the interaction effect between each of the four MAS information characteristics and decentralization on managerial performance, the partial derivatives of equations (2a) to (2d) were performed, resulting in equations (3a) to (3d) respectively. Figures 1(a) to 1(d) show the graphs for equations (3a) to (3d) respectively. In each of the graphs, the vertical axis represents the respective relationship between the degree of the sophistication of each of the MAS information characteristics and managerial performance. The horizontal axis indicates the degree of decentralization. The plotted line on each graph represents the change in managerial performance, given a change in the degree of sophistication of each of the MAS information characteristics over the degree of decentralization.

From the results of graphing equations (3a) to (3d), the following observations are made:

- (i) When the equations are at zero, the points of inflection are as follows:

<i>Equation Number</i>	<i>Variable of MAS Information Characteristics (X_2) for $\delta Y / \delta X_2$ at Point of Inflection</i>	<i>Point of Inflection</i>
(3a)	Broad Scope	3.11
(3b)	Aggregation	2.91
(3c)	Integration	3.80
(3d)	Timeliness	3.70

Table 3

Interaction Between Decentralization and MAS on Managerial Performance

Variable		Coefficient	Value	SE	t-stat.	Probability
SSE						
Equation (1a): $Y = b_1X_1 + b_2X_2$						
X_1	DEC	b_1	-0.01	0.08	-0.16	n.s.
X_2	SSE	b_2	0.08	0.08	1.02	n.s.
$R^2 = 0.024$; Adjusted $R^2 = 0.019$; $n = 48$; $F_{(2,45)} = 0.56$; n.s.						
Equation (2a): $Y = b_1X_1 + b_2X_2 + b_3X_1X_2$						
X_1	DEC	b_1	-0.28	0.13	-2.17	<0.05
X_2	SSE	b_2	-0.28	0.16	-1.76	<0.10
X_1X_2	Interaction*	b_3	0.09	0.04	2.54	<0.025
$R^2 = 0.149$; Adjusted $R^2 = 0.091$; $n = 48$; $F_{(3,44)} = 2.56$; $p < 0.067$						
R^2 explained by interaction term = 0.125						
SAE						
Equation (1b): $Y = b_1X_1 + b_2X_2$						
X_1	DEC	b_1	0.01	0.08	0.16	n.s.
X_2	SAE	b_2	0.02	0.08	0.20	n.s.
$R^2 = 0.003$; Adjusted $R^2 = 0.042$; $n = 48$; $F_{(2,45)} = 0.064$; n.s.						
Equation (2b): $Y = b_1X_1 + b_2X_2 + b_3X_1X_2$						
X_1	DEC	b_1	-0.35	0.15	-2.29	<0.05
X_2	SAE	b_2	-0.32	0.15	-2.23	<0.05
X_1X_2	Interaction*	b_3	0.11	0.04	2.72	<0.01
$R^2 = 0.146$; Adjusted $R^2 = 0.088$; $n = 48$; $F_{(3,44)} = 2.52$; $p < 0.071$						
R^2 explained by interaction term = 0.143						
SIE						
Equation (1c): $Y = b_1X_1 + b_2X_2$						
X_1	DEC	b_1	0.03	0.07	0.46	n.s.
X_2	SIE	b_2	-0.04	0.07	-0.60	n.s.
$R^2 = 0.010$; Adjusted $R^2 = 0.034$; $n = 48$; $F_{(2,45)} = 0.222$; n.s.						
Equation (2c): $Y = b_1X_1 + b_2X_2 + b_3X_1X_2$						
X_1	DEC	b_1	-0.31	0.14	-2.29	<0.05
X_2	SIE	b_2	-0.38	0.13	-2.89	<0.01
X_1X_2	Interaction*	b_3	0.10	0.03	2.96	<0.005
$R^2 = 0.174$; Adjusted $R^2 = 0.118$; $n = 48$; $F_{(3,44)} = 3.09$; $p < 0.037$						
R^2 explained by interaction term = 0.164						

Table 3 (continued)

Variable		Coefficient	Value	SE	t-stat.	Probability
STE						
Equation (1d): $Y = b_1X_1 + b_2X_2$						
X_1	DEC	b_1	0.06	0.08	0.73	n.s.
X_2	STE	b_2	-0.08	0.08	-1.03	n.s.
$R^2 = 0.025$; Adjusted $R^2 = 0.018$; $n = 48$; $F_{(2,45)} = 0.574$; n.s.						
Equation (2d): $Y = b_1X_1 + b_2X_2 + b_3X_1X_2$						
X_1	DEC	b_1	-0.33	0.18	-1.85	<0.10
X_2	STE	b_2	-0.37	0.14	-2.60	<0.025
X_1X_2	Interaction*	b_3	0.10	0.04	2.40	<0.025
$R^2 = 0.137$; Adjusted $R^2 = 0.079$; $n = 48$; $F_{(3,44)} = 2.34$; $p < 0.087$						
R^2 explained by interaction term = 0.112						

Notes:

* The value of the unstandardized regression coefficients, its standard error and the level of significance are independent of the points of origin of the main independent variables. Hence, the data do possess information content.

DEC = Decentralization, SSE = MAS Information Characteristic of Broad Scope, SAE = MAS Information Characteristic of Aggregation, SIE = MAS Information Characteristic of Integration, STE = MAS Information Characteristic of Timeliness, SE = Standard Error.

All of the equations (3a) to (3d) are positive (negative) when X_1 has a value above (below) the respective point of inflection. This means that each of the sophisticated MAS information characteristics contributes positively to managerial performance in the range of the respective X_1 values above the point of inflection, since the slope for each equation is positive. However, below that inflection point each of the sophisticated MAS information characteristics decreases managerial performance as can be seen from the negative slope.

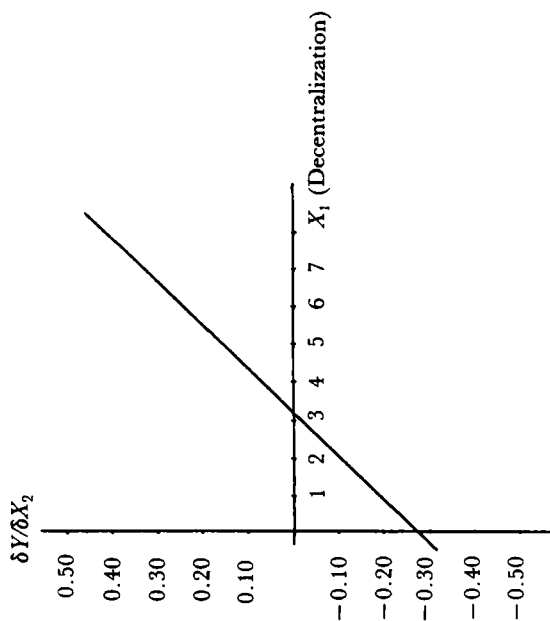
(ii) The respective inflection points are well within the observed range of values (i.e. 1.00 to 7.00) and close to the mean value for the degree of decentralization (X_1) in the sample. Hence, it is concluded that the degree of sophistication of each of the MAS information characteristics (X_2) has a contingent (non-monotonic) effect on managerial performance (Y) over the range of the degree of decentralization (X_1) values.

(iii) The graphing of the results for equations (3a) to (3d) provides these symmetrical and nonmonotonic relationships:

1. In organizations where there are high degrees of decentralization, the presence of high degrees of sophistication in the information characteristics have a positive effect on managerial performance. From the graphs, the slope for each equation is an increasing positive one, so that the positive

Figure 1a

Effects of Decentralization (X_1) on the Relationship
Between the MAS Information Characteristic of
Broad Scope (X_2) and Managerial Performance (Y)



Notes:

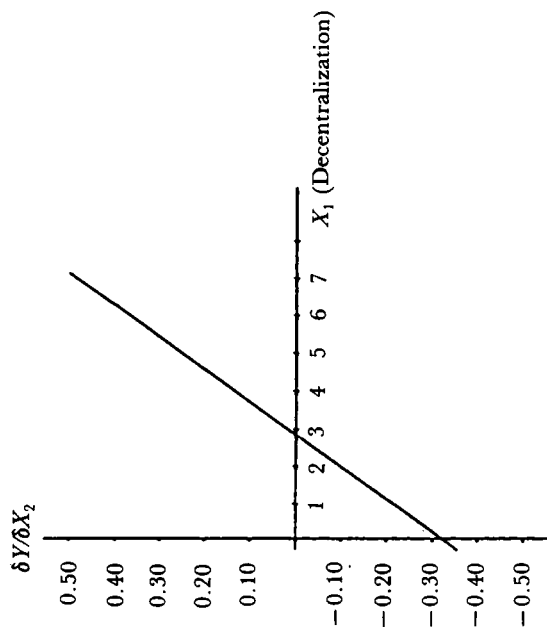
$$\delta Y / \delta X_2 = b_2 + b_3 X_1 \quad \text{--- Equation (3a)}$$

$$= -0.28 + 0.09 X_1$$

Point of Inflection on $X_1 = 3.11$

Figure 1b

Effects of Decentralization (X_1) on the Relationship
Between the MAS Information Characteristic of
Aggregation (X_2) and Managerial Performance (Y)



Notes:

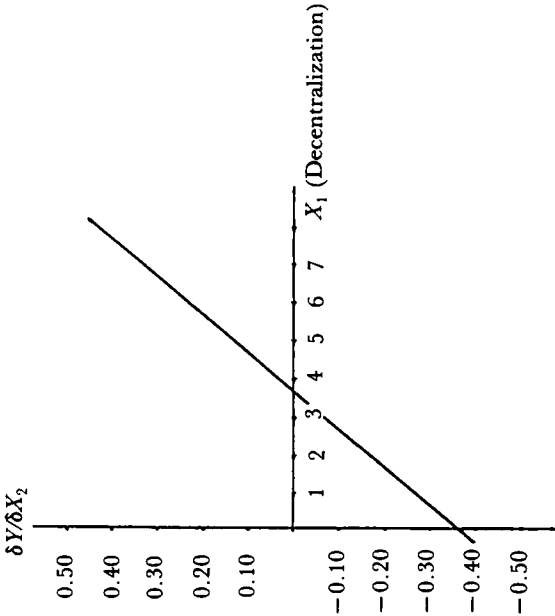
$$\delta Y / \delta X_2 = b_2 + b_3 X_1 \quad \text{--- Equation (3b)}$$

$$= -0.32 + 0.11 X_1$$

Point of Inflection on $X_1 = 2.91$

Figure 1c

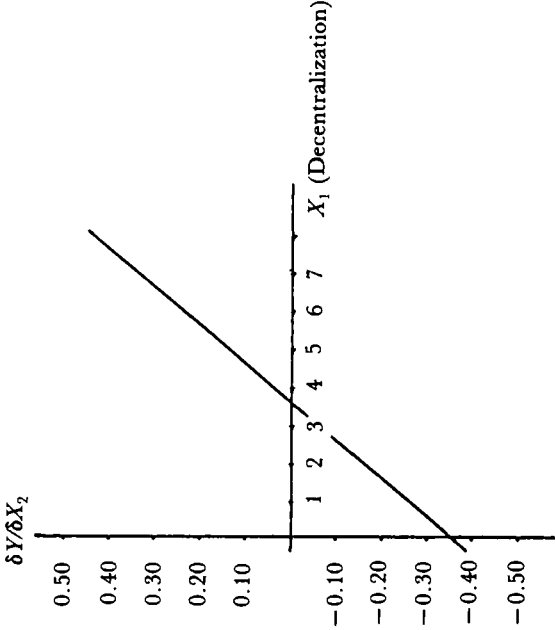
Effects of Decentralization (X_1) on the Relationship Between the MAS Information Characteristic of Integration (X_2) and Managerial Performance (Y)



Notes:
 $\delta Y / \delta X_2 = b_2 + b_3 X_1$ — Equation (3c)
 $= -0.38 + 0.10 X_1$
Point of Inflection on $X_1 = 3.80$

Figure 1d

Effects of Decentralization (X_1) on the Relationship Between the MAS Information Characteristic of Timeliness (X_2) and Managerial Performance (Y)



Notes:
 $\delta Y / \delta X_2 = b_2 + b_3 X_1$ — Equation (3d)
 $= -0.37 + 0.10 X_1$
Point of Inflection on $X_1 = 3.70$

effects of the MAS information characteristics become greater when the degree of decentralization is increased.

2. In organizations where the degree of decentralization is low, the presence of a high degree of sophistication of the MAS information characteristics have a negative effect on managerial performance. From the graphs, each of the slopes is a negative one, so that the negative effects of the degree of sophistication of the MAS information characteristics become greater when the degree of decentralization is lower.

The need for more empirical evidence to support the relationship between decentralization and the MAS variables (Tiessen and Waterhouse, 1983) is met by the results of this study. Furthermore, the results suggest the presence of a contingent relationship between the sophistication of each of the MAS information characteristics and managerial performance over the range of decentralization in an organization.

The results which support hypotheses 1 to 4 are consistent with the notion that a high degree of decentralization promotes a high information processing capability as more managers are involved in making decisions. A MAS which provides more sophisticated information will enhance the decisions of the managers, hence contributing to higher performance. This explanation is similar to that of Duncan (1973) who suggested that organizational structure has important implications for the ability of the organization to gather and process information.

SUMMARY AND IMPLICATIONS

To the organizational designer the implication is that, when undertaking the designing of the MAS, there is a need to be conscious of two issues:

- (a) The moderating effect of decentralization on the sophistication level of each of the MAS information characteristics affecting managerial performance.
- (b) The relationship of the sophistication of each of the MAS information characteristics on managerial performance is nonmonotonic over the range of the degree of decentralization.

The main practical implication that can be drawn from the discussions of the results is the impact on the design of control subsystems in the organization. It can be inferred from the results that any study which examines the notion that organizational performance is affected by only one control subsystem in the organization is likely to be inadequate. Organizational designers will benefit from being aware of the need to adopt an integrated approach towards designing the overall control systems in organizations. In addition, they are provided with information on how the control subsystems interact with each other to affect performance.

The results provide a pattern of relationships on the interaction effects of control subsystem variables on managerial performance. The implication for the organizational designer is that any changes in one of the control subsystems (e.g. the organizational structure) may necessitate compensating changes in other control subsystems (e.g. the sophistication level of different MAS information characteristics) so as to promote higher performance in the organization. Being aware of the interaction relationships between the control subsystem variables enables the organizational designer to understand the internal consistency of the control subsystems necessary to enhance performance.

LIMITATIONS OF THE STUDY AND DIRECTIONS FOR FUTURE RESEARCH

Despite the advantages of the cross-sectional approach, a possible weakness in such an approach is that there are a number of other potentially important differences between the organizations in the sample that may not have been identified. This is a limitation to the study. Perhaps longitudinal studies and case study style research may serve to complement the present cross-sectional approach (Otley, 1980; Merchant and Simons, 1986; and Briers and Hirst, 1990).

As with most empirical studies, the results are generalizable to only the population from which the sample was drawn. The results cannot be generalized to other settings. However, this limitation is mitigated because the population consists of organizations which will most likely use a range of sophisticated MAS and have decentralized structures.

The study did not consider all the variables that might affect the managerial performance of an organization. It was assumed that the two control subsystem variables were potentially significant. The variables included in the present study represent only a small subset of the variables which may be significant to the performance of an organization and its members. For example, the competitive environment and strategy of the organization may moderate the effects of the interaction between the MAS and organizational structure on performance.

This research should be replicated in other developing countries in the South East Asia region as these countries are members of the same economic trading bloc but having dissimilar social and cultural conditions to that of Singapore.

CONCLUSION

This study has recognized a weakness in control subsystems research and sought to redress the situation. A simple empirical model is developed from a control systems perspective with the variables in the model being derived from extant contingency literature. The model incorporates two control subsystems (the

organizational structure — decentralization and the MAS) and four hypotheses are tested. The moderating effect of decentralization on each of the MAS information characteristics affecting managerial performance was identified. The analytical methodology of utilizing partial derivative to test for contingency relationships as advocated by Schoonhoven (1981) and Govindarajan (1986) has proved to be a feasible approach in this study as well.

The results of the study provide support for the hypotheses that are generated. The main finding is that decentralization significantly moderates the sophistication level of each of the MAS information characteristics to affect managerial performance, thus highlighting the benefits that can be derived from a joint consideration of the appropriate control subsystems in an organization to promote higher managerial performance.

This study adds to the limited knowledge of management accounting research, with particular reference to the design of MAS, in organizations operating in Singapore. With respect to business organizations in developing countries, this study is of practical significance because the empirical results provide information about the appropriate design of control subsystems which these organizations can adopt to enhance the performance of their respective sub-unit managers.

NOTES

- 1 Sophistication of MAS information refers to a greater variety and quantity of the information pertaining to the respective MAS information characteristics of scope, aggregation, integration and timeliness.
- 2 The author would like to acknowledge the observation raised by the anonymous referee.
- 3 Senior management level staff are personnel who are holding managerial positions. As reported in *The Straits Times Weekly Overseas Edition* (21 December, 1991, p. 20), the Stock Exchange of Singapore has defined managerial position as '... the position of a head of department or division and any other positions which are higher'.
- 4 The factor analysis adopts the proportion criterion of one which provides the decision point for determining the number of factor groupings to be accepted and refers to 100% variance accounted for by the factor solution for a variable. In addition, any item which has a factor loading of less than 0.40 for a variable measurement is excluded in the final analysis (Chenhall and Morris, 1986). In this study, each of the MAS information characteristics of scope and aggregation has two factor groupings. For each variable, the scores of the items for the two factor groupings were aggregated and the mean score for the variable was computed and used in the final analysis. To examine the individual factor grouping separately for each of the variables of scope and aggregation will cause the scope of this study to expand considerably. This procedure follows the approach that was applied by Bourgeois (1985) and Govindarajan (1986).
- 5 For equation (2) of this study, it is argued and, as demonstrated by Southwood (1978) that by selecting a suitable choice of origin points for X_1 and X_2 , the coefficients b_1 and b_2 could be reduced to zero, leaving only the two-way interaction term with its unchanged coefficient b_3 in the equation. This will mean that, except for the term b_3 , the beta coefficients in equation (2) are not interpretable since they could be varied by shifting the origin points of X_1 and X_2 . The implication is that equation (2) is only useful for learning '... about the significance and nature of the impact of interaction between X_1 and X_2 on Y and not about the nature of their main effects' (Govindarajan, 1986, p. 509).
- 6 Several researchers in contingency theory research have adopted $p < 0.10$ as a level of significance (e.g. Schoonhoven, 1981; and Govindarajan, 1986).

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