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Management Control Systems Design of Malaysian Research and Development Units

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ABSTRACT

The nucleus for any high income economy is its successful innovation agenda. This gives rise to the importance of well-managed research and development (R&D) activities for the economy. To address this issue, the study aims to understand the relationships between task uncertainty and Management Control Systems (MCS) in R&D units of Malaysian manufacturing firms. Specifically, the relationship between two dimensions of task uncertainty, task variability and task analyzability; and four characteristic of MCS are investigated. The MCS characteristics were conceptualized using the framework that includes the MCS degree of formalization; degree of tightness; degree of influence and participation involved; and the scope of information used. This study suggests fit between task uncertainty and MCS will enhance R&D performance. Survey questionnaires were administered to managers of R&D units in 61 manufacturing companies operating in Malaysia. Using moderated regression analysis, the results showed that high unit performance was reported when there was interaction (1) between task non-analyzability and controls formalization, (2) between task variability and influence and participation of subordinates in control process, and (3) between task variability and scope of information. These findings suggest that the two dimensions of task uncertainty affect different MCS characteristics in a different manner to produce high R&D unit performance. This study provides important implication for management as it involves a greater understanding of the governance structure of the R&D unit. The finding suggests that the design of the MCS needs to take into account information gaps among employees, which contribute to uncertainty when performing their work tasks.

Keywords: Management Control System; task uncertainty; research and development

Introduction

The strive to achieve a high income economy has increased the need for greater research and development (R&D) activities in Malaysia, in both the public and private sectors. The commitment of the Malaysian government is clearly outlined in the tenth Malaysian plan, with RM150 million allocated to the Business Development Fund and the provision of tax incentives for R&D works (Tenth Malaysian Plan 2010). The sincerity of the agenda is questionable, however, as past experience indicates a reduction in the R&D gross expenditure as percentage of Gross Domestic Product from 0.69 percent in 2004 to 0.21 percent in 2008 (Tenth Malaysian Plan 2010). Conversely, there might be unknown hurdles that prevent successful execution of the R&D innovative efforts.

Activities in R&D units are the principal keys to continuous improvement processes in organizations (Berg, Leinonen, Leivo & Pihlajamaa 2002). Accordingly, all activities in R&D need to be controlled efficiently to ensure their potential benefits can be fully realized by the respective organizations (Hertenstein & Platt 2000). However, Jensen (1993) argued that the major source of failure for R&D innovative capabilities is the overall governance systems, including the management control system utilized by the organization.

One distinctive feature of the R&D, which may contribute to management control complexity, is uncertainty in the tasks performed. The time consuming nature of the production of output tends to result in scepticism concerning whether a particular project will be successful, particularly since changes inevitably emerge during the progression towards a finished product (Anthony et al. 1989). There is also a high involvement of professionals in the work process (Anthony & Govindarajan 2007) and creativity plays a vital element in the overall success of the project (Silaen & Williams 2009). Indeed, according to Abernethy and Brownell (1997) and Brownell (1985), task uncertainty became the dominant factor that differentiated the R&D units from other functional units within an organization. Therefore, task uncertainty appeared as the significant factor that needs to be considered in the management of R&D units (Nixon 1998; Souder & Moenaert 1992).

Thus, the development of management control systems (MCS) in R&D has to accommodate this uniqueness (Anthony & Govindarajan 2007). Arguably, a standardized control system can hamper creativity, as it will create tension within the workgroup (Kerssens-van Drongelen & Bilderbeek 1999; Nixon 1998). The contingency approach to management control indicates that fit between situational factors, such as the task uncertainty and MCS design, will result in high unit performance. Understanding the phenomenon will therefore assist organisations in gaining a competitive advantage which, in turn, will enable their long term survival in the business environment. Review of prior studies indicated limited empirical evidence with regard to MCS in R&D units, particularly in Malaysia.

The purpose of this paper is to study the relationships between task uncertainty and MCS in R&D units in Malaysian manufacturing firms. Specifically, the relationship between two dimensions of task uncertainty, task variability and task analyzability; and four characteristic of MCS are investigated. The MCS characteristics were conceptualized using the framework suggested by Whitley (1999) that include MCS degree of formalization; degree of tightness; degree of influence and participation involved; and the scope of information used. This study suggests fit between task uncertainty and MCS will enhance R&D performance.

This paper is motivated by the importance of the capabilities of R&D units in generating growth within the Malaysian economy and the lack of MCS research addressing governance issues in the area**.** The findings for this study shall facilitate the understanding of the effects of appropriate management, human management and, in particular, the management of R&D units in light of their potential contribution to the development of Malaysian economy.

The remainder of the paper is organised as follows. First, the conceptual framework that forms the basis of this study is presented followed by a formulation of the hypotheses. Next, the research method is outlined, detailing the sampling and measurement of variables. Following this, the analysis and results of the study are provided. Finally, findings of the study are discussed and conclusions are drawn.

THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

The contingency approach is premised upon the notion that the design and use of control systems and procedures is contingent upon the context of the organizational setting in which these controls operate (Fisher 1998). Based on the approach, when there is 'fit' between organisational and environmental contextual factors and MCS, organisational performance will be enhanced. Contingency-based studies have a long tradition in the study of MCS design and have been the main source of our knowledge about the relationships between MCS and the elements of context (Chenhall 2003). The importance and vitality of this approach is evident from the continuous studies published in the area (Gerdin and Greve 2004). The scope of diversity, such as specific control systems requirements that vary depending on a number of variables, suggests sensitivity to the propositions within contingency theory (Woods 2009).

Prior studies have identified task uncertainty as an important contingent factor in R&D units (Brownell 1985; Govindarajan 1988; Abernethy & Brownell 1997; Omta & de Leeuw 1997; Hoyt & Gerloff 2000). Notably, it is 'coping with uncertainty that has directed management accounting contingency researchers' attention to the design parameters of management information system as well as relative importance of financial control strategies *vis-a-vis* other control mechanisms' (Abernethy and Stoelwinder 1991: 106).

The uncertainties stems from scepticism concerning the success of an R&D activity, as its process usually requires a long time (usually more than one year) to complete (Kim & Oh 2002a; 2002b). Activities performed are based purely upon management's belief that R&D is a good investment without any guarantee on the success.

Due to the uncertainty element, changes regarding tasks are frequently made after the original plan is developed (Anthony et al. 1989; Naveh 2007). R&D units are also heavily involved in performing non-routine tasks (Abernethy & Brownell 1997). The lack of information and experience needed to perform new tasks, which are constantly assigned, may contribute to non-routine tasks in R&D units (Davila 2000). The changing nature and non-routine characteristics of tasks in R&D units formed dimensions of task uncertainty, as stated in Perrow's model of technology (1970).The model developed by Perrow (1970) is among the earliest studies that characterize task uncertainty from a technology perspective. The model suggests task uncertainty exists in two dimensions: task variability and task analyzability. The original terms for task characteristics in Perrow's Technology Model (1970) are number of exceptions (refer to as task variability-TV by many researchers like Souder and Moenaert 1992; Withey, Daft and Cooper 1983) and task analyzability-TA.

Task variability refers to the frequency of unexpected and novel events that occur in the conversion process, while task analyzability is the degree of the existence of clear procedure in carrying out tasks. To enable the same direction of conceptual analysis with TV, the term of TA was changed to 'task non-analyzability-TNA', following Chang et al. (2003). These two task characteristics were used broadly by prior researchers in detailing the task uncertainty concept, for example Chang et al. (2003), Chong (1996), Lau et al. (1995), Mia and Chenhall (1994) and Brownell and Hirst (1986). In this study, the two dimensions of task uncertainty will be tested separately. Following the work of Dunk (1995), Williams and Seaman (2002) and Chang et al. (2003), both task dimensions are assumed to have their own 'theoretical roles' in justifying the effect on the task of work unit.

Consistent with contingency theory's assumption, organizational performance is assumed to be effective when there is fit between task uncertainty and MCS design (see for example, Hirst 1983; Gresov, Drazin & Van de Ven 1989; Mia & Chenhall 1994; Williams & Seaman 2002). According to Whitley (1999), there are four general characteristics of MCS across organisations that may apply at every level of management: (1) the degree of formalization in control system, (2) the degree of control tightness exercised, (3) the degree of unit members' influence and involvement in control system, and (4) the scope of information used in the control system. Each of these characteristics will be briefly discussed as follows.

THE DEGREE OF FORMALIZATION

MCS formalization refers to the degree of reliance on formal rules and procedures (Whitley 1999) and includes systematic procedure in performance measurement; budget as the main control mechanism; and written orders and guidelines in performing activities. If these mechanisms are used extensively, the degree of formal control is considered as high.

Low task uncertainty refers to clear and predictable tasks, (Fry & Slocum 1984) specifically where tasks do not vary; there is a low probability of irregular tasks to be assigned; and the tasks tend to be repetitive. So, formal guidelines developed from past experience can fully accommodate the information needed to carry out a given task. In this situation, it is more appropriate to use more formal rules and procedures (Fry & Slocum 1984; Abernethy & Stoelwinder 1991; Abernethy & Brownell 1997).

In contrast, formal procedures will be less useful when the tasks are highly variable (Argote 1982; Fry & Slocum 1984; Gresov et al. 1989; Chenhall 2003). As tasks become irregular, information within standardized procedures, developed based upon previous tasks, may be difficult to adapt to evolving and unpredictable scenarios (Naveh 2007). Therefore, using a MCS with a high degree of formalization in conditions with high task variability can have negative effects upon the effectiveness of the unit.

H_1: When task variability is low (high), a MCS with a high (low) degree of formalization will be positively related to the performance of the R&D unit.

The degree of formalization is expected to decrease when tasks become more non-analyzable. Rationally, when task non-analyzability is high, additional information is needed because tasks become more complex and cannot be precisely predicted (Gresov et al. 1989). Standard and routine procedures will only limit the information needs. On the other hand, Gresov et al. (1989) highlights that if a task can be easily analysed (or low task non-analyzability), whereby employees are clear on the task and can clearly understand instructions, less formal control will only create disagreement among employees regarding the most suitable method to perform the task. As a result, a stressful working atmosphere is created. Therefore, formal procedures are more appropriate to assist employees in effectively and efficiently performing tasks in low non-task analyzability situations.

H_2: When task non-analyzability is low (high), a MCS with a high (low) degree of formalization will be positively related to the performance of the R&D unit.

THE DEGREE OF CONTROL TIGHTNESS EXERCISED

The degree of control exercised refers to how tightly or loosely a control is being exercised over a work unit (Whitley 1999). According to Merchant and Van der Stede (2003), a MCS can be tightly exercised when there are (1) clear definitions on result and action controls, (2) specific performance targets, (3) effective communication regarding the targeted result, and (4) complete measures on performance.

When task variability is low or tasks are routine, performance targets can be easily developed. Thus, emphasizing tight controls can promote high organisational performance. In contrast, when task variability is high, tight controls can hinder creativity and create undesirable behaviour because, in such situations, employees may require additional information to carry out different tasks (Govindarajan 1988; Auzair & Langfield-Smith 2005). Accordingly, when confronted with unexpected events, the use of flexible controls by managers enable them to prioritise, revise plans and reallocate resources to meet more strategic objectives (Frow, Marginson and Ogden 2010). This indicates that in high task variability, control needs to be loosely exercised.

H_3: When task variability is low (high), a MCS with a high (low) degree of control tightness will be positively related to the performance of the R&D unit.

With regard to task non-analyzability, a similar principle as discussed above follows the rationale. According to Auzair and Langfield-Smith (2005), when tasks can be easily analyzed, targets concerning the performance can easily be defined. In such a situation, emphasizing tight control can ensure employees act according to the organization's desire. In contrast, when task variability is high there is incomplete knowledge regarding cause and effect relationships (Thompson 1967). Therefore, in order to deal with high task non-analyzability situations, using control loosely will assist R&D units to achieve their desired goals.

H_4: When task non-analyzability is low (high), a MCS with a high (low) degree of control tightness will be positively related to performance of the R&D unit.

THE DEGREE OF INFLUENCE AND INVOLVEMENT

The degree of influence and involvement refers to the employees' degree of influence and involvement in the control process, in regards to the target setting process, monitoring procedures and performance evaluations (Whitley 1999). According to Milani (1975), employees are considered highly involved in the control process once they can give an opinion or suggestion with or without being asked.

Prior studies indicate that the degree of employees' influence and involvement will result in different impacts upon unit performance due to varying levels of task uncertainty. According to Abernethy and Stoelwinder (1991), if the task is routine (i.e. low task variability and low task non-analyzability), programmed control with limited employee participation in budget decisions would be more effective. Supporting this statement, Lau et al. (1995) emphasizes that in order to achieve high performance, a programmed budget is used as a tool to limit the degree of participation. However, in situations where task uncertainty is high, budget participation (where the degree of influence and involvement is high) will provide opportunities for employees to control important issues, such as financial, human power and information (Lau et al. 1995). The ability to control resources can avoid adverse effects arising due to uncertainties (Lau & Tan 1998). Additionally, when tasks are uncertain, there will less information and superiors encourage budget participation to access private information that is otherwise held by subordinates (Kyj & Parker 2008). Hence, a high degree of influence and involvement in situations of high task uncertainty can contribute to better unit performance.

H_5: When task variability is low (high), a MCS with a low (high) degree of employees' influence and involvement will be positively related to the performance of the R&D.

H_6: When task non-analyzability is low (high), a MCS with a low (high) degree of employees' influence and involvement will be positively related to the performance of the R&D unit.

THE SCOPE OF INFORMATION

According to Chenhall and Morris (1986), the scope of information refers to the dimension of focus, quantity and time-frame of information used in control systems. The scope of information is considered broad when information has long term prospects, focusing on external and nonfinancial factors (Chenhall & Morris 1986; Gul 1991). Chong (1996) confirms an earlier study by Galbraith (1974), indicating that the scope of information will be different according to different levels of task uncertainty. For example, when a task is highly uncertain, more information will be needed, indicating that a broader scope of information will be required by decision makers to make a decision.

In situations of high task variability (i.e. when many unexpected task can occur), the type of information required to perform each task will be different. In addition, there is probability that employees do not have adequate information (Chong 1996). Therefore, a broad scope of information is essential to assist employees in performing their tasks (Chenhall & Morris 1986; Chang et al.2003). But, in situations where tasks do not vary, Chong (1996) suggests that the information required has already been acquired through past experiences and sufficient procedures have probably been developed. Hence, the narrow scope of information is sufficient in this situation and additional information will unnecessarily increase the burden upon employees.

H_7: When task variability is low (high), a MCS with a narrow (broad) scope of information will be positively related the performance of the R&D unit.

According to Chang et al. (2003), when task non-analyzability is high, a task cannot be easily understood by employees and there is no objective and precise procedure to guide the task. Additionally, cause-effect relationships cannot be recognized. Therefore, a broad scope of information is needed to provide the employees with the requisite information to carry out the task (Gul & Chia 1994; Chong 1996). In contrast, when a task is analyzable, requisite information can be obtained from past experience or readily developed procedures (Chong 1996). Therefore, a broad scope of information is considered inappropriate because information will only further burden employees and consequently affect the effectiveness of unit's performance (Gul & Chia 1994; Chong 1996).

H_8: When task non-analyzability is low (high), a MCS with a narrow (broad) scope of information will be positively related to the performance of the R&D unit.

RESEARCH METHODOLOGY

SAMPLE AND SURVEY PROCEDURE

A four-page questionnaire was constructed and mailed to R&D unit managers of manufacturing companies operating in Malaysia. Based upon the conclusions reached in a prior study (Abernethy and Brownell 1997), these managers were expected to have the best knowledge of various aspects of the R&D units and the outcomes of pilot tests confirm the expectation. As the R&D unit is the unit analyzed in this research, several considerations were made in the selection of the sample. The list of companies selected was derived from two sources: (1) companies that reported R&D expenses with the Malaysian Industrial Development Authority (MIDA), and (2) companies with R&D activity in the Malaysian Ministry of Science, Technology and Innovation's (MOSTI) website. MIDA records revealed that 3,296 companies reported R&D expenses but telephone conversations made with several companies indicate that, in most cases, only companies with more than 350 employees have R&D units. This reduced the sample to 535 companies. The further search for companies from the MOSTI website increased the sample to 686 companies. These two sampling frames were used in this study because there is no existing comprehensive list of companies in Malaysia with R&D units.

From 686 companies, 140 responses were received. Only 61 responses sufficiently fulfilled the criteria to be used in the data analysis (i.e., a company with an R&D unit). Although this represents only an 8.89 percent response rate, the number was considered sufficient for further analysis. It is unclear at this point whether this represents the population as no comprehensive list exists, despite significant effort being made at the initial stage to compile a list of companies with R&D units. On average, the R&D units operate less than 10 years and have a staff of less than 10 employees. The principal focus of R&D activities is on development research (54%), followed by applied research (36%) and basic research (10%). This sample profile demonstrates that the development of R&D units among Malaysian manufacturing companies is still at an early stage and the focus of R&D units is principally focussed upon development research, the last stage of R&D process cycle (Kerssens-van and Bilderbeek (1999) classify R&D project as basic, applied and development).

MEASUREMENT OF VARIABLES

Instruments to measure all variables were adapted from prior studies with some modifications (items to measure the variables are listed in the Appendix). As the analysis was made at the R&D unit level, modifications were made to change the wording of some questionnaire items and removed particular items that were not consistent with the objective of this study.

All instruments were measured using the 5-point Likert scale. The instrument developed by Withey et al. (1983) was used to measure task variability and task analyzability. Respondents were asked to indicate the extent to which the listed items best reflected their tasks in their units. Only eight out of ten items were selected. The two items not included in this study focused on individual level tasks. The items were factor analyzed to test for construct validity. All items load well above 0.50 (Hair et al. 2010) and were therefore retained in the analysis.

A number of prior studies were referred to when measuring MCS characteristics. In an effort to measure the degree of formalization, nine of eleven items were selected from statements on formal procedures developed by Hanks et al. (1994). To measure the degree of control exercised, the instrument developed by Simons (1987) was used. The five-item instrument was modified to make it consistent with the objectives of the present study. Milani's (1975) instrument on influence and the involvement of employees in budgeting was used with some modification to measure the third characteristic of MCS. Finally, for the scope of information, this study used the six-item instrument developed by Chenhall and Morris (1986). All items utilized to measure MCS characteristics were factor analyzed to test for construct validity. Regarding the degree of formality, only items that load well above 0.50 were retained in the analysis. Inspections of the items that load below 0.50 suggest that their exclusion would not alter the purpose of measuring the degree of formality. However, in regards to the degree of control exercised; and the influence and involvement; and the scope of information, excluding the items would alter the purposes of measuring these constructs. Thus, all original items relating to these issues were retained for analysis, similar to the approach undertaken in prior studies (Tsui 2001; Bouwens & Abernethy 2000; Otley & Pollanen 2000).

The dependent variable, R&D unit performance, was measured using a combination of two self-rated performance instruments constructed by Van de Ven and Ferry (1980), and Brownell and Merchant (1990). A combination of the two instruments enables the assessment of performance over a period of time (horizontal assessment) and between individual units within the organisation (intracompany assessment). Although self-rated measurement has been criticised as being biased towards respondents, it should be noted that it is impossible to obtain consistent measurement for the diverse performance activities of all organizations involved (Dunk 1995). It is also argued that, so far, there is no objective performance measurement for a cross-sectional study (Abernethy & Stoelwinder 1995). Based on these arguments, aself-rated performance instrument is still considered an appropriate measure for performance to be used in this study.

TABLE 1. Descriptive Statistics of Research Variables

Variables	Theoretical Range	Actual Range	Mean	Standard Deviation
Task variability	1-5	1-5	2.97	0.89
Task non-analyzability	1-5	1 - 4.5	2.44	0.68
MCS formalization	1-5	2.25 - 5	4.10	0.61
MCS control tightness	1-5	2.60 – 5	3.86	0.62
Influence and involvement	1-5	2.60 – 5	3.62	0.51
Information scope	1-5	2.33 - 5	3.97	0.51
Unit performance	1-5	2.88-4.88	3.70	0.51

TABLE 2. Pearson Correlations Matrix

	1	2	3	4	5	6
1. Task variability	1.000					
2. Task non-analyzability	0.458**	1.000				
3. MCS formalization	0.081	- 0.291**	1.000			
4. MCS control tightness	0.027	- 0.072	0.405**	1.000		
5. Influence and involvement	- 0.140	- 0.122	0.179	0.321**	1.000	
6. Information scope	- 0.093	0.156	- 0.123	0.203	0.236*	1.000
7. Unit performance	- 0.079	- 0.349**	0.239*	0.442**	0.423**	0.286*

** $p \leq 0.01$ (*1-tailed*), * $p \leq 0.05$ (*1-tailed*).

TABLE 3. Reliability Analysis

Variable	No. of items	Cronbach's α
1. Task variability	4	0.883
2. Task non-analyzability	4	0.823
3. MCS formalization	4	0.801
4. MCS control tightness	5	0.788
5. Influence and involvement	5	0.719
6. Information scope	6	0.707
7. Unit performance	8	0.885

RESULTS

DESCRIPTIVE STATISTICS

Table 1 presents the descriptive statistics for all variables. The MCS formalization variable reported the highest mean compared to other variables, indicating that R&D units in Malaysia have extensively used formal policies and procedures in their control systems. Notably, the mean scores for task uncertainty dimensions are both lower than the midpoint of the measurement scale, indicating low task uncertainty faced by the units under study. Table 2 shows the correlations among all variables. Observation of the correlation matrix indicates all correlations are less than 0.5 and, therefore, multicollinearity was not considered to be a problem. The Cronbach's alpha for the seven multiple-items scale are above the commonly accepted standard of 0.70, as suggested by Nunnally (1978). The results are presented in Table 3.

HYPOTHESES TESTING

A two-way interaction model was employed to test the hypotheses. A separate regression analysis was conducted to test the interaction effect of task variability and task non-analyzability on each MCS characteristic.

$$Y = b_0 + b_1 (TASK_i) + b_2 (MCS_j) + b_3 (TASK_i{*}MCS_j) + e$$

where,

- Y : R&D unit performance
- TASK : Task uncertainty characteristics
  - i = 1 : task variability (TV);
  - 2 : task non-analyzability (TNA)
- MCS : MCS characteristics
  - j = 1 : degree of formalization (formal);
  - 2 : degree of control exercised (tight);
  - 3 : degree of influence and involvement (influence);
  - 4 : scope of information (scope)
- $TASK_i{*}MCS_j$: Interaction between task uncertainty i and MCS characteristics j
- e : *standard error*

The result of every hypothesis was determined by the b_3 value, the coefficient of the interaction between task uncertainty and MCS characteristic. The hypothesis is supported if the b_3 value is significant at p<0.05 and its sign shows the same direction with the hypothesis statement. Result for each hypothesis is shown as follows.

TABLE 4. Results of Hypotheses Tests

H	Interaction	Interaction direction	R^2	F	b_3 Coefficient	b_3 t-value	b_3 *p* value
H_1	TV × Formal	-ve	0.142	2.919	-0.232	-1.695	0.096
H_2	TNA × Formal	-ve	0.294	7.343	**-0.537**	**-2.977**	**0.004**
H_3	TV × Tight	-ve	0.281	6.902	0.224	2.313	0.024
H_4	TNA × Tight	-ve	0.328	8.637	0.123	0.839	0.405
H_5	TV × Influence	+ve	0.274	6.653	**0.348**	**2.485**	**0.016**
H_6	TNA × Influence	+ve	0.269	6.486	0.081	0.363	0.718
H_7	TV × Scope	+ve	0.215	4.831	**0.343**	**3.074**	**0.003**
H_8	TNA × Scope	+ve	0.242	5.652	-0.088	-0.521	0.605

The results above indicate that the H_2, H_5 and H_7 hypotheses were supported. The results indicate that high R&D unit performance was reported when there were interaction (1) between task non-analyzability and formalization, (2) between task variability and influence and participation of subordinates, and (3) between task variability and scope of information. The results will be discussed further in the following section.

CONCLUSION

The purpose of this paper is to investigate the relationships between task variability and task analyzability and four characteristics of MCS in R&D units of Malaysian manufacturing firms. The MCS characteristics were conceptualized using the framework suggested by Whitley (1999) that includes the MCS degree of formalization; degree of tightness; degree of influence and participation involved; and the scope of information used. Fit between the task dimensions and MCS is expected to enhance R&D performance.

The findings suggest that hypotheses H_2, H_5 and H_7 are supported. In general, it was found that when tasks can be analyzed, formalized MCS would be more appropriate. The data also suggests, when tasks vary that a MCS should allow for further staff influence and involvement. It was also found that a broad scope of information would be more appropriate when tasks vary. These findings suggest that the two dimensions of task uncertainty affect MCS characteristics in a different manner to produce high R&D unit performance. The results from this study support prior studies in similar areas (Victor and Blackburn 1987; Abernethy and Brownell 1997; Kyj and Parker 2008).

In analyzing H_1, it was expected that the performance of R&D unit would be enhanced with formal controls when there was low task variability (indicated by a negative direction for the interaction beta coefficient). The results, however, did not support the expectation. It is possible that this insignificant finding was influenced by the nature of new R&D units (i.e., more than 50% of the respondents have established their R&D unit for less than 10 years). Their knowledge is still not adequate to deal with multiple tasks that may occur in the future. Thus, formal controls, consisting of written rules and procedures, at any level of task uncertainty are not appropriate as the expansion of new knowledge is still required.

While it was expected that the relationship between low task uncertainty characteristics and tight controls would enhance performance (indicated by a negative direction of the interaction beta coefficient for hypotheses 3 and 4), the data demonstrates a converse relationship. The interaction beta coefficient was positive and significant for H_3. In other words, the data suggests that tight control is suitable in conditions of high task uncertainty. This indicates that factors other than information may also need to be considered before control can be exercised over a unit. While an information gap is a contributing factor to the selection of a proper control design, the risk of failure in the production of R&D output is another factor that may need to be considered. The long term nature of R&D production processes may increase the possibility of not achieving intended outputs. According to Kim and Burton (2002), the failure risk is low when task uncertainty is low. Therefore, an extensive expansion of new knowledge can occur when the risk is low by reducing the tightness of control. In contrast, the risk of failure is high in high task uncertainty situations and the risk can be avoided or reduced by exercising tighter controls.

In regards to H_6, the relationship between task non-analyzability and the degree of influence and involvement did not produce significant effects concerning the performance of an R&D unit. This may be due to the nature of environment in the R&D unit itself, where strong cooperation between unit members is always needed. The cooperation includes sharing ideas, information and support. This cooperation occurs in every task without being restricted to a certain level of task uncertainty. Therefore, the participation of employees in control processes can ensure long-lasting cooperation and that information needed to perform tasks can be delivered easily (Bisbe & Otley 2004).

The findings relating to H_8 implicitly suggest that a broad scope of information is needed despite the level of analyzability of tasks in the R&D unit. This could be due to the nature of R&D units as they are always seeking for new knowledge. According to Ditillo (2004), R&D can be categorized as a 'knowledge intensive firm' where the development of new knowledge is a critical requirement. Therefore, information is needed across the R&D units, whether the tasks performed are considered low or high in uncertainty. In addition, 54% of respondents pursued development types of R&D activity. Therefore, the type of task pursued by the respondent did vary significantly and may have influenced the overall data analyzed to test these hypotheses.

In summary, the key finding in the study suggests the role of information in determining an appropriate MCS design. The significant relationship between the dimensions of task uncertainty and MCS characteristics could be traced back to the definition of the concept of uncertainty by Galbraith, (1973) who posits that uncertainty is the gap between information required and information already obtained by the organization. An appropriate MCS design enhances performance when employees perceive themselves as possessing sufficient information to perform a particular R&D task. Nevertheless, the findings also suggest that the 'knowledge seeking' characteristics of R&D units dominates the type of control designed. Despite facing low task uncertainty, in some circumstances, written rules and procedures; and tight controls are not appropriate to the R&D units.

Several limitations need to be acknowledged when interpreting the results of this study. Samples in this study were selected randomly, since there are no detailed sampling frames on companies with R&D units. However, given that the research in this area is still in its infancy, this presents a challenge to be undertaken in future studies. The low response rate may have also limited the ability to generalise the findings of this study. However, the sample size received is considered sufficient for a meaningful statistical analysis to be undertaken. Another limitation is that this study did not focus on any particular industry in the manufacturing sector, so a possibility exists the unique characteristics within each industry setting may affect the overall results of the study.

The present study contributes to the contingency theory of MCS in relation to R&D units. Specifically, the literature on the role of MCS in creativity and innovation seeking organisations has been expanded by identifying the control characteristics that enhance performance. The study also has important implications for management in understanding the governance structure of R&D units. The findings indicate that management needs to consider the information gaps in relation to the ability of employees to perform their tasks when designing appropriate MCS. We argue that, when tasks are uncertain, R&D unit performance is enhanced when less formal and loose controls are exercised; and a broad scope of information is provided. In instances where large information gaps exist between outcome and effort, strict rules and procedures may only hinder creativity. We believe the understanding of appropriate control design is important to the success of R&D units that, in turn, contribute to further development in the Malaysian agenda for innovation.

Future studies may consider concentrating on specific industries, particularly competitive industries, such as the electric and electronic industries, or industries that emphasize R&D activities in the general operation of the companies, such as industries involved in the production of biochemical and medical equipment. Future research can also examine the relationship between task uncertainty and specific control mechanisms, such as budget and performance measurement, or other mechanisms that are of critical importance to the success of the operations of R&D units. Future research may also consider longitudinal and in-depth studies, given the long term nature of most R&D process.

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APPENDIX

QUESTIONNAIRE ITEMS & FACTOR LOADINGS

Task Uncertainty

Task Variability	Factor Loadings
1. Routine works	0.788
2. Subordinates basically perform repetitive activities in doing their job	0.877
3. Subordinates tasks remain the same from day to day	0.907
4. Subordinates do the same job in the same way from day to day	0.775
Task Non-Analyzability	
1. Understandable sequence of steps that can be followed in doing the work in the unit	0.736
2. Clearly known way to do major types of work normally encountered in the unit	0.868
3. Clearly defined body of knowledge in guiding subordinates to do their work	0.751
4. Reliance on established procedures and practices by subordinates	0.785

Management Control Systems

Degree of Formalization	Factor Loadings
1. Formal policies and procedures guide most decisions	-
2. Important communication between units members are documented by memo	-
3. Formal job descriptions are maintained for each position	0.725
4. Reporting relationships are formally defined	0.855
5. Lines of authority are specified in a formal organization chart	0.755
6. Rewards and incentives are administered by objective and systematic criteria	-
7. Capital expenditure are planned well in advance	-
8. Plans tend to be formal and written	0.731
9. Formal operating budgets guide day to day decisions	-
Degree of Control Tightness	
1. Amount of summary measures of included in periodic planning or control reports provided to middle and senior management	0.751
2. Importance of the following activities	
a. Meeting budget targets	0.770
b. Achievement of operating efficiencies	0.809
3. Accuracy on the perceived predetermined performance standards	-
4. Tightness of control systems	-
Degree of Influence and Participation	
1. Level of involvement of subordinates in setting up the control	0.803
2. Subordinates' influence on final control	-
3. Importance of subordinates' contribution in control setting process	0.841
4. Subordinates' state their requests, opinions and suggestions without being asked	0.597
5. Superior seeks members' request, opinion and suggestions	-

Scope of Information	
1. Information which relates to possible future events	-
2. Quantification of the likelihood of future events occurring	-
3. Non economic information	0.621
4. Information on broad factors external to unit	0.665
5. Non financial information on	
a. Production information	0.755
b. Market information	0.882

Performance

R&D Unit Performance	Factor Loadings
1. Quantity or amount of work produced	0.59
2. Quality or accuracy of work produced	0.644
3. Number of innovations or new ideas introduced	0.513
4. Reputation of work excellence	0.556
5. Attainment of production or service goals	0.503
6. Efficiency of operations	0.564
7. Morale of operating personnel	0.570
8. Unit effectiveness relative to other units	0.514