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Management control systems framework for R&D organisation: a new approach

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Keywords

Research and Development, R&D, Uncertainty, Management Control Systems, MCS, MCS Framework.

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Introduction

The purpose of research and development (R&D) activities is to contribute new knowledge whether or not these activities have specific commercial objectives (Place, 1977, p. 19). This may include creating new or improved devices, products, process systems, and concepts (Nason, 1981, p. 27). Considering the nature of the R&D function, the expected output should not be the same as that which had been previously produced. In turn, the task may be characterised by non-repetitive tasks in which causal relationships may be poorly understood in advance. Therefore, this type of organisation may experience an uncertain environment (Duncan, 1972; Lorsch & Morse, 1974; Simons, 1987).

Environmental uncertainty may influence the effectiveness of goal setting, planning and control systems simultaneously. Since goals and planning have a close relationship with the control function, (Euske, 1984; McCaskey, 1974), the different characteristics of goals and planning (McCaskey, 1974; Davila, 2000) may influence the choice of control systems (Chenhall, 2003; Davila, 2000; Abernethy & Brownell, 1997; Hartmann, 2000).

This study proposes a management control systems (MCS) framework for a R&D organisation in the light of four key elements of MCS, namely Desired Ends, Actors, Control Implementation, and Control Tools. The interactions among those elements are discussed in the paper, so the importance and emphasis of each element in different control stages can be identified.

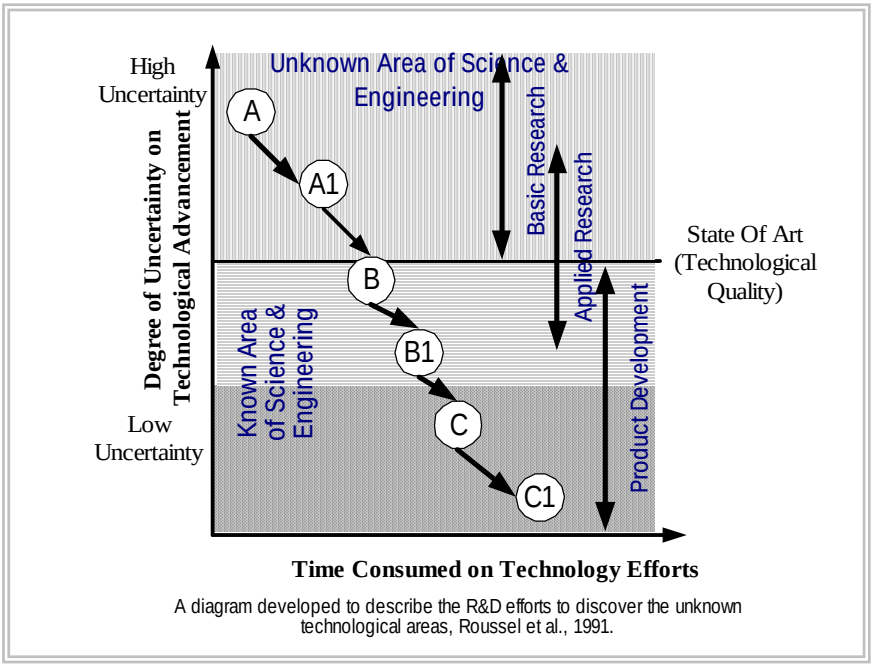
Research and Development Organisations

The US National Science Foundation (NSF) defined the R&D task into three categories (Rockness & Shields, 1984, p. 169):

> Basic research: Original investigation for the advancement of scientific knowledge not having specific commercial objectives, although such investigations may be in fields of present or potential interest to the reporting organisation.
>
> Applied research: Investigations directed to the discovery of new scientific knowledge having specific commercial objectives with respect to products or processes.
>
> Development: Technical activities of a non-routine nature concerned with translating research findings or other scientific knowledge into products or processes.

Roussel, et al. (1991), classified R&D operations into known and unknown areas as presented in figure 1. The R&D operation may be undertaken within known and/or unknown science and engineering areas. A line called State of Art (Technological Quality) that represents the boundary between the known and unknown knowledge separates these two areas.

Figure 1: Relationship between degree of uncertainty and technology quality



A diagram developed to describe the R&D efforts to discover the unknown technological areas, Roussel et al., 1991.

When the R&D function operates in unknown areas such as at point A, Roussel, et al., (1991) called this type of operation as fundamental R&D. In this type of R&D operation, uncertainty is high and confidence of probability of success is impossible to calculate (Roussel, et al., 1991, p. 81). Moreover, this situation at best refers to decision under uncertainty rather than risk. The effort at point A is to discover the unknown technology would result in enabling the organisation to possess the knowledge as situated at point A1. The knowledge obtained from activity A would give direction for R&D activity as depicted at point B.

When the R&D function operates at point B, which is situated close to the State of Art line, the uncertainty is less compared to point A. Although the technical risks are still significant, it may be possible to calculate the confidence of probability of success (Roussel, et al., 1991, p. 81). The output of the operation can be seen as patent and/or patent application. In addition, the operation in this area may involve a large investment compared to point A. This investment is for research as well as for development activities. The result obtained from activity B would give knowledge to the organisation as located at point B1. Since the knowledge at point B1 is already in hand, the company may conduct subsequent R&D operations that are represented by point C, and would position the company at point C1. The operation of the R&D function at point C deals with more certainty regarding the output, less technical risk and higher probability of success compare to operation at point A and B.

Another explanation that arises from the diagram in Figure 1 is that, the closer the organisation is situated to the bottom line indicates that the technology possessed is obsolete and would have little value in respect to competitive advantage. In contrast, where the organisation is located far from the bottom line, the higher the technology quality possessed by the organisation, the better the value in respect to competitive advantage. However, it should be kept in mind that the purpose of this diagram is to simplify the situation held by a R&D organisation. It does not ignore other R&D operations that may be positioned at points other than those three points.

As the output of R&D activities is knowledge, it involves a learning process to gain the knowledge. According to Place (1977, pp., 19-20) there are two types of learning process resulting from the R&D activities; type I and type II learning. Type I learning is the extension of present areas of knowledge, it is more certain and predictable. The program of Type I learning

can be scheduled and budgeted for even if it requires a longer time and larger investment. This learning may be found in applied research but more likely is in product development that uses a variety of inputs to support the operation (Place, 1977).

Type II learning requires an intuitive leap away from the present areas of knowledge, that is brand new knowledge. It cannot be kept on schedule and budget. The program is exciting and rapid, and demands a relatively small investment. Though it is difficult to place a clear boundary between basic and applied research (Nason, 1981), the type II learning process is likely to occur during the basic research function up to applied research.

Regarding applied research, as its objective is to fuel societal change by the creation of new scientific knowledge as well as the utility of that knowledge to the society, then it would possess those two types of learning (Place, 1977). However, the emphasis of the effort of applied research may vary along the way from basic research to product development. When the applied research effort is closest to basic research, the emphasis would be on type II learning, whereas if the effort were closest to product development, the emphasis would be on type I learning. It could be said therefore, that type II learning will occur within the process of developing the ideas in which the new ideas produced would be used as a direction for the project, whereas the type I learning would predominantly occur during the project life cycle.

The R&D operation is clearly a learning process to transform the unknown to the known. The utilization of this new knowledge needs innovative scientists and management to interpret the expertise and translate it into viable business projects. In any of those situations described above, it seems that to be successful a R&D unit needs its employees to have innovative behaviour. Innovation in this case is not limited to the development of the existing product, but also a breakthrough in new knowledge to benefit the entire business. The behaviour may be different from those assumed by administrative behaviour that tends to be bounded by rigid rules and procedures. The scientists might require a fair degree of autonomy (Abernethy & Stoelwinder, 1991) to give them a space for innovation. As the scientists are the most important assets of R&D units (Twiss, 1992; Jain & Triandis, 1990), more understanding of their behaviour is needed to be able to manage the task in the R&D organisation.

Organisational Environment and Goals

Environmental uncertainty may influence the effectiveness of goal setting. Goal ambiguity at the organisational level as caused by environmental uncertainty may create difficulties in setting clear and certain operational goals. Thompson (1967, p. 127) referred to goals as "...some imagined state of affairs which may conceivably be attained or approached (if not finite) at some future time." In a similar vein, Latham & Yukl (1975, p. 824) used a simple definition of goals, being "...what the individual is consciously trying to do." If goals were defined as a psychological trait, then it would be related to the environmental characteristics perceived by individuals and the goal setting process.

Four possible purposes of the goals are mentioned by Daft (1983, pp. 82-84) they are; (a) to legitimate the organisation's existence, (b) to provide direction and decision guidelines, (c) to formulate criteria for performance appraisal, and (d) to reduce uncertainty. Apparently these four purposes may be found with different emphases among organisations. The first purpose is legitimating organisational existence. For this purpose, the official goals seem to be very relevant to the requirement of the external environment where the organisation deals with the external members or bodies. The rest of the purposes, such as direction, criteria for performance, and minimising ambiguity, would be considered relevant to the requirement of the internal environment. Nevertheless, to be able to be used, these three purposes of operative goals are preferred to be clear, concrete, rational and understandable.

Unfortunately, the issue of organisational goals is not without problem. For example, Weick (1969, p. 37) argued that;

> …the view common to most organisation theories attributes to goals more stability than they seemingly have. It is probable that goals are tied more closely to actual activities than has been realized, and that they are better understood as summaries of previous actions. Much of the organisation's work does not seem to be directed toward goal attainment. Instead, it can be understood more readily as actions with a primitive orderliness, this orderliness being enhanced retrospectively when members review what has come to pass as a result of the actions.

Similarly, March (cited in Cooper et al, 1981, p. 181) suggested,

> ...it seems to me perfectly obvious that a description that assumes goals come first and action comes later is frequently radically wrong. Human choice behaviour is at least as much a process for discovering goals as for acting on them.

In relation to Management Control Systems, Chenhall (2003, p. 135) argued that;

> Distinguishing official and operative goals would seem an essential aspect of MCS [*Management Control Systems*] research that includes consideration of goals, mainly as it flags that the issue of organisational goals is far from unproblematic.

Some authorities proposed a different approach than economic rationality to deal with environmental uncertainty in goal setting (Cohen, et al, 1972; Cooper et al, 1981; March & Simon, 1958; March, 1978; Lindblom, 1959). Cohen et al. (1972) characterised intangible goals as organised anarchies where problematic preferences, unclear technology, and fluid participation exist. The R&D organisation may deal with this type of situation. For this type of organisation, the choice behaviour in setting the goals is different to those organisations under environmental certainty. March & Simon (1958) suggested a bounded rationality model to replace economic rationality. March (1978) proposed the technology of foolishness as the basis for action. Lindblom (1959) proposed the science of muddling through, while Gouldner (1959, cited in Georgiou, 1973, p. 293) proposed a natural system model, where the organisation was viewed as an organism, in which its primary concern is to survive. Those alternative views direct the choice to a position, which emphasises learning and adaptive behaviour. In order to adapt to a situation, an organisation needs to learn.

During the learning process, the announced goals may be used as a tentative guide for the organisation to act. Furthermore, during the process of the action, the organisation may find some desired practical directions to be followed. The choice of the directions may be based on their priorities in relation to the announced goals and is bounded by the constraints dealt with by the organisation. The new directions chosen would be followed by the action that is characterised by the learning process. However, once the directions are perceived to be inappropriate during the process of the action, then other desired directions may be chosen to replace the old direction. This is a continual process of action during the organisation’s life.

Organisational Environment and Control

Environmental uncertainty has been seen to require different control systems (Chenhall, 2003; Davila, 2000: Abernethy & Brownell, 1997: Hartmann, 2000). Many studies had been done to investigate this matter. Amigoni (1978) conducted a literature review on management control systems and suggested that effective control systems should match appropriate combinations among three important elements: *independent variables, distinctive features of the management control systems*, and *control tools*.

However, the study by Amigoni (1978) attempted to tie the direct influence of environmental characteristics to the choice of control systems, and ignored the qualities of goals and planning that would probably have had more effect on the choice of control systems. The choice of control tools could not be connected directly to environmental characteristics. The control systems are a function of goals and planning systems. Control systems are mostly used as devices to ensure

that the direction to goals attainment is followed, and that the planning function plots the path in that direction. However, a study, which investigates the relationship between environmental uncertainty, goal setting, planning systems and control systems together, is rarely found.

The organisational goals or objectives are not always clear and measurable quantitatively, as stated by Euske (1984, p.7) that;

> …the goals and objectives of the organisation are given to the management control system, which addresses how best they can be accomplished. The specificity of the goals and objectives affects the success of a management control system. Poorly specified goals and objectives will create difficulty because of the resulting uncertainty and ambiguity.

However, when goals are ambiguous and technologies uncertain by nature, the applicability of the control concepts, which pretend that goals come before action, will be problematical. This matter has been long identified by Otley and Berry (1980, p.241) who said,

> …firstly, organisational objectives are often vague, ambiguous and change with time. They are often set by ill-defined processes, and are multiple and partially conflicting. In addition, they are congruent to only a varying extent with the objectives of various interest groups associated with the organisation. Secondly, in this situation, measures of achievement are possible only in correspondingly vague and often subjective terms. Thirdly, predictive models of organisational behaviour are partial and unreliable, and furthermore different models may be held by different participants. Finally, the ability to act is highly constrained for most groups of participants, including the so-called 'controllers,' by virtue of the limited range of possible actions open to them.

Similarly, Chenhall (2003, pp. 137-138) concluded that;

> …from these illustrations it can be seen that a consistent stream of research over the past 20 years has confirmed that uncertainty has been associated with a need for more open, externally focused, non financial styles of MCS. However, hostile and turbulent conditions appear, in the main, to be best served by a reliance on formal controls and an emphasis on budgets. The question may be posed, what is the appropriate MCS for organisations operating in conditions of uncertainty, turbulence and hostility?

Although studies that explicitly examine the relationship between goals and control are rarely found in literature, some of them may be reviewed. Ouchi (1977) examined the appropriateness of two types of control: *behaviour control* and *output control* under those four situations in 78 retail department store companies in the USA. *Behaviour control* refers to control of behaviour of subordinates by watching and guiding their behaviour toward the expected behaviour preferred by the supervisors. *Output control* refers to the measurement of output in which knowledge of the transformation process is not compulsory.

Throughout the study, Ouchi (1977) indicated that better knowledge of the transformation processes is associated with less emphasis on output control, except for sales person groups. For this group it was indicated that output control was predominantly used. These findings led him to conclude that the availability of an output measure would influence the emphasis on output control. In addition, the incompleteness of either one of these two factors may contribute to a certain level of goal ambiguity.

The measurability of output is considered to be the ability to determine the value of output with regard to the value of input being used. In the case of a research and development organisation that produces new knowledge, it is plausible to suggest that the organisation may have difficulty on measurability of the output. For this type of organisation the expected benefit resulting from the expected output is difficult to predetermine, and hence would cause goal

ambiguity. Furthermore, one aspect that causes a low degree of knowledge of the transformation process is the inability of the organisation to define a relatively clear expected output in the first place. Therefore, this condition would also be considered as creating goal ambiguity.

Some studies that investigated the behavioural aspect of control systems indicated that the failure to match appropriate control systems with goal characteristics caused undesirable results for the organisation such as the use of financial data that create job related tension (Hopwood, 1972) and manipulating behaviour (Birnberg, et al., 1983). Since the use of financial data was found to create tensions, this financial dimension would be less appropriate in controlling organisations, which dealt with uncertainty, particularly R&D organisations. In R&D organisations the creativity of the individual member plays an important part during the organisation's life (Gibson, 1981), and the tension and/or pressure resulting from the control system may reduce creativity and innovation (Abbey, 1982; Gerstenfeld, 1970). Other reasons to disregard the emphasis on the financial dimension for the organisations that dealt with uncertainty is based on its inability to adequately reflect performance, difficulties in defining means-ends relationships, and difficulties to predetermine the expected outcomes (Govindarajan, 1984). The undesirable condition resulting from the emphasis of the financial dimension on control systems would shift the system to a need for other non-financial dimensions (Govindarajan, 1984).

Management Control Systems Framework

Giglioni & Bedeian (1974) reviewed the literature on the evolution of the management control concept from 1900 to 1972. Their historical study identified some definitions of management control in the early literature. Newman (1951, cited in Giglioni & Bedeian, 1974, p. 298) wrote of three control elements he described as; standards or plans, motivation, and corrective action by mentioning that MCS is concerned with

> ... seeing that operating results conform as nearly as possible to the plans. This involves the establishment of standards, motivation of people to achieve these standards, comparison of actual results against the standard, and necessary corrective action when performance deviates from the plan.

Brech (1965, pp. 13-14) defined management control systems as,

> ..checking current performance against objectives and targets in terms of predetermined standards contained in the plans, with a view to ensuring adequate progress and satisfactory performance whether physical or financial; also contributing to decisions in continuing or changing the plans, as well as 'recording' the experience gained from the working of these plans as a guide to possible future operations.

Brech (1965) employed the yardsticks or standards of objectives or targets as the criterion for performance measurement and the use of feedback information for corrective action. The definition clearly assumed that objectives and targets are measurable quantitatively and/or in monetary terms.

Ouchi (1977, pp. 96-97) also held a similar position by saying that,

> ...the control system itself consists primarily of a process for monitoring and evaluating performance, while the preconditions specify the reliability and validity with which such comparisons can be made.

Similarly, Anthony et al., (1989, p. 12) pointed out that, "...management control includes both actions to guide and motivate efforts to attain organization goals and actions to correct ineffective and inefficient performance." The definitions of Ouchi (1977) and Anthony et al (1989) still contain the notions of the control concept defined in the earlier literature by making

the standard criteria central to the function of the control mechanism. Overall, the above views seem to presume that the environment is certain.

Birnberg & Snodgrass (1988, pp. 447-448) hold the view that organisational control is a process used to modify the behaviour of performers through delimiting the decision space and defined management control system as;

> ...a mechanism designed to limit the decision space of individuals within an organization so as to affect their behaviour. ...Central to this definition …is the notion that the organization's goals are achieved by coordinating the work of individuals and units throughout the organization as they carry out their appointed tasks.

In a similar vein, Flamholtz (1983, p. 154) viewed the control function as a behavioural modification process by defining management control as, "...any actions or activities taken to influence the probability that people will behave in ways which lead to the attainment of organizational objectives." Furthermore, Chua et al. (1989, p.4) pointed out three meanings of control:

> ...one, as a means of steering or regulation, which is the classical cybernetic meaning: a second as a means of domination of one or more people or groups of people by other people or groups, which has more sociological and political overtones: and a third, as a process of the management of control and power.

From the definitions of MCS, four broad core elements of MCS are identified; *desired ends*, *actors*, *control implementation*, and *control tools*. These control elements needed to consider in designing the MCS, and will be described below.

Desired ends

The element of *desired ends* refers to expected ends or the final destination of an action at the end of an operational cycle. These ends, if tangible and physically quantifiable, are used as measurement criteria where the comparison process can take place. In a situation of uncertainty and unpredictable output however, the criteria or standards are unable to be set in advance the focuses would be the direction of the organisational objectives rather than the achievement of the standard. One may argue that the desired ends may be similar to those of organisational goals. However, this study prefers to use the desired ends as being able to cover comprehensively the notions that are embodied in organisational objectives, rather than goals that comprise disagreement among authorities (Lindblom, 1959; Cohen et al, 1972; Georgiou, 1973; Cooper et al, 1981). The alternative perspective suggested an endeavour to consider the elements embodied in the desired ends.

The element of *desired ends* may have two sub-elements. The first sub-element is the *direction* of an action to describe where to go, rather than what to achieve. The second sub-element is a *yardstick* to measure the progress of an action or the result of an action. When the organisation deals with a highly certain environment, the desired ends can be translated into precise and reliable quantitative figures such as are represented by a number of units or monetary attributes. Therefore, the emphasis would be on the *yardstick*.

In a situation of environmental uncertainty however, the means-ends relationships are unclear, the prediction of future events and consequences cannot be made relatively accurate, and the *desired ends* cannot be translated reliably into quantitative features. Therefore, the *desired ends* may only contain the *direction* without being able to be described in quantitative figures. Being a *direction* only, the *desired ends* cannot be used accurately to measure the performance as in the case of quantitative measurement. Rather *desired ends* can only be used by the control systems to guide the action toward the desired direction.

Actors

The element of *actors* refers to the individuals who are involved in the control system that is relevant to a decision-making situation. In the context of control, the *actor* may have two sides. One side is as a subject who exercises the control function, and the other side is as an object being controlled. However, it is argued that every individual within the organisation may be subject to formal control, but at the same time, the individual will also be an object being controlled. Nevertheless, to limit this broad understanding, in this context, *actor* will refer to individuals or groups of individuals within a system as the objects being controlled. Five aspects are embodied on the element of *actors,* they are; *behavioural* (Flamholtz, 1983; Birnberg & Snodgrass, 1988), *domination* and *power* (Chua et al., 1989), *decision space* (Birnberg and Snodgrass, 1988) and *motivation* (Newman, 1951 cited in Giglioni & Bedeian, 1974; Anthony, 1989).

The *behavioural* aspect in this case refers to a behaviour that is preferred by the systems where the actors operate. Preferred behaviour then will relate to a set of required behaviour that is defined by individual(s) who have more power to dominate others in the systems, and which mostly conveys their pleasure. In the context of an organisation, preferred behaviour refers to the achievement of the desired ends that may or may not be objectively measurable.

Domination refers to the ability to influence others in making decisions, and *Power* refers to the degree of strength of the influencing capacity. Though it is difficult to distinguish *domination* from *power*, this study considers them distinct. An individual within the organisation may have an ability to dominate others, however, the strength of dominating ability will relate to the degree of power the individual has in hand. In other words, the magnitude of the dominating ability is power. Though this study does not intend to measure the degree of power, it is plausible to suggest that the degree of power may be measured. Therefore, keeping these two aspects distinct will enable a more detailed analysis of the elements embodied in the concept of management control.

Decision space refers to the degree of authority, which is given to an individual to enable the individual to act within the system. This element commonly exists through formal authority that is given to an individual or a sub-unit within the organisation such as job description or job specification of a position occupied by an actor, and amount of funds allocated to a particular operation that is assigned to an actor. As a formal authority, this element will deal with formal rules and procedures embodied in the control system.

Motivation is another important aspect in the element of actors. The subject that exercises the control function should be able to identify potential factors that can be used to motivate the actor to remain within a preferred behaviour. The motivational element is commonly presented by monetary reward and hierarchical promotion. However, for R&D organisations where the output is difficult to measure relatively accurately by financial data, and it is difficult to distinguish the contribution of each member to project achievement, and when the actors prefer to place their reputation ahead of monetary and hierarchical promotion (Luecke, 1973), potential motivational factors other than monetary and hierarchical promotion are needed.

Control Implementation

The control implementation consists of two main aspects; *control types* and *control implementation stages*. Regarding the control types, this study suggests two types of control may be applied; *formal* and *informal control* type. The *formal control type* refers to an explicit process that is carried out to influence actors in making a decision toward desired ends that is similar to administrative control (Hopwood, 1974) and explicit control (Birnberg & Snodgrass, 1988). The *formal* control type will be carried out with regard to written norms such as accounting reports, job description, employee appraisal system, budget, rules, standards, statistical reports, and diagrams such as PERT and CPM.

The *informal control type* refers to an implicit process that is carried out to influence actors in making decisions toward desired ends. As an implicit process, the informal control type will be implemented with regard to norms and values that are accumulated to form a belief among a group(s) of individuals within an organisation. The accumulation of norms and values may emerge from two sources that will be used to construct two types of informal control: *surveillance* and *cultural* control. *Surveillance* control may come from written norms and values that have been internalised by the actors, and applied to the actors who perform the tasks by watching and guiding them toward the proper way in performing the tasks. *Cultural* control is the accumulation of norms and values that are originated from common norms, beliefs, and shared values among the actors in a group without having any relationship with written norms. Since the accumulation of the norms and values has been internalised by the member, it may construct an informal control that will bind the individual mind to behave toward the committed behaviour namely self-control (Hopwood, 1974; Jaworsky, 1988).

Regarding the *stages of control implementation*, this study proposes three stages of control implementation. The first stage may be carried out during the selection and provision of input that will be used for an operation and will be referred to as *input control* in this study. The second stage may be performed during the process of operation to monitor how tasks are performed and will be referred to as *process control*. The third stage of control may be carried out after the operation has been completed to monitor what outputs have been achieved, and this type of control phase will be referred to as *output control*.

Control tools

The element of *control tools* refers to instruments that are used in performing the control function. The purpose of the control function is to influence the action toward attaining the desired ends. However, the desired ends are commonly multiple and vague, and therefore they need agents which would be able to represent the value embodied in the desired ends.

The fundamental role of the *control tools* is to represent both the value of the desired ends and the effort, so the control function can monitor, compare and evaluate how far the effort is performed concerning the desired ends. Moreover, the uses of *control tools* may be multiple, and may often be substituted for one another; therefore, the appropriate control tools chosen may influence the success of the control systems (Merchant, 1985; Bisbe and Otley, 2004; Tatikonda & Rosenthal, 2000).

Various *control tools* can be found in the literature (Hopwood, 1972; Brownell, 1982; Otley, 1978; Govindarajan, 1984; Khandwalla, 1972; Merchant, 1985; Macintosh & Daft, 1987; Rockness & Shields 1984). However, their existence during the control process is inconclusive, and therefore needs modification. To provide a broader perspective and to allow a more detailed analysis of the appropriateness of control tools, this study proposed two elements of control tools that need to be considered: *dimensions* that are contained in the control tool and *values* that are represented by the control tool.

Dimension refers to the solid characteristics of the criteria that are used by the control systems regarding the result that is expected to be attained. As an instrument of the control function, control tools may contain various dimensions that can be classified into four groups: *Directional, Bureaucratic, Scientific* and *Financial*. *Directional dimension* refers to control tools that contain qualitative characteristics that represent the general directions to be followed by the action such as system goals and general policy guidelines. The *bureaucratic dimension* refers to the control tools that contain either quantitative or qualitative characteristics which represent the technical tasks, such as standard operating procedures, quality control, inventory control, and scheduling including PERT, CPM, and production scheduling. The *scientific dimension* contains the control tools that are used particularly to measure ideas and innovations such as new or improved processes, products or techniques, patents and patent applications, scientific publications, membership of professional organisations and so forth. The *financial dimension* refers to the

control tools that contain monetary measurement. This dimension is very familiar in accounting literature and includes budgets, cost effectiveness report, standard costs, and return on investment and so forth.

As an agent to mediate desired ends and actual performance, the control tools should contain *values* that ideally represent these two extreme points. Three values of representation are proposed in this study: *external values*, *internal values*, and *social values*. *External value* refers to values that are developed by an external party. For example, the use of the market mechanism to define a fair price for transfers (Ouchi, 1979; Lebas & Weigenstein, 1986) can be considered to contain external values.

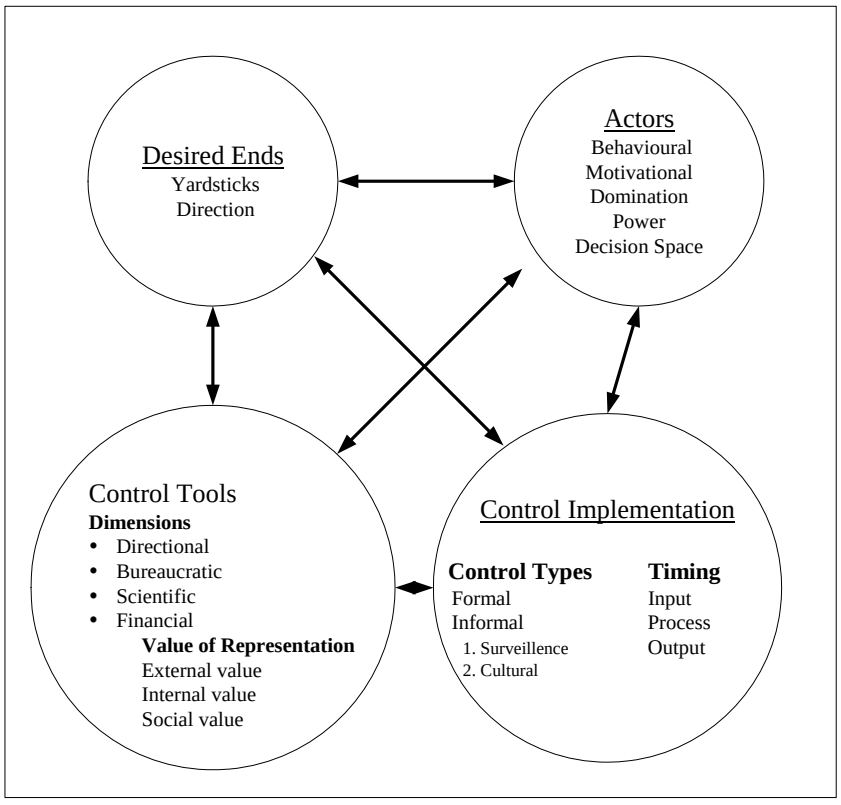
Internal values refer to values that are developed by an internal party by reference to the internal condition of the organisation. An example of internal values can be seen in the bureaucratic control (Ouchi, 1979, Lebas & Weigenstein, 1986) that is commonly labelled by setting rules, standard operating procedures and policies, standard costs, and so forth. The value setting process of internal values may be done by force and be dominated by the dominant party within the organisation. This type of value setting would have a greater chance for dysfunctional behaviour if it is used in a high uncertainty and low goal congruence situation

Social values refer to values that result from social interaction among the members of a group of individuals. The existence of social values may be reflected by the organisational culture. The value setting process in this circumstance is not done by force; rather, it is accepted by the members willingly. The social values are not disturbed by clear or unclear boundaries of desired ends, because they are set by the social interactions that have a chance to change over time. Since the social values are accepted through willingness rather than enforcement, the use of social values in the control system will have less chance of significance for dysfunctional behaviour than the internal values. Though this study divided the values represented by the control tools into three types, it should be kept in mind that in exercising the control tools there would be a combination among these values embodied in the set of control tools applied.

The Relationship among core elements of Management Control Systems

The interrelationship among core elements of control may be suggested as depicted in FIGURE 2 below.

Figure 2: The Relationship among core elements of Management Control Systems



The relationship between the *desired ends* and the *control tools* occurs during the three important functions of the control systems: monitoring, evaluation, and performance measurement (Birnberg & Snodgrass, 1988). The control systems will monitor, measure, and evaluate the action by reference to the desired ends. The purpose of these control functions is to ensure that two aspects are included in the desired ends: yardstick and direction. With regard to the yardstick dimension, the control systems will function to measure and evaluate how far the expected outputs have been achieved by the action. Whereas, with respect to the directional dimension, the control systems will function to ensure that the actions are still in the correct directions for achieving the desired ends.

The level of uncertainty experienced by the organisation influences the focus on the two dimensions of desired ends. When deal with less uncertain environment such as concrete and measurable goals, and repetitive tasks, the control systems may be emphasised on the yardstick dimension. As it is envisaged by that perfect situation, the expected output may be relatively complete in representing the characteristics of the desired ends while the direction will still be used to indicate where to go. Since the situation becomes more certain, the members of the organisation may use a predictive model in defining the description of desired output relatively accurately. The use of a predictive model in turn will encourage the control tools to use internal values which commonly involve quantitative attributes such as; standard cost, budget, financial ratios, statistical quality control, and so forth.

In contrast, under an imperfect situation such as when all the environments are uncertain, unpredictable, undergoing changes, and with goals that cannot be measured quantitatively, the organisation may focus its control system on the directional dimension. For this situation, the control tools may use either external or social values.

More precisely, when dealing with a perfect situation, the yardstick may be the core dimension of the control system and the direction would be the peripheral dimension, and vice versa for the imperfect situation. Therefore, the relationship between the dimension of the desired end and the tools is said to constitute the control system. In a perfect environment, the tools may be dominated by internal values. On the other hand, under an imperfect situation, the external and social values may play an important role as control tools (Hayes, 1977; Abernethy and Brownell, 1997; Chenhall, 2003).

The relationship between *desired ends* and *actor* essentially relies on the behavioural dimension, that is, how preferred behaviour is defined in regard to the desired ends. Under a perfect situation, preferred behaviour is clear, that is, the achievement of a clear and certain desired end. The motivational element may be based on monetary and other hierarchical promotions. It should be kept in mind that the perfect situation is indicated by routine and repetitive tasks and relatively predictable and quantifiable output as in a production unit. Since the perfect situation is characterised by the above qualities, the delegation of authorities along the hierarchy will be clear and then the decision space can be defined precisely. In turn, the capacity to dominate others may come from the formal network rather than the informal. Furthermore, the degree of power to influence others in making decisions will be dominated by the formal source rather than the informal (Abernethy and Brownell, 1997; Chenhall, 2003).

In a situation of uncertainty, where the tasks are more uncertain, unclear, and the outputs are relatively less predictable and less quantifiable such as those dealt with by a R&D organisation, the control toward those five elements of actor should be different. The behaviour is guided toward the organisational system goals, which are dominated, by the directional characteristic rather than the yardstick. Motivation may not be based merely on monetary and hierarchical promotion; it should also cover individual satisfaction such as reputation and professional acknowledgment. Moreover, as it is caused by unclear and less quantifiable goals, the delegation of authority among individuals would not be clear and the decision space for every individual cannot then be defined precisely. The source of power may not only come from the formal

network but also from the informal network, as it is the result of social interaction among the members. In turn, the domination element may not be based only on the formal hierarchy but also on informal elements including seniority and professional norms. Therefore, considering that the control system involves behavioural modification devices, the differences in the actors' elements under those two conditions should be taken into account.

The relationship between the *desired ends* and *control implementation* is related to the implementation of the predominant control type between the two dimensions of desired ends. Many studies can be found in the literatures that have examined this relationship (Hopwood, 1972; Brownell, 1982; Govindarajan, 1984; Hirst, 1983; Abernethy & Stoelwinder, 1991, Abernethy and Brownell, 1997; Tatikonda & Rosenthal, 2000; Ditillo, 2004; Bonner, et al, 2004). Most of those studies indicated that when the yardstick dimension dominates the characteristics of the desired ends, the formal type of control and the surveillance type of control may be appropriate. In contrast, when the directional dimension dominates the characteristics of the desired ends, informal control (particularly cultural control) may play an important role in the implementation of the control systems.

The relationship between the *actors* and *control tools* traditionally rests on the function of the control system to measure the behavioural element. Output is commonly measured as a surrogate for behaviour. However, at an extreme point where the appropriate outputs cannot be taken for granted, the behaviours cannot be measured with regard to the output resulting from behaviour. In this situation, the control system cannot precisely monitor and evaluate the output, which is derived from the behaviour. Moreover, to monitor and to evaluate an action does not necessarily mean to measure it quantitatively. The action can be monitored and evaluated with regard to the direction. Therefore, this study does not view the control function as limiting the measuring process, but rather as consisting also of the process of influencing behaviour. The influencing process may be carried out through the other four actors' elements that will affect the behaviour by driving the action toward the achievement of the desired ends.

Traditionally the motivational aspect has been viewed with regard to the reward system. However, aside from the reward system that emphasises the financial dimension and rank, it is suggested that the use of scientific dimensions such as scientific publications, seminar attendance, and patents can also be used.

Domination, power and decision space may be influenced by four dimensions of control tools (directional, bureaucratic, scientific and financial). For example, directional and bureaucratic dimensions may limit the decision space of the actor, therefore making a decision possible only within a particular area. In turn, those dimensions of control tools will also reduce the power and domination of the actor in influencing his or her peers in making a decision. The reduction of power and domination may result from delimiting the decision space. The scientific and financial dimensions may also have the same effect on decision space. When the independent panel or expert rating can evaluate the appropriateness of the scientific quality proposed, the actors' decision space would be bound by that quality. Similarly, the financial dimension as described by the budget availability would also limit the actors in making a financial decision.

The relationship between the *actors* and the *control implementation* refers to the use of the control type to influence behaviour through the other four actors' dimensions. However, it is difficult to describe this relationship without involving the characteristic of the desired ends. In a situation of certainty, the formal and surveillance control type may be applied to influence motivation and to measure the output that results from the behaviour. In addition, it can also be used to monitor and evaluate whether the actors operate within the decision space that is given, and to monitor whether or not the actors have a significant power in dominating their peers in making a decision. However, in a situation of uncertainty, the use of formal and surveillance types of control may be less appropriate and may lead to dysfunctional behaviour. Therefore,

under environmental uncertainty, cultural control may be a significant factor involved in control systems.

The relationship between the *control tools* and the *control implementation* refers to the use of the tools employed in the implementation of the type of control. As the instruments of the control function, the control tools may be used by the formal and informal control type. However, most of the control tools in literature seem to have quantitative expression, although some of the control tools may have qualitative characteristics such as bureaucratic evaluation, political public affairs, directional constraint and general policy guidelines. Moreover, the majority of those control tools may be used in performing the formal control rather than the informal type of control. Though it is difficult to place a clear boundary on the use of control tools between formal and informal control, in some ways the use of control tools in those two types of control may be distinct, and needs to be defined by reference to those two control types.

The characteristics of control tools that are used by formal the control type are clearly defined in the literature. These control tools may refer to written norms. Examples of the tools used by informal control that may be found in the literature and include shared values (Hopwood, 1974), personal objectives (Jaworsky, 1988), mutual commitments among employees toward objectives (Hopwood, 1974; Ouchi, 1979; Jaworsky, 1988), and norms (Jaworsky, 1988; Lebas & Weigenstein, 1986). In turn, as the informal control contains surveillance and cultural control, the control tools that are used by surveillance and cultural control may also be distinct. The formal control type may use any or a combination of the four dimensions of control tools. However, the surveillance control type may only use the bureaucratic dimension of the control tools. Moreover, the cultural dimension of the control type may use either the directional or the scientific dimension of control tools.

Findings and Conclusion

Acknowledging the presence of these four control elements will broaden the comprehension of the control concept. However, a description of the use of these dimensions is required. The dimensions may be complementary. However, in exercising control, it is possible that one dimension will be more dominant than other dimensions, depending on the situation being dealt with by the organisation (Hopwood, 1983).

Though the relationship among the dimensions seems to be conspicuous from the above discussion, the degree of combination between perfect and imperfect situations may occur in a practical situation. Therefore, the relationship among the control elements has potential to be explored. The above discussion has indicated the appropriate use of the content embodied in each core elements of the control systems in perfect and imperfect situations. Table 1 presents a combination of core elements in two possible situations.

Table 1: The Influence of Organizational Environment toward the Choice of Control Elements.

Environmental Situations				
Control Elements	Low level of uncertainty		High level of uncertainty	
Desired Ends	Yardstick			
	Direction		Direction	
ACTORS	Behaviour	through output	Behaviour	through culture
	Motivation	monetary & rank	Motivation	monetary, promotion,
	Domination	formal hierarchy		and professional accreditation
	Decision space	formal hierarchy	Domination	formal & informal
	Power source	formal hierarchy	Decision space	formal & informal
			Power source	formal & informal
CONTROL TOOLS	Internal values		external and social values	
FORMS/STYLE	Formal & Surveillance		Cultural	

A perfect situation allows the control functions to use both the yardstick and directional dimensions of the desired ends. In relation to the actors, it would also be plausible to use monetary and hierarchical promotion, which is measured by the output, by using motivational devices to encourage behaviour toward the achievement of the desired ends. Moreover, in a perfect situation, the potential of influencing others and the source of power for that capacity may come from the formal hierarchical base. In turn, the decision space can be clearly defined and can be based on the formal distribution of authority. In a perfect situation, the control tools that mostly contain internal values such as bureaucratic, financial and some of the scientific dimensions may dominate the control function. In turn, the use of formal and surveillance control types may dominate the control function in a perfect situation.

In an imperfect situation, where the environment is uncertain and the expected output is unclear, the yardstick dimension seems to be less useful, and the directional element becomes significant. For this situation, the appropriateness of the actors' elements would also be affected. When the situation becomes uncertain, the cultural aspect may be significant in motivating behaviour. Moreover, in an imperfect situation, the decision space cannot be clearly defined. Furthermore, the domination, and power source may also come from informal interactions.

An imperfect situation may also influence the use of the control tools. In an imperfect situation, the control tools that contain external and social values such as directional and scientific dimensions may play important roles in the execution of the control function. Similarly, in an imperfect situation, the cultural control type as part of the dimension of control type may play a significant role in the execution of the control function.

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