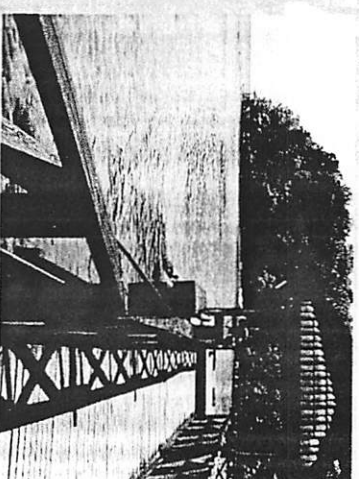The 8th International Management & Accounting Conference (IMAC 8)

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Programme Book

Leveraging Governance towards Sustainability

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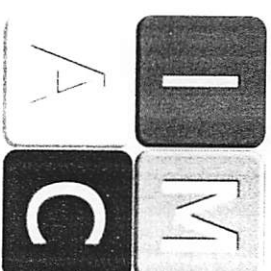Tel: +603-8921 4488 /5748/5774/3427/5732
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Professor of Sustainable Enterprise, School of
Management, University of Technology, Sydney,
Australia

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Welcome Message from the Vice Chancellor, Universiti Kebangsaan Malaysia

Assalamualaikum W.B.T. and Salam Sejahtera

I would like to take this opportunity to congratulate the School of Accounting and School of Management, Faculty of Economics and Management, UKM for organizing the International Management and Accounting Conference (IMAC) for the eighth time.

The aim of IMAC 8 is to create an environment to network, exchange ideas, share knowledge and pursue other developmental opportunities with colleagues from around the globe and across different business disciplines that are related to the theme "Leveraging Governance towards Sustainability". It is my hope that this conference will make significant contributions to the development of the accounting and management profession and to bring academics and the professionals closer.

I also hope that the conference will lead to collaborative efforts between the local and international scholars in research and teaching. I would like to extend a warm welcome to all speakers and participants and I wish you all a successful and fruitful conference.
Thank you.

PROFESSOR DATUK DR. NOOR AZLAN GHAZALI
Vice-Chancellor
Universiti Kebangsaan Malaysia

Performance Measurement and Management System for Research and Development Activities: A Review of Literature and Proposed Research Agenda

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ABSTRACT

Research and development activities (R&D), involved in various stages in the innovation process, have become more complex in view of the current uncertain and dynamic environments. Thus, managers as decision-makers faced the problems of finding the right performance measures for R&D. Hence, the purpose of this paper is to conduct a review on the literature pertaining to designing and implementing a performance measurement and management system of R&D activities with the focus of identify possible research gap. In so doing, the paper discusses and analyse both of normative and empirical research on performance management system and management control of R&D activities. The nature of R&D activities, the need of appropriate system to measure and manage their performance together with the research issues that were examined in this areas and also the insights gained from the research were discussed in this paper. How performance measurement and management system work at R&D were also discussed.Consequently, this paper identifies the research gap and proposed possible research issues to be investigates.

Keywords: *Performance measurement, Performance management system, Management control system, Innovation, Research and development*

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1. Introduction

The business environment has become more competitive, and organizations are facing many forces that leads them to change in order to be sustainable and achieve their goals. The success and sustainability of an organisation depends on its performance and how the objectives are carried out to its effect. Organisations are trying to manage performance of each employee, team and process to ensure that the goals are met in an efficient and effective manner. Effective utilisation of performance management system is critical to enhance organisational performance, so as to achieve a competitive position in global marketplace (Sahoo and Jena, 2012). Performance management aims to create the context for successful implementation of actions in order to reach the objectives and targets (Carenys & Sales, 2012).

With the uncertainty of the environment, most businesses understand that in order to reach the organisation objectives and achieved good performance, innovation become a necessity. The capacity to innovate is among the most important factors that impact business performance (Škerlavaj, Song, & Lee, 2010). It has been argued that R&D department is the responsible unit in creating and nurturing the innovation. R&D activities has been studied in several ways, and at different levels of analysis (Richtnér & Rognes, 2008). R&D activities require proper utilisation of various resources ranging from human to technical and the accountability for these resources is often being questioned by the management as well as by the shareholders. As a result of that, a growing interest can be identified in managing, controlling, and monitoring R&D activities (Bone and Saxon, 2000). In this context, the use of performance management system become important to R&D activities by evaluating the successfulness of their activities.

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Initially R&D was first considered as a process with uncertain, unpredictable and sometimes unstructured activities, that makes them almost impossible to control (Cho & Lee, 2005; Ghosh & Willinger, 2012 ; Popp, Santen, Fisher-Vanden, & Webster, 2013). However, recently several researchers have argued that R&D activity is an accountable one (Kerssens-van Drongelen and Cook, 1997; Chiesa, Frattini, Lazzarotti, & Manzini, 2009). The role of R&D and itscontribution to the organization's competitive advantage seems to be significant especially in organisation operating in competitive environment. Technologicaladvances and customer and profit-oriented markets have demanded R&D to facilitate broad areas of activities such as differentiation, time to market, value for money, service and economic production. The technology fusionas technology improves, shortened product life cycles, intensified competition have pushed toward the development and adoption of specific methods for assessing the value of R&D (Kulatunga, Amaratunga, & Haigh, 2011; Popp et al., 2013).

A variety of performance measures were being used ranging from financial to non-financial, qualitative to quantitative (Kulatunga et al., 2011). In particular, R&D turned out to be considered accountable in terms of its efficiency, effectiveness, internal and external customer focus and alignment to corporate and business strategy. This change in R&D accountability raised the need for an appropriate performance management system for R&D. As a result performance management system will be useful in evaluating the success of R&D activities (Godener and Soderquist, 2004; Ojanen and Vuola, 2006; Chiesa et al., 2009). It is shown in the academic literature that an effective performance management system for R&D needs an appropriate structure. Designing the structure of the performance management system means to identify the control objects whose performance have to be monitored and to select the specific dimensions of performance and indicators they are responsible for (Chiesa et al., 2009).

This paper focuses in examining at a macro level, the evolution of research on performance measurement and management systems at R&D department in the last 20 years. The feasibility and applicability of all frameworks or models were analysed in order to gain all the insight on how performance measurement and management system work and used for R&D activities.

2. The Nature of Research and Development (R&D) Activities

The development of new products or services through innovation is increasingly seen as an essential tool for sustained organizational performance (Allen, Adomdza, & Meyer, 2015). Based on the importance of innovation, the existence of R&D at the productive and dynamic organization become important and as a must. To remain competitive in the market, organisations should make sure their customer expectations are properly met, and future demands of the customers are properly addressed. In this respect, R&D acts as a valuable "input" for the development of the organisations. R&D activities are needed to find new ways to produce goods and services with less time, at lower cost, yet with increased quality and to develop new products, materials, methods, and processes (Gann, 2000; Kulatunga, Amaratunga, & Haigh, 2007).

The purpose of research and development (R&D) activities mostly is to contribute new knowledge, wether these activities have specific commercial objectives or not. The R&D activities may include creating new or improved devices, products, process systems, and concepts (Silaen. & Williams., 2009). The dispersion of R&D activities is studied at different levels of analysis andin several different ways. The study of how companies handle the dispersion of R&D activities have been done at three different levels of analysis; a strategic

(R&D strategy), an organizational (R&D organization), and a project team level. (Tidd, Besant &Pavit, 2001;Richtnér & Rognes, 2008).

In some companies, R&D activities covers three main areas of activity: fundamental research, applied research and experimental development. Fundamental research is primarily carried out to acquire new knowledge about the essence of a phenomena and facts that are investigated without any particular application or visualization. Applied research and experimental development, in turn, have a specific practical purpose. Every different type of R&D activity requires different resources and leads to the different type of output and outcome and sometimes needs specific requirements. Therefore R&D type has to be considered when describing the key performance indicators and also designing the performance measurement (Chiesa, Frattini, Lazzarotti, & Manzini, 2007;Laliene & Liepe, 2015).

It has long been acknowledged that R&D collaboration plays an important role, for the success of innovation projects. Chesbrough and Crowther (2006) found a stable or increased R&D activities in organizations based on the open innovation which use the purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively . This indicates that open innovation become a complement for internal R&D activities. Lichtenthaler and Ernst (2009) alsofound evidence that the role of open innovation is being a complement to internal R&D instead of a substitute (Schroll & Mild, 2011).To be more specific, a firm's R&D-department has a role to fulfiltwo tasks: learning and innovating. Learning means the process or the effort of the management and organization of the firm to increase their technical knowledge base and prospective technological competencies underlying the product and process innovations. Whereas innovating means is ultimately a practical construct or a respond to the competitive or institutional environment and to help the

organization cope with emerging external or internal contingencies by creating a new or developing the existing product, service, or process (Christensen, 2002; García-Valderrama, Mulero-Mendigorri, & Revuelta-Bordoy, 2008: Gils, Vissers, & Wit, 2009; Walker, Chen, & Aravind, 2015).

3. Conceptualization of Performance Measurement and Management System

A performance measurement and management system is statedas a dynamic and balanced system that facilitates support of decision-making processes by elaborating and analysing all relevant informations (Neely, 2002 ; Paolo Taticchi, Balachandran, & Tonelli, 2012).

In order to study more in depth the role and the value of performance measurement and management systems, first of all the concepts of performance measurement and performance management have to be distinguished. In this respect, Taticchi (2010) has emphasized that performance measurementshould not be confused with performance management. Measuring performance is a necessary but not sufficient condition for performance management. According to Bititci et al. (1997), "performance measurement system is the information system which is at the heart of the performance management process and it is of critical importance to the effective and efficient functioning of the performance management system. Performance management is themanagement processes and the behaviours management uses/adopts to manage the performance of an organisation". Therefore, performance measurement systems should be not stand-alone systems, but rather essential systems to support or operationalize other management and decision-making processes, such as planning, budgeting, process improvement and so on(P Taticchi, 2010).

Several research discuss that traditional performance measurement systems have focused on tracking the progress of the organization. Most of the performance measures take the internal

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perspective on how processes within the company are progressing. Thus, performance measurement system give some information about quality, productivity, uptime, or budget performance. This kind of measures take an outside-in perspective. They look at the organization from the perspective of external stakeholders. However, the uncertainty of the environment and the competitive threats from global market have enhanced the importance of taking an inside-out perspective. The idea is to look at an organization's environment and its landscape from the perspective of the company. The company is not anymore the centre of the measurement system but rather a perspective to look into the world. These landscape scorecards map the landscape of a company to identify, measure, and track those actors that are potential sources of opportunities or threats (A. Davila, 2012).

Performance measurement and management system consisting of specific steps and principles, which interact and work together in an interdependent way to achieve specified objectives. Nevertheless, there is no exact or right way nor recipe on how to set performance management systems, since each organization has different needs, habits, structures and models and the system must respect all those, thus its design and implementation varies from company to company (P Taticchi, 2010). Halachmi (2005) describes performance management as: "...a broader and more meaningful concept than simple performance measurement", listing processes indicative of broader performance management such as catering to stakeholders, attending to human behavioural factors and handling issues in the environment (Dickinson, 2008).

Defining and implementing a performance measurement and management system within the organization is considered as an important and critical activity for supporting decision making, motivating people, stimulating learning, improving coordination and communication. In other words, the performance management system is nowadays considered fundamental for

achieving the organization's objectives. As a consequence, all the main activities, processes and functions within companies have recently become the object of a performance management system including production, logistics, also the administrative processes (Chiesa, Frattini, Lazzarotti, & Manzini, 2008).

Some research in performance measurement is explaining the variability of performance measurement design through contingency factors of the environment, the organization, and the characteristics of top management. For instance, managers have different attitudes toward the use of performance measurement systems. Roughly, they align betweenanalytical managers who rely heavily on them and intuitive ones who use their informal networks and their own intuition to a larger extent. These two types of managers need different systems. The former feels more comfortable with detailed information, while this same level of information can be overwhelming for the latter type (Burkert, Davila, &Lueg, 2011). Experiments have also found that the environment and the level of knowledge also affects the design of performance measurement systems(A. Davila, 2012).

4. Trends and Characteristics of Performance Measurement and Management System for R&D Activities

In the early 90's, most of the published work on R& D evaluation has been carried out by scientists, engineers, economists and research managers (Nixon, 1998). The argue was that competitive pressure on firms has rapidly changed the management of R&D from a relatively isolated in a laboratory to one that emphasizes simultaneous development based on the close collaboration of everyone in the value chain. During the early of 2000s, when researcher and academicians seems to be getting more involved in this area of study, they've been argue that companies must design and develop products so that they can compete on price early in the

life-cycle. In other words companies must compete on simply to survive, including time, price, quality, appearance, service and customization, are forcing companies to adopt new product design processes and architectures that can economically and rapidly accommodate technology and product life cycle changes (Kerssens-van Drongelen et al., 2000; Bone and Saxon, 2000: Gann, 2000; Kulatungga et al, 2007). However, this approach lately being called into question because of pressure for quicker and more efficient results. Shareholders are also demanding more information about the precise contribution of R&D to corporate performance. In this case, a performance measurement and management system can be used as a balanced and dynamic system that facilitates support of decision-making processes by congregating, elaborating and analyzing relevant information (Neely et al., 2002). The notion of "balance" refers to the need of using diverse measures and perspectives that secured together offer a holistic view of the organization (Kaplan and Norton, 1996). The concept of "dynamicity" refers to the need of developing a system that continuously monitors the internal and external environment and reviews objectives and priorities known as performance measurement and management system (Bititci et al., 2000).

Despite the growing use of performance measurement and management systems, companies experience difficulty in implementing and practising them, with consequent risk of partial benefits or total goal failure. (Ittner et al., 2003). Since 1990s, many performance measurement and management systems or frameworks were designed in an effort to offer integrated solutions (RDF, BSC, SPC, IPMS, CBS, IPMF and BEM) or methodologies to fix specific concerns including for R&D activities. The balanced scorecard (BSC) model that comprehended several qualities such as the use of financial and non-financial information to produce composite measures of performance that has been argued as suitable for measuring

performance of R&D activities . The BSC has received large attention in the last fifteen years and it has been applied to numerous industries successfully. The models and frameworks developed lately possess characteristics of linking strategy to operations, recommending balanced set of measures (both financial and non-financial), struggling to create quantitative relations incorporating performance indicators and addressing performance measurement as a rational process(Paolo Taticchi et al., 2012).

The models and frameworks review presented in the some previous research has provided a picture of the performance measurement and management system design evolution. In this section, the consistency of performance measurement and management system for R&D activities according to the literature has been describe as follow:

a. When striving for effective new product development, R&D management facesseveral challenges, including project selection,communication, team/individual performance evaluation, benchmarking, etc. In this context, performance measurement can be seen simply as a tool that is supposed to help in grasping "the big picture" and in making good decisions. It is noted that performance measurements drive behaviour and they are needed and useful for fostering the prioritization of effort. Thus, whatever the purpose (for example project selection, communication, etc.), measurement nevertheless may contribute to the way R&D efforts are managed (Schumann et al., 1995 ; Suomala, 2005).

b. Measurement can be seen as a systematic means for obtaining information and understanding concerning phenomenon,issue or uncertainty that is rather complicated for R&D activities. The challenge of product development management and measurement has received both academic and practical attention. From the practical and industrial view, it is highly relevant for companies striving for effective and efficient R&D investments to seek

operational tools for better management. On the other hand, some writers (Chiesa &Masella, 1996; Kerssens-van Drongelen&Bilderbeek, 1999) have established holistic approaches for the assessment of R&D effectiveness. Academicians also proposed a variety of methods available for R&D project selection (Hollander, 2000), performance evaluation for managerial purposes, customer perspective (Hirons et al., 1998; Nixon, 1998), and benchmarking. Many creditable reports that describe the state of the art of R&D measurement have been published (Brown &Svenson, 1998; Tattichi, 2010 ; Suomala, 2005 ; Chiesa et al., 2008).

c. As a general requirement, at least two kinds of objectives should be set for the utilization of performance measurement and management system in R&D activities. First, the measures should convey essential information on the present state of activities. On the other hand, the measures should provide some guidance for long-term improvements. In addition, measures can be regarded as motivators. Thus, performance measurement has to be more carefully constructed (Lynch & Cross, 1995 ; Otley, 1999 ; Suomala, 2005).

5. **What Research Argued about Performance Measurement and Management System for R&D Activities.**

Environmental uncertainty has been seen to require different control and measurement systems (Chenhall, 2003; T.Davila, 2000; Hartmann, 2000). Some of the 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 control system. However, hostile and turbulent conditions appear, in the main, to be best served by a reliance on formal controls and an emphasis on budgets. In this case the question about what is the appropriate control or

measurement system for organisations operating in conditions of uncertainty, turbulence and hostility still not answered (T.Davila, 2000; Silaen. & Williams., 2009).

R&D was first considered as a process with uncertain, unpredictable and sometimes unstructured activities, that makes R&D almost impossible to control. However, recently it has been thought of as an accountable one (Kerssens-van Drongelen and Cook, 1997). The role of R&D and its contribution to the organization's competitive advantage seems to be significant in the competitive environment. The technology fusion, shortened product life cycles, intensified competition have pushed toward the development and adoption of specific methods for assessing the value of R&D (Ortt and Smits, 2006), In particular, R&D turned out to be considered accountable in terms of its efficiency, effectiveness, internal and external customer focus and alignment to corporate and business strategy. (Pearson et al., 2000; Bremser and Barsky, 2004).

This change in R&D accountability raised the need for an appropriate performance management system for R&D. The performance management system will be useful in "evaluating the successfulness of R&D activities (Godener and Soderquist, 2004; Ojanen and Vuola, 2006; Chiesa et al., 2009). Literature shows that an effective performance management system for R&D needs an appropriate structure. Designing the structure of the performance management system means to identify the control objects whose performance have to be monitored and to select the specific dimensions of performance and indicators they are responsible for (Chiesa et al., 2009).

Managing R&D is vital for many organizations to survive in the competitive anddynamic environment. Thus, managers as decision-makers have always been faced into the problems of finding the right performance measures for R&D. Research also found that the measures of R&D performance can be utilized for multiple purposes: for strategic control, for justifying the

existence of R&D, for providing information and improving activities, for motivating and for benchmarking. However, R&D performance measures selection may be difficult for a series of reasons (Ojanen, 2003): first, the special characteristics of R&D influence the R&D performance analysis problems. Secondly, the above-mentioned characteristics and challenges bring forth the significance of the influencing factors and dimensions that need to be recognized in order to derive the selection criteria for measures andchoose the right performance measurement and management system (Bigliardi & Dormio, 2010).

In highly uncertain and dynamic R&D environments, the performance measurement and management system serves the purpose of motivating people, particular cautions are required (Kerssens- van Drongelen and Cook, 1997; Chenhall, 2003; Abernethy and Brownell, 1997; Hartmann, 2000; Amigoni, 1978) conducted a literature review on management control or measurement systems and suggested that effective control systems should match appropriate combinations among distinctive features of the management control systems and control tools (Silaen. & Williams., 2009). In the case of a R&D organisation, it is plausible to suggest that there may be difficulty in measuring the output, and so there should not be an emphasis on output control. 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 such as job related tension (Hopwood, 1972) and manipulative behaviour (Birnberg et al., 1983; Silaen. & Williams., 2009).

The main objective of control for performance measurement and management system here is to diagnose R&D activities, it is necessary to choose standards to measure performance against that give the possibility to objectively judge the value of a specific indicator and to make comparisons over time, thus enlightening eventual improvement in R&D performance. At the

same time, the frequency and the timing of the measurement must be chosen so that the performance management system is capable of gathering and transferring performance data to R&D and top managers timely and coherently with their informational needs. A performance management system is useful if it manages to monitor all of the critical performances that are assumed as dimensions of performance of the system itself (Chiesa et al., 2008).

The objectives for which the performance management system is adopted significantly influence the design of all its constitutive elements, both in the contexts of general business and in case of R&D (Chiesa et al., 2008; Ojanen and Vuola, 2006).Defining standards for performance measurement is far more challenging in R&D than other business activities, because of the higher degree of uncertainty, isolation and secrecy that characterises firms' innovative processes (Chiesa et al., 2009).

Ojanen and Vuola (2003) present the simplified system approach of selecting and developing performance measures and evaluation methods for R&D, were are such a dimensions as the strategic objectives, the purpose of measurement, the level of analysis, the type of R&D and others integrated and they determine the whole evaluation process of choosing the right set of organization-specific measures for R&D (Lalienė & Sakalas, 2014).

6. Research Gap

Whilst several decades of R&D studies have produced some deal of data, but has not been able to resolve the right performance measurement and management system for R&D activities. Poolton and Barclay conclude that managers are still relying on gut feeling regarding "best practice" in new product development. Analogously, research has tended to be theory-driven instead of being applications-based (Poolton&Barclay,1998). Ijiri, (1975) conclude that performance measurement is not able to indicate whether the activities at R&D and the

successfulness has been a result of a set of good decisions or just produced by good luck. The influence of good (or bad) luck on performance measures is certainly inconvenient as measurement is not only a passive representation of real life phenomena but it is also an active agent that affects real life through its influence on the decision-maker (Suomala, 2005).

Driva et al (2000), conclude that in most cases companies do not measure the R&D activity very well but they are striving to find out how to do it effectively. In this respect, it seems fair to claim that a good deal of work to improve the efficiency of the interface between industrialR&Dmanagement and academicR&Dresearch is still needed. In R&D settings, the distinction between qualitative and quantitative indicators is particularly relevant: given the difficulties in measuring uncertain and intangible performance, an appropriate balance between the use of qualitative and quantitative metrics is critical: the former allow to capture un-measurable aspects, while the latter give the opportunity to reduce the subjectivity of the evaluation (Pappas and Remer, 1985; Werner and Souder, 1997; Driva et al., 2000).

Moreover, literature shows that an effective performance measurement and management system for R&D needs an appropriatestructure. Designing the structure of the performance measurement and management system for R&D means to identify the control objects whose performance have to be monitored and to select the specific dimensions of performance and indicators they are responsible for (Poh et al., 2001; Sandstrom and Toivanen, 2002; Nixon, 1998; Schumann et al., 1995; Hauser, 1998; Bremser and Barsky, 2004).

Defining standards for performance measurement is far more challenging in R&D than other business activities, because of the higher degree of uncertainty, isolation and secrecy that characterises firms' innovative processes. Literature widely acknowledges that the performance measurement and management system is a managerial tool that should fit the business context in

which it is used (Emmanuel et al., 1990; Burns and Waterhouse, 1975; Waterhouse and Tiessen, 1978). Considered the significant differences between Research and Development activities mentioned above, it is reasonable to expect that the design of the constitutive elements should be differentiated according to the R&D type to which it is applied (Chiesa, Frattini, Lazzarotti, & Manzini, 2009).

All those literature review conclude that there are no such appropriate performance measurement and management system that might be fit for every R&D activities in every kind of industry and in such a different environment.Therefore, indicators within the R&D performance measurement and management system need to be modify to keep the overall R&D project within the expected goals. Precise understanding of the targets and the work involved within each phase of the R&D activities guides the team members in identifying their contributions in terms of achieving the overall goals. Further, allocation of roles and responsibilities to the correct personnel will ensure the right people are doing the right job thus enhancing the quality of work.

This situation open the opportunity for researcher and academicians, to seek more information and develoupt some in depth review about proper performance measurement and management system specifically for R&D activities.

7. *Future Research Opportunities*

The response to this difficulties in selecting the suitable performance measurement and management system for R&D department, is to recognise the need for better management of R&D activities. In this case R&D managersneed to render accounts of R&D activities, and directing all the members of R&D for their operational objectives to be focused on supporting the strategy of the company. Hence, those things will enable the managers as decision-makers to identify and justify the potential rewards for R&D activities. However, this paper certainly find a

lack of homogeneity in the consideration of the indicators for R&D, since each company develops them in a different way, making it practically impossible to undertake any type of research that relates the advantages of the use of this technique with other parameters that could be available to the researcher.

The difficulties in implementing and practising the right performance measurement and management system for R&D activities also caused by uncertainty whether comes from technology, market, or customer behaviour. Every uncertainty need different information, and different strategy. So, for the conclusion here, there are no such performance measurement and management system that work successfully in every kind of R&D activities for all kind of the project or companies. Every project, every product development and every research in creating new product will need different control and measurement. Sometimes in certain project doesn't event need control at all and must build prototype instead to overcome the uncertainty.

In a situation of uncertainty as dealt with by a R&D unit however, the means-ends relationships are unclear, the prediction of future events and consequences cannot be made relatively accurately, and the desired ends cannot be translated reliably into quantitative features. Therefore, the desired ends may only contain thedirection to guide the action and cannot be used accurately to measure the performance quantitatively. The control indicator also would have a greater chance for dysfunctional behaviour if it is used in a highly uncertain and low goal congruence situation as in the case of R&D activities.

The literature review in this paper uncovers avenues for future research which can be elaborate in the following:

a. The in-depth research about the specific model of control system, performance measurement and management system for R&D activities with high uncertainty. What kind of information and key performance indicator suitable for this kind of unit.

b. The research to emphasis of control types, control dimension and values along different types of R&D activities would be enriched the existing literature about performance measurement and management system for R&D activities.

c. The in-depth research about the use of performance measurement and management system in supporting R&D activities.

d. How the performance measurement and management system could help the decision making and learning process.

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