The influencing of contingency factors on the performance of R&D in the research units at the Iraqi universities: a conceptual framework.

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Abstract

Based on the framework of the study, this research aims to show the influence of the contingency factors on the performance of R&D activities in research units. The research uses environmental uncertainty as a moderate variable to reflect the effect of 5 contingency variables (strategy, organizational structure, size, financial support, and regulations) on the performance of R&D. To determine the performance of R&D the study used Sveiby's theory Intangible Assets Monitor (IAM) through the four dimensions (growth, renewal, stability/risk and efficiency) . That is, it has been uniquely used by other studies; especially, in developing countries. The study is based on survey mail technique; a number of mails were sent to 276 research units in the Iraqi universities to collect the required data.

Key words: Research and Development (R&D), Contingency Theory, Intangible Assets Monitor (IAM), Environmental Uncertainty, Research Units.

Introduction

During the 70s and 80s of the last century and at the beginning of this century, Research and Development (R&D) activities have witnessed many changes in the R&D environment . It has further witnessed a huge number of techniques, and several ways of measurement and evaluation of such activities (Kerssens-Van Drongelen et al., 2000; Lazzarotti et al., 2011). The Cost and size of R&D activities has increased in the

2000s.That is, in 2000, the global R&D expenditure totaled $729 billion. Besides, R&D started to have millions of workers worldwide; for instance in the U.S.A, the number of employers reached 1 million workers. Such a great number refers to the significance of R&D activities throughout the world (Howells, 2008; Sakata et al., 2009). However, according to OECD (2008), the expenditure of R&D is unstable in all over the world due to the changes in the environment, such as changes in the economic aspect, policy, growth of society etc.

R&D has two important aspects and requires many human and technical recourses ; First, Industrial R&D can be seen as a continuum that starts as basic or applied research and ends with the developing and designing of commercial products. Accordingly, R&D can be seen as a pool of knowledge that can create a competitive advantage (Jokioinen & Suomala, 2006). Second, R&D activities are the cornerstone in any organization; especially, in universities; they are the basic engine to produce the knowledge for the society specifically to develop economy and to maintain the linkage between the university and other organizations (Berman, 2010; Chang et al., 2005; Joseph & Abraham, 2009; Tijssen, 2006).

In this content, R&D is the process of creating work undertaken on a systematic basis to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications (OECD, 2008). Three elements of research and development contained by R&D are: Basic research: it is an activity that aims to generate knowledge related to the working principles of natural and social sciences without a direct relation to industrial applications (products, services, production processes). The second element is the applied research**:** it is aims to produce

knowledge required to define the means and to fulfill a specific and explicit need. The third element is development**:** it consists of the systematic use of knowledge oriented to the development of materials, methods, tools, and systems. Development is composed of a series of phases: designing; prototyping and testing, engineering, installing, maintaining and post commercializing service (Chiesa & Frattini, 2007; Chiesa et al., 2008; Chiesa et al., 2009; Frattini et al., 2006). Thus, R&D can be defined as a set of activities resulting from the use of mental abilities, which are used in a scientific and logical way. Such activities help create the necessary knowledge to sustain and develop various organizations. This requires three stages: first, creating ideas (basic research); second, transferring ideas into action (applied research), and third, developing practice (development).

The purpose of this study to Highlight the attempts that show the effect of contingency factors on performance of R&D in the research units of the Iraqi universities by using the environmental uncertainty as a moderate variable to reflect its effect on performance. Moreover, the theory of Sveiby (IAM) has been currently used to determine the performance of R&D through the four dimensions (growth, renewal, stability/risk and efficiency) . This theory has been uniquely used by other studies; especially, in developing countries.

R&D Activities in Iraqi Research Units

Iraq is a third- world country faces a real problem in R&D, owing to the absence of a clear-cut approach in the relevant activities and to a lack of strategies and of appropriate relevant organization due to the political and economic conditions witnessed by Iraq since the end of 1950s (Al-Asadi, 2009).

These conditions affected directly the research activities and scientific movement in the Iraqi universities and other scientific institutions (Al-Asadi, 2009). In spite of the increased interest in R&D activities in terms of the expenditure value, an increase in the departments of research staff, the pursue of open systems and policies in research by linking them with the society and the agreements with global universities and research institutions, the Iraq R&D system, is like many developing countries still suffers from weaknesses and shortcomings in its performance . Additionally, there is still an absence of a clear-cut approach in drawing strategies and organization and in managing of these activities to be consistent with the developments in the field of knowledge as well as with the political and economic challenges faced by such countries (Diab, 2001; Nour, 2005; Gaillard, 2008), including Iraq . However, there is a great interest and attempt to pave the way in order to keep abreast of advanced countries, especially in R&D fields.

Some Deliverables on the Iraqi higher education system after 2003[1]

Deliverables	Year (2003-2010)
Number of Iraqi universities and technical institutes.	48 (2010)
Number of teaching staff in higher studies	8412 (2009-2010)
Number of higher study's students	15545 (2006), 6894 (2009-2010)
Number of research centers and units of R&D	167 (2009-2010)
Number of patents	95 (2003-2009)

[1] (Ministry of Higher education and Scientific Research, Directorate of Research and Development in Iraq (www.researchdep@moher.gov.iq); Ministry of Planning in Iraq, the statistical group , 2004, 2007; University Guide, 2003, 2006, 2009. 2010; Ministry of Planning in Iraq and Bate Al-Hikma, National Report of the State for Human Resources Development , Baghdad, 2008; UNSCO, 2007).

% of the expenditure of R&D (from the budget of the Ministry of Higher Education)	% 3.7 (2008-2009) , %2 (2003-2004)
Number of pioneering projects	131 (2004),160 (2008)
% the of linkage between universities and the society.	Unknown
Number of journals	237 (2008-2009)
% of those involved in the university teaching now	% 73.4 (2007)
Rate of income per capital	2847.9 $ (2008)
Number of population	29681000 (2007)

Literature Review and the Framework of Study

R&D has a long history, and its scientific roots have three stages throughout the period from 1920 to1960 (Godin, 2006). The first development is only a series or a list of activities without labels. The second development was identified by creating a subcategory of research, alongside with basic and applied research. The third development becomes a separate category as far as the research is concerned. It gives one the acronym that is originated from research and development (R&D).

The emergence of R&D in the previous time was due to both industry and technology. In this respect, three factors, as Godin thought, have contributed to the development of R&D: organizational, analytical and political. The approaches to the industry and management of R&D could be identified in the last decades. They have

witnessed dramatic changes in that field of the R&D (Chiesa, 1996). However, the first attempt dated back to the 1870s. At that time, the first specialized R&D laboratories were established in industry (Freeman & Soete, 2009), see also (Mowery, 2010). Chisea et al., 1999 and Rogers, 1996: pinpointed out the development R&D and the strategic role of R&D in 1970s, 1980s (a traditional role to strategic role). Szakonia, (1994); Werner & Souder, (1997) ; Kerssens-Van Drongelen & Bilderbeek, (1999), and   Kerssens-Van Drongelen et al.(2000): all pointed to the development of principles and techniques with respect to the aspects of researching and measuring the performance of R&D.

Contingency Theory and IAM

Several contingency approaches were developed in the late 1960s (Burn & Stalker, 1961; Lawrence & Lorsch, 1967; Thompson ,1967; Pugh et al.,1969; Burrell & Morgan , 1979; Chenhall, 2003), as a reaction to the failure of many theories at that time. Those approaches tried to find a suitable design for organizations; such as a case in point is the Bureaucracy theory for Max Weber and the scientific management of Frederick Winslow Taylor because they neglected that management style and organizational structure influenced by various environmental aspects (Thompson, 1967; Burrell & Morgan, 1979; Emmanuel et al., 1990) .

Therefore, the contingency theory was one of the best approaches dealing with the problems of organizations that had been faced at that time. In this context, contingency theory is a class of behavioral theory that claims there is no best way to organize a

corporation, lead a company, or to make decisions. Instead, the optimal course of action is contingent (dependent) upon the internal and external situation (Burn & Stalker, 1961; Lawrence & Lorsch, 1967; Thompson ,1967; Pugh et al ,1969; Burrell & Morgan, 1979; Otly, 1980; Emmanuel et al., 1990; Howell et al., 2010).

Many studies examined the impact of the theory of contingency system of designing and measuring R&D (Kerssens-Van Drongelen, et al, 2000). Furthermore, researchers have studied the relationship between contingency factors and performance measurement to provide useful roles and guidelines to R&D managers, who confront multi-faced and complicated evaluation in environment (Cho & Lee, 2005).

 However, a few studies gave explicit attention to the contingency perspective of R&D activities (Kerssens-Van Drongelen & Cook, 1997).

In this context, the contingency theory tries to interpret and reanalyze R&D activities as a base of R&D nature. Consequently, R&D activities are considered unpredictable and unstructured process that seem almost impossible to control (for it needs a complex control). The results of R&D are unknown in short time and in the transformation processes between input and output. Besides, usually complex work involves many parties; especially, the human recourses (competences) and the strategic role that helps to create a competitive advantage, more interdependency and integration with other departments (Hayes, 1977; Ouchi, 1977; Rockness & Shields, 1984; Kerssens-Van Drongelen & Cook, 1997; Chiesa et al., 2009) .These activities are complex in nature and have many difficulties to measure and determine the performance of R&D due to an unclear cause-effect relationship of transforming processes between input and the

output (high uncertainty) (Hayes, 1977; Chiesa et al., 2007; 2009; Valderrama et al., 2008).

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To determine the performance of R&D activities, the current research is based on the theory of Sveiby for Intangible Assets Monitor (IAM). There will be four dimensions to be used (with the certain modifications that suite the nature of research). These dimensions include the following: growth, renewal, efficiency and stability/risk, (Sveiby, 1997. The reasons behind depending on this theory are the following: 1-IAM represents a new conceptual framework that deals with R&D; especially, as one of important elements of intangible assets. It is fundamental by nature , and is not by Balance Scored Card (BSC) or any theory, (Sveiby, 1997; Bontis et al., 1999; Bowhill, 2008). 2 -IAM has more flexibility to produce information that can be used for any purpose, whether internal or external. This is due to the fact the theory focuses on human actions that have a vital role in creating tangible assets beside intangible ones (linking between internal, external and competences structures). Therefore ,this advantage is consistent with the nature of R&D (Sveiby, 2001; Marr et al., 2004). 3-IAM can give a clear view about the activities of R&D as the important elements in intangible assets in short and long time because of the stated indicators (Sveiby, 1997). Moreover, using financial and non- financial indicators and the transfer to strategic level like other theories gave the framework a good role in measuring the performance of R&D (Sveiby, 1997; Marr et al., 2004). 4- IAM used the term knowledge as the basic notion of the theory. This represents the millstone in R&D activities (Igel & Numpraertchai, 2004);

and it is the source of innovation through R&D activities (Joseph & Abraham, 2009) that helps get a competitive advantage (Bontis, 2001).

Environmental Uncertainty

The study uses environmental uncertainty as a moderate variable to reflect the effect of contingency variables on the performance of R&D. Miliken (1987) defined the environmental uncertainty as the inability to predict the events or changes of the environment. A few studies have been conducted to investigate the role of environmental uncertainty as a moderate variable, such as that of (Aronson et al.(2006) and Chen et al.(2005).

Based upon the literature, ones can indicate the relationship between the contingency variables (strategy, organizational structure, size, financial aspects and regulations) and its effect on the performance of R&D through the environmental uncertainty. The theory of IAM was used to determine the performance of R&D by using the following four dimensions (growth, renewal, efficiency and stability/risk . Therefore, in order to let those various variables having an a clear structure to indicate their relationship , this paper proposed a model, as shown in (Figure 1) to illustrate these relations .

Please insert figure 1 about here

The Effect of Contingency Variables and IAM Theory

Lanerak et al. (1999) referred to the effect of the relationship between strategic typology of Miles & Snow (1978) and the performance of R&D. They further stated that different strategies make different performances of R&D of different capabilities. Chung et al. (2009) tested the contingency variables (the type of Miles & Snow for strategy) in

universities they found that there is a direct and indirect effect of these variables on performance. Debackere (2000), found a significant relationship between mixed or hybrid structure and the performance of R&D. Chung et al.(2009) found a weak relationship between the organizational structure in terms of autonomy and performance under the environmental uncertainty as a moderate variable. Most of the research on the relationship between the size of a firm and R&D was empirically based on Schumpeterian hypothesis (Cohen, 1995; Pradhan, 2002). The basic Schumpeterian hypothesis assumed a direct positive relationship between the size of a firm and innovation; that is between the size and performance of R&D in universities. Wallmark (1997) found a positive relationship between the size of research units and the performance of R&D. The relationship between size and R&D performance under uncertainty (the technological competence as an indicator to the relationship) was investigated by Lee & Song (2005).They pointed out that there is no direct effect of firm size on R&D intensity.

Modell (2003) found that there was a significance relationship between changing the used measurement and performance by the change controls, under uncertainty in universities. Carayal (2004) found out that using rewards and incentives system does not provide incentive to improve R&D activities in universities; and that the relationship between the two sides is weak. Czamitzki & Kraft (2004) found a positive relationship between rewards and incentives system and R&D performance in the research units in Germany. Chaster (1995) supported the effect and the positive relationship between incentives and R&D performance. Payne & Siow (2003) showed that the relationship between funding and performance in universities is difficult to defect. Bronwyn (2003)

found a significant relationship between the financial policy and R&D performance. Mowery & Sampat (2010) found a significant relationship between linking a university to industry and the performance of R&D in universities. Geuna & Nesta (2006) asserted the positive relationship between the regulation and policy that used in linking university with industry and the performance of R&D under uncertainty condition.

Proposition 1 : According to figure 1, the first proposition can be stated as the direct and indirect relationship between contingency factors and the performance of R&D contains two assumptions as shown below:

P1.1 ; There is a positive relationship between four dimensions of R&D performance and the effect of contingency variables (strategy, organizational structure, size, financial aspect , and regulations).

P1.2 ; There is a positive relationship between contingency variables (strategy, organizational structure, size, financial aspect , and regulations) and the environmental uncertainty on the four dimensions of the performance of R&D.

Proposition 2 : Based on using the theory of IAM, one can develop other indicators depending on the availability of information empirically side and also from the literature review (Al- Turki & Dffuaa, 2002; Brown & Svenson, 1988; Brown & Gobeli, 1992; Carayol & Matt, 2004; Chiesa et al., 2009; Payne & Siow, 2003; Ramli et al., 2004; Szakonyi, 1994; Sveiby, 1997; Valderrama et al., 2008). The assumption that helps show the performance is as follow:

P2: Using the four dimensions of IAM to determine R&D leads to improvement in the performance of R&D and gives a clear vision about the measurement of performance and evaluation .

Conclusion and implication

This research is based on two theories (contingency theory and IAM theory) to show the effect of contingency factors on the performance of R&D activities in the research units of Iraqi universities. Such an aim was achieved by using the environmental uncertainty as a moderate variable. This study is one of the a few studies that tackled this subject under the influence of contingency factors. Thus, the lack of studies in this respect is due to the complex and the dynamic nature of the R&D units and the different objectives, especially in universities (Chung et al., 2009; Coccia, 2008; Langford, 2006). The current study is a modest contribution to finding some sort of solutions for the problems of the performance of R&D activities in universities and the variables that affect it.

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