

Perceived Organizational Variables, Knowledge Management and Research and Development Engineer's Creativity: A Review and Proposed Model

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Abstract: Taking into account the increasing importance of Original Design Manufacturing (ODM) in the industry and since the firm's innovation performance is often linked with the creativity of its Research and Development (R&D) engineers, the ODM firms need to motivate these employees to increase their creativity in work. In spite of the valuable results of the R&D engineer's creativity to the company, conceptual and empirical work on the antecedents of R&D engineer's creativity remains scant. Consequently, the main objective of this study is to propose a framework linking perceived organizational variables (support, integration, knowledge and skills and information and communication) as predictors of R&D engineer's creativity. Since, knowledge management perception has an impact on employee creativity, knowledge management has been identified as a potential mediator in the earlier-mentioned relationship. A review of the literature to support the model within the context of R&D engineers attached to the Malaysian ODM firms is given.

Key words: Research and development, creativity, organizational variables, knowledge management, Malaysia

INTRODUCTION

In this competitive and ever changing world, talent has been characterized as one of the important roles in supporting Malaysia to realize its objective of propelling the economy to a high income status. Therefore, the great attention is given to human capital that lies at the core of innovation and a high income economy. In order to achieve Malaysia's aspirations, it is important to develop, attract and retain a world class base talent. The 10th Malaysia Plan (10MP) recognizes that Malaysia is facing severe human capital deficiency problem. In conjunction with that Talent Corporation (TC) is setup by Prime Minister, YAB Dato Seri Mohd Najib in 2011 to attract, nurture and retain talent required for high income economy which is in line with the Economic Transformation Program (ETP) and to bring Malaysia's growth path back to the trajectory in order to achieve vision 2020.

One of the key activities from TC is to develop collaborative initiative among industries and government agencies to address talent requirement and demand in Malaysia. This TC fast track program involves apprenticeship with hands on experience working on actual R&D projects at host companies, such as Intel and Altera (PEMANDU, 2012a). To kick start this collaboration effort, 4 main ODM industries, namely semiconductors, solar, Light Emitting Diode (LED) and industrial electronic are identified because they are the

important contributors to the national economy, estimates to provide incremental Gross National Income (GNI) of 11.53 billion and creates 36,900 jobs by 2020 (PEMANDU, 2012b). This implies that Malaysia needs the R&D engineers to fill up the demand in these 4 main ODM industries.

Despite all exciting stack of R&D projects roaring to roll out, too much time has been wasted without a proper appreciation of developing skilled R&D engineers. In 2011, Malaysia's Gross Expenditure for R&D (GERD) of RM 9.4 billion and it was ranked 31st out of 125 countries in the Global Innovation Index (INSEAD, 2011). On the other hand, GERD/GDP ratio of 1.07 in 2011. In comparison to Asia Pacific countries, like Taiwan, Singapore, China, Korea and Japan which accounted for 2.9, 2.3, 1.8, 3.7 and 3.3, respectively (ASTRS, 2012), Malaysia has the lowest ranking. Big gap is observed between Malaysia and the neighborhood countries despite overall Malaysia's R&D performance still shows gradual growth. There is always a room for improvement and more effort is required to accelerate the current situation.

The R&D engineers capabilities to create, disseminate and apply knowledge are critical factors in determining the R&D engineers creativity. The R&D engineers creativity includes generating new (novel or adopted) ideas and solutions, developing new product and new method and producing an applicable prototype or model for the use of the organization. This implies that

ODM industries highly demand for the creative R&D engineers to produce and develop innovations, as well as to help these ODM industries to face the complexity of economic context and to go over the competitors. Given the importance of R&D engineers creativity in enhancing the ODM organizations growth and performance; examining the influencing factors in stimulating R&D engineers creativity in order to bring the ODM organizations towards global competition is warranted.

In general, organization has widely recognized the influencing factors such as individual, organizational and environmental variables that will enhance R&D engineers creativity. Therefore, this study aims to explore the influence of both personality factors and organizational variables that might help to increase the R&D engineers creativity level. Positive personality factors, such as self esteem, creative self efficacy, intrinsic motivation and extrinsic motivation affects and fosters cognitive complexity, creativity and innovation (Ford, 1996; Isen, 1999; Woodman *et al.*, 1993). Personality development which refers to skills development and motivational enhancement have played a significant role in most of the organization now-a-days. With the right skill set, it smoothen the interaction between clients, co-workers and superiors. Subsequently, it helps the employee to face any challenges with confidence and positive approach (Barron and Harrington, 1981). On the other hand to promote R&D engineers creativity within the organization, some organizational variables must be well shaped to motivate creativity of the engineers, such as organizational support, integration and information and communication (Boland and Tenkasi, 1995; Koc, 2007; Tang, 1998).

Knowledge management is a management discipline which focused on the development and usage of knowledge to support the achievement of strategic business objectives. The learning process occurred to improve the stock of knowledge available to the organization and to amplify the value of its intellectual assets such as R&D engineers creativity when knowledge is acquired and applied. If an organization demonstrates competence in knowledge management, it can be considered as having a knowledge management-orientation (Darroch and McNaughton, 2002). R&D engineers who are willing to acquire, share and transfer the knowledge will be viewed to have the higher creativity level. Hence, knowledge management may intervene the direct relationship between perceived organizational variables and R&D engineer's creativity.

LITERATURE REVIEW

Creativity versus innovation: Creativity is widely accepted as the production of novel and useful idea while

innovation is the successful implementation of creative ideas within an organization (Amabile, 1983, 1998; Amabile *et al.*, 1996). Therefore, creativity is a subset of innovation. Oldham and Cummings (1996) distinguished creativity is at individual level and innovation is at the organizational level.

Generating new ideas from individual is the ultimate source in order to provide the basis requirement for organizational innovation (Shalley and Gilson, 2004). Creative employee generates useful idea about organizational product, practices or procedures (Shalley and Gilson, 2004). However if the new idea did not go through a defined set of processes to an ultimately valuable conclusion, they are merely interesting artifacts. To appreciate creativity, the new ideas must be converted into business model and launched in the market. This is particularly true for societies that need to prosper in the midst of rapid scientific and technological advancement. It is vital for adolescents to be creative thinkers in order to keep up with today's accelerating social and technological development.

One of the most powerful ways to cultivate creativity is to share and to probe. Creative employees useful ideas are transferable to others in the organization for their own use and development (Shalley and Gilson, 2004). Thus, creativity at individual level will lead to the development of innovative products, process or procedure at the organizational level, through idea generation and implementation.

Research and development engineers creativity: R&D engineers are company's special professional workforce and their roles are to produce and develop innovations. Engineer is the key driver for technological innovation and new venture creation (Ulijn and Fayolle, 2004; Fayolle *et al.*, 2005). Creativity in an organization helps to face the complexity of economic context and to go over the competitors. Survival of companies will depend on the ability to innovate and stimulate creativity. Global society is facing challenging futures that require innovative and practical engineering solutions. Engineering graduates entering the profession need to be equipped with not only core engineering competencies and generic skills but also need to include critical thinking, analytical abilities, creativity and awareness of global social context (NAE, 2004). Generating fresh solutions to problems and the ability to create new products, processes or services for a changing market are part of the intellectual capital that give a company its competitive edge.

Scholar has formulated explicit distinctions between two main types of creativity which are special talent (Maslow, 1962) and self-actualizing (Sawyer, 2006).

According to the respective researcher, special talent is ascribed to people whose contribution is recognized by society. There is a myth that creativity is limited to several individual who are naturally creative. In fact, initial research focus on the personality traits of highly creative people, as they are found to have traits like independence of judgment, autonomy and self confidence (Barron and Harrington, 1981) which allowed them to break their social and occupational groups to propose novel ideas that might not be readily accepted. Self actualizing on the other hand is referring to collaborative, improvised and it is influenced by shared cultural knowledge and processes. Creativity is a skill that can be learned and applied. Learning to be creative is akin to learning a sport. It requires practice to develop the right muscles and a supportive environment in which to flourish.

In order to promote R&D human resources, based on Grossmann (2007)'s analysis, the favorable ways is to increase public expenditure targeted on the education of scientists and engineers. His study argued about two measurements that will foster R&D based growth: Private sector R&D subsidies (demand) and publicly provided education for science and engineering skills development (supply). The supply side is desirable mainly due to the fact that it does not affect the organization income distribution but unambiguously raises productivity growth (Grossmann, 2007). In other words, R&D activities need specialized skills set and that public education is a rival good.

Perceived organizational variables: Organizational variable is an important predictor of performance. Many studies have found a positive relationship between organizational variables and various measures of performance. For instance, Miron *et al.* (2004) identified organizational factors that can affect creativity and Rice (2006) acknowledged the association between organizational characteristics and employee creativity. Also, there is a positive relationship between climates that emphasizing creativity, innovation and their profits (Ekvall, 1996). Besides, creative work is classified as contextualized due to the fact that successful outcome relies on the capabilities, pressures, resources and socio-technical systems in which employees work (Mumford *et al.*, 2002).

For a company to achieve its flawless innovation, it must continuously involved in New Product Development (NPD) activities which are increasingly being charged with the job of managing and restructuring the corporation's technology portfolio and its success would have to be measured in terms of what has brought to that portfolio (Van Remoortere and Boer, 1992). Organization can foster employees creativity by creating a work

environment that encourages creativity. Organizations need to work towards institutionalized creativity (Nagasundaram and Bostrom, 1994) which means the organization has harnessed the power of creative individual to gain a synergy that makes the creative benefits across the organization greater than the sum of the individual creative efforts.

In order to promote innovation within the organization, perception of support for innovation must be well shaped to motivate creativity of the employee. Organization's guidance and support underpin the entire process of innovation and its influence permeates through the entire organization (Tang, 1998). Support refers to tangible and intangible support for innovation activities that are coming from the organization and management. For example, organization's supports including direction, goal and success in innovation would cultivate employee's creativity. Moreover, basic beliefs and values, mission and strategies, operational procedures and systems, rewards and resources in the form of time, money and facilities will add value to innovative and creative process (Tang, 1998). Management supports with the availability of suitable and right resources, work practices, as well as organizational structures are regarded as necessary booster for innovation (Tang, 1998).

Organizations emphasize the cross-functional integration and teamwork for innovation capacity because it overcomes uncertainty and minimize knowledge disparities (Boland and Tenkasi, 1995). Cross-functional department like R&D, marketing, human resources, operations, finance, manufacturing are encouraged to operate in close relationship among each other. Expectation from the cross functional integration should lead to a constructive discussion and sound decision for optimal solutions (Koc, 2007). In addition, integration will develop interpersonal networks which play an important role in innovation adoption (Nijssen and Frambach, 2000).

Knowledge based organization, like R&D, solve customers problem by means of knowledge base provided by the employees or engineers (Koc, 2007). It will be the continuous effect with virtuous cycle between applying knowledge to and learning from to influence the progress of the existing or new project (Tang, 1998). Knowledge and skills that are collected and disseminated will influence idea generation. It is well understood that both creativity related skills and domain related knowledge are necessary for organization to innovate (Nonaka and Takeuchi, 1995). Organization should focus to improve knowledge and skills of the workforce and means of fostering ideas for innovation.

Information flow has to be smooth among different function to reduce resistance to innovation (Koc, 2007). Organizations do not only provide reliable information

and communication infrastructure but also used its reliable system to enhance employees understanding and participation in activities for innovation (Tang, 1998). Employee is responsible to make sure information is safely exchanged through clear communication channel in firms (Koc, 2007). Base on the basis of the preceding discussion, it can be expected that R&D engineers perceptions of their organizational variables (support, integration, knowledge and skills and information and communication) will directly and positively affect their creativity. Thus, we posit that:

Proposition 1 (P₁): The organizational variables as perceived by R&D engineers (support, integration, knowledge and skills and information and communication) have positive influence on their creativity:

- P_{1a}: support has positive influence on the R&D engineers creativity
- P_{1b}: integration has positive influence on the R&D engineers creativity
- P_{1c}: knowledge and skills has positive influence on the R&D engineers creativity
- P_{1d}: information and communication has positive influence on the R&D engineers creativity

Knowledge management: There are many different definitions for knowledge management. Different perspectives or schools of knowledge management can yield different dimensions and meanings (Yahya and Goh, 2002). Knowledge management is usually analyzed from a process perspective (Gold *et al.*, 2001; Zheng, 2007). In the early literature, Wiig (1997) defined knowledge management as a set of activities that guides a firm in acquisition of knowledge from both inside and outside the company. Recent literature such as Ralph noted that knowledge management is a management discipline focused on the development and usage of knowledge to support achievement of strategic business objectives. Many people and also organizations interpret knowledge management, as the creation of knowledge repositories. Therefore, knowledge management can be viewed as a conscious strategy of getting the right knowledge to the right people at the right time while helping people with sharing and putting information into action in ways that strive to improve organizational performance (O'Dell and Grayson, 1998).

Knowledge management addresses the identification, growth and re-use of the company's intellectual capital to enable firm's business growth. Managing knowledge is considered key to achieving breakthrough competitive advantage (Kidwell *et al.*, 2000). Therefore, it is important for an organization to effectively manage knowledge internally and externally (Gold *et al.*, 2001). If the

organizations have emphasized in knowledge management, it will help in maximizing knowledge related effectiveness of an organizations and return from its knowledge assets (Alavi and Leidner, 2001; Davenport and Prusak, 1998). In summary, these definitions shared a common theme in that knowledge management, as a process to enhance knowledge application to achieve the employees creativity for improving organizational innovation performance. Employees who perceive their organizations that effectively manage knowledge within organization will lead to increase their creativity level.

Knowledge management as a mediator in the perceived organizational variables-R&D engineers creativity relationships: According to Uljin and Fayolle (2004), R&D engineers are company's special professional workforce and their roles are to produce and develop innovations. In other word, R&D engineer is the key driver for technological innovation and new venture creation. Thus when the R&D engineers perceive some of the organizational factors (herewith support, integration, knowledge and skills and information and communication) as supportive as well as these organizational factors support the process of knowledge management within the organization, they are likely to feel importance and valued. They will feel the courage to acquire, share and apply the knowledge within their job function. Under such circumstances and based on the theory of individual creative action (Ford, 1996), it can be expected that when the perception of the organization factors and knowledge management is high, R&D engineers are more likely to give in return by intensifying their creativity level. Hence:

Proposition 2 (P₂): Knowledge management mediates the relationship between organizational variables (support, integration, knowledge and skills and information and communication) and R&D engineers creativity:

- P_{2a}: knowledge management mediates the relationship between support and R&D engineers creativity
- P_{2b}: knowledge management mediates the relationship between integration and R&D engineers creativity
- P_{2c}: knowledge management mediates the relationship between knowledge and skills and R&D engineers creativity
- P_{2d}: knowledge management mediates the relationship between information, communication and R&D engineers creativity

CONCEPTUAL FRAMEWORK

Based on the earlier discussion and considering employee creativity based on the theory of individual

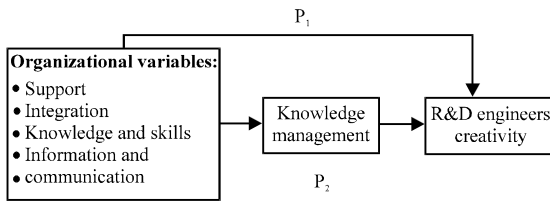


Fig. 1: Conceptual framework of the study

creative action (Ford, 1996), a conceptual framework is advanced as shown in Fig. 1. Perceived organizational variables are assumed to predict R&D engineers creativity while knowledge management will mediate the relationship between perceived organizational variables and R&D engineers creativity.

CONCLUSION

In today's competitive world, survival of companies is very much depending on the ability to innovate and stimulate creativity. This aspect emphasizes the dominant role played by R&D engineers in utilizing their creativity to deliver fresh solutions to problems and the ability to create new products, processes or services for a changing market that give a company its competitive edge. There are two main types of creativity, namely special talent (Maslow, 1962) and self-actualizing (Sawyer, 2006). Special talent is ascribed to people whose contribution is recognized by society and this type of creativity is limited to several individual who are naturally creative (Maslow, 1962). Self-actualizing on the other hand is referring to collaborative, improvised and it is influenced by shared cultural knowledge and processes (Sawyer, 2006). Creativity is a skill that can be learned and applied. The increasing of the competitiveness at the global level has urged the firm to be innovative which has further amplified the importance of the creativity among the key human resource.

The role of R&D as a crucial driving force of economic development is widely acknowledged in Malaysia. R&D is viewed as a top priority in national policy on growth as it entails high value added activities. With the fierce competition and the acceleration of product development cycles, the most strategic question that is confronted to most of the organizations is how to increase the performance of R&D engineers in particular their creativity level. Apparently, it depends on the type of sector, business, innovation and strategic objectives that had been set to formulate a suitable way for R&D organizations to be structured, as optimally as possible.

Aligned with this backdrop, a conceptual model has been proposed linking a mix of organizational variables (support, integration, knowledge and skills and information and communication), as possible predictors of R&D engineers creativity. On top, since R&D engineers judgment about knowledge management process within the organization may affect their creativity level, this variable has been posited to play a mediating role in the organizational variables-R&D engineers creativity relationship.

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