

**EXAMINING THE INFLUENCING FACTORS OF
R&D ENGINEERS CREATIVITY IN ORIGINAL
DESIGN MANUFACTURING SECTOR**

by

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DECLARATION

I hereby declare that the project is based on my original work expect for quotations and citation which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at the USM or any other institutions.

(Signature)

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ABSTRAK

Tujuan kajian ini adalah untuk mengesan secara langsung persepsi Organisasi Pembelajaran , persepsi Organisasi Faktor dan serta kecekapan Pengurusan Pengetahuan dari bahagian Penyelidikan dan Pembangunan (R & D) kreativiti jurutera ; dan menyiasat sama ada pengurusan pengetahuan boleh dijadikan mediator dalam hubungan di atas. Pembolehubah pembelajaran organisasi terdiri daripada empat sub-elemen iaitu merupakan komitmen pengurusan, perspektif sistem , sikap keterbukaan & eksperimentasi dan pemindahan pengetahuan & integrasi. Sementara itu Organisasi Faktor pula terdiri daripada lima sub-elemen seperti sokongan organisasi , integrasi organisasi , maklumat & komunikasi , sumber organisas dan, budaya korporat. Kecekapan Pengurusan Pengetahuan terdiri daripada empat unsur iaitu perolehan, pengagihan, pertukaran dan kombinasi. Terdapat sejumlah tujuh hipotesis mengenai hubungan yang diuji dengan sampel 140 daripada empat puluh syarikat ODM. Data it diperolehi melalui kajian pos di Semenanjung Malaysia. Berbekalkan dengan system SmartPLS , data telah dianalisis, dengan hasilnya menunjukkan hubungan bahawa komitmen pengurusan dan sokongan organisasi mempunyai hubungan yang positif dan signifikasi dengan kreativiti para jurutera R &D ini. Selain itu, hanya budaya korporat diantarai oleh keberkesanan pengurusan pengetahuan dengan kreativiti jurutera R & D ini yang positif dan signifikasi dengan kreativiti jurutera R &D. Implikasi teori ini dengan cadangan praktikal kajian juga turut dibincangkan dengan menggunakan perisian SmartPLS untuk menganalisis data-data berkenan.

ABSTRACT

The purpose of this study is to examine the direct effect of the perception of organizational learning variables, the perception of organizational factors and knowledge management efficiency with Research and Development (R&D) engineer's creativity; and investigate whether knowledge management have moderating effect in the above relationship. Organizational learning variable comprises of four sub-elements which is the managerial commitment, system perspective, openness & experimentation, knowledge transfer& integration. Meanwhile organizational factor consist five sub-elements of organization support, organization integration, information & communication, organization resources, corporate culture. Knowledge Management Efficiency consists of four elements which are acquisition, distribution, exchange and combination. There is a total of seven hypothesis relationship which was tested with a sample of 140 from forty Original Design Manufacturer ODM organizations source from postal survey in peninsular Malaysia. Using SmartPLS to analyze the data, the result shows that managerial commitment and organizational support shows positive and significant relationship with the R&D engineer's creativity. In addition, only corporate culture is mediated by the knowledge management effectiveness with the R&D engineer's creativity. The theoretical and practical implications of the study and well as recommendation are also discussed.

Chapter 1:

Introduction

The chapter discourses the circumstances of the study, research issues, research queries research goals, importance of the study, meaning of the key variables, and flow of the thesis.

1.1 Background of study

Investigative activities that are performed with the purpose of encountering a new unique that can either lead to the new development or of products improvement are also known as the research and development (R&D) activities.(Wang, Lu, Huang, & Lee, 2013). For the future growth of the organization, R&D activities need to be expanded, with creating new ideas about scientific, discovering their operation and by understanding technological purpose of detection and empowering the development of important new products and processes. Therefore, R&D is of importance where organization keep a sharp eye on suppliers and customers to keep pace with then changing modern trends, needs, demands and desires of their customers.(Zeschky, Daiber, Widenmayer, & Gassmann, 2014) Unfortunately, R&D is difficult to manage, due to the fact the area of the research is not known in advance. As a result, more money spend on R&D activity may not guarantee results. Hence R&D activity requires talented individual which can result in "more creativity, more innovation, higher profit or a greater market” share(Wang et al., 2013)

Talent is set as the measurement of competency, knowledge or aptitude to perform activity by the individual (Farndale, Scullion, & Sparrow, 2010) In R&D industry, talent management is viewed as critical task for firm. The firm has urged to manage the talents of its human capital for the sake of its future. The talent may be physical or mental, the higher the competency, the higher the chances of achievement for the firm. Talent management activities comprise of human resource planning activities such as recruiting, retaining,

developing and rewarding its human capital to improve business value. Malaysia has identified talent management as one of the important factors in its quest to reach high income status economy by 2020. In order for the Malaysian economy to make the jump, greater attention must be given to human capital, which is the source of creativity, innovation and driver for high income economy. Malaysian leaders have realized that to achieve the Vision 2020, it is of paramount importance to attract, develop and retain a pool of talented human capital.

The 10th Malaysia Plan (10MP) recognizes that Malaysia is facing severe human capital deficiency problem. (Jamal, 2008). Subsequent investigation reveals the outflow is due to better offers from neighboring countries like Singapore, Hong Kong and Australia as expats. In order to stem the outflow of human capital, the Talent Corporation (TC) was set up by the YAB Dato' Seri Mohd.Najib, the Malaysian Prime Minister, in 2011 to attract, develop and retrain the pool of talented human capital required for the nation's high income economy, to meet its Economic Transformation Program (ETP) and align the nation growth path towards achieving Vision 2020.

TC functions are to coordinate and form plans among industries and government agencies to meet the human capital needs of Malaysian industry. Among the key activity conducted by the TC initiated a Fast Track program that involves an apprenticeship with practical experience with real R&D projects at host companies, like Intel and Altera, with attached formal trainings at the Penang Skills Development Center (PSDC).

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. One of the collaborative events involves apprenticeship with well-known MNC such as Intel & Altera called the TC Fast Track program which involves practical working R&D. In order to kick start this collaboration effort, the Economic Transformation Program (ETP) has

identified five main Original Design Manufacturers (ODM) industries, namely semiconductors, solar, light emitting diode (LED), medical and industrial electronics because they are the important future contributors to the national economy. It is estimates to provide incremental Gross National Income (GNI) per capita to US\$15,000, thus attracting US\$444 billion in investments and creates 3.3 million new jobs by 2020.((PEMANDU), 2013) This implies that Malaysia needs the R&D engineers to fill up the demand in these five main ODM industries.

In order to fulfill the demand of the ODM industries, fast remedial action is needed. However too much time has been wasted without a proper appreciation of developing skilled human capital especially R&D engineer. From a national view, Malaysia’s GERD of RM 9.4 billion, shows an increase of threefold compared 2006 at RM 3.6 billion was shown in figure 1.1

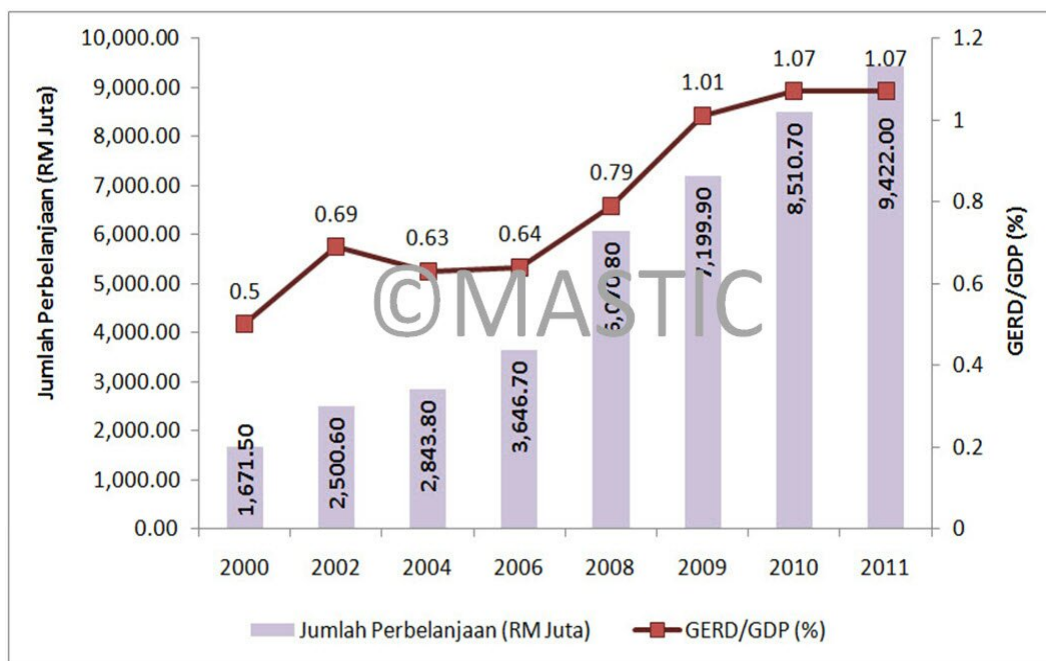


Figure 1.1 R&D Expenditure, 2000 – 2011. Sourced from <http://www.mastic.gov.my>

.On a global perspective, Malaysian GERD/GDP ratio of 0.70 was placed on 33th in the world. In comparison to Asia Pacific countries like Taiwan, Singapore, China, India and Indonesia, which accounted for 2.35, 2.60, 1.55, 0.85 and 0.15 respectively? There is a gap

observed between Malaysia and the Asia Pacific countries, despite overall Malaysia's R&D showing gradual increase. There is much more effort needed to accelerate from current situation to meet the standards of neighboring countries.

Major countries worldwide have prospered because having the ability to capitalize on the best and brightest mind around. R&D is definitely a priority in national policy on growth as it enables the creation of new high value innovation which sustains the national economy. The role of R&D as a vital driving force of economic development is widely acknowledged, with the fierce competition and the acceleration of product development cycles, the most strategic question that organization needs to answer is how to increase the output of the R&D engineers. However the criteria differ between types of firms, the criterion varies even between ODM sectors due to wide range of specialization involved. Based on existing literature research, there is no perfect organization structure for innovation (Teece, 2010). Therefore in R&D organization, the management team needs to carry out internal and external technology competency assessment periodically. This would enable the identification and benchmarking of the status of the R&D engineer's performance relative to rivals. This is partly due to the uncertainties and rapid market changings as well as increased demand of improved R&D services. (Gao, Yao, Zhu, Sun, & Lin, 2011)

1.2 Problem Statement

The studies on the innovativeness at the individual and national level in Malaysia have been widely examined, for instance national innovation system, (Berger & Diez, 2006; W. L. Chen, Sandhu, & Jain, 2009; Chong, Chan, Ooi, & Sim, 2011; Idris & Tey, 2011) firm level innovativeness capability and management(Asmawi & Mohan, 2010; Ebrahim, Rashid, Ahmed, & Taha, 2012; Rasiyah, 2007). However, as far as the organizational level, especially in the areas of organizational learning capability and knowledge management effectiveness for engineer level of creativity concerned, it has seen some consideration in Malaysia

especially in the context of R&D for the OMD sectors. The limited attention in this area is partly due to the perception of the organization that info exchange may lead to losing the technological edge to the rivalry and ultimately profitability for the governing body. One of the articles that could have been found to relate to the field of creativity level of engineers is determined by the perception of organizational learning in the technology profession. (Zaharim et al., 2009). Furthermore findings from Zaharim (2009) stated that the Malaysian employers tend to expect their graduates hired to be equipped with the relevant employability skills and abilities. Hence only small amount of resources are allocated for organizational learning despite increasing funds are poured into R&D expenses.

Various disciplines have been extensively the creativity especially by (Amabile, Schatzel, Moneta, & Kramer, 2004; Davis, 2010; Menzel, Aaltio, & Ulijn, 2007b) in the western context. Prior to the modern creativity research study, it is focus on individual creativity thinking as indicated in by Graham's Wallas "Art of Thought"(1962) (Edgar, Faulkner, Franklin, Knobloch, & Morgan, 2008) which was later expanded by (Kaufman & Beghetto, 2009) into "four C" model of creativity. The research have also branched into evaluation of groups of creative individual traits(Perry-Smith, 2006) and extensively discussed in "Organization Behavior"(2011) by (Griffin & Moorhead, 2011). On the other hand, Amabile (2004), studies the successful firms, discovering other factors to enhance creativity, such as knowledge (expertise & thinking skills) and organization motivation (extrinsic &intrinsic); indicating creativity can be trainable by organizing. Meanwhile Nonaka (2011) examined from successful Japanese firms and found creativity with knowledge management as being important with the emphasis on tacit knowledge.

These mentioned researches focused on the subject of individual creativity from the respect to only individual, organizational, knowledge perspective factors as causal factors. Yet it lacks the studies that will consolidate these three factors altogether. In lodge to occupy

this gap, this study will consider into the consideration of the comprehensive factors which incorporate individual, organizational and knowledge. The individual factor discusses the perception of the organizational learning, influencing the creativity of the technologists.

An organization that learns and adapts in order to encourage originality, expansion and output is also known as organizational learning. This not only comes from the daily operation of using complicated knowledge systems but rather in simple terms of acquisition, distribution, exchange and combination of knowledge in order to come up with new solutions and out of box ideas that aid in continuous tricky issue solving for the organization.(Abdi & Senin, 2014; Vasenska, 2013).

The organizational factor discusses the organization activity and policy promoting creativity within the employees leading to a nurturing corporate culture that endorses creativity which will lead to long term sustainable innovation. (McLean, 2005). Since most of the previous studies in regards to the creativity are based on direct relationship between critical determinants,(M.-H. Chen & Kaufmann, 2008) and creativity. The moderating effect of knowledge management that consists of elements acquisition, distribution, exchange and combination will be studied. The knowledge acquisition are plays the role of data mining, through debating, brainstorming, road-mapping towards employee creativity.(Wierzbicki & Nakamori, 2007). The knowledge distribution deals with concern of circulation through emails, weblog, social media(Lau & Tsui, 2009). Meanwhile the knowledge exchange deals with the sharing of ideas and experience between individual, teams, organization and external sources with the aim of quality upgrade and understanding of the research (Collins & Smith, 2006). Lastly the knowledge combination concerns that hold that analysis of diverse knowledge are best treated by a team with greater diversity since greater cognitive diversity leads to higher performance potential. (Taylor & Greve, 2006)

In a nutshell, this study is to identify the factors of both organizational learning and organizational factors are significant towards the R&D engineers in the ODM sector and how it can be effectively mediated by the knowledge management. This could provide significant contribution to academics as it affects disciplines of both organizational learning and knowledge management. Furthermore it is able to give insights to organizational management to increase its innovation level through its R&D engineer's creativeness in order to meet the Malaysian Vision 2020 challenge due in about 5 years' time.

1.3 Research Questions

Based on the statement of problem above, the objective of this study, aims to address the following research questions as below:

- 1) How does the perceived organizational learning (managerial commitment, system perspective, openness & experimentation and knowledge transfer & integration) influencing the R&D engineer's creativity level?
- 2) How does the perceived organizational factor (organizational support, organization integration, information & communication, organizational resources and corporate culture) influences the R&D engineer's creativity level?
- 3) How does the perceived organizational learning (managerial commitment, system perspective, openness & experimentation and knowledge transfer & integration) influences the knowledge management effectiveness?
- 4) How does the perceived organizational factor (organizational support, organization integration, information & communication, organizational resources and corporate culture) influences the knowledge management effectiveness?
- 5) How does the knowledge management effectiveness (acquisition, distribution, and exchange and combination) influence the R&D engineer's creativity level?

- 6) How does the knowledge management effectiveness, mediates the relationship between the perception of organizational learning (managerial commitment, system perspective, openness & experimentation and knowledge transfer & integration) and the R&D engineer's creativity level?
- 7) How does the knowledge management effectiveness, mediates the relationship between the perception of organizational factor (organizational support, organization integration, information & communication, organizational resources and corporate culture) and the R&D engineer's creativity level?

1.4 Research Objective

This study attempts to fulfill the following objectives.

- 1) To examine whether the perceived organizational learning (managerial commitment, system perspective, openness & experimentation and knowledge transfer & integration) influencing the R&D engineer's creativity level.
- 2) To examine whether the perceived organizational factor (organizational support, organization integration, information & communication, organizational resources and corporate culture) influences the R&D engineer's creativity level
- 3) To examine whether the perceived organizational learning (managerial commitment, system perspective, openness & experimentation and knowledge transfer & integration) influences the knowledge management effectiveness?
- 4) To examine whether the perceived organizational factor (organizational support, organization integration, information & communication, organizational resources and corporate culture) influences the knowledge management effectiveness?
- 5) To examine whether the knowledge management effectiveness (knowledge acquisition, knowledge distribution, and knowledge exchange and knowledge combination) influences the R&D engineer's creativity level?

- 6) To examine whether the knowledge management effectiveness, mediates the relationship between the perception of organizational learning (managerial commitment, system perspective, openness & experimentation and knowledge transfer & integration) and the R&D engineer's creativity level?
- 7) To examine whether the knowledge management effectiveness, mediates the relationship between the perception of organizational factor (organizational support, organization integration, information & communication, organizational resources and corporate culture) and the R&D engineer's creativity level?

1.5 Significance of the study

This study aims to resolve several theoretical and practical implications which will lead towards the literature for R&D engineer's creativeness through the theoretical relationship posted in the research framework. This stands for the linkage between the perceived organizational learning; organizational factor, knowledge management and R&D engineer's creativity are supported and affirmed.

The cognitive evaluation theory (CET) also plays an important role of the individual, organization and knowledge factors. This hypothesis is utilized to talk about the effects of external factor to individual's internal motivation affecting their operation. CET is derived from the theory of Self-Determination, which consists of the factor competence, relatedness and autonomy. In order to develop competence, organizational learning is important to allow the employee to learn from their mistakes as well as preventing future mistake. Learning through own mistakes is known as the single-loop learning compared to double loop learning which is a more complicated process in which a mistake is corrected by rethinking and finding out the root cause of the problem. This would be further covered in section 2.7. This organizational learning also influences the learning curve of the employee. With these

learning processes, the employees are able to gain knowledge faster allowing higher contribution to the organization.

In terms of practical perspective, this study is used to evaluate and identify the important factors affecting the creativity of the R&D engineers of the ODM sector organization. These organization are moving rapidly to implement and improve the R&D innovation performance, must first tackle the issue of creativity of their engineers since the engineers are the base level that contributes to the new ideas. Engineers would need to think extensively, act confidently, and cope with changes effectively. The leaders of the organization also need to embrace such thinking to become creative leaders. Hence the organization would be able to create wealth through fostering new innovation with creative and entrepreneurship. Subsequently this study would further contribute to the literature on the creativity of the R&D engineers for the ODM sector within a Malaysian context in which there is limited coverage of research being performed.

1.6 Definitions of Key Variables

The variables used for the intention of this study are specified and demonstrated in the succeeding section.

1.6.1 R&D Engineer Creativity

The R&D Engineers creativity is defined as the human capital that is involved in the activity of making original, suitable, valuable and ideas in order to solve issues and increase efficiency (Houghton & DiLiello, 2010)

1.6.2 Perceived Organizational Learning

Perceived organized leaning is a conceptualized as learning resources available to individuals by the organization (Rosdi, Chew, & Omar, 2014). In this study, four components of the perceived organized learning were examined, namely managerial commitment, system perspective, openness & experimentation, knowledge transfer & integration.

- Managerial commitment is refers as the organization responsibility to enable its employees comprehend the value of learning and share actively in the firm's success (J. C. Chen, Silverthorne, & Hung, 2006; Jerez-Gomez, Cespedes-Lorente, & Valle-Cabrera, 2005)
- System perspective refer to the organization ability to bringing the organization's employees collectively with the same identity.(Senge, 2014)
- Openness & experimentation refers to the mood of openness that salutes the coming of raw views and points of thought, both inside and outside while experimentation allows for generative learning agreeing self-knowledge to be perpetually transformed, broadened, and revisited. (Senge, 2014)
- Knowledge transfer & integration, refers to the simultaneous occurrence of both processes rather than successively. The source of these two processes is from the knowledge absorptive capacity perspective from organization to individual and vice versa. (Camisón & Forés, 2010; Rhodes, Lok, Hung, & Fang, 2008)

1.6.3 Organization Factor

Organization variable is about fostering employees' creativity through making a desirable work environment enabling the organization innovativeness. (Menzel et al., 2007b). In this subject field, five variables of the organizational factor are identified, namely support, integration, information & communication, system resources and organization culture.

- Organization Support refers to both the tangible and intangible care for novelty activities of the organization and management. (Cheung & Wong, 2011)
- Organization Integration is defined as the employee union into the organization and strengthening one another through thoughts and actions. (Vallejo, Romero, & Molina, 2012)

- Information & communication are referring to the organization process of recording, optimizing and dissemination of knowledge to generate ideas and opportunity. (Senge, 2014)
- Organization resource refers to the necessary capital needed to sustain the natural process to generate creativity and invention. The capital can exist in terms of financial, personnel and knowledge. (Adams, Rhee, & Whitley, 2007)
- Corporate culture refers to the organization's emphasis on the behavior of collective individuals' values, norms, system, languages, assumptions, beliefs and habits within the organization (Davis, 2010)

1.6.4 Knowledge Management Effectiveness

Knowledge management effectiveness serves as the medium between perceived organizational learning, organizational factor and R&D engineer creativity. Through good implementation of knowledge management system, it can be counted on to raise the firm's competitive from to better market outlook giving the employee self-drive to creativity development leading to invention. (Zheng, Yang, & McLean, 2010). In this study four variable are identified, namely, acquisition, distribution, exchange and combination .(Nonaka & Peltokorpi, 2006)

- Acquisition referring to the activity of extracting, arranging and unifying the knowledge from internal (self or within an organization) or external (competitors) (Yu, Dong, Shen, Khalifa, & Hao, 2013)
- Distribution refers to the process of communication, sharing and distribution of information between each other, groups and organization. (Wei, Liu, Wang, & Wang, 2012)

- Exchange refers to the usage of the tools allowing for the rapid discovery, search and retrieval ad-hoc queries on knowledge sources such as bulletin boards discussion group forums, blogs, wikis, and directories. (Collins & Smith, 2006; Mehta, Hall, & Byrd, 2014)
- Combination refers to the synthesis of team members' specialized knowledge into systemic-level contextual knowledge allowing for the establishment of a larger base of relevant and targeted knowledge to solve the organizational problem or task at hand.(Mehta et al., 2014)

1.7 Organization of Dissertation

In general, this management project is presented in five chapters. Chapter 1 shows the background of the study, research problem, research questions, research objectives, significance of study, and definition of the variables. The Chapter 2 illustrates the literature reviews done by previous studies that involved the independent, dependent, and mediating variables. The developed research framework and hypotheses were discussed according to the review of the literature. Next, Chapter 3 demonstrates the research methodology used in this study. The methodology is discussed in depth on the population and sample, questionnaire design, measurements, data collection techniques as well as statistical analysis techniques. Chapter 4 discusses the results of statistical analysis. Lastly, the final chapter presents the discussion on the findings, implications, limitations of the study, recommendations and conclusion.

Chapter 2

Literature review

2.0 Introduction

This chapter highlights the literature on the topic of engineer's creativity (dependent variable), perception of organizational learning (independent variables), perception of organizational factors (independent variables) and knowledge management effectiveness (mediator) as well. The purpose of this chapter is to provide understanding among the variables used in this study and how they can contribute to the study. Towards the end of the chapter, theoretical framework and the hypothesis will be developed.

2.1 Creativity versus Innovation

Creativity is a state of affairs in which novel and valuable idea are created while innovations are the successful implementation of the creative ideas inside the establishment. (Berg, Taatila, & Volkmann, 2012). Therefore practical application of creativity can be regarded as an innovation (Escribá-Esteve & Montoro-Sánchez, 2012).

Innovation is always the objective of the firms, but the spark of creativity which generated the ideas leading to the birth of innovation should not belittle. Generating the continuous spark of ideas from the individuals should be the ultimate goal for any organizational innovation. (Schein, 2010). Creative individuals ,who produces useful ideas leading to improved organizational products, practices or procedures (Shalley & Gilson, 2004). However if the ideas are not processed to have an ultimate conclusion, they will remain random thought and interesting observations. In order to best capture creative ideas, new ideas need to be acquired, transferred and stored into knowledge bank where it can be

converted into innovation. This is particularly vital for organizations that need to survive in the midst of rapid scientific and technological advancement.

Another method frequently discussed to cultivate creativity and innovation is through share and probing of ideas. Creative employees' useful ideas are transferable to others for their own use in the firms or else for further development (Shalley & Gilson, 2004). Thus creativity generated need to be acquired and stored within the organizational system allowing for innovation.

Although on that point are many scholarly interests in creativity, in this study it is confined to fostering creativity through organizational learning and preparation, especially as amplified by technology, and the use of creative resources to better the economic level of the systems. (Donate & Pablo, 2014). Amabile (2004) argued that to improve creativity in firms, three parts were required: 1) Expertise; 2) Creative thinking skills; 3) Motivation on intrinsic and extrinsic. The three components depend majorly on the organization itself to enhance, for example, given sufficient training and exposure, the expertise of the individuals would increase, which result in increased creative thinking skills that can be amplified with motivation, especially the extrinsic motivation such as reward and recognition or even negatively such as threats of retrenchment or being fired. (Amabile et al., 2004).

There has been research studies have found that establish that organizational effectiveness does not solely depends on the individual creativity but the efforts of the workforce, in other words collective effort and teamwork (Boateng, 2014). Findings show that the organizational efforts put up by R&D teams comprising of cross-functional team members have better results in harvesting more marketable innovation. In some extreme cases, smaller businesses banding together to form R&D alliance to work as a cross-functional teams to achieve both company shared agendas.

Nonaka (2006), who examined several successful Japanese companies, similarly saw creativity and knowledge creation as being important to the success of organizations. In particular, he emphasized the role that tacit knowledge has to play in the creative process. (W. L. Chen et al., 2009)

2.2 Research and Development Organization

Every organization need sustainable growth hence they would need to have a research & development (R&D) team responsible for the sustainable growth of the organization and ultimately the nation. R&D is not just about developing of futuristic concepts rather practical ideas which can be turned into economically viable innovative products.

R&D organization should focus on the development of creative work that needs to be tackled on a regularly in order to improve knowledge, thus allowing it to be used for conceiving new applications. R&D activities cover areas like the basic research, strategic research, applied research and also experimental research and development. This activities naturally requires huge sums of investment in time and capital as well as committed talents.(Asmawi & Mohan, 2010)

As indicated in the 10MP, Malaysia need to shift from a manufacturing centered economy to knowledge centered economy. Efforts by the government have been done to promote and encourage the private sector to drive the growth through providing infrastructure prioritizing specific National Key Economic Areas (NKEAs) such as part of the its strategy(Economic-Planning-Unit, 2011). The NKEA plans, includes efforts such as revamping the nation education curriculum as well as providing the R&D funding, thus allowing a larger pool of funds on a Mudharabah basis (risk sharing). The government increase R&D spending during the Tenth Plan period through a mixture of public R&D funding with enabling support for private sector R&D (Economic-Planning-Unit, 2011)

R&D projects in the high technology organization are risky in nature resulting in the changing of goals and requirements during the project cycle due to uncontrollable market forces and technology disruption leading to end of the project. The R&D project can end when there is no longer any need to perform experimental work or activities or due to legal reasons such as bankruptcy or patent infringement. In lieu of this the bankruptcy law has been reviewed to facilitate an environment that accepts failure as a part of innovation and allow organization a safety net ((PEMANDU), 2013). Due to the inherent risk in R&D activities, the R&D organization leadership should consistently monitor the performance the R&D project aspects especially at the root level, the R&D engineer.(Teece, 2010)

2.3 Research and Development Engineer's Creativity

R&D engineers are the company's elite workforce and their roles are to generate creative ideas leading to the development of innovations. Creativity in an organization allows it to face the complexity of economic context and to overcome its competitors. Survival of the firm depends on its ability to continually improve and revolutionize new products. Meanwhile the organization ability inherently depends on the talent of its human capital. Human capital such as R&D engineers entering the profession need to be equipped not only with the core engineering competency and common sense but also need to include critical thinking, analytical abilities, creativity and awareness of global social context (W. L. Chen et al., 2009)

Grossman (2008) argued that in order to promote R&D human capital, the best method is through increase of public expenditure targeting on the education of the scientist and engineers (Grossmann & Steger, 2008). He points out two measurements that will foster the R&D based organization which is the private sector R&D subsidies (short term), and the improvement in publically provided learning for science and engineering skills development (long term). Both areas, needed to accelerate the level of talented human capital available. In

short, R&D activities require human capital with trained skill set which is best fostered at a young age.

Nevertheless, the skill set can be educated and trained to upgrade the value of the human capital. In order to understand the skillset involved, explicit distinction need to be derived. Scholars have studied and identified two main types of creativity which are special talent (Maslow, 2013) and self-actualizing (Richards, 2007). Maslow inferred that special talents are attributed to individual who have contributed to the organization.

There is a myth that creativity is limited to only several individuals who are naturally creative. In fact, initial research focus on the character traits of top creative individuals found that they have common traits such as freedom of judgment, independent and self-confidence (Shalley & Gilson, 2004) which allows them to leave their social baggage's to come out with great ideas which is out of the box and readily accepted.

On the other hand, self-actualizing refers to the collaborative, improvised and it is influenced to shared cultural knowledge and processes.(Richards, 2007) Hence creativity is a skill-set which can be learned and applied. Studies by (Grossmann & Steger, 2008) shows that by utilizing public funds to improve the skillset of the future engineers and scientist through education. In Malaysia, although these skill-set are best learned young at school, nevertheless there exist technical centers and government programs such as the “Up skilling” program (Talent Corp) and Industrial Skills Enhancement Program (Perbadanan Tabung Pembangunan Kemahiran) which acts to produce the necessary qualified baseline human capital for the organizational.((PEMANDU), 2013). In short, the skillset needed by the R&D organization are trainable using public funds but further specialized skilled may require own organization learning mechanism to further improve on the engineers creativity.

2.3.1 The Importance of R&D engineers' creativity

Base on the developing countries, for instance China and India, which provide key asset to entice global R&D investment. The key asset or the critical mass refers to the mixture of low salary with proper education that gives to well-trained researches (UNCTAD, 2013). The critical mass serves as one of the important pull factors for the international firms to expand the R&D investment out of their home countries. This is in contrast with the norm whereby international R&D activities used to be embedded in their respective home countries. (Dunning & Lundan, 2009). Therefore, investment to human resources in emerging countries have a noteworthy impact in enticing R&D venture and this will increase over awhile(Awang, 2004; Mustapha & Abdullah, 2004)

The availability of skillful engineers in the emerging countries does not naturally equate into successful R&D centers immediately, it just offers increased percentage of success with constant supply of engineering graduates (Y. C. Chen, 2008; Lai & Yap, 2004; Mani, 2004). Emerging countries also need to equip themselves with stable political climate, active self-financing economy with sufficient scale of manufacturing to encourage more R&D investment(Y. C. Chen, 2008). The scale of the technological effort will also affect the choice of the location of oversea R&D activities by multinational companies.(Song, Asakawa, & Chu, 2011). In the Malaysian context, programs under the ETP, managed by the Performance Management and Delivery Unit (PEMANDU), have managed to secure more than RM 200 billion of committed foreign investment. ((PEMANDU), 2013)

2.3.2 Measurement of Research and Development engineer's creativity

Past scholar researching into creativity (Amabile et al., 2004; Piller & Walcher, 2006; Woodman, Sawyer, & Griffin, 1993) creativity is termed as the process of forming novel idea to solve problems and to increase efficiency.

Creativity can be seen as an individual or team level process or trait (Hülshager, Anderson, & Salgado, 2009; Pirola-Merlo & Mann, 2004). In this study, R&D engineers' creativity measurement is based on self-assessment of individual perceptions of engagement in creative activity in the R&D environment. (Houghton & DiLiello, 2010)

2.4 Perceived Organizational Learning

Over recent years, organizational learning has turned into an emerging study topic with many studies about it from differing perspectives. Some studies take those views from a mental approach, a sociological approach and also from the view of organizational theory. The learning has been considered, from a tactical view, to have significant value to the firm through R&D innovations. This approach allows the blooming new concept of organizational learning, that suggests a move away from the old method of resolving issues with the management.

Organizational learning are a lively practice based on knowledge, which suggests shifting among the different levels of action, from the individual to the group level, and then to the organizational level and back again (Jerez-Gomez et al., 2005) as shown in figure 2.2:

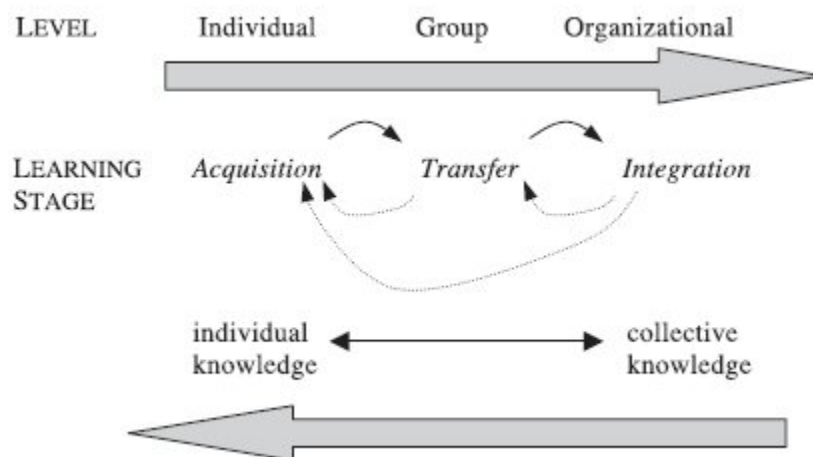


Figure 2.2: Organizational Learning Process

This activity comes from the knowledge acquisition from the individuals and progresses with the exchange and integration of this knowledge until a corpus of collective knowledge is created and retained in the organizational processes and culture.(Egan, Yang, & Bartlett, 2004) The collective knowledge has the influence on the information acquired and how it was processed and distributed

Analyzing the learning as a method contains of three elements. 1), knowledge or, more precisely, the collection, along with its distribution and integration within the organization, making it into an indispensable resource (Jerez-Gomez et al., 2005). This gives the notion that the organizational learning is not only a collection jar but also contributes to the individual learning of persons (Boateng, 2014).

2) This collection and distribution of new knowledge shows the reality of constant internal changes that can happen at an individual perception or thinking level (Bapuji & Crossan, 2004; Fiol & Lyles, 1985). 3) This deep changes can shape into a process of constant improvement that allows the organization's actions to be upheld or improved (Fiol & Lyles, 1985; Garvin, 2012), or even to achieve a competitive advantage based on organization' different learning capabilities (Brush & Artz, 1999; Kor & Mahoney, 2005)

This method of organizational learning ultimately allows the capability of an organization to process knowledge (to create, acquire, transfer, and integrate knowledge) and to modify its behavior to reflect the situation, with a view to improving its performance. (Argote, 2012)

In order for the development of effective organizational learning capability, it requires four conditions. First, the manager must provide strong support to organizational learning. Manager should led the project himself , thus making clear of his support and his attempt to get all the personnel onboard (Jamal, 2011). Second, he needs facilitate an atmosphere of openness that would give the perspective of the firm to be seen as a system in which each

element are free to must make its own contribution so as to obtain a satisfactory result (De Geus, 1988; Senge, 2014). If a shared vision is lacking, the individual actions do not contribute towards organizational learning.(Small, 2006).

Thirdly, he needs continuously grow the organizational knowledge, based on the transfer and integration of knowledge from individually (Nonaka & Peltokorpi, 2006). Creating a corpus of organizational knowledge, in the routines and processes of the work itself, is crucial for guaranteeing the organization's continuous learning, irrespective of the individuals that form part of it (R. L. Daft & Weick, 1984). Lastly, simply adapting to the changes within the established framework does not due to difference in economy and market would render the universal model inadequate to cope with its current competitive environment (Chiva, Alegre, & Lapiedra, 2007). The firm must try to go beyond an adaptive learning and focus on the learning level it needed to build up the organizational system in force. If necessary, be bold to make changes for more innovative and flexible alternatives, generative learning (Senge, 2014); a learning that requires an open mentality towards new ideas and a great deal of experimentation (Jerez-Gomez et al., 2005)

2.4.1 The Importance of Organizational Learning

Studies from (Zaharim et al., 2009) shows that globalization are forcing organizations to seek for more competent engineers. The level of competency required not only the academic qualification but also relevant capabilities, skills, abilities and personal qualities. According EPU (2004) report indicated that the graduates are "...well trained in hard skills such as in ICT, engineering ,marketing and management but graduates lack soft skills such as ability to analyze, communicate, problem solving and poor interpersonal skill".

Due to lack of competent human capital, R&D firms have to resort to hire foreigners with the necessary skillset. A global software company, Exact plans to expand it R&D center at Malaysia by 50% headcount to develop the new cloud offering for regional market. The

R&D team however would be comprised of international software development team to fuel the expansion and development of the firm's cloud portfolio, (Anonymous, 2013). This could have been avoided, if the organizational learning is able to generate the necessary competent human capital it needed to expand the company. Indirectly this shows that the level of organizational learning in the country is still have much to be improved.

Several researches in R&D company have realized that the Malaysian learning and educational system are unable to deliver the graduates fully equipped with employability or generic skills required by employers nowadays or in the near future (Zaharim et al., 2009).

2.4.2 The effect of Perceived Organizational Learning on R&D Engineer's Creativity

Previous researches of organizational learning deals from either the macro perspective and investigate the overview of the organizational learning environment rather than from the perspective of the individual employee. Studies by (Vera & Crossan, 2004) related to the strategic management view on organizational learning while (Lopez, Peón, & Ordás, 2005) evaluated from the firm profitability on organizational learning.

The researches focus on the measurement of the organizational learning with emphasis on end result, rather than examining on the actual learning process such as how effective the situation in reflect from the individual perspective which could affect the internal motivation to drive for the individual creativity. Previous studies by (Stern & Deimler, 2006) from Boston Consulting Group focus on the individual experience learning curve while some focus on measuring patents generated (Rothaermel & Deeds, 2006) and also R & D expenditure (Bierly & Daly, 2007)

Some recent studies by (Nonaka & Von Krogh, 2009) attempts to bridge this gap through the perspective of tacit-knowledge and knowledge conversion on the organizational learning. However it gravitates more towards the process of knowledge transfer of tacit knowledge between senior to junior employees.

The studies from (Jerez-Gomez et al., 2005) shows that organizational learning highly correlate with the employee creativity in terms of management commitment, system perspective, openness & experimentation and knowledge transfer & integration. This study would take the individual perspective of the organization support as part of CET theory to evaluate the external effect of organizational learning towards individual creativity.

Individual perception of the management 'commitment to drive towards the process of change, taking the responsibility for creating an organization that is able to regenerate itself and face up to new challenges(Lin, 2008). The management should review old beliefs and mental models that may be useful in the past but now an obstacle to perpetuate assumptions that do not correspond to the current situation. (De Geus, 1988; Hines, Holweg, & Rich, 2004; Nonaka & Von Krogh, 2009)

Using the model, the R&D engineer's capabilities to create, disseminate, and apply knowledge are critical factors in determining the R&D engineers creatively can be greatly enhanced. This system perspective allows the R&D engineer's 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. (Hwang & Kandampully, 2012). areas of the firm should have a clear view of the organization's objectives and understand how they can help in their development (Ferrell, Gonzalez-Padron, Hult, & Maignan, 2010) The organization should be seen as a system that is made up of different parts, each with its own function but act in a coordinated manner (Senge, 2014). In order to viewing the firm as a system requires recognizing the importance of each relationships based on the exchange of information and services (Voltmer, Rosta, Siegrist, & Aasland, 2012) and the development of shared mental models of organizational learning (Senge, 2014). It implies that the shared knowledge, perceptions, and beliefs, it will be enhanced by the existence of a common language and joint action by all the individuals