International Management Conference (IMaC) 2011
16 – 17 April 2011, Taman Tamadun Islam, Kuala Terengganu, Terengganu
Universiti Sultan Zainal Abidin (UniSZA)

DEVELOPMENT OF ABSORPTION CAPABILITY ATTRIBUTES FOR TECHNOLOGY TRANSFER PERFORMANCE: A PILOT STUDY IN NATIONAL AUTOMOTIVE INDUSTRY

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Abstract: Technology transfer is one of the strategies to obtain advanced technology in order to enhance technological development. Malaysia has shown its positive progress in technology transfer through a steady trend by bringing in advanced technology into the country especially during the past two decades. Although there have been many empirical studies regarding the key success factors of technology transfer performance, firm absorption capabilities is seldom discussed. In practice, the technology transfer will not be successfully achieved if technology absorption capabilities are not taken seriously. Therefore, this study was conducted to investigate the relationship between absorption capability attributes; employee capability, knowledge sharing, working culture, R&D capability and communication capability with technology transfer performance. These five attributes/variables were developed based on the Malaysian Government Reports. The pilot study was conducted by using questionnaire surveys which were distributed to national automotive companies. The pilot results were analyzed using Statistical Process for Social Science (SPSS) software. The result found that the cronbach's alpha values for all variables were greater than 0.6 and thus accepted. In conclusion, by presenting this new development of absorption capability variables, the real data could be proceeded to be collected. However, in-depth analysis needs to be carried out to confirm the validation of the instruments used.

Keywords: Absorption capability, Technology Transfer Performance, National Automotive Industry

INTRODUCTION

Technology transfer is one of the strategic means to enhance the nation's technological capabilities (MITI, 2010) through the introduction of new techniques by investing in new plants, the improvement of existing techniques or technologies and the generation of new technology and innovation (Hoffman and Girvan, 1990). Although technology transfer is not a new phenomenon but it has become a subject of considerable interest to many groups such as government, multinational corporations and education institutions.

From the beginning of participation in technology transfer since 1960s, Malaysia has been aspired to move towards a technology-driven and high technology production-based pattern of development. In fact, Malaysia has been categorized in the group of countries that have the potential to create new technologies on their own (Mani, 2000). The Malaysia government has provided various incentives such as tax benefits, established Free Trade Zone areas and even amended the labour laws (Narayan & Rasiah, 1992) in order to spur technology transfer into Malaysia. In addition, Malaysia government has implemented and passed a few policies such as the National Economic Policy, the National Development Policy, and a Vision 2020, which encouraged local firms to engage in technology transfer.

The IMD World Competitiveness Yearbook 2010 ranked Malaysia at 10th position in overall performance out of 58 economies compared to 18th position out of 57 economies in the previous year (Malaysia Productivity Corporation, 2010). However, Malaysia's technological performance is still lags behind more advanced economies such as Korea and Singapore. The empirical evidence from Malaysia Productivity and Investment Climate Survey Report (PICS) indicated that low technological performance in Malaysia associated with low level of firms' absorption capability (Economic Planning Unit, 2009). Issues such as poor communication within organization, lack of individual's motivation to share knowledge between each others, lack of firm's R&D capability to acquire new technology, difference in firm's working culture and shortage of adequate education and skills possess by workforces have raised the question of whether firms in Malaysia have the capability to absorb and acquire new technology, and so help to improve the technological performance of Malaysia.

Specifically, a number of government of Malaysia reports have highlighted the problems with firm's absorption capability in this country. For example, a report of Malaysia Productivity and Investment Climate Survey (PICS) revealed that Malaysian workforces capabilities which encompass the skills, knowledge and experience that Malaysian firms must accumulate in order to gain competitive advantage have became a constraint to the firm's productivity (Economic Planning Unit, 2009). The survey found that many workers felt that their jobs required more education and/or skills than what they had. Only seven percent of workers felt that they had chosen the right field of study for the job that they were performing (Economic Planning Unit, 2009). In addition, the survey also found that more than 40 percent of Malaysian firms reported vacancies due to inadequate qualification and lack of basic and technical skills that appropriate to their jobs. Another survey carried out by the Malaysian

Employers Federation (MEF) involving 205 member companies reported that the major weaknesses among local graduates are lack of communication skill and inability of the graduates to communicate well especially in English (New Straits Times, 2009). The PICS 2007 also reported the same result that the communication capability among workers in Malaysian manufacturing companies is still low (Economic Planning Unit, 2009). Although the percentage has declined from 67 percent in 2002 to 35 percent in 2007, a majority of managers at manufacturing establishments still believe that their locally-hired workers were lack of communication capability. The National Survey on Research and Development Report revealed that in year 2000, Malaysia had only 15 RSEs for every 10,000 workforce, 21 RSEs and 18 RSEs for every 10,000 workforce in year 2002 and 2006 respectively (MASTIC, 2008). Though stated in the Ninth Malaysia Plan (2006-2010) that Malaysia will focus on producing more researchers, scientists and engineers (RSE) and target to have 50 RSEs for every 10,000 workforce by 2010 (Ninth Malaysia Plan, 2006) however, this target is still far to achieve.

The increasing reliance on the application of advanced technology has forced Malaysia to strive to facilitate the development and application of knowledge intensive technologies (MITI, 2010). In order to achieve this purpose, the Government of Malaysia has launched the Knowledge-based Economy Master Plan with the aim to transform Malaysia from Production-based economy (P-economy) to knowledge-based economy (K-economy). However, very few Malaysian firms have initiated knowledge management programs due to lack of knowledge sharing atmosphere in Malaysian firms (Tehraninasr and Raman, 2009). The concern of government in transforming firms in Malaysia to be knowledge-driven industries has resulted to the development of a first-class working culture which encompassing the acquisition of knowledge and skills as well as the internalisation of positive and aggressive attitudes, values and ethics. Very Honourable Dato' Sri Mohd Najib Tun Abd Razak, in his speech on the 13th Civil Service Conference, has emphasized 'culture for excellence' whereby the culture of innovation, creativity and continuous improvements should be adopted as a work culture at all levels of the organization (Parliament, 2008).

Consequences of these issues have caused Malaysian firms still at low level of technological activities (Zainal Abidin, 2004) and the reluctance of multinational companies to transfer their key technological knowledge to Malaysia (Zaidah, Md. Zabid & Sambasivan, 2007). Throughout the last two decades, a considerable amount of researches has been done on identifying important factors of absorption capability Malaysian firms. To date, however, researchers have not reached a consensus as what are the most critical factors that affect technology transfer performance in Malaysia (Gorschek et al., 2006). Moreover, there have been no attempt to relate all the possible factors of technology absorption capability (e.g. employee capability, knowledge sharing, working culture, R&D and communication capabilities) in one single setting to investigate their influences on technology transfer performance, which demonstrate the significant gap of knowledge. Therefore, a study on firm's absorption capability is important to Malaysian firms to move in a path toward high growth and high technology to achieve its Vision 2020.

LITERATURE REVIEW

TECHNOLOGY TRANSFER

Technology transfer is one of the strategies to obtain advanced technology in order to enhance technological development. However, it is necessary to define technology first before we go further. Many researchers have viewed and defined technology in various ways (Lindquist, 2003). According to Wie (2003) technology is a collection of physical processes that transform inputs into outputs with procedural techniques and organizational arrangements for carrying out the transformation. As Lorentzen et al. (2003) stated that technology involved knowledge, equipments, and documents that help firms to upgrade their performance. Technology has become one of the important elements for social and economic development in several newly industrialized countries (Tai-Yue & Shih-Chien, 2007).

Technology transfer, however, as defined by Jain and Triandis (1990), is a process by which science and technology are transferred from one individual or group to another that incorporates this new knowledge into its way of doing things. In addition, Butler and Gill (1999) viewed technology transfer as a learning process whereby technology and knowledge is combined. Harrison & Samson (2002) suggest technology transfer as a movement of ideas, skills, information, technical know-how and people from the providing organization to the recipient organization.

Technology transfer in national automotive industry began in 1981 when Dr Mahathir proposed a joint venture with Mitsubishi Motor Corporation (MMC) to manufacture national car. HICOM and Mitsubishi has signed an agreement in December 1982 upon the approval of the National Car Project by the Cabinet. The transfer of technology in Malaysian automotive industry has been progressed further with the acquisition of the United Kingdom's prominent automaker (Lotus International) in 1996 and the introduction of a new engine, the Campro. The engine was developed by the first Malaysia automaker, PROTON, in collaboration with its affiliate, the Lotus International (United Kingdom). In 2001, Malaysia finally produced an entirely self-developed vehicle, Waja, and Proton Gen-2 in 2004. However, in October 2008, PROTON renewed its technology transfer agreements with MMC after Mitsubishi ended their 22-year partnership in 2005. As a result, the Proton Inspira, is to be based on the Mitsubishi Lancer platform, has officially launched on 10 November 2010. Since 1995, the recorded number of Technical Transfer Agreements signed between Malaysian companies and their foreign technology partners is 98. These includes Technical Assistance; Licensing and Patent; Trademarks; Services; and Sales and Marketing/Distribution. PROTON has also taken great steps in positioning itself in the international market. The acquisition of Lotus International Ltd. and Michigan Research Institute is aimed at giving PROTON a boost in the R&D department. The buying over of DRB-HICOM shares in PROTON by Petronas is also seen as a strategic move by PROTON. The strategic alliance between Petronas and Sauber is expected to help PROTON in producing high quality vehicles. PERODUA, in its effort to

develop its products, has formed strategic alliances with Daihatsu Motor Co. and Stola (Italy) to be their main technology provider. PERODUA's R&D investment has focused on developing its capabilities in automotive technologies ranging from testing, design and styling engineering to ultimately manufacturing engineering skills. Towards this end, PERODUA has invested substantially in manpower training, computer related facilities and equipment, to provide the necessary basic infrastructure for R&D work.

Previous studies on technology transfer covered many perspectives For example, an empirical study conducted by Guan et al. (2006) on 2,334 Chinese industrial firms found that technology transfer activities generally improve innovation performance of most industrial firms. According to Sexton and Barrett (2004) transfer would become smoother when people know how to use certain technologies. This would lead to innovativeness compared to technologies that are beyond people understanding. In addition, the organizational learning literatures also stressed on the importance of knowledge and learning process in the study of technology transfer (Daghfous, 2004). For example, this study (Daghfous, 2004) suggests that a firm should strive to attain a certain level of knowledge and incorporate learning processes in order to acquire and integrate the newly appropriate technology in the organization. The more learning capabilities a firm can handle, the more technology can be transferred. Another area of interest in studying technology transfer is on performance. A study conducted by Julia et at. (2009) on 110 companies from the R&D Consortia in Taiwan focus on firms' technology advantage and marketing advantage in order to measure the performance of technology transfer. In another study carried out by Chinho et al. (2002) on electronic and other manufacturing firms in Taiwan operationalize technology transfer performance by using profits and elements of execution, and strengthening the technical operations of the organization. Moreover, a study in the construction industry carried out by Stewart & Waroonkun (2007) identified that three technology transfer outcomes, namely economic advancement, knowledge advancement, and project performance by using financial, schedule and quality indicators.

ABSORPTION CAPABILITY

As technology transfer involves the process of transmission and absorption of knowledge (Davenport and Prusak, 2000), the recipient's firm ability to absorb the knowledge transferred depends on the degree of their absorptive capacity. Past studies have shown that a low degree of technology recipient's absorptive capacity impedes both intra and inter-firm knowledge transfer (Cohen and Levinthal, 1990; Gupta and Govindarajan, 2000; Lane et al., 2001). Technology absorption is a costly learning activity that a firm can employ to integrate and commercialise knowledge and technology that is new to the firm (Goldberg et al., 2008). Example of absorption include adopting new products and manufacturing processes developed elsewhere, upgrading old products and processes, improving organizational efficiency, achieving quality certification, etc. In a study by Kneller (2002), it is suggested that technology absorptive capacity would contribute to firm's ability in adopting a particular

technology. Madanmohan et al. (2004) suggested that the extent of firm's technology absorptive capacity will determine their level of participation in technology transfer process and the type of technology that they can operate efficiently.

The concept of absorptive capacity originates in the field of macroeconomic where it represents the ability of an economy to utilize and absorb external information and resources (Adler, 1965). Cohen and Levinthal (1990) adjusted this macroeconomic concept and viewed absorptive capacity as a firm-level construct. Cohen and Levinthal (1989) introduced the absorptive capacity construct as the firm's ability to identify, assimilate and exploit knowledge from the environment (p. 569). They argue that absorptive capacity depends greatly on prior related knowledge and diversity of background. In their widely cited paper in Administrative Science Quarterly, Cohen and Levinthal (1990) has refined the definition of absorptive capacity as a firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends (p. 128). They assume that a firm's absorptive capacity tend to develop cumulatively and is depend on the absorptive capacity of its individual members. However, a firm's absorptive capacity is not simply the sum of the absorptive capacities of its employees but also the organization's ability to exploit information through transfers of knowledge across and within subunits (Cohen and Levinthal, 1990). Furthermore, they focus on internal mechanisms whereby the structure of communication in transferring knowledge subunits are able to influence the firm's absorptive capacity.

There are many absorption capability attributes or factors that determine the performance of technology transfer activity. A research carried out by United Nations (2005) found that a lack of sufficiently skilled labour force unable to assimilate and adapt new knowledge to local conditions is an impediment to foster technology transfer. Meanwhile, a study by Mohamed et al. (2009) indicate that knowledge base factor, level of employee's readiness which include technical skills, experience and communication, and willingness to learn give affects to the technology transfer performance. There are also many factors inhibiting the adoption of new technologies by Small and Medium Industries in Malaysia as listed by Burhanuddin et al. (2009) such as lack of managerial skills, lack of skilled and talented workers, limited capacity for knowledge and technology acquisition, and limited staff to conduct research for new technology and innovation.

EMPLOYEE CAPABILITY

Identify and recruit the right employees with the right education and skill sets from the start will ensure the successful of firms and organizations. According to Monappa (2005), employees are recognized as the key to building a world-class organization and a finite resource for which organizations have to compete while Hong (1994) agree that employee is the most important entity because it plays a key role in acquiring new technology and integrating old and new technologies during the process of technology transfer. According to Cohen and Levinthal (1990), firm's ability to absorb and acquire new information resides with its employees. It includes two elements: prior related knowledge and intensity of effort

(Cohen and Levinthal, 1989, 1990; Kim, 1993). Therefore, the employee's ability, based on their educational background, and acquired job related skills, may represent the prior knowledge which firm and organization needs to assimilate and use (Cohen and Levinthal, 1990).

A study by Ashekele and Matengu (2008) on an SME manufacturing enterprise at the northern town of Rundu, Namibia found that relatively high levels of skill among employees provided impetus for a desire to be more competent. They also found that the willingness of employees to learn and adopt new technologies is an asset to firm's success. Another study on technology transfer in defence industry conducted by Haris and Ahmad (undated) concluded that retention of employees with their experience and skills within the organization make a transfer of knowledge and expertise success and facilitate the creation of a learning organization.

KNOWLEDGE SHARING

A basic concept in the resource-based view of firm is that knowledge can be shared (Nonaka & Takeuchi, 1995). However, not much company includes knowledge sharing as part of its key component as knowledge sharing is considered as difficult to measure (Christensen, 2007). Van den Hooff and Van Weenen (2004) state that knowledge sharing is a process whereby individuals exchange their intellectual capital and collectively create new knowledge. Kim and Lee (2006) defined knowledge sharing capability as the ability of employees to share their work-related experience, expertise, know-how and contextual information with other employees within or across teams or work units.

According to Sung and Gibson (2000), the success of technology transfer occurs when knowledge and technology are shared and transferred across personal, department or organizational, and well accepted and understood by users. According to Li-Hua (2004) without knowledge sharing and transferring, technology transfer does not take place as knowledge is the key to control technology as a whole. As articulated by Lall (2000), "developing countries obtain industrial technologies mainly from the industrialized world, and their main technology problem is to master, adapt, and improve on the imported knowledge and equipment. Unlike the sale of a good, where the transaction is complete when physical delivery has taken place, the effectiveness of technology transfer can be a prolonged process, which involving local learning to complete the transaction" (p.15). In conclusion, knowledge sharing is seen as a learning process where organization units continually interact with others in order to enhance the process of firm's technology development.

WORKING CULTURE

In general, working culture is the personality of an organization. Working culture plays significant roles in influencing members of an organization in terms of commitment, loyalty and satisfaction. It also gives significant contributions by influencing the thought, feeling,

interacting and performance in the organization (Ungku Norulkamar et al., 2005). Working culture includes the practice, beliefs, assumptions, principles, legends, and norms that affect how a person thinks, makes decisions, and carry out tasks within an organization (Zuliana and Khalil, 2008).Literature on change management explains that culture represents a core set of values governing the attitudes that employees adopt towards change and their approaches to the introduction of something new (Ang and Massingham, 2007). It dominates how employees interact, and how decisions are made (Simonin, 2004).

Past studies reveal that a high degree of organization performance is related to an organization, which has a strong working culture (Kotter and Heskett, 1992; Denison and Mishra, 1995). Moreover, there are recent studies done have contributed significantly to the field of culture and performance studies. For example, a study by Raduan et al. (2008) on the high technology industry of the American, European, Japanese and Malaysian MNCs located in Malaysia discovered that there is possible relationship between culture of all MNCs with organizational performance. Another study by Lucas (2010) found that the transfer of organizational practices, in which will lead to organizational performance is influenced by the culture of teamwork. A study on technology transfer by Chinho et al. (2004) using LISREL analysis expose that most of the Taiwanese firms have different working culture such as manager-leading, performance -oriented and success-oriented which tend to influence technology transfer performance differently.

R&D CAPABILITY

Research and development, according to the Organization for Economic Co-operation and Development, refers to creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this stock of knowledge to devise new applications (OECD, 2008). R&D capability has been defined as the firm's ability to reframe the present knowledge and produce new knowledge (Fleming, 2001).

The investigation on the impact of R&D capability towards firm's performance have been documented by many authors. For example, a research done by Johansson and Loof (2008) found that investment in R&D capability, which represents firm's R&D strategy, associated with the firm's economic performance (productivity and profitability). Their study also argue that investment in hiring a stock of R&D knowledge labours reflects the R&D capability of an organization. Another study on innovation effectiveness by Chinho et al. (2011) concluded that different levels of firm's R&D capability leads decision makers to choose an appropriate commercialisation strategy.

Moreover, there are few past studies explore the importance of R&D capability for technology transfer. According to Zhouying (2005), R&D enables firms to create new technologies and/or to build on existing technologies obtained through technology transfer. Cohen and Levinthal (1990) argue that R&D involves innovation and learning whereby a by-product of R&D is therefore to enhance a firm's absorption capability, which in turn boosts the efficiency of technology transfer.

COMMUNICATION CAPABILITY

Communication capability is the foundation for successful human interaction regardless of the setting in which it occurs (Marques, 2010). The importance of communication capability in the workplace becomes more profound as well (Cascio, 2000). It is not only demonstrated in the increasing number of research papers and books, but also in the inclusion of courses and workshops on organizational communication (Marques, 2010). Moreover, many managers have taken several initiatives to increase communication capability among their employees such as encouraging their employees to participate in courses and workshops that will increase and improve their interaction capability (Staples, 2001).

Communication is defined by Narimah and Saodah (2002) as the sharing of information between two or more individuals or groups to achieve mutual understanding. Abdullah and Ainon (2002) have came out with a clear definition of communication as to transfer or deliver messages either by speech, actions, writings or images from the sender to the receiver. In the world of work, effective communication capability is essential for the success of every individual and increasing it will only result in victory in the workplace and personal life.

There are few studies that investigated the association between communication capability and technology transfer performance. For instance, an empirical study by Chinho et al. (2004) using LISREL analysis found that an effective communication of the organizations is the key factor to improve technology transfer performance. Jassawalla and Sashittal (1996) investigate the practical issues of technology transfer. From in-depth interviews with 40 managers of high-tech industrial organizations, their study emphasizes the importance of human interactions during technology transfer.

METHODOLOGY

SAMPLING

The sampling frame of this pilot study comprised of two major national car maker in Malaysia i.e., Proton and Perodua. The two national car makers were selected because over the years they have engaged with partners overseas for the development and production process. The targeted population was all executive people attached to R&D departments comprising of managerial, technical and administrative level. These people were selected because they were close to the decision-making and more exposed to the involvement in technology transfer activities.

About 60 questionnaires were mailed to the HR departments of the respective companies by using proportionate stratified random sampling. The HR department distributed the questionnaires to the executives in R&D department based on the guidelines provided by the researcher.

INSTRUMENT

The questionnaire is divided into three sections which address the five hypotheses formulated in the study. Section A comprises questions about general information of the respondent such as gender, age, working experience and others. Section B contains questions about independent variables which are absorption capability attributes. Five items measuring the employee capability (Minbaeva et al., 2003; Minbaeva, 2005; Vinding. 2000); five items measuring knowledge sharing (Kim and Lee, 2006; Andrawina and Govindraraju, 2009; Ling, Sandhu and Jain, 2008); six items measuring working culture (Ang and Massingham, 2007; Lucas, 2010); seven items measuring R&D capability (Fleming, 2001; Zhouying, 2005; Johansson and Loof, 2008); and seven items measuring communication capability (Larson and Kulchitsky, 2000; Kivimaki et al., 2000; Mohr and Nevin, 1990). Section C contains questions about dependent variable. There are 12 items measuring technology transfer performance. All the items in Section B and C were measured using five-point Likert scale from 1 = strongly disagree to 5 = strongly agree, and 1 = to a very small extent to 5 = to a very great extent, respectively.

FINDINGS FROM PILOT STUDY

RELIABILITY AND VALIDITY

Before proceeding to a grand scale data collection, pilot study needs to be carried out first in order to test the reliability and validity of the instrument. In determining the reliability of the instrument, a general rule is that the indicators should have a Cronbach's α of 0.6 or more (Hair et al., 2006). With the range of α values between 0.818 and 0.928 obtained in this pilot study (shown in Table I), it is concluded that the questionnaire is reliable and acceptable for further data collection.

In order to validate the instrument, content validity has been applied. It ensures that the measure includes an adequate and representative set of items that tap the concept (Sekaran, 2003). This is where the panel of experts contributes. The questionnaires were given to four professionals in the Engineering faculty and Technology Management department at Universiti Malaysia Pahang to evaluate on the content and relevancy of the questionnaire. Other professional in manufacturing field also evaluated the questionnaires on the same basis.

Apart from the content validity, this pilot study considers construct validity as well, as suggested by Tu (2002). To achieve construct validity, the data was examined using principal component analysis as the extraction technique and Varimax as the method of rotation. With a cut-off loading of 0.4 and eigenvalues greater than 1.0, none of the attributes was dropped

(Table II). Further, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy indicated a practical level of common variance.

Table I: Internal consistency of the constructs

Construct	**Total Items**	**Cronbach's α**
Employee Capability	5	0.818
Knowledge Sharing	5	0.856
Working Culture	6	0.836
R&D Capability	7	0.868
Communication Capability	7	0.889
Technology Transfer Performance	12	0.928

Table II: Factor Analysis results

Construct	**KMO measure of sampling adequacy**	**Eigenvalue**	**Percent of total variance explained**
Employee Capability	0.822	2.918	58.355
Knowledge Sharing	0.842	3.256	65.124
Working Culture	0.805	3.337	55.610
R&D Capability	0.828	3.951	56.450
Communication Capability	0.828	4.246	60.650
Technology Transfer Performance	0.861	1.055	76.052

CONCLUSION

This paper contributes to the existing body of knowledge in terms of narrowing the research gap by examining the causal relationship between firm's absorption capability and technology transfer performance in national automotive car companies in Malaysia. Most of the researches studied absorption capability attributes in macro level and only a few focuses on micro level. The novelty of this study is that it provides a holistic perspective of the critical

factors of firm's absorption capability that influence technology transfer. The framework of this study is built up by adapting Chinho et al. (2004) model and based upon the issues provided in the government reports as well as from extensive review of literature. By combining the variables and testing them in a single setting, this has allowed us to generate more accurate picture of the causal relationships between the variables. Moreover, the pilot results found that these variables, which are employee capability, knowledge sharing, working culture, R&D capability and communication capability, comply the requirement of the cronbach's alpha values. Therefore, the development of absorption capability variables toward technology transfer performance could be presented for this study and the real data could be proceeded to be collected.

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