VOL. 11, NO. 8, APRIL 2016 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences


www.arpnjournals.com

THE ROLE OF TACIT AND CODIFIED KNOWLEDGE WITHIN TECHNOLOGY TRANSFER PROGRAM ON TECHNOLOGY ADAPTATION

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ABSTRACT

Knowledge and technology transfer is the way to improve technology capability. The process of knowledge and technology transfer can be analysed based on knowledge classification. It involves tacit and codified knowledge. Each type of knowledge has a unique characteristic. The diversity of characteristics will potentially affect the result, and indeed the success, of knowledge and technology transfer. It is important, therefore, to understand any differences in phenomena associated with the process of transferring knowledge and technology base on knowledge classification for SMEs. Using data from hundreds of SMEs and in-depth discussion with the peak bodies of government agencies, universities and industries, the policy directions for government regarding to knowledge and technology transfer to support local industry in developing economies were developed.

Keywords: tacit, codified, knowledge, technology adaptation.

INTRODUCTION

About five decades ago, organisation in developed countries started to face a new paradigm where resource-based competitiveness was being replaced by knowledge-based competitiveness [1]. Since knowledge and technology have created prosperity, traditional factors such as land, human labour, and natural resources are no longer the most important issues, and are continuing to be displaced by human resource development and knowledge-technological capability [2]

Developed countries have been successful in managing knowledge as the most vital resource of today's enterprises, for example, the United Kingdom's Knowledge Partnership Program [3]. They have gained from learning how to improve organisational knowledge to develop businesses, organisational commitment and construct sustainable competitive advantage [5] [6]. In contrary, small to medium enterprises [SMEs] in developing countries are facing a hard situation from the complex competition; therefore SMEs need to improve their organisational knowledge and technology to be survive in the competition [32]. Knowledge improvement is needed, whether tacit or codified knowledge. These two types of knowledge have their own characteristics. This research was to find the relation of tacit and codified knowledge to technology adaptation. The impact of the knowledge to technology adaptation will influence the way to promote successful technology transfer program in developing countries.

KNOWLEDGE

Knowledge is a significant part of technology itself. Developing communities have considered knowledge to be a main factor in the implementation of new technologies. Developing communities also focuses on the development of knowledge concepts and practices and their transfer to organisations, in order to improve organisation performance and initiate sustainable development.

Knowledge emerges from the processing of the perceived information and the contextualisation of the person [7]. Knowledge is a fluid mix of frame experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences information [5]. This argumentation shows that knowledge can only exist in the context of a person and his beliefs and experience [4].

TACIT AND EXPLICIT KNOWLEDGE

Essential classification of knowledge views it as either tacit or explicit [4] [8]. According to Dutta and Weiss [9], explicit or codified knowledge is amenable to the printed page, and is easily transmitted. Codification is the process by which firm-specific knowledge and expertise are put into symbolic form [10]. Explicit knowledge means the knowledge that has been expressed in words and numbers. It can be transferred formally and systematically in the form of data, specifications, manuals, and drawings, for example written instructions, procedures, statistical data, designs and specification, standards [6] [10] [4].

Investors to make decisions about buying or selling stocks can use this knowledge. In explicit knowledge transmission, the problem of communication and cultural transfer is usually less. This is because fewer personal contacts need to be involved between transferor and transferee. This is used to advantage by reducing transference costs compared with the situation when participants have to spend money for training or learning [11] [12]. But in transferring explicit knowledge, problems occurs because of a lack of familiarity with using codifying methods or a different way of codification [10]. In the process of transferring, transferor and transferee are forced to adopt a common language or

communication code, which can be used to transfer technical material and/or to discuss technical issues.

In contrast, tacit knowledge includes insights, intuitions, and experiences [6]. This knowledge is difficult to express and formalise, and therefore difficult to share. According to Popper [13], a definition of tacit knowledge is difficult to articulate. It is deeply embedded in personal beliefs, attitudes, values and experiences, which give tacit knowledge its meaning. Tacit knowledge is difficult to articulate in writing and is acquired through personal experience [14], for example, by observing a particular industry, analysts might gain knowledge to make recommendations to investors concerning the likely short-term and long-term market trends for the stocks of firms within that industry [6]. Such knowledge would be considered tacit, unless the analyst can verbalize it in the form of a document that others can use and learn from.

However, even though the explicit and tacit forms of knowledge are quite distinct, it is possible to convert explicit knowledge into tacit [4]. For instance, by reading a particular book, an individual learns from the book, thus converting the explicit knowledge contained in the book into tacit knowledge in the individual's mind. Similarly, tacit knowledge can sometimes be converted into explicit knowledge, for instance when an individual with substantial tacit knowledge about a topic writes a book formalizing that knowledge [6].

TECHNOLOGY ADAPTATION

In essence, adaptation is ensuring that something is suitable for a designated purpose, or fitting something into a system where it could not be fitted before. This invokes consideration of processes that lead to the modification of things to fit varied circumstances different from where they came from [15]. In the 1960s, several economists explained how technologies could be diffused among countries. Differences among the ability of nations to develop technology and adapt it into their particular circumstances were the primary cause of the varying ability to appropriate what others had innovated [16]. Technological progress, according to Arrow [17], is endogenous, because superior technology is embodied in new capital goods and can be acquired through 'learning by doing', however, this concept is not able to explain the improvements in technologies that arose from the investment by individual firms in research and development [18]. By assuming the presence of an explicit technology-producing sector, it explained how diffusion could help transfer better technologies.

The process of technology transfer requires that the transferee organisation be receptive if a new technology is to be adapted [18] [19]. When the technology transfer to an organisation encourages its employees to continually learn from each other, the employees are then likely to possess the information and knowledge needed to adapt the new technology. Furthermore, when employees are aware of ongoing and potential changes, they are less likely to be caught by surprise. Awareness of new ideas and involvement in free-flowing discussions prepares employees to respond to change and makes them more likely to accept the change. Therefore, wide dissemination of knowledge is likely to stimulate greater adaptation among employees [6]. By way of example, Buckman Laboratories, a privately owned U.S specialty chemical firm with about 1,300 employees, was named 'the [year] 2000 Most Admired Knowledge Enterprise'. Chairman Bob Buckman remarked that the company's knowledge effort was intended to continually expose its employees to new ideas and enable them to learn from these ideas [20]. He also emphasized that the employees were prepared for change as a result of being in touch with the latest ideas and developments.

Technological adaptation within a learning process is complex. Some of the associated elements are explicit, while others are tacit and are embodied deeply in people and organisations [18]. The tacit element of learning makes the adaptation of technology more difficult as its complexity increases. Making effective use of new technologies requires the deliberate building of knowledge capabilities associated with the technology within the employees.

Upgrading technology often requires the development of sophisticated capabilities. Specialised managerial skills would also be needed to facilitate technological capability development. These skills can be regarded as tacit rather than explicit [21]. The usual stages of technology development [i.e. basic research, applied research, development and learning process] can be bypassed through technology transfer [22].

Within a successful technology transfer process, the firm will adapt the new technology. The technology transfer process does not have to be radical, as incremental technology adaptation is a source of significant competitive advantage to organisations [23]. Studies have shown that the cumulative impact of incremental improvements significantly increased productivity [24]. Incremental experience-based changes are competitively significant because of other special qualities [23], because it provides a more sustainable competitive advantage to the firm, because it is harder for competitors to observe and copy [25]. Furthermore, adaptation to technologies often helps to shape on-going research activities where, in some industries, user adaptation is a major source of new product ideas [26].

In short, the competitive and organisational impacts of technologies can have significant dependence on transferee adaptation to initial innovation qualities [23]. To reach a sustainable basis, the process of technology adaptation should evolve into an on-going learning process that will improve the technology capability of the organisation.

FIELD WORK RESEARCH

To provide the reader a perspective about the target area of this research, a fieldwork research was conducted in Pasuruan, East Java, Indonesia. Pasuruan is a coastal city in the Indonesian province of East Java

where a large number of SMEs are located, with a significant proportion manufacturing metal goods, in particular non-ferrous metals and electroplating. A foundry is also located in Pasuruan. More specifically, Pasuruan SMEs are involved in the manufacture of motorbike and car accessories (examples observed by the author include hand brakes, machine block covers, lamp covers and front grills).

In the fieldwork, author found that the majority of the SMEs in Pasuruan were small. According to the Department of Industry and Trade, there were about 500 distinct SMEs in Pasuruan that employed a total of about 6,000 people. The number of employees in each SME varied from 5 to 20. During fieldwork, the author found that the education levels of both the owners and the employees in Pasuruan were in general, older owners and employees (a minimum of 40 years of age) completed elementary education at best, whereas younger owners and employees were found to have completed senior high school with a minority having completed a university bachelor's degree. As was observed, SMEs in Pasuruan operate on a reactive production schedule, based on customer orders.

The origin of the metal-based industries in Pasuruan is unknown. However, in the mid-1800s, under Dutch colonisation, there were several sugar factories in Java. The Dutch government built large metal-based factories, namely NV De Bromo, NV De Industries, and NV De Vulkaan in Pasuruan to supply spare parts for the Javanese sugar factories (Syahra, 2004). In 1958, the Indonesian government gained control of these factories and renamed them PN Boma, PN Bisma and PN Indra. In 1971, these three companies were merged into a single entity, PT Boma Bisma Indra (PT BBI). According to the Department of Industry and Trade, following the creation of PT BBI, the company became involved in the transfer of knowledge and technology to SMEs in Pasuruan. PT BBI participated in supplier development programs and human resources training programs to SMEs. Technology transfer programs have included SME machinery and equipment calibration to enable standardisation of product manufacture between SMEs.

Government agencies have been involved in knowledge and technology transfer in metal-based SMEs in Pasuruan. According to the Department of Industrial and Trade, and reaffirmed during interviews with the author, government agencies have supported knowledge and technology by providing equipment, tools, training programs and expertise to improve local competitiveness. Government initiated technology transfer programs can be conducted from one to ten or more years. Government programs seek to strengthen SMEs within a manufacturing sector, and to increase SME profitability. According to Department of Industrial and Trade, government supporting program for SMEs tend to focus on human resources development through training programs that focus on, for example, production, quality control, and material and product standardisation. Government programs have also facilitated exchange and placement of technicians and engineers. The author found that local government supported knowledge and technology for SMEs by providing a simple administration bureaucracy for new SMEs to operate. Local government, through the Department of Industry and Trade, provided a free knowledge and technology consultation service for SMEs, and provided a location where training programs could be conducted.

According to Department of Industrial and Trade, Pasuruan SME owners have gained advantages from knowledge and technology transfer programs. The author was advised that the improved capability of local SMEs enabled them to collectively win a tender for component painting for Honda's motorbikes from PT Astra Honda Motor (PT Astra is a license holder of Honda Indonesia).

According to Department of Industrial and Trade, universities involved in knowledge and technology transfer programs for SMEs provided training programs for SME human resources in particular. Universities also collaborated with government to provide expertise in short-term technology transfer programs.

During fieldwork, the author was able to observe where programs had been successful, for example, productivity enhancements through increased efficiency in both time required to complete a process and energy used to complete a process. SMEs had become familiar with the standardisation of products and systems through, for example, ISO 9000 (international) and SNI (Standard Nasional Indonesia, i.e. the local Indonesia National Standard).

Informal knowledge and technology transfer

During fieldwork, the author identified that SMEs in Pasuruan experienced informal knowledge technology transfers due to the presence of large (employing thousands of workers) and benevolent metal-based manufacturing companies in the region. Workers in these large companies were observed to have spread their knowledge within their local communities. Many workers from the large companies founded metal-based SMEs, often with the support of the large company and with support and collaboration within the immediate community around the worker's house – usually the first site of the SME. By sharing information among those who have worked in large metal-based companies, workers have disseminated the knowledge into the SME community and become an effective informal knowledge and technology transfer hub among SMEs in Pasuruan.

MATERIAL AND METHOD

The available literature refers to instances where either tacit knowledge or explicit knowledge is the more dominant in the transfer of technology [27]. The reasons put forward as to why tacit knowledge is more dominant include: the skills and experiences embedded to the transferors are crucial in technology transfer, whereas the argument that codified knowledge is dominant in knowledge and technology transfer is based on the fact

that codification is measurable with an associated aid to knowledge and transfer technology program effectiveness [28].

In the fieldwork completed by the author, anecdotal feedback indicated that codified knowledge is dominant in Javanese metal-based SMEs because the transferees have sufficient pre-existing skills and experience but lack technical [codified] knowledge. Based on this work, the research question is posed, with reference to Javanese metal-based SMEs:

Research question: To what extent does tacit and codified knowledge directly impact on technology adaptation?

Associated hypotheses

Hypothesis 1a: Tacit knowledge has a direct impact on SME technology adaptation

Hypothesis 1b: Explicit knowledge has a direct impact on SME technology adaptation

The current research will attempt to answer which of tacit knowledge and codified knowledge dominant in knowledge and technology transfer programs in Java metal-based SMEs. The current research will also seek to determine if either type of knowledge is important.

This research examined the relation between the knowledge and technology adaptation. The conceptual and theoretical model is shown in Figure-1.

Statistical modelling

Structural Equation Modelling [SEM], a statistical methodology is utilised to analyse the survey data in this research. SEM is adopted to quantify the strength of proposed relationships within a technology transfer model.

Source of empirical data

The subjects of the research were SMEs involved in metal-based SMEs in emerging economies [Indonesia]. This domain was chosen because SMEs in this area were pioneering in terms of knowledge and technology transfer. As part of the long history of experiences in knowledge and technology transfer, and consequently, accumulated knowledge, the metal-based manufacturing industry was deemed appropriate as the subject of the survey of this research.

Emperical data were obtained from those prospective respondents' areas. A total of more than 250 organisations, representing a response rate of above 50 percent of 300 respondents. An issue related to the level of analysis was the person in the organisation who was directly selected to complete the questionnaires. In this survey, the person who prefers to be chosen to answer the questionnaires was the manager or the owner of the organisation who are responsible to technology transfer program.

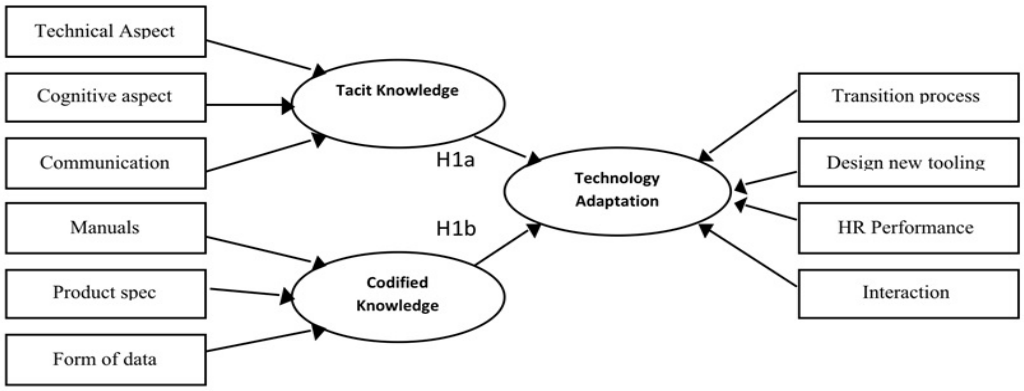

Figure-1. The role of tacit and codified knowledge.

Table-1. List of items to measure the knowledge construct.

Constructs	Indicators	Measurement Items	Sources
Tacit	1. Technical aspect	1. The expertise is provided 2. The technical exchange 3. Transferring expertise's skill transfer	4; 10; 27
	2. Cognitive aspect	4. Stimulating transferor skill on new technology 5. Transferring expertise' experience	
	3. Communication	6. Communication between transferee and transferor	
Explicit	1. Manuals	1. Introduction on technology/ product specification 2. Blueprint of the new technology	4; 10; 27
	2. Product specification	3. Managing product standardisation	
	3. Form of data	4. Statistical data 5. Words and numbers in scientific formulas	

Table-2. List of items to measure the technology adaptation constructs.

Constructs	Indicators	Measurement Items	Sources
Technology Adaptation	1. Transition process	1. Technology transition process 2. Integrating the new technology/system	18; 23
	2. Designed new tooling	3. Ability to design new tool	
	3. Human resource performance	4. Ability to receive and absorb the new technology/system 5. Perform skill improvement 6. Ability to improve performance to meet the standardisation	
	4. Transferor interaction	7. Capability to interact with transferor	

[Modified from the previous studies of: 4; 10; 18; 23; 27]

The research instrument

The development process of the measurement instrument started with derivation of the constructs of knowledge and technology adaptation. The areas associated with knowledge and technology transfer program were also exposed. Those constructs had multiple items. In sum, the appropriate scientific process that was used to collect data provides confidence about the quality of the data. The data is accurate and has been measured well. This therefore the propositions and hypotheses of this study can be thoroughly tested with accuracy.

To verify the reliability and validity of the instruments, a range of reliability and validity tests were conducted. For the purpose of examining the constructs in this research, the adequacy of the one-factor congeneric models were based on the t-value, chi-square [χ^2], p-value, RMSEA, GFI, AGFI and CFI [29]. The result of the analysis of the one-factor congeneric models show that all construct models provide 'good fit' indicating that there is no problem of unidimensionality after modification (see Table-3).

STRUCTURAL EQUATION MODEL

There has been comprehensive assessment of the measurement part of the SEM; therefore the next step is to examine the full structural part of the SEM. The Maximum Likelihood [ML] estimation method was applied to estimate the parameters and calculate the goodness of fit indices. The LISREL software package was utilized in this study [30].

As a result, Figure-2 shows that the t-value for tacit knowledge is -2.81, and t-value for codified knowledge is 18.72, higher than the cut off t-value of 1.96. It explains that codified knowledge has more significantly impacts on adaptation.

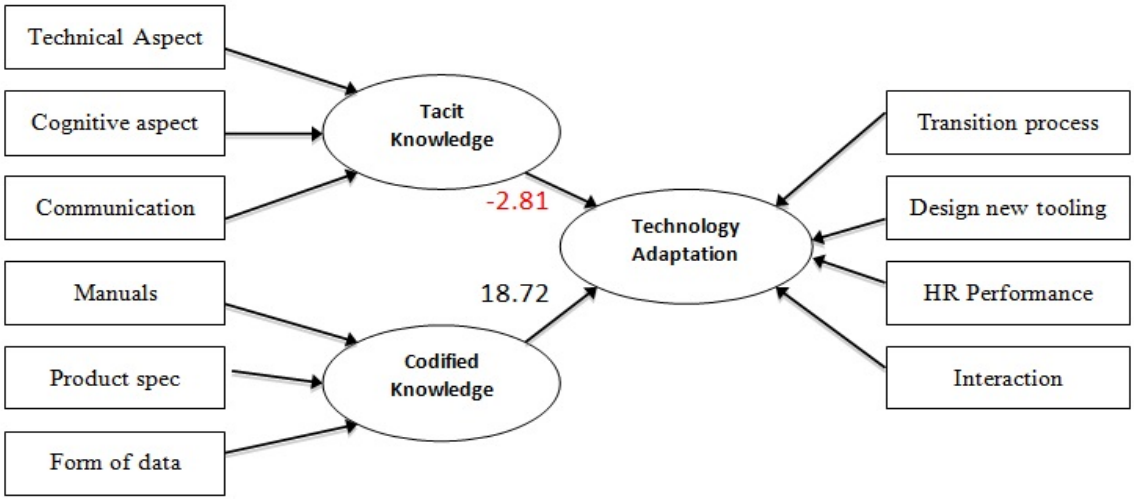

Figure-2. The diagram of t-value results of model.

Table-3. Goodness of fit indices.

Measure Obtained	Criteria for Good Fit	Criteria for Marginal Fit	Results
Absolute			
Chi-square [χ^2 [34.7], df [23], p-value [0.056]	P Value ≥ 0.05		Good Fit
GFI=0.97	0.90<GFI<1.00	0.80<GFI<0.90	Good Fit
RMSEA =0.045	RMSEA<0.05	0.05<RMSEA<0.08	Good Fit
Incremental			
CFI=1.0	0.90<AGFI<1.00	0.80<CFI<0.90	Good Fit
NFI = 0.99	0.90<IFI	0.80<NFI<0.90	Good Fit
TLI = 0.99	0.90<TLI	0.80<TLI<0.90	Good Fit
Parsimonious			
Chi-square [χ^2] =34.7, df =23	1<[χ^2]/df <2		Good Fit
AIC=78.66	AIC< saturated AIC		Good Fit
Saturated AIC = 90			

GOODNESS OF FIT

The overall fit model is evaluated from the Goodness of Fit between data and the model. Five measures of fit are shown [χ^2- good fit: p>0.05]; Normed chi-square [χ^2/df –good fit: 1< χ^2/df< 2]; goodness of fit index [GFI-acceptable fit: 0.95<GFI<1]; Tucker-Lewis Index [TLI-acceptable fit: TLI>0.95; root mean-square error of approximation [RMSEA-acceptable fit: RMSEA < 0.05. The Goodness of Fit indices results show the good fit of the data to the model [Table-3]

RESULT AND DISCUSSION

The result shows that the t-value for the relationship between tacit knowledge and technology adaptation is -2.80. On the other hand, the t-value for codified knowledge is 18.72, much higher than the critical t value of 1.96. These results indicate the rather interesting situation where even both tacit and codified knowledge have significant impact, tacit knowledge is considerably less influential on the technology adaptation of firms than is formalised knowledge. Previous studies state that either tacit knowledge or explicit knowledge is more dominant in the transfer of technology. A reason advanced as to why transferors are more concerned with transferring tacit knowledge is that tacit knowledge is very crucial for technology transfer but it is difficult to transfer [4] [18]; whereas, the argument for why codified knowledge is dominant in knowledge and technology transfer is based on the belief that codification is measurable and easier to deliver, which may lead to effective knowledge and transfer technology programs [31].

In the fieldwork, it was revealed in interviews that codified knowledge might be more appropriate in the setting of the fieldwork, because the transferees have sufficient skills and experience but lack technical knowledge [codified knowledge]. These differing results and arguments led to the research question of to what extent does tacit and codified knowledge directly impact on technology adaptation?

Measured by the test of the correlation between either tacit knowledge or codified knowledge and technology adaptation, the empirical evidence supports that codified or explicit knowledge was more influential in improving the technology adaptation of the companies surveyed. It is quite possible that both types of knowledge were transferred [i.e. sent from the transferor to the transferees]. However, the usefulness of the information was different. In the case of technology transfer with the characteristics of economic development in Java, explicit knowledge has a more significant impact on technology adaptation when exchanged in knowledge and technology transfer programs than does tacit knowledge.

In terms of tacit knowledge, a possible explanation is that under domestic/local technology transfer, although the process of transferring tacit knowledge was 'similar in nature' [i.e. similar culture, language] between transferors and transferees, there are still difficulties in transferring tacit knowledge. Within a similar culture numerous problems of interpretation difficulties still exist.

This research finding offers additional support to some previous research findings on technology transfer [10] [18] research on knowledge transfer by Canadian firms confirmed that where there are cultural differences, it is more difficult to transfer implicit knowledge. The non-explicit [tacit] nature of knowledge left room for numerous problems of interpretation between Canadian firms [as the transferors] and Chinese firms [as the transferees].

A corollary to this could be that where there is a similar culture between transferor and transferee, implicit knowledge can be more successfully transferred.

Based on this research finding, the empirical evidence demonstrates that codified knowledge is a substantial part of the knowledge and technology transferred ready to be adapted by the transferee organisation. Whether this reflects the nature of the information that is routinely transferred to the respondents to the survey, or the capacity of transferees to assimilate

tacit knowledge, or simply that tacit information is unimportant to the adoption of technology in the metals industry is open to conjecture and cannot be answered from the data collected. However, In the case of technology transfers within developing economies such as Java, explicit knowledge has more of a significant impact on technology adaptation in the knowledge and technology transfer programs than has sometimes been reported in the literature. Therefore it is possible to propose that the object of transfer should be codified knowledge rather than tacit knowledge. This research has found suggestions in the literature for this situation – attributing it to the difficulty of transferring tacit knowledge in both cross-cultural and mono-cultural environments. Should it be considered to transfer tacit knowledge, every effort should be made to convert it to a more codified form.

REFERENCES

[1] Drucker, P. 1994. The age of social transformation. The Atlantic Monthly, 274[5], 53-70.

[2] Liu, P.L., Chen,W.C. and Tsai., [2004] "Empirical study on the correlation between management capability and competitiveness in Taiwan's industry," Technovation, Vol 24, pp.971-977.

[3] Grady, R., & Pratt, J., 2000. The UK Technology Transfer System: Calls for Stronger Links between Higher Education and Industry. The Journal of Technology Transfer, 25[2], 205-211

[4] Nonaka,I., Takeuchi,H. 1995. The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation? Oxford University Press, New York.

[5] Davenport,T.H., Prusak,L., 1998. Working Knowledge: How Organizations Manage What They Know. Boston: Harvard Business School Press, 1998.

[6] Becerra *et al*, 2004. "Knowledge Management: Challenges, Solutions, Technologies, Pearson, Prentice Hall.

[7] Greiner, Bohmann, and Krcmar 2007, A strategy for knowledge management. Journal of Knowledge Management Vol 11 No. 6.pp 3-15].

[8] Polanyi, M. 1966. The Tacit Dimension. Routledge and Keoan, London.

[9] Dutta and Weiss [2002], The relationship between a firm's level of technical innovativeness and its pattern of partnership agreements. Management Science 43: 343-356.

[10] Marcotte, C., Niosi, J., 2000; Technology Transfer to China. The Issues of Knowledge and Learning. The Journal of Technology Transfer, 25[1], 43-57.

[11] Williamson, Oliver, 1979,'Transaction-Cost Economics. The Governance of Contractual Relation', Journal of Law and Economics 22, 233-262.

[12] Williamson, Oliver, 1981, 'The Economics of Organisation: The Transaction Cost Approach', American Journal of Sociology 87, 548-577.

[13] Popper K., 1972. Objective Knowledge: An Evolutionary Approach. Clarendon Press: Oxford.

[14] Hansen MT, Nohria N, Tierney T. 1999. What's your strategy for managing knowledge. Harvard Business Review 77: 106-116.

[15] Anderson, 1993; Agile Product Development for Mass Customization, How to Develop and Deliver Products for Mass Customization, Niche Markets, JIT, Build-to-Order, and Flexible Manufacturing, with an introduction by B. Joseph Pine II.

[16] Gerschenkron, Alexander, 1962; Economic backwardness in historical perspective, a book of essays, Cambridge, Massachusetts: Belknap Press of Harvard University Press.

[17] Arrow, K., 1969. Classificatory notes on the production and transmission of technological knowledge, American Economic Review, Papers and Proceedings, May, 244–250.

[18] Candra and Kolavalli, Chandra, Vandana. 2006; Technology, adaptation, and exports: how some developing countries got it right**.** Washington, DC: World Bank, 2006.

[19] BPPT [Agency for Assessment and Aplication of Technology], 2005. "Indonesia - Badan Pengkajian dan Penerapan Teknologi. Vol.4, 99.

[20] Business Wire, 2000, in Becerra *et al*, 2004. "Knowledge Management: Challenges, Solutions, Technologies, Pearson, Prentice Hall.

[21] Amsden, A., 2001; The Rise of "The Rest": Challenges to the West From Late-Industrializing Economies, Oxford University Press.

[22] Gumbira S.E, Rachmawati, Muttaqin, M.Z. 2001. Manajemen Teknologi Agribisnis [Technology Management of Agribusiness]. Bogor. IPB.

[23] Tyre, Marcie J, 1997. Gaining Competitive Advantage From New Technologies: Pattern of User

Adaptation. Research on Technology Innovation Management and Policy, Vol6, pages 191-214.

[24] Enos, J.L. 1989. "Transfer of Technology", Asian-Pacific Economic Literature, 3, pp. 3-37. in Chen, Edward K.Y 1994. Introduction: Transnational Corporations and Technology Transfer to Developing Countries. Vol.18 The United Nations Library on Transnational Corporations.

[25] [25] Porter, M.E., 2008. "Competitive Advantage": Creating and Sustaining Superior Performance. The Free Press. [Revision].

[26] Von Hippel, Eric, 1988; Sources of Innovation. New York: Oxford University Press.

[27] Gorman, M. E., 2002; Types of Knowledge and Their Roles in Technology Transfer. The Journal of Technology Transfer, 27[3], 219-231.

[28] Nonaka, I., 2003, Continuous Innovation: The power of tacit knowledge, in L.V.Shavinina [Ed.], International Handbook on Innovation. Oxford: Elsevier Science.

[29] Singh, Prakash J and Smith, J.R. Smith. Relationship between TQM and innovation: an empirical study. Journal of Manufacturing Technology Management. Vol 15-Number 5. 2004. pp.394-401.

[30] Hair Jr., Anderson, R.E., Tatham, R.L., and Black, W.C., 2010; Multivariate Data Analysis, [7 ed.], New Jersey: Prentice-Hall.

[31] Nonaka, I., 2003, Continuous Innovation: The power of tacit knowledge, In: L.V. Shavinina [Ed.], International Handbook on Innovation. Oxford: Elsevier Science.

[32] Marino,L., Strandholm, K., Steensma, H.K. and Weaver, K.M., 2001. Harnessing Complexity: The Moderating Effect of National Culture on the Relationship between Entrepreneurial Orientation and Strategic Alliance Portfolio Complexity. Department of Management and Marketing Tuscaloosa, pp: 1-19.

[33] Syahra, R. 2004: Faktor-Faktor Sosial Budaya dalam Peningkatan Daya Saing: Kasus Industri Logam di Sukabumi, Ceper Tegal dan Pasuruan. Jurnal Masyarakat dan Budaya, VI.