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ABSTRACT

This paper discovers the role of Triple Helix in improving Small to Medium Enterprises (SMEs)' technology capability in developing economies context by testing the model of the role of the Triple Helix in technology transfer program. Characteristics and motives of the transferors have potentially affected the result, and indeed the success, of technology transfer program. It is important to understand any differences (e.g. characteristic and motives) associated with the process of transferring knowledge and technology of the Triple Helix to SMEs. The findings of characteristics and motives of Triple Helix in the technology transfer programs will support a better understanding of the role of Triple Helix on technology capability. This research also provides empirical evidence to claims that there is a significant effect of technology capability on competitiveness. With 250 respondents, the result provides confidence that the propositions and hypotheses of this study can be tested thoroughly and with accuracy.

Key words: Enterprises, Technology capability, Developing economy

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1. INTRODUCTION

Businesses in developed economies began to face a new paradigm where resource-based competitiveness was being replaced by knowledge-based competitiveness (Drucker, 1994). 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 (Harkin and Copper, 2016; Grady and Pratt, 2000), and distinctive approach to knowledge creation in Japan (Nonaka and Takeuchi, 1995). They have taken advantage from learning how to manage organisational knowledge to accelerate businesses, strengthen organisational commitment and build sustainable competitive advantage (Davenport and Prusak, 1998; Beccera et al., 2004). In contrast, small to medium enterprises (SMEs) in developing countries, such as Indonesia, that are facing an increasingly complex external environment due to rapid technological change and progressively sophisticated competitors (Marino et al., 2001), need to accelerate their organisational knowledge and use of technology to compete successfully.

The overall aim of this research was to discover the role of the transferors (government, universities, business and interplay among transferors) and the relationship between technology capability and competitiveness, and also provide a contemporary empirical support within the context of SMEs in a developing economy, with a particular focus in Indonesia.

2. MATERIALS AND METHODS

2.1. Triple Helix

The concept of Triple Helix was developed by Etzkowitz and Leydesdorff (Abd Razal et al, 2016; Etskowitz and Leydesdorff, 1997). The Triple Helix model, where the helices correspond to government, business, and university (Etzkowitz and Leydesdorff, 1997), is about the collaboration between government, universities, and industry as three main actors involved in national innovation (Etzkowitz and Leydesdorff, 1997). The term Triple Helix is an analogy for the central idea that when each helix (either government, universities and industry) is associated to each other, the overall value of collaboration is strengthened. The model depicts three different degrees of collaboration, which relate to different outcomes in terms of maximizing national innovation potential (Abd Razal et al, 2016).

2.2. Requirement for Technology Transfer

Successful competition requires a rapid response capability to provide goods or services for customer needs (Surachman, 2005). In this environment, creating and maintaining competitive advantage through knowledge management systems has occurred widely (Davenport and Prusak 1998, Samudro et al., 2011; Samudro and Mangkoedihardjo, 2006; Zack 1999; Alavi and Leidner, 2001). However, the limitation capability of SMEs resources (e.g. human resources and facilitating technologies) to create in-house development of their technological capability to achieve minimum required capability, results external resources to support their performance in developing technological capabilities, so-called 'knowledge and technology transfer' (Marcotte and Niosi, 2000; Gorman, 2002) programs.

Since knowledge and technology transfer involves technology suppliers, the process of knowledge and technology transfer can be analysed based on transferor characteristics. It is widely recognised that the transferors involved in knowledge and technology transfer are government, businesses, and universities (Kremic, 2003; Lee, 1997; Friedman and Silberman, 2003; Graddy and Pratt, 2000). Each organisation has a unique primary mission in transferring technology, for instance, government has distinct characteristics and motives compare to industry and universities. The motives of government might be a legal mandate, whereas for industry the motives may be profit (Kremic, 2003; Bozeman, 2000; Handoko et al, 2014) and for universities the motives is merely community service (Irawati, 2006). The diversity of characteristics and motives will potentially affect the result, and indeed the success, of knowledge and technology transfer. It is important, therefore, to understand any differences (e.g. characteristic and motives) associated with the process of transferring knowledge and technology from government, universities and businesses to SMEs. Further, Porter (2001) stated that technology transfer would be valuable if it is capable of improving a organisation's competitiveness.

2.3. Technology transfer and technology capability

In a period of rapid change and high competitiveness, technology plays a vital role in supporting a SMEs's performance. By elevating transferee technology capability during a technology transfer program, the transformation process inside the SMEs becomes more effective and efficient. Ultimately, the chance to develop low cost production, better performance products and earlier availability, will impact on an organisation's competitiveness. Improved methods for production, inventory control, material handling, quality assurance and technology may provide both direct and indirect benefits that result in a more competitive company (Porter, 2001).

Technology transfer is a bypass to improve technology capability (Liebrenz, 1982; Handoko et al, 2014), particularly technology transfer for SMEs in developing countries where SMEs are mostly lack of human resource technology capability (BPPT, 2005; Handoko et al, 2014). Technology transfer programs, therefore, potentially support SMEs to increase their technology capabilities (Tjahjadi et al, 2017; Tjahjadi and Handoko, 2017; 2017; Handoko et al, 2014; Handoko et al, 2018; Padmadinata et al, 2006). Technology capability can be improved through knowledge and technology based learning processes (Handoko et al, 2014). Effective learning processes can improve the capability of the SMEs as organisation to utilise the technology (Rogers, 2003).

2.4. Characteristics of the transferor

The transfer agent is the institution or organisation that seeks to transfer the technology, for example, government, university, business organisation (Bozeman, 2000). Indeed, a significant proportion of the published work on technology transfer deals with the question: "How does the institutional culture of the transferors affect its ability to conduct technology transfer?" (Bozeman, 2000). Some studies suggest that organisational and professional changes enable closer academic and industry collaboration, for example, the studies completed by Ertkowitz (1994; 1998) and (Lee, 1996).

2.5. Government as technology transferor

Transferors have their own motives for engaging in technology transfer programs. Motive is a reason or desire or even the goal of the transferors to give technology transfer (Bozeman, 2000; Kremic, 2003). Governments are motivated to engage in technology transfer programs for example, to encourage wealth generation by encouraging technical innovation with legislation, for example in the USA, the Stevenson-Wydler technology Innovation Act of 1980 (Bozeman, 1997; 2000, Kremic, 2003). Other, often related, motives for government include, economic development, outgrowth of cooperative research and development, scientific and engineering entrepreneurship, and personal wealth generation within the populace (with the associated increase in taxation revenue). According to Kremic (2003), "the technology transfer process set point, or goal, is to deliver practical benefit to the public".

This includes the creation of patents, licenses and encouraging industry and academia collaboration in pursuit of national economic benefit.

2.6. Business as technology transferor

The motive of Large Enterprises (LEs) in transferring technology to SMEs is profit (Kremic, 2003). LE, in conducting technology transfer is usually associated with the need for potential (low cost) suppliers (SMEs) to support their products (Hayashi, 2002; Handoko et al, 2014). Subcontracting linkages are an essential support for the development of SMEs, and this in turn benefits LEs. In order to achieve the required standard of product quality or production from SMEs (supplier), large enterprises (transferors) may transfer the technology that is needed (BPPT, 2005).

As a transferor of technology to SMEs, LEs offer advantages such as, greater tacit capability (expertise, experience, culture), explicitness capability (statistical data, written instructions, blueprints), as well as more funds, equipment and market availability. In Java, Indonesia a partnership program has been established, called Foster Parents Scheme, between LEs, such as corporations that produce electricity or process oil, and SMEs (Tambunan, 2005). However, technology transfer by business has its limitations. LEs, in transferring technology to SMEs, tend to transfer to support particular, and often limited, product or service that is needed by the transferor. This results in a limited transfer of technology by LEs to SMEs and this, in turn, limits the technology capability of SMEs (BPPT, 2005).

Other motivations for LEs to engage SMEs include the potential for: lower wages for workers and managers; and, skill specialisation. Hayashi (2002) asserts that:

- lower wages is the most important motivation for LEs to subcontract SMEs,
- specialisation is the second important motivation, and
- producing better products is the third important motivation.

This indicates that by establishing close relationship with the local SMEs, LEs seek to ensure that supplied products meet their technical, quality, and delivery requirements. Types of subcontracting linkages with the local SMEs are Technical specification, Quality Control (QC) support, and production technology support. LEs can also provide SMEs with additional technical linkages to support areas such as QC and production technologies (Hayashi, 2002).

2.7. Universities as technology transferor

Universities have a crucial role in society as producers and transmitters of knowledge (Irawati, 2006). Universities have become increasingly involved in technology transfer by establishing offices for technology transfer, business incubators and capital funds schemes for start-up companies (Landry et al., 2006); and more generally, by offering human resources and R&D opportunities and recorded precedent (i.e. library repositories) (BPPT, 2005). The role of universities within regional initiatives to encourage innovation has evolved in recent decades (Gunasekara, 2005; Lee, 2000), commencing with the Innovation System approach, which highlighted the importance of knowledge spillover from the teaching and research activities performed by universities toward regional economic and social development (for example, Gunasekara, 2005; Etzkowitz and Leydesdorff, 1997). Moreover, there is an increasing level of academic commercialisation activities, such as patenting and licensing, and the creation of spin-off initiatives (for example, Friedman and Silberman, 2003; Thursby and Kemp, 2002; Zucker et al., 1998).

The Triple Helix model, where correspond to government, business, and university (Etzkowitz and Leydesdorff, 1997), strengthens the role of universities in their regional community. Universities are motivated to engage in technology transfer schemes to: further outreach programs; gain knowledge about practical problems; enhance undergraduate teaching; gain insight into research areas of potential interest; seek out potential business collaboration opportunities; create student internships and job placement opportunities and, community service (Lee, 2000; Burvill and Lewis, 2001;Irawati, 2006)

2.8. Developed vs Developing Countries

There were inconsistent results regarding previous empirical research finding on the effectiveness of technology transfer in developing countries (Marcotte and Niosi, 2000). Some research has suggested that companies from developing countries may learn how to use the knowledge acquired during technology transfer rapidly with tangible outcomes (Handoko et al 2016; Handoko et al 2014; Marcotte and Niosi, 2000), whereas other studies offered a more pessimistic outlook of technology transfer outcomes (Freeman and Hagedoorn, 1994; David, 1997). According to Freeman and Hagedoorn (1994), "the fact that developing countries have received little technology transfer is likely due to the lack of indigenous capability to capitalize on the learning process that comes with inter-firm technology transfer" (Marcotte and Niosi, 2000). This issue has a bearing on the capacities of recipient firms and quite possibly also on the success of the technology suppliers. In developed countries, many transfer of technology policies that involve government, higher education and industry sectors have been established, such as in the UK, the USA and Australia (Harkin and Copper, 2016; Grady and Pratt 2000; Lee, 1997). In the USA, the federal government, federal R&D laboratories, research universities and industrial firms have been involved in technology transfer programs that address technology development (Lee, 1997).

2.9. Fieldwork Research

To provide a perspective about SMEs in Indonesia, a fieldwork was conducted for this research to gain information about target areas of Java, Indonesia. In the fieldwork research, data from peak industry bodies and government departments, such as the Agency for the Assessment and Application of Technology (BPPT) and information regarding national and provincial government policies from government departments, were sourced. Face-to-face interviews with SMEs and discussions with staff at a series of universities in Java are conducted. The fieldwork also searched for evidence of technology transfer that had previously occurred. This involved the review of information about SMEs in metal goods industry sector that had already been the recipient of technology transfer from government, universities and/or private businesses, and/or from foreign organisations (based on government to government agreements). BPPT recommended the districts of Ceper in Central Java and Pasuruan in East Java to the author, as being particularly involved in knowledge and technology transfer.

2.10. Conceptual Framework and Research Design

Hypotheses

In order to formally achieve the aim posed in the previous section, hypotheses that can be empirically tested are formulated. The relationship of the model will be analysed with the Structural Equation Modeling (SEM) technique (Hair et al, 2010).

Transferors

The roles of the transferors are postulated to be significant. There are three significant groups in developing countries that are responsible for and/or concerned with technology transfer, i.e.

government, business and universities. Each has its own methods, particular motives and characteristics when transferring technology. The question is to what extent the levels of transferors' technology transfer activities/approach (methods, motives and characteristics) has related with SME's technology capability.

Outcomes

Technology transfer is valuable if it enables an improvement in an organisation's competitiveness (Porter, 2001). Since the role of technology transfer is to provide a shortcut to innovation, through technology adaptability to increase technology capability, those transformations can be worthwhile if they are able to enhance an SME's competitiveness.

The research instrument

The development of the measurement instrument started with derivation of the constructs of technology transfer. Using the psychometric approach, measurement items that encapsulated the core ideas of the constructs were developed. All constructs had multiple items. The draft instruments were pretested with experts and then subjected to pilot testing with a sample of metal-based SMEs organisations. Since the pilot study involved a rather small sample size, tests such as those for reliability and validity were conducted. This approach was taken to ensure that the measurement instrument was capable of measuring what was intended to be measured. For all items, Cronbach's alpha coefficient values were greater than the acceptable value of 0.6 (Hair, 2010), indicating that the items assigned to the constructs were reliable. Eventually, the final measurement instrument was developed. The most popular scales applied by researchers are the Likert, Guttman and Thurstone scales (Sarantakos 1998). In this research, the Likert scale was chosen to measure all items. The construct, indicators and measurement items to measure the transferor, technology capability and competitiveness dimension were adopted and modified from previous studies. Indicators were identified and broken down into measurement items as shown in Table 1.

In sum, the rigorous scientific process that was used to collect data provides sufficient confidence that the quality of the data is high and has been measured well (e.g. reliability and validity). This therefore provides confidence that the propositions and hypotheses of this study can be tested thoroughly and with accuracy.

Table 1 List of items to measure the construct

Constructs	**Measurement Items**
Transferors	Responsibility of the transferors Project terms of technology transfer programs Communication built by transferor Conference, meeting Technology transfer through industry visit Workshop program Personnel exchange Sufficient feedback process
Constructs	Measurement Items
Technology capability	Ability to identify feasible investment technology Ability to locate and purchase suitable technology Ability to start up the technology process Ability to maintain the technology Ability to generate dynamic technical changes Ability to generate dynamic organisational changes
Competitiveness	Skills in production process

	Quality performance over the past two years High value product Product and service quality Superiority of customer service Reliability and durability of products Cost efficiency Cost production Product that only a few SMEs can achieve Time delivery Manufacturing flexibility Customers' needs based new product Technology Product design Product utility/functions Market share Total sales average of the industry Market objectives

(Note: modified from some previous study of Kremic, 2003; Bozeman, 1997; Lee, 1997; Bell, 1987; Wei, 1995; Kumar et al, 2003; Xenophon et al., 2002; Schlie, 1996; Tracey, et al., 1999; Porter, 2001; Handoko et al, 2014)

3. RESULTS AND DISCUSSION

3.1. Transferors, technology capability and competitiveness constructs

To certify the reliability and validity of the instruments, a range of reliability and validity tests were conducted, including construct validity. The items assigned to the constructs, which show multicollinearity, were deleted. Since none of the correlation coefficients were greater than 0.9. Having established that items had no multicollinearity problems, the next step was a treatment to check whether all items were one-dimensional. 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. 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 uni-dimensionality after modification.

3.2. Full 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 full structural model for technology transfer described in previous section was specified and the Maximum Likelihood (ML) estimation procedure was applied to estimate the parameters and calculate the goodness of fit indices. ML is considered the most common fitting criteria (Kelloway 1998). SEM research using Likert scales has applied ML as an estimation technique for decades (Breckler, 1990). In practice, researchers have treated variables with Likert scales as continuous variables, and used Maximum Likelihood (ML) as the estimation method procedure (Wijanto, 2008; Gozali, 2011). In the same way, Bentler and Chou (1987) and Byrne (1998) argued that given normally distributed categorical variables, a continuous method can be used with confidence if the variables have three or more categories.The data obtained for this research has been tested for normality. The results for skewness and kurtosis are consistent with normal distributions, so ML has been adopted as the approach for relationship estimations. The LISREL software package was utilised in this study. Negative error variances were fixed at small positives values (Hair et al, 2010).

Table 2 shows that the t value for joint programs is 4.17. It is the highest t value of the four proposed transferor influences on technology capability, and compares with the t value of government of 0.59, business of 0.13, and university of 0.05. The t value for joint programs is also higher than the critical/cut off t value of 1.96. On the other hand, the t values for government, university and business are significantly smaller than the critical t value = 1.96, which indicates that only the variable joint programs has a significant impact on technology capability.

Table 3 shows that the variable of technology capability has significant impact on the variable competitiveness. Thus it explains that technology capability significantly impacts on organisation competitiveness.

Table 2 t-value of relationships between dependent and independent variables

Dependent Variable	Independent Variable			
Technology capability	Government	Business	University	Joint programs
	0.59	0.13	0.05	4.17

Table 3 t-value of relationships between dependent and independent variables

Dependent Variable	Independent Variable
Competitiveness	Technology Capability
	4.39

3.3. Model Fit of Full Model

The overall fit model is evaluated from the Goodness of Fit between data and the model. It is not possible in SEM to do overall testing of the Goodness of Fit directly because SEM does not recognise the use of only one particular measure to identify 'the power' of the model predicted (Singh, 2002). As a solution, researchers have developed several measurements of Goodness of Fit or Goodness of Fit Indices, which can be utilised collectively. Five popular measures of fit (Hair et al., 2010; Singh and Smith, 2004) 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 4)

Table 4 Goodness of fit indices

Goodness of fit indices results
Chi-square (χ^2 (267.71), df (220), p-value (0.02) GFI=0.92 RMSEA =0.029 TLI = 0.99 Normed Chi-square (χ^2) =1.22

3.4. Hypotheses results compared to previous studies

Having shown empirical support or otherwise for the research hypotheses through scientifically developed studies, it is important to compare these research results with previous findings published in the literature to determine the veracity of the claims that are being made in this study. Some findings of this research support previous research however some are distinct.

The success or failure of a technology transfer program is indeed influenced by the transferee (Rogers, 2003; BPPT, 2005, Handoko et al, 2014). There is a possibility that the transferors have their own motives that lead to their methods in technology transfer programs being different from each other (Bozeman 2000; Kremic, 2003;, Handoko et al, 2014). The results of this empirical research, as seen by the low values of the t-statistic in Table 2 and Table 3 for the impacts of the independent variables government, university, and business lead to the three hypotheses H1a, H1b and H1c being rejected. However, hypothesis H1d and H2 are accepted.

The results in Table 1 and Table 2 also show that each t-value is positive, indicating that the affects are positive even though in three cases (government, university and business) they are not significant. On the other hand, this research provides empirical evidence to suggest that the interplay amongst the transferors has a direct positive impact on technology capability. The results show that when the technology transfer program is performed by a single transferor, either the government, a business or a university the impact is not sufficient to affect the transferee's technology capability. In contrast, the empirical evidence supports the significant impact of joint programs in transferring technology to increase the transferee's technology capability. Possible explanations for the ineffectiveness of technology transfer programs when applied by a single transferor (government, business or university) might be associated with the motives of the transferor. The empirical evidence regarding the level of effectiveness technology transfer concerning the motives of the transferor is consistent with previous studies such as Rahm and colleagues (1988),Tambunan (2007), Bozeman (1997), Handoko et al (2014).

The motives of the transferor in transferring technology vary in nature (Handoko et al, 2014). The problem of transferring technology may occur because of the distortion in applying technology transfer policy between technology transfer agent and their management (Handoko et al, 2014). For example, with government, the policy associated with technology transfer programs is provided through laws and executive orders (Spivey, 1994), however the government agencies who are responsible for the technology transfer programs may not deliver the message that technology transfer is crucial or even desired (Spivey, 1994; 1997).

In terms of the involvement of the transfer agent in the technology transfer programs; the problem of motivation in transferring technology may occur when management does not distribute the technology transfer mandate to the 'workers'. The distortion of policy of technology transfer between levels of management and the level of the employees who are involved directly in the technology transfer program means a lack of motivation of the employees in transferring technology may also emerge. In the literature the "answer to the question 'what motives your technology transfer activity' quite often was 'we were told to', 'part of the job' are examples of a lack of motivation that may lead to unsuccessful technology transfer programs" (Bozeman, 2000; Spivey et al., 1994; Kremic, 2003; Handoko et al, 2014).

In terms of a business transferor, this empirical finding is consistent with a previous finding presented by Thee and colleagues (1985) who argued that technology transfer through subcontracting by large enterprises (LEs) did not provide SMEs with opportunity to sufficiently improve technical and other capabilities. In contrast, this research finding is not supportive of the research of Hayashi (2002) who found that support from LEs to SMEs positively affects the SMEs' productivity. The apparent contradictions in the findings may be explained by arguing that under subcontracting, knowledge and technology transfer programs by LEs are targeted to support a particular/ limited product that is needed by the LEs (transferor), that might be due to patent and license, and therefore it leads to the limitation of the transfer of technology by businesses to SMEs that in turn limits the technology capability of SMEs (BPPT, 2005). Thus, even though it might improve the productivity of the particular product (Hayashi, 2002) it does not sufficiently improve long-term technological capability.

This research finding might be consistent with the characteristic of the transfer agent/local government employees in Indonesia. As an example, the following discussion considers issues present when transferors were associated with local government. The local government employees who have responsibility to transfer knowledge were state employees, obtaining their salary from the Indonesian government. It did not matter whether the employees were successful or unsuccessful in completing a technology transfer process, as they received their salary regardless of outcome (Handoko et al, 2014). The consequence of a lack of motivation may lead to inappropriate programs that, in this study, have empirically been revealed to insufficiently improve the transferee's technology capability. On the other hand, the empirical evidence supports the proposition that interplay among different transferors in a consortium enables a combination of motives to drive successful technology transfer programs. Another possible explanation for the success of joint technology transfer programs is that the transferors perform at their best; since under inter-organisation collaboration, the programs could be supervised by each of the transferor's management involved in the programs. By contrast when there was a single transferor, supervised by their own organisation, their own manager, or even their own colleagues, there is not the same motivation to be seen to be performing at a high level (Spivey et al., 1994).

4. CONCLUSIONS

This study empirically supports a possible interaction/synergy of different motives from different transferors into one, to achieve one target. This research also provides empirical evidence to claims that there is a significant effect of technology capability on competitiveness. This finding is empirically consistent with the previous thought about the importance of technology capability to improve long term competitiveness

REFERENCES

[1] Abd-Razak A., Rowling M., and White G., Mason-Jones R. (2016), "Public Sector Supply Chain Management: A Triple Helix Approach to Aligning Innovative Environmental Initiatives. Foresight and STI Governance", Vol. 10, No 1, pp. 43-52.

[2] Alavi, M. and Leidner, D. (2001), "Knowledge management and knowledge management systems: Conceptual foundations and research issues", *MIS Quarterly*, Vol. 25 no.1, pp.107.

[3] Becerra, I., Gonzales, A. and Sabherwal, T. (2004), "Knowledge Management: Challenges, Solutions, Technologies", Pearson, Prentice Hall

[4] Bentler, P.M. and Chou, C.P. (1987), "Practical Issues in Structural Modeling", *Sociological Methods and Research*, Vol.16, pp.78-117.

[5] BPPT, Agency for Assessment and Application of Technology). (2005), "Indonesia". *BPPT*, Vol. 4, No.99.

[6] Berry, A., Rodriquez, E. and Sandee, H. (2001), "Small and Medium Enterprise Dynamics in Indonesia", *Bulletin of Indonesia Economics Studies*, Vol.37, No.3, pp. 63-84.

[7] Bozeman, B. and Coker, K. (1992), "Assessing the Effectiveness of Technology Transfer from US government R&D Laboratories: the Impact of Market Orientation", Technovation, Vol.12 pp.239–255

[8] Bozeman, B. (1997), "The Cooperative Technology Paradigm: An Assessment Technology Transfer and Public Policy", Quorum Books, Westport, Connecticut, London.

[9] Breckler, S.J. (1990), "Application of Covariance Structure Modeling in Psychology: cause for Concern?" Psychological Bulletin, Vol. 107, pp. 260-271.

[10] Bunker, D. and Yin, L. (2005), "Australian Accounting Review", *Accounting & Tax Periodicals*, Vol. 15, No.3, p. 55.

[11] Byrne, B.M. (1998), "Issues and Opinion on Structural Equation Modeling with LISREL, PRELIS, and SIMPLIS: Basic Concept Applications and Programming", New Jersey: Lawrence Erlbaum Associates, Inc.

[12] Davenport, T.H. and Prusak, L. (1998), "*Working Knowledge: How Organizations Manage What They Know*", Boston: Harvard Business School Press.

[13] David, P. (1997), "Rethinking Technology Transfers: Incentives, Institutions and Knowledge-Based Industrial Development", in Feinstein, C. and C. Howe Žeds, C. "*Chinese Technology Transfer in the 1990's*", U.K.: Edward Elgar, pp. 13-37.

[14] Drucker, P. (1994), "The Age of Social Transformation", *The Atlantic Monthly*, Vol. 274, No. 5, pp. 53-70.

[15] Etzkowitz, H. (1994), "Knowledge as Property: Myth and the Debate over Academic", Patent Policy. Minerva, Winter.

[16] Etzkowitz, H. and Leydesdorff. L. (1997), "Universities in the Global Economy: *A Triple Helix of University-Industry-Government Relations*", London Cassel Academic, Goddard and Chatterton.

[17] Etzkowitz, H. (1998), "The Norms of Entrepreneurial Science: Cognitive Effects of the New University–Industry Linkages", *Research Policy*, Vol. 27, pp. 823–833.

[18] Flyn, B.B., Shroeder, R.G. and Sakakibara, S. (1994), "A Framework for Quality Management Research and Associated Measurement Instrument", *Journal of Operations Management*, Vol. 11, pp.339-366.

[19] Freeman, C. and Hagedoorn, J. (1994), "Catching up or falling behind: patterns in international interfirm partnering", *World Development*, Vol. 22, pp. 771–780.

[20] Friedman, J. and Silberman, J. (2003), "University Technology Transfer: Do Incentives, Management, and Location Matter?" *Journal of Technology Transfer*, Vol. 28, pp. 17-30.

[21] Gorman, M. E. (2002), "Types of Knowledge and Their Roles in Technology Transfer", *The Journal of Technology Transfer*, Vol.27, No. 3, pp. 219-231.

[22] Gozaly, (2011), "Structural Equation Modeling" Badan Penerbit Universitas Diponegoro. Semarang.

[23] Grady, R. and Pratt, J. (2000), "The UK Technology Transfer System: Calls for Stronger Links between Higher Education and Industry", *The Journal of Technology Transfer*, Vol. 25. No. 2, pp. 205-211.

[24] Gunasekara, C. (2005), "Reframing the Role of Universities in the Development of Regional Innovation System", *Journal of Technology Transfer*, Vol. 31, pp. 101-113.

[25] Hair, J.F., Black, W.C., Babin, B.J. and Anderson, E.R. (2010), "Multivariate Data Analysis", Seventh edition, Person Prentice Hall.

[26] Handoko, F., Smith, A. and Burvill, C. (2014), "The Role of Government, Universities, and Business in Advancing Technology for SMEs' Innovativeness", *Journal of Chinese Economic and Business Studies*, Vol. 12, No. 2, pp. 171-180.

[27] Handoko, F., Nursanti, E., Harmanto, D. and Sutriono. (2016), "The Role of Tacit and Codified Knowledge within Technology Transfer Program on Technology Adaptation" *Journal of Engineering and Applied Sciences*, Vol. 11, No.8, pp. 5275-5282.

[28] Handoko, F., Nursanti, E., Gatot, G. Tjahjadi, M E., Hutabarat, J., Mulyadi, L., and Kustamar. (2018), "Green Industrial System in Indonesia". *3rd International Conference on Electrical Systems, Technology and Information, ICESTI 2017*. DOI: 10.1051/matecconf/201816401010

[29] Harkin, C., Copper, A., 2016. Knowledge Transfer Partnership within the 'Creative Industry.' A case study of Clusta Ltd. Journal of Innovation Impact", *Future Technology Press*, Vol. 5, No.1, pp. 54-66.

[30] Hayashi, M. (2002), "The Role of Subcontracting in SMEs development in Indonesia: Micro-level evidence from metalworking and machinery industry", *Journal of Asian Economics*, Vol. 13, pp. 1-26

[31] Hong, J-C. (1994), "Technology Transfer and Human Resource Development. Industrial and Commercial Trainning", *MCB University Press*, Vol. 26 No. 11, pp. 17-21.

[32] Kelloway, E. K. (1998). *Using LISREL for structural equation modeling: A researcher's guide*. Sage.

[33] Kumar, V., Kumar, U. and Persaud, A. (2003), "Building Technological Capability through Importing Technology: the Case of Indonesian Manufacturing Industries", *Journal of Technology Transfer*, Vol. 24, pp. 81-96.

[34] Landry, R., Amara, N. and Rherrad, I. (2006), "Why are some university researchers more likely to create spin-offs than others? Evidence from Canadian universities", *Research Policy*, Vol. 35, No. 10, pp. 1599-1615.

[35] Liebrenz, M.L. (1982), "Transfer of Technology: US Multinationals and Eastern Europe", New York, Praeger Publisher",

[36] Lee, Y.S. (1997), "Technology Transfer and Public Policy", Quorum Books, Westport Connecticut, London.

[37] Lee, Y.S. (2000), "The Sustainability of University-Industry Research Collaboration: an Empirical Assessment", *Journal of Technology Transfer*, Vol. 25, No. 2, pp. 111-133.

[38] Marcotte, C. and Niosi, J. (2000), "Technology Transfer to China The Issues of Knowledge and Learning", *The Journal of Technology Transfer*, Vol. 25, No.1, pp. 43-57.

[39] 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.

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

[41] Padmadinata, U.H., Sugarmansyah, U. and Nurzall, R. (2006), "Kemampuan Pengembangan Teknologi dan Permasalahannya (Technology Development Capability and Issues)", Kongres Ikatan Sarjana Ekonomi, Jakarta.

[42] Porter, M.E. (2001), "Competitive Advantage: Creating and Sustaining Superior Performance", The Free Press (Revision)

[43] Rahm, D., Bozeman, B. and Crow, M. (1988), "Domestic Technology Transfer and Competitiveness: an Empirical Assessment of Roles of University and Government R&D Laboratories", *Public Administration Review*.

[44] Rogers, E.M. (2003), "Diffusion of Innovations.", New York: Free Press.

[45] Samli, A. C. (1985), "Technology Transfer: Geographic, Economic, Cultural, and Technical Dimensions", Westport, Conn. Quorum Books.

[46] Samudro, H., M. Faqih, E. Sudarma. (2011). Green architecture criteria for high-rise building that serves as a rental office in the city of Surabaya. Journal of Applied Sciences Research 7(5): 566-571.

[47] Samudro, G. and Mangkoedihardjo, S. (2006). Water equivalent method for city phytostructure of Indonesia. International Journal of Environmental Science and Technology, 3(3), 261-267.

[48] Sandvig, J. C. (2000), "The Role of Technology in Small Firm Diversification", *The Journal of Technology Transfer, Vol. 25*, No.2, pp. 157-168.

[49] Schlie. (1996), "The Contribution of Technology to Competitive Advantage", Handbook of Management of Technology, McGraw Hill.

[50] Singh, P.J. (2002), "A Study of Theoretical and Empirical Bases of Operationalising Popular Quality Management Approaches in Manufacturing Organizations in Australia", Dissertation, The University of Melbourne.

[51] Singh, P. J. and Smith, J.R. (2004), "Relationship between TQM and Innovation: an Empirical Study", *Journal of Manufacturing Technology Management* Vol. 15, No. 5. pp. 394-401.

[52] Spivey, W.A., Munson, J.M., Nelson, M.A. and Dietrich, G.B. (1997), "Coordinating the Technology Transfer and Transition of Information Technology: A Phenomenological Perspective", IEEE Transaction on Engineering Management.

[53] Surachman. (2005), "Pengaruh Manajemen Skill terhadap Orientasi Bisnis (The Impact of Skill Management on Business Orientation)", Dissertation. Airlangga University.

[54] Thee, K.W. (1985), "Kaitan-Kaitan Vertikal Antar Perusahaan dan Pengembangan Sistem Subkontraktor di Indonesia: Beberapa Hasil Studi Permulaan (Vertical inter-firm lingkages and the evelopment of subcontracting system in Indonesia: some case studies)". *Masyarakat Indonesia*, Vol.12, pp. 219-213.

[55] Thursby, J. G., Jensen, R. and Thursby, M.C. (2001), "Objectives, Characteristics and Outcomes of University Licensing: A Survey of Major U.S. Universities", *Journal of Technology Transfer*, Vol. *26*

[56] Thursby, J. and Kemp, S. (2002), "Growth and Productive Efficiency of University Intellectual Property Licensing", *Research Policy*, Vol. 31, pp.109-124.

[57] Tjahjadi, M.E., Handoko, F., Sai, S.S. (2017), "Novel image mosaicking of UAV's imagery using collinearity condition" *International Journal of Electrical and Computer Engineering*, 7 (3), pp. 1188-1196. DOI: 10.11591/ijece.v7i3.pp1188-1196

[58] Tjahjadi, M.E., Handoko, F. (2017), "Single frame resection of compact digital cameras for UAV imagery" *4th International Conference on Electrical Engineering, Computer Science and Informatics, EECSI 2017*. DOI: 10.1109/EECSI.2017.8239147.

[59] Tjahjadi, M.E., Handoko, F. (2017), "Precise wide baseline stereo image matching for compact digital cameras" *4th International Conference on Electrical Engineering, Computer Science and Informatics, EECSI 2017*. DOI: 10.1109/EECSI.2017.8239106.

[60] Tracey, M. (1999), "Manufacturing Technology and Strategy Formulation: Keys to Enhancing Competitiveness and Improving Performance", *Journal of Operation Management*, Vol, 17, pp. 411-428.

[61] Wei, L. (1995), "International Technology Transfer and Development of Technology Capabilities: A Theoretical Framework", Technology society Vol.17, No.1, p. 103, in Kremic, T., 2003; Technology Transfer: A Contextual Approach. *The Journal of Technology Transfer, Vol. 28, No.* 2, pp. 149-158.

[62] Wijayanto, S.H. (2008), "Structural Equation Modelling with LISREL 8.8, Concept and Tutorial", Graha Ilmu, Jogjakarta.

[63] Xenophon A.K. (2002), "Integrated Product Development Practices and Competitive Capability: the Effect of Uncertainty, Equivocality, and Platform strategy", *Journal of Operation Management*, Vol. 20, pp. 331-355.

[64] Zack, M.H. (1999), "Developing a Knowledge Strategy", California Management Review, Vol. 41 No.3, pp. 125-145 in Becerra et al, 2004. Knowledge Management: Challenges, Solutions, Technologies, Pearson, Prentice Hall.

[65] Zucker,L. (1998), "Intellectual Human Capital and the Birth of U.S. Biotechnology Enterprises", *American Economic Review*, Vol. 88, No.1, pp.290-306.

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