

THE MEDIATING EFFECT OF ABSORPTIVE CAPACITY ON THE RELATIONSHIP BETWEEN SOCIAL CAPITAL AND TECHNOLOGY TRANSFER PERFORMANCE

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ABSTRACT

Social capital and absorptive capacity were highlighted as crucial to ensure the realization of the success of technology transfer. The study presented in this article investigate the effect of social capital and absorptive capacity on technology transfers performance by focusing on the technology advantages as the output of the transfer activities. Hypotheses were developed and tested by using data gathered through a survey on high technology companies operating in Malaysia technology parks. Correlation and regression analysis were executed by using SPSS 19. Based on the results of the study, social capital appears to be a prerequisite for the realization of technology transfer as it is the unique interconnectivity of human capital which will provide some technology players with an advantage over those who are not so well-connected. It was found that both social capital and absorptive capacity have significant effect on the performance of technology transfer. The findings also indicated that the elements of absorptive capacity mediate the effects of social capital on technology advantages in terms of relational and cognitive dimension. This study possibly will contribute in enhancing the performance of technology transfer especially in terms of the firm's human resource capability and management capability.

Key words: *technology advantages, social capital, absorptive capacity, technology transfer, high technology industry.*

INTRODUCTION

Technology is determinant of innovation and knowledge generation therefore having modernized technology is essential for business firms to remain competitive in energetic and dynamic business landscape today. As technological development is progressing rapidly, firms must respond quickly to the emergence of new technologies. For this reason, it is important for the firms to be involved in technology transfer, especially when firms' ability in internal research and development is limited (Jagoda, Maheshwari, & Lonseth, 2010; Noor, 2010).

Towards flexible transfer of knowledge and technology, various efforts have been taken by the government. One of the great movements is by looking at the success of technology parks for innovation opportunities. Technology parks were developed as an evolutionary process and must be done together with the production-based economy.

According to Sarif, (2008), the government has established Malaysia technology parks through conventional planning process which then assimilates under the Eighth Malaysia Plan (2001-2005) and was continued in the Ninth Malaysia Plan (2006-2010). These were aligned with the aims of Malaysian's Science and Technology Policy to take full advantage of the utilization and development of science and technology as a device for nourishing economic expansion.

This paper discusses on technology transfer performance and focuses on the important firm-specific assets which are absorptive capacity and social capital. The purpose is to provide empirical validation on the relationships and influence of these variables on technology transfer performance.

LITERATURE REVIEW

Technology Transfer

In this paper technology transfer is defined as the movement theoretical and practical knowledge, the movement of skills, the movement of system of government and physical structure that can be used to develop products and services as well as production and delivery systems from the location where it was generated to the receiving location (Mitelman & Pasha, 1997; Li-Hua & Lu, 2013). Normally, firms transfer technology with the purpose to build products and services to achieve their business objectives. Li Hua (2006) highlighted that the performance of technology transfer can be indicated by the firm's capability to attain its goals or aims of the technology transferred.

According to Whangthomkum, (2006), there are three mutual objectives that firms expect to attain from end to end of technology transfer which are the primer of different or new techniques, the enhancement of different or new techniques and the generation of different or new knowledge. There are multiple outcomes from a success technology transfer process. The end result of a success technology transfer not only limited to having the skill to operate, retain or repair the machineries in the production level but a success technology transfer also may improve the firm's human resource capability and management capability. These include the ability to learn, acquire, absorb and apply new external technologies. The firm should be able to get hold of knowledge implanted in product materials, physical assets, processes and production, (Rose et al., 2009). These probably will improve the company's technological capabilities.

High technology capabilities will assist the firms in generating projected products that reach the requisite quality level. Accordingly it will support in reaching the firms'

production efficiency goals. For that reason this study focused more on technology advantages such as the increased in technological capabilities, increase the management skill and capabilities, the ability to manage acquired technology and increased innovation rates.

Social Capital

Social capital comes into passionate development in the late 1990s. Nahapiet and Ghoshal (1998) describe social capital as the resources available and potentially available from the network of relationships found in the individual or community. Putnam (2000) describes social capital as the link or network of relations, activities or associations that bind people together as a community through definite norms and inner competencies particularly trust. These elements are important for civil society, and productive of future collective action. Social capital is a surrounding substance of various social relations, joint with certain normative and cognitive social institutions that support collaboration and mutual benefit, wherein the density of matrices raise with closeness (Camison & Fores, 2010).

Although the concept of social capital has found extensive recognition, there remains widespread vagueness about its meaning and effects (Koka & Prescott, 2002). Social capital has many elements associated with complicated social context. It covers many aspects of the social context for example social bonds, believing or trusting relationships, value structures that enable actions of individuals, it is therefore important to clarify the dimensions of social capital as has been deliberated by a number of scholars (Coleman, 1988; Putnam, 1995; Nahapiet & Ghoshal, 1998, etc.), (Tsai & Ghoshal, 1998).

For the purpose of this study, three dimensions of social capital proposed by Nahapiet and Ghoshal (1998) was adopted. These dimensions are structural social capital, relational social capital, and cognitive social capital. According to Nahapiet and Ghoshal (1998) the structural social capital is the dimension of social capital which designates the structure of linkages between people within group or organization which include network connectivity, network patterns and organization relationships. While the relational social capital is the dimension of social capital which designates the sort of personal relationships people have established with each other through a times past of communications which include the elements such as trust, norms, obligations and recognition. The cognitive social capital is the dimension of social capital which is about those resources providing shared representations, understandings and systems of meaning which include common language, coding and narrative.

Absorptive Capacity

Technology transfer involved the process of diffusion and absorption of knowledge. Therefore absorptive capacity is a useful conceptual device in order to understand the success of technology transfer (Sazali et. al., 2009).The concept first appeared as important in the 1980s, with the acquisition and application of new knowledge as the fundamental role in business competitiveness. A study by Cohen & Levinthal (1990) is

in general accepted as the founding paper. Based on the study, absorptive capacity is defined as the ability of a firm to identify the value of new external information, assimilate it, and apply it to commercial ends. In the context of technology transfer, absorptive capacity is related to firm's affectionateness to technological change (Kedia & Bhagat, 1988).

Besides that, Zahra and George (2002) acknowledged absorptive capacity as a dynamic capacity embedded in routine and processes. They grouped the four dimensions of absorptive capacities into two main categories those are potential capacities and realized capacities. Potential capacities include knowledge acquisition and assimilation of knowledge whereas realized capacities include transformation and exploitation of knowledge. The extended model of absorptive capacity by Zahra and George (2002) maintained that former knowledge, which is corresponding to a firm's experience, is essential to develop absorptive capacity. Moreover, they put emphasis on other factors, for example external knowledge sources and corresponding external knowledge, are equally important.

Although the outcomes from prior studies on technology transfer in Malaysia (Noor, 2010; Sazali, et. al., 2009; Sarif & Ismail, 2006; Abidin et al. 2012) emphasized that the increase in absorptive capacity has positive influence on the success of technology transfer. Still, the studies on absorptive capacity are varied and some of the studies are on conceptual bases that necessitate for more empirical studies. Hence, this study includes internal social capital and absorptive capacity to provide empirical verification on the relationships and influence of these variables on technology transfer performance. Pull together from the literature review and discussion a research framework was developed (Figure 1).

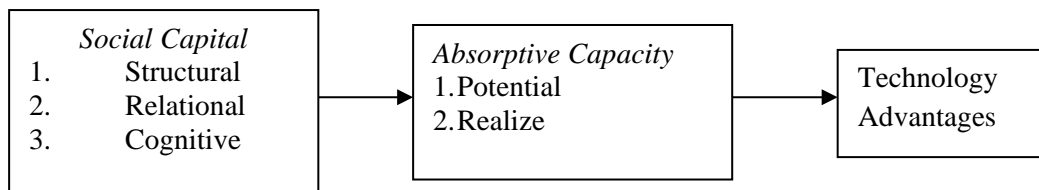


Figure 1
Research Framework

Based on the research framework the following hypotheses are formulated.

Hypotheses statements on the mediating effect of potential capacity

H_A *Potential Capacity mediate the relationship between social capital and technology transfer performance*

H_{A1} Potential Capacity mediates the relationship between structural and technology advantages.

- H_{A2} Potential Capacity mediates the relationship between relational and technology advantages.
- H_{A3} Potential Capacity mediates the relationship between cognitive and technology advantages.

Hypotheses statements on the mediating effect of realize capacity

- H_B *Realize capacity mediates the relationship between social capital and technology transfer performance*
- H_{B1} Realize capacity mediates the relationship between structural and technology advantages
- H_{B2} Realize capacity mediates the relationship between relational and technology advantages.
- H_{B3} Realize capacity mediates the relationship between cognitive and technology advantages.

METHODOLOGY

Data of this study was gathered through a survey conducted on high technology industry operating in four Malaysia technology park. These technology parks have been in operation for more than ten years. Based on the information gathered, the total companies located in the four selected technology parks give a target population of 518 companies. From the target population, desired sample size was determined. Within each technology park, a simple random sample of the companies was selected. A total of 358 respondents were needed in order to get 95 per cent of confidence level. However only 97 were returned, and out of 97 only 90 were completed and can be used for data analysis. Although the response rate is low, 25.13%, it is acceptable as response rate of studies in Malaysia especially which used company as it unit of analysis can be as low as 9% (Noor, 2010).

A set of close ended questionnaire which divided into four sections was developed. The first section was to obtain the background details of the firm and the respondent. The second section was developed to gather information about technology transfer performance of the firms in terms of technology advantages. The other two sections were developed to gather information on the independent and mediating variables. Seven-point scale was used to measure all items for each variable.

The data was screened and prepared for hypotheses testing. Factor analysis and reliability test were done to confirm the validity and reliability of the instrument used. The Kaiser-Meyer-Olkin (KMO) values are more than 0.6 and the Bartlett's test of sphericity are significant for each variable confirming the factorability of the dimensions. The alpha values of reliability analysis for each variable range from 0.734 to 0.942 which are more than 0.6, therefore it can be established that the instrument is reliable.

ANALYSIS AND FINDING

Regression analyses were used to organize the hypothesis testing. In this study multiple regression analysis was used to predict the variations in the dependent variables in response to change in the independent variables. Regression analysis was done to test on the hypothesis regarding dimension of social capital and absorptive capacity whether they have some sort of relationships with technology transfer performance.

This study followed the test standard proposed by Baron and Kenny (1986), Judd and Kenny, and James and Brett (1984) to examine the existence of mediating effect. This standard established that four conditions must be encountered to identify the existence of mediating factor between the dependent variables and the independent variables. Firstly, the independent variables must affect the dependent variables; this condition establishes that there is an effect that possibly will be mediated. The second condition is the independent variables must affect the mediating variables; this condition essentially involves treating the mediating variables as if it were a dependent variable; the mediating variables must affect the dependent variables. If one of these conditions is not fulfilled, it can be concluded that mediation is not possible.

The third condition is to establish the effect of the mediating variables on dependent variables. The independent variable must be controlled because it is not sufficient just to correlate the mediating variables with dependent variables as the mediating variables and the dependent variables may be correlated because they were both caused by the independent variables. The fourth condition is established by examining the change occurs in the effect of the independent variables on dependent variable. The concurrent effect of the independent variables and the mediating variables on the dependent variables is smaller than the individual effect of the independent variables on the dependent variables. The effects in both third and fourth conditions are estimated in the same equation. The summaries of these regression analyses are provided in Table 1 until Table 4.

Table 1
Regression analysis between Social Capital (IV) and Technology Transfer Performance (DV) (Condition I)

IV	DV	Coefficient (β)	F	R^2
Structural	Technology advantages	0.773***	130.340***	0.597
Relational	Technology advantages	0.507***	30.457***	0.257
Cognitive	Technology advantages	0.380***	14.828***	0.144

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Table 1 provides the summary of regression analyses which conducted to identify whether the independent variable (social capital dimensions) directly influence the dependent variables (technology transfer performance). Although there are varieties of

significant levels, the results show that all the independent variables have significant positive influence on all the dependent variables. The outcomes established that there are effects that may be mediated.

Table 2
Regression analysis between Social capital (IV) and Absorptive Capacity (Mediating variable) (**Condition II**)

IV	DV	Coefficient (β)	F	R ²
Structural	Potential Capacity	0.604***	50.510***	0.365
	Realize Capacity	0.539***	36.123***	0.291
Relational	Potential Capacity	0.530***	34.439***	0.281
	Realize Capacity	0.451***	22.478***	0.203
Cognitive	Potential Capacity	0.462***	23.819***	0.213
	Realize Capacity	0.557***	39.492***	0.310

*** p<0.001, **p<0.01, *p<0.05

Table 2 shows the summary of regression analyses to identify the effects of the independent variable (social capital dimensions) on the mediating variables (absorptive capacity). The results approve that all the independent variables have significant positive influence on the mediating variables with p<0.001 level of significant. Therefore, condition I and condition II are fulfilled.

Table 3 and Table 4 recapitulate the results of multiple regressions on the independent variables, mediating variables and dependent variables. They provide information to examine the occurrence of Condition III and Condition IV. Table 3 provides the results of regression analyses conducted to examine the mediating effect of potential capacity on the relationship between social capital dimensions and technology transfer performance dimensions. While Table 4 provides the results of regression analyses conducted to examine the mediating effect of realize capacity on the relationship between social capital dimensions and technology transfer performance dimensions.

Table 3
Regression analysis about Social capital (IV) and Potential Capacity (Mediating variable 1) to Technology Transfer Performance (DV) (**Condition III and IV**)

Hypothesis	IV	DV	Coefficient (β)	F	R ²
H _{A1}	Structural	Technology	0.731***	65.253***	0.600
	Potential Capacity	Advantages	0.069		

H _{A2}	Relational	Technology	0.329**	22.247***	0.338
	Potential Capacity	Advantages	0.336**		
H _{A3}	Cognitive	Technology	0.183	17.517***	0.287
	Potential Capacity	Advantages	0.426***		

*** p<0.001, **p<0.01, *p<0.05

The existence of mediating effect can be determined by comparing the results of regression analyses between IVs and DVs when the regression analyses were conducted without mediator (Table 3) and the results of regression analyses between IV and DV when the regression analyses were conducted with Mediator (Table 3 and Table 4). If the influence of Mediator on DV is statistically significant in Table 3 and Table 4, then the interpretation is that the Mediator mediates the relationship between IV and DV. If the relationships between IV and DV become not significant with the introduction of the mediator, then the interpretation is that mediator fully mediates the relationship. If the relationship between IV and DV is statistically significant, then the interpretation is that mediator partially mediates the relationship (Shaver, 2005, Ramayah & Ignatius, 2010).

Table 3 reveals that the influence of Potential Capital and Relational Dimension on Technology Advantages are statistically significant ($\beta=0.336$, $p<0.01$ & $\beta=0.329$, $p<0.01$), this result confirms that Potential Capacity has partially mediates the relationship between Relational Dimension and Technology Advantages. Hence, the result supports H_{A2}. It is found that the Potential Capacity has significant effect on the relationship between Cognitive Dimension and Technology Advantages ($\beta=0.426$, $p<0.001$). Hence, the influence of Cognitive Dimension on the Technology Advantages is not significant ($\beta=0.183$, $p>0.05$) when Potential Capacity was included in the regression analysis. This confirms that potential capacity has fully mediates the relationship between cognitive dimension and technology advantage and this support H_{A3}. However, the influence of Potential Capacity on Technology Advantages when the regression analysis was conducted with Structural Dimension is not significant, therefore hypotheses H_{A1} are not supported. In summary, it is found that Potential Capacity has moderating effect on the relationship between Relational Dimension and Technology Advantages; relationship between Cognitive Dimension and Technology Advantages.

Table 4

Regression analysis about Social capital (IV) and Realize capacity (Mediating variable 2) to Technology Transfer Performance (DV) (**Condition III and IV**)

Hypothesis	IV	DV	Coefficient (β)	F	R ²
H _{B1}	Structural	Technology Advantages	0.704***	67.563***	0.608
	Realize Capacity		0.127		
H _{B2}	Relational	Technology Advantages	0.350***	23.843***	0.354
	Realize Capacity		0.349**		

	Cognitive	Technology	0.142		
H _{B3}	Realize Capacity	Advantages	0.428***	16.129***	0.270

*** p<0.001, **p<0.01, *p<0.05

Table 4 summarizes the results of regression analyses those were conducted to examine the mediating effect of realize capacity on the relationship between social capital dimensions and technology transfer performance dimensions. From Table 5, it is evidence that the independent variable (relational dimension) and the mediating variable (realize capacity) have significant effect on dependent variable (technology advantage) ($\beta=0.350$, $p<0.001$ & $\beta=0.349$, $p<0.01$). This result confirms that Realize Capacity partially mediates the relationship between Relational Dimension and technology advantages. Hence, the result supports hypothesis H_{B1}.

The results indicated that realize capacity fully mediates the effects of Cognitive Dimension on Technology Advantages ($\beta=0.428$, $p<0.001$). In summary, it is found that realize capacity has moderating effect on the relationship between relational dimension and technology advantages; relationship between cognitive dimension and technology advantages; relationship between cognitive dimension and production performance; and relationship between cognitive dimension and business performance These findings support hypotheses H_{B2} and H_{B3}. Table 5 summarize the results of hypotheses H_A and H_B.

Table 5
Finding of the hypotheses H_A and H_B

Hypothesis	Hypothesis Statement	Remarks
<i>Mediating effect of potential capacity</i>		
H _{A1}	Potential Capacity mediates the relationship between structural network and technology advantages.	Not supported
H _{A2}	Potential Capacity mediates the relationship between relational and technology advantages.	Supported
H _{A3}	Potential Capacity mediates the relationship between cognitive and technology advantages.	Supported
<i>Mediating effect of realize capacity</i>		
H _{B1}	Realize capacity mediates the relationship between structural network and technology advantages	Not supported
H _{B2}	Realize capacity mediates the relationship between relational and technology advantages.	Supported
H _{B3}	Realize capacity mediates the relationship between cognitive and technology advantages.	Supported

DISCUSSION

The result reveals that social capital dimensions have strong positive relationship with potential capacity and realize capacity supporting H₂ of the study. Step 3 is to show that Potential Capacity and Realize Capacity (Mediating Variables) effect the dimensions of Technology Transfer Performance (Dependent Variables) with the dimensions of Social Capital (Independent Variable) being controlled to establish the mediating effect of mediators which is Step 4. Hence, the estimation of the effects of Step 3 and Step 4 are delivered in the same equation. Figure 2 demonstrates the results of each step in establishing the mediating effect of Potential Capacity on the relationships between Social Capital dimensions and Technology Advantages.

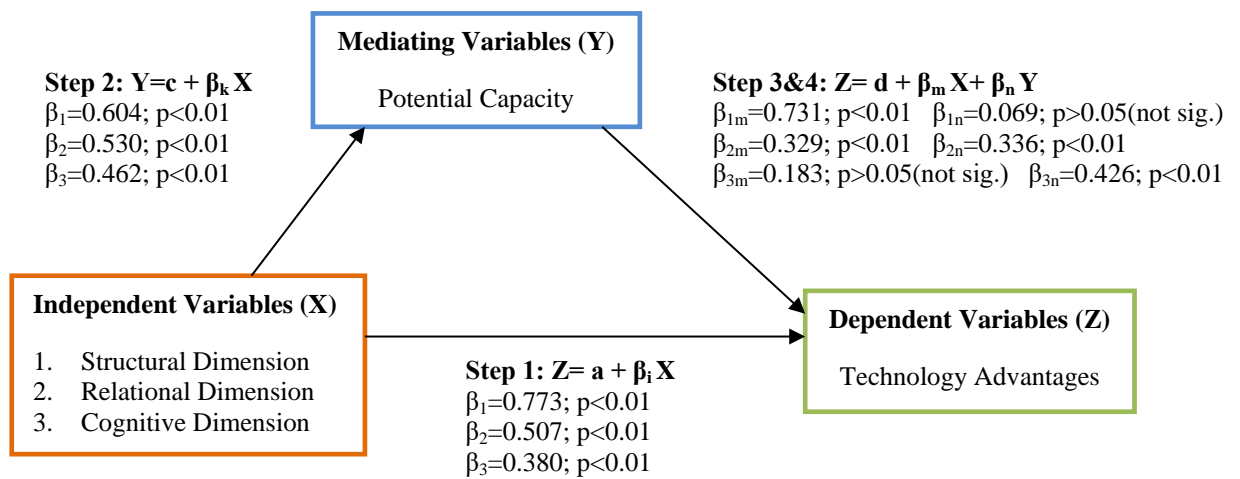


Figure 2
Mediation of Potential Capacity on Social Capital Dimensions and Technology Advantages

Figure 2 shows that all the relationships are significant in Step 1 and Step 2 which tolerate the analysis to proceed to Step 3 and Step 4. In step 3 and 4, when Relational Dimension and Potential Capacity are regressed together on Technology Advantages, Potential Capacity is significant ($\beta_{2n} = 0.336; p < 0.01$) fulfilling Step 3 (supporting H_{A2}) besides, Relational Dimension also significant ($\beta_{2m} = 0.329; p < 0.01$).

The result proven that there is partial mediating effects of Potential Capacity on the relationship between Relational Dimension and Technology Advantages. As well, when Cognitive Dimension and Potential Capacity are regressed together on Technology Advantages, Potential Capacity is significant ($\beta_{3n} = 0.426; p < 0.01$) fulfilling Step 3 (Supporting H_{A3}) while Cognitive Dimension is not significant ($\beta_{3m} = 0.183; p > 0.05$ (not sig.)). Consequently, Potential Capacity was proven to be a full mediator between Cognitive Dimension and Technology Advantages. On the other hand, Potential Capacity does not have any significant influence on Technology Advantages when regressed together with Structural Dimension (not supporting H_{A1}).

Figure 3 demonstrates the results of each step in establishing the mediating effect of Realize Capacity on the relationships between Social Capital dimensions and Technology Transfer Performance dimensions.

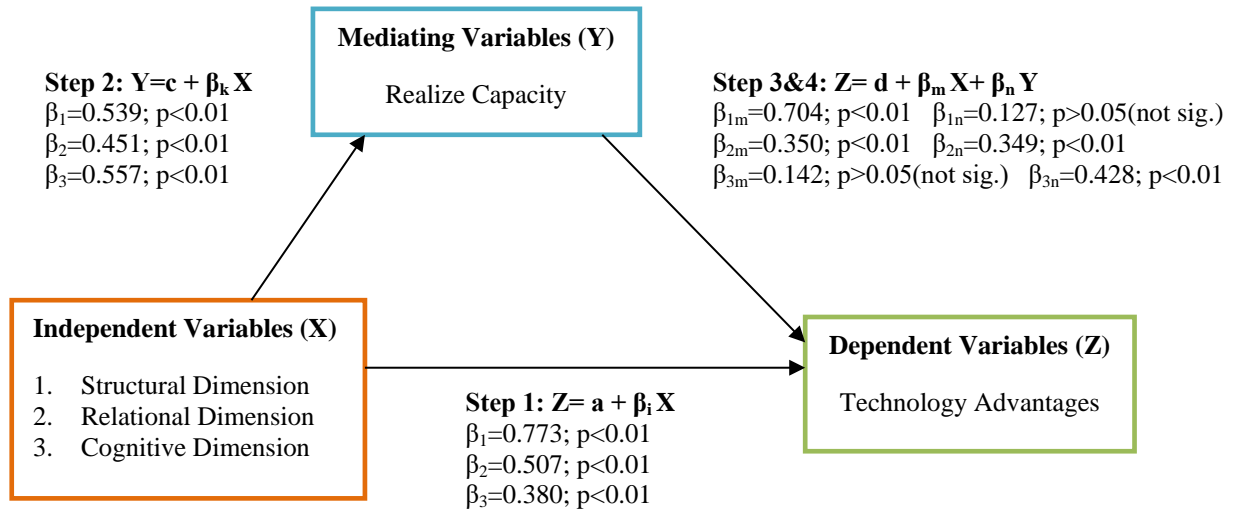


Figure 3
Mediation of Realize Capacity on Social Capital Dimensions and Technology Advantages

Figure 2 discloses that all the relationships are significant in Step 1 and Step 2 which tolerate the analysis to proceed to Step 3 and Step 4. In step 3 and 4, when Relational Dimension and Realize Capacity are regressed together on Technology Advantages, Capacity is significant ($\beta_{2n} = 0.349; p < 0.01$) fulfilling Step 3 (supporting H_{4B2}) besides, Relational Dimension also significant ($\beta_{2m} = 0.350; p < 0.01$). The result proven that there is partial mediating effects of Realize Capacity on the relationship between Relational Dimension and Technology Advantages. As well, when Cognitive Dimension and Realize Capacity are regressed together on Technology Advantages, Realize Capacity is significant ($\beta_{3n} = 0.426; p < 0.01$) fulfilling Step 3 (Supporting H_{B3}) while Cognitive Dimension is not significant ($\beta_{3m} = 0.183; p > 0.05$ (not sig.)). Consequently, potential capacity was proven to be a full mediator between cognitive dimension and technology advantages. On the other hand, Realize Capacity does not have any significant influence on Technology Advantages when regressed together with Structural Dimension (not supporting H_{B1}).

CONCLUSION

This paper revealed the importance of two essential internal factors to enhance the performance of technology transfer namely social capital and absorptive capacity. The influence of social capital and absorptive capacity on technology transfer performance was examined by developing model that identifies three dimensions of social capital. In

detail, the study provides an empirical test on the influence of these variables on one of the most important outcome of technology transfer that is technology advantages. It discourses the social capital as the factors which influence the success of technology transfer with absorptive capacity interface. This study follows the line proposed by Abidin et al (2012), by propositioning absorptive capacity as mediator of the effect of social capital on the performance of technology transfer.

Based on the results of the study, social capital appears to be a prerequisite for the realization of technology transfer as it is the unique interconnectivity of human capital which will provide some technology players with an advantage over those who are not so well-connected. The strong influence of structural dimension lead us to conclude that the configuration of linkages between people within organization assist in access to knowledge among network members which is important to the accomplishment of technology transfer. The findings are accordance with the previous studies by Li and Zhu (2009) and Rad et. al (2011) which highlighted the importance of social capital in the element of technology transfer. Therefore, it is believed that firms which have created a favorable context in the relationship between organizational leverage potentially to achieve high performance of technology transfer.

Besides that, absorptive capacity which is an edifice of routines or the firms' ability through which they acquire, assimilate, transform and exploit the technological knowledge (Selmi, 2013) also plays an important role in ensuring the success of technology transfer. From the findings, it can be concluded that the elements of absorptive capacity mediate the effects of social capital on technology advantages in terms of relational and cognitive dimension. These explain that the element of social capital such as trust, norms, recognition, common language and narrative potentially increase the performance of technology transfer with the present of the ability to identify and assimilate new external knowledge and the ability to transform and exploit new knowledge.

There are multiple outcomes from a success technology transfer process. The various roles in technology transfer may be driven by different goals of the individuals and organization. In other words, these various perspectives generated a large number of potential measures. According to Amin (2005), an effective technology transfer will satisfy several criteria such as economic sustainability, social acceptability, environmental abatement or mitigation sustainability, and technological sustainability. However, this study focused only on technology advantages as the outcome of the technology transfer. Therefore, further study could test more on other potential measures of technology transfer performance.

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