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The Level of Absorptive Capacity among Contractors in Technology Transfer Project: Electrical Train Service (ETS), Malaysia

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Abstract

In a global competitive environment, technical changes are rapid, volatile and very complex. Nowadays, technology is labelled as a weapon towards organization for performance and productivity, which made absorptive capacity (ACAP) an important aspect. Absorptive capacity refers to an organization's ability to recognize, capture, assimilate, transform and exploit the new technology within the organization. In order, to allow technology transfer to be successful, the organization is required to have a strong ACAP. However, a previous study has outlined that the level of ACAP in the construction industry is relatively low and this has made the technology transfer process in the industry very challenging. Thus, this research aims to explore the ACAP level and technology transfer activities in a construction project. The objectives of this paper are to identify the factors that enhance ACAP in the technology transfer process, to measure the level of ACAP in the technology transfer process and to identify a suitable suggestion in order to improve ACAP in the technology transfer process. 35 contractors from the electric double track (ETS) project, in Segamat have been involved, with a 35% of respond rate. The contractors from the ETS project have been chosen as the project is known as a mega project and has involved various foreign technology and experts, which allow technology transfer to happen actively. Questionnaires are used as the research instrument and descriptive data analysis is conducted using the Statistical Package for the Social Sciences (SPSS) version 25. The findings show that the organizational factors contribute a significant influence towards ACAP in the technology transfer process. The ACAP level that is experienced by the respondents contribute towards good work performance, while the communication and skills aspect are to increase the level of ACAP in the technology transfer process. Based on the findings of this study, the organizations, contractors, academics, and others need to alert and view one of these issue as an important problem and to establish further cooperation in maintaining the level of absorptive capacity of new technology in the process of technology transfer in order to achieve optimal levels over a period of time.

Keywords: Malaysia, absorptive capacity, technology transfer, contractors

1.0 INTRODUCTION

In the era of globalization, Malaysia's construction industry plays a crucial role in the nation and economic growth. Currently, the industry encourages the construction players to implement foreign technology at work to promote productivity, efficiency, output quality and values; Malaysia's construction industry is required to improve its construction practice, management skill, as well as the current technology state so as to allow its players to widen their marketplace. However, Azman et al. (2014) outline that the construction industry doesn't show much improvement in the technological aspect, which make the technology transfer (TT) in the industry passive. TT is defined as a transferring process of skill, knowledge, tools from one person to another person or from one place to another (Uusitalo, 2013). Inkpen and Dinur (1998) highlighted that TT had been widely used from various sectors in order to improve the current technological state, employee competencies and organization productivity. A successful TT process will enhance technology expertise, compactivities and organization performance. Therefore, at this moment, the competent worker is a valuable asset within an organization.

Despite that, TT has a widen technology usage in the construction industry especially in an infrastructure project (Stewart & Waroonkun, 2007). An infrastructure project is usually labeled as a mega project that is involved with complex and the latest technology in the market (Sexton & Barrett, 2003). One of the TT projects in Malaysia is the MRT project, which is a public transportation project that involves the technological aspect that helps to control the air pollution and congestion issue in Malaysia.

However, most of the Malaysian contractors are still reliant on non-skill and foreign labour due to financial aspect (Kakhki & Palvia, 2016). Idris et al. (2014) outline that most contractors are hardly exposed to the latest technology or technological knowledge due to the lack of the technological expert presence (Peetawan & Suthiwartnarueput, 2018). Pitt et al. (2009) have indicated that the perception of the Malaysian Construction Practitioners towards implementing and adopting new technologies in the construction industry is to be considered in a short-term view, rather than the long-term. Bernama (2018) has reported that the local contractors encounter challenges in completing

the design stage at the designated time due to insufficient skills, knowledge, and the equipment to carry out the work. Thus, the emphasis of TT in the industry is required in order to allow active technology usage, to produce technology expert and to reduce workload in the industry (Kamal & Flanagan, 2014). Nonetheless, the current research focuses on the rail project in Malaysia – as the project is the best training platform for graduates and skilled workers in rail technology, which is a large-scale infrastructure project that is being implemented in the country (Daily News, 2018). Moreover, the ETS project has also required foreign technology which allow TT to be applied (Stewart & Waroonkun, 2007). Therefore, this research aims to identify the ACAP factors among the contractors in the TT process, to measure the ACAP among the contractors in the TT process and to assess the suitable alternatives for ACAP improvement among the contractors in the TT process, for the construction project of the Electricity Twin track Gemas-Johor Bahru (ETS), in Segamat.

■2.0 LITERATURE REVIEW

In previous studies, most of the research explores ACAP on large organizations that are equipped with the workforce, finance, sophisticated structure, and R&D facilities (Liao et al., 2003). Financial aspect and R&D facilities are known as the effective ways for organizations to build their background knowledge, competitive advantages and to enhance the ACAP level (Lane & Lubatkin, 1998). Kodama (2008) states that ACAP is an important aspect towards the TT process that is to be implemented between universities, industries and organizations; ACAP is usually measured by the financial aspect, R&D facilities and the number of patterns (Omar et al., 2012). This research has been conducted at the ETS project-Gemas, to explore the ACAP and TT practice in the construction project.

2.1 ETS Project Gemas

This study comprises 150 high-skilled manpower of Bumiputera contractors at the twin electric train construction project in the Gemas District to Johor Bharu (Yusof, 2017). The contractors who are involved in this project represent the respondents to this study. This project is chosen due to the ACAP between the skilled workforce (local contractors and international contractors) who are involved during the Building Information Modeling (BIM) practice, railway control, railway construction, power management control, and the SCADA system in adopting of a new technology. Figure 1 shows the location map of the construction of a twin electric train project from Gemas to Johor Bahru.

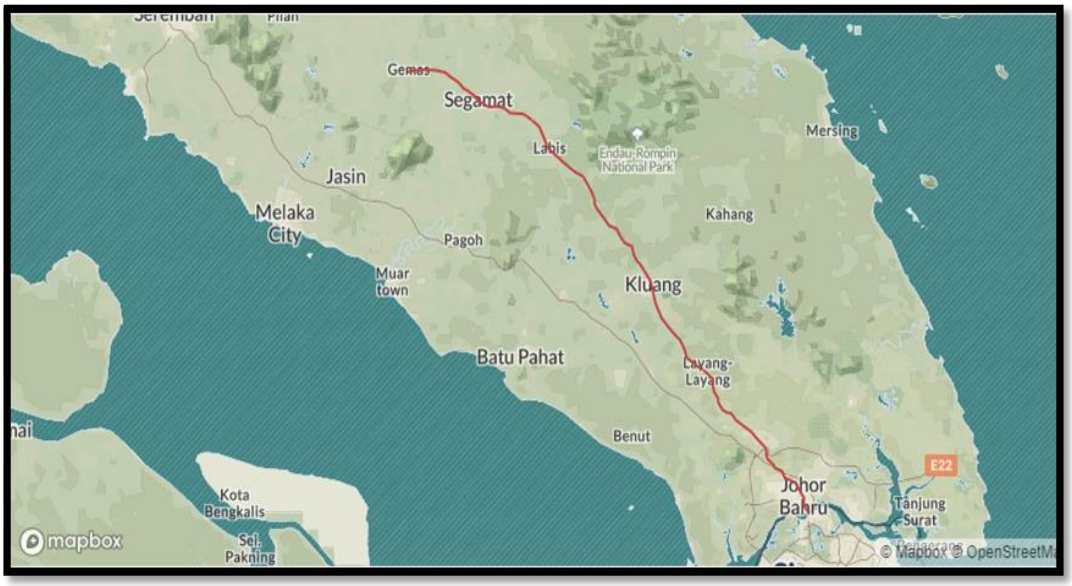

Figure 1 Location map of Gemas-Johor Bahru twin electric project

2.2 Absorptive Capacity

Absorptive capacity (ACAP) is defined as an organisation's ability to recognise, capture, assimilate, transform and exploit the new technology within the organisation (Zimmerman et al., 2007). In order words, to allow TT to be successful, the organisation is required to have a strong ACAP in the organisation. Omar et al. (2011) opine that ACAP is the best medium of organisations to gain and update their knowledge regarding the latest technology in the marketplace. Communication in the organisation is required for efficiency as it allows the TT process and ACAP to take place (Kuznetsov & Yakavenka, 2005). However, TT in the construction industry is usually exposed to critical communication issues due to the fact that many organisations have different background and different level of understanding (Uusitalo, 2013). According to Sexton and Barrett (2003), the organisation aspect usually becomes the barrier in TT as it is usually involved with a lack of technical staff, the lack of knowledge, management incompetency and the lack of provided training.

Omar et al. (2012) outline that ACAP in an organisation requires technical information and skills, management and facilities that enable the organisation to efficiently use equipment and technology. ACAP in the construction industry will allow the contractors to appreciate, understand and evaluate environmental changes (Liao et al., 2003), as well as to promote a lesser number of injuries and accidents, reduce less wastage and to enhance productivity in the construction site (Kuznetsov & Yakavenka, 2005). Therefore, the high ACAP level in CI helps the contractors to be more proactive and responsive. In previous research, the financial aspect and R&D facilities are considered to be the best alternative to allow ACAP activities (Lane & Lubatkin, 1998).

2.3 Technology Transfer

Technology transfer (TT) is the process of transferring or sharing skills and knowledge from one person or a place, to another. TT which is a useful resource for technology improvements is widely used in various industries (Inkpen & Dinur, 1998). The TT component consists of skill transfer, technical knowledge, machinery, soft skills and equipment (Wie, 2003); it can be enhanced if the theory is accurately applied by its practitioners and researchers (Zimmerman et al., 2007). According to Omar et al. (2011), TT involves a lot of management for developing countries around the world, including Malaysia. Therefore, in this study, TT is defined as a technology process, knowledge and equipment in the ETS project transferred from a developed country to developing countries such as the operating systems and equipment used for ETS projects.

To build a better ETS for the consumers, TT is required. Moreover, in line with the current technological developments, building information modeling (BIM) has made proactive measures in the aspects of asset management and railway infrastructure through the development of the Railway Assets Intelligence System (RAILS). Various factors and obstacles in the ETS Malaysia project were found by previous researchers. Cheng (2011) emphasizes that a weak financial system, human resource constraints, and the limitation or inability to accept technology are the problems that are faced by most of the companies in Malaysia. From the literature studies, it shows that the factors from human resources, economic status and organizational capabilities affect TT at ETS Malaysia for projects. The problem of procurement and the learning environment is among the barriers in the implementation of the technology transfer in the ETS Malaysia project.

First, among the many Spanish firms investigated by Escribano et al. (2009), they have included the views of the factors and the characteristics of the construction organizations, with five unique factors and features, such as lack of technical, lack of knowledge, management expertise, financial resources and organizations. Table 1 shows some factors that are based on the different authors. Next, the level of absorptive capacity encompasses the views of the factors and the characteristics of identifying the recipient level of a construction organization with unique factors and features of the organization, time, financial resources, and skilled workforce. Table 1 also demonstrates some level of capacity of absorption that have been mentioned by the different authors. Third, the absorptive capacity of the new technology transfer process includes the measures to enhance the level of absorptive capacity in the technology transfer process where they identify the manufacturing organizations with four unique steps and features such as communication, resources, technical capabilities, and knowledge. To that extent, Table 1 depicts some measures to increase the level of absorptive capacity in the technology transfer process based on the different authors.

Table 1 Characteristics of the absorptive capacity of the use of new technologies in the technology transfer process

Authors	Criteria	Characteristics
Chen and Haynes (2015)	Factor	Lack of Resources, Knowledge, Financial,
Lerch et al. (2010)		Organization, Financial
Omar et al. (2012)		Organization, Cost Allocation, Tools
Elmuti and Abou-Zaid (2013)		Lack of Skilled Workforce, Organization
Pitt et al. (2009)	Level	Organization, Financial
Gibson and Nelson (2015)		Organization
Uusitalo (2013)		Organization, Skilled Workforce
Bolatan et al. (2016)		Organization, Skilled Workforce
Chen and Haynes (2015)		Organization, Skilled Workforce
Kakhki and Palvia (2016)		Organization, Knowledge
Sexton and Barrett (2003)	Measure	Organization, Skilled Workforce, Knowledge
Chen and Haynes (2015)		Organization, Communication, Technical Ability
Peetawan and Suthiwartnarueput (2018)		Organization, Resources

■3.0 RESEARCH METHODOLOGY

This research is quantitative oriented and a questionnaire is used as the research instrument. The questionnaire is involved due to the large number of respondents. The questionnaire will allow the researcher to identify the ACAP factor among the contractors in the TT process, to measure the ACAP level among the contractors in the TT process, and assess for the best alternative of enhance ACAP among contractors in TT process. The respondents will be G4 to G7 contractors at ETS Gemas Project, with 150 respondents as this is the contractor classes that are involved in the project. The contractors are chosen as they are known as the entity that carries a higher workload compared to others (Bernama, 2018).

This research considers construction professional including the site manager, project manager, M&E engineer, C&E engineers and management to the respondents, as the individual with an education background has a higher ACAP (Liao et al., 2003). This research has used the Krejcie and Morgan's (1970) formula as shown in Figure 2 in order to identify the accurate number of respondents, i.e., 108. A pilot test has been conducted before the questionnaire distribution in order to ensure that all the questions are valid and reliable. In this research, SPSS is used for data analysis and the measure of distribution is used in descriptive analysis.

Formula for determining sample size

$$s = X^2NP(1-P) \div d^2(N-1) + X^2P(1-P)$$

s = required sample size.

X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

N = the population size.

P = the population proportion (assumed to be .50 since this would provide the maximum sample size).

d = the degree of accuracy expressed as a proportion (.05).

Figure 2 Formula determining number of samples (Krejcie & Morgan, 1970)

■4.0 RESULTS AND DISCUSSION

4.1 ACAP Factor among Contractors in TT Process

In this research, there are four factors that have been listed based on LR, which include organization, skill, tools and the financial. Based on the findings, organization is labelled as the highest contributor for ACAP among the contractors in TT with a mean value of 4.10, as shown in Table 2. The finding is followed by skill with a mean value of 4.09, tools with a mean value 3.97, and financial with a mean value of 4.05.

This research finding is supported by the previous research outcome, as according to Lerch et al. (2010), the organization is one of the contributors to influencing the level of absorptive capacity. According to Omar et al. (2012), the factors that affect the absorptive capacity of new technologies are often associated with the organization. This can be seen more clearly when the average value of the overall mean on the part of this question is 4.10. In this section, many respondents have agreed with the fact that a university research collaboration is a channel for the organization to build their background knowledge, and to absorb external sources of knowledge.

Next, Elmuti and Abou-Zaid (2013) have expressed industrial efforts, including the transfer of new technologies to skilled manpower, to be difficult due to the lack of skills in industrial management and technical skills among skilled technicians in infrastructure projects. In this part, many respondents have agreed with the fact that human resource management practices (HRM) could influence the employee's performance.

Table 2 Overall mean score

Factor	Average Total Mean	Level of Influence
Organization	**4.10**	**High**
Skill	4.09	High
Tools	3.97	High
Financial	4.05	High

4.2 ACAP Level among Contractors in TT Process

In this research, four factors have been listed based on LR, which include organization, technologies, skill worker and the financial. Based on the findings, financial is labelled as the highest contributor for ACAP among the contractors in TT with a mean value of 4.15 as shown in Table 3. The finding is followed by the skill worker with a mean value 3.89, organization with a mean value of 3.86 and technologies with a mean value of 3.83.

This research finding is supported by the previous research outcome, and according to Pitt et al. (2009), Uusitalo (2013) and Kakhki and Palvia (2016), it has been found that measuring the level of absorptive capacity of new technologies on the ETS project consists of four categories. These four categories are organizations, technologies, skilled worker, and the financial. In the perception of the Malaysian Construction Practitioners on the implementation of construction in using new technologies it is in a short-term view, rather than

considering the use for a long time due to the cost constraints that are encountered (Pitt et al., 2009). Finance also plays an important role in the level of absorptive capacity as it can affect the number of individual recipients. This can be seen with the average amount of this level of absorptive capacity that has been identified with a mean of 4.15. Based on the assumptions of the researchers, the mean represents a high level of absorptive capacity for the skilled workforce. This shows that the respondents have a high level of absorptive capacity with a good financial system for the organization.

Furthermore, according to the statement by Uusitalo (2013), technology transfer also involves many things or effects such as inconsistency in the use of technology in infrastructure construction projects. Next, Omar et al. (2011), said that in Malaysia, the absorptive capacity of skilled manpower in the use of new technologies is slowing down as the technology is not available in Malaysia. This can be seen with the average mean for the level of absorptive capacity which has been identified as the second highest mean, at 3.89. Based on the assumptions of the researchers, the mean amount represents a high level of absorptive capacity for the skilled workforce. This shows that the respondents have a high level of absorptive capacity of skilled manpower in the technology transfer process.

Based on the findings, the researchers can evaluate the level of absorptive capacity of the use of new technologies by the contractors in the ETS projects. Based on the assessment that has been conducted, the researchers have found that the level of absorptive capacity by the contractors in the ETS project is said to be at a high level with a high average value of 4.15. The result shows that the most impactful towards absorptive capacity are the skill workers because most of them are exposed to using new technology on the construction site. The researchers have also made assumptions based on the average mean for the level of absorptive capacity of new technologies among the contractors in the technology transfer process on the ETS project, as shown in Table 3.

Table 3 Overall score of absorptive capacity level

Categories	Average Total Mean	Level
Organization	3.86	High
Technology	3.83	High
Skill Worker	3.89	High
Financial	**4.15**	**High**

4.3 Suggestions to Enhance ACAP among Contractors in TT Process

In this research, three factors are listed based on LR, which include organization, communication and skill. Based on the findings, communication and skill are labeled as the highest contributor for ACAP among the contractors in TT with a mean value of 4.21, as shown in Table 4. The finding is followed by organization with a mean value of 4.14.

This research finding is supported by the previous research outcome, as according to Omar et al. (2011), technology transfer is a complex measure that requires a clear definition from the beginning, this is to ensure that the seller and the technology buyer clearly understand the implications and to try to maximize interest for both parties (Omar et al. (2012). Technology transfer is a trading step that allows the recipient firm to access or imitate the complete technology capabilities for the donors (Peetawan & Suthiwartnarueput, 2018). In other words, to enhance technology transfer steps is a technology movement through several communication channels from one individual or organization or country to another country (Chen & Haynes, 2015). This can be seen more clearly when the mean value on this part of the question is 4.21. Based on the assumptions that have been made by the researchers, the following mean value is at a high level. This indicates that communication can increase the level of absorptive capacity, with the highest mean value of 4.21 in the statement “Employers need to know the environment that takes place at work”.

Subsequently, the organization's ability to adapt to new technologies to find the expected benefits of the technology acceptance process relies on the current technical and organizational capabilities (Chen & Haynes, 2015). The technology transfer process is one of the key steps to enhance the use of technology in the management of product innovation and services, and it has also been recognized as a very useful way to be competitive among other firms (Peetawan & Suthiwartnarueput, 2018). This can be seen more clearly when the mean value on this part of the question is 4.21. Based on the assumptions that have been made by the researchers, the following mean value is at a high level. This indicates that skills can increase the level of absorptive capacity with the highest mean value of 4.21 on the four statements that have attained the same value of mean and the highest value for "Employers must send existing employees to attend training programs organized by CIDB", "Employers should motivate the workers to use new technologies ", “Employers must hold an excellent worker system so that the company's productivities increase", and "Training programs for high skilled are held less to train employees".

Based on the findings, researchers can evaluate the level of capacity of the use of new technologies by the contractors in ETS projects. Based on the assessment that has been conducted, the researchers have found that the level of absorptive capacity by the contractors in the ETS project is said to be at a high level, with a high average value of 4.21. This shows that the level of absorptive capacity of new technologies in ETS projects needs to maintain a good financial system to maintain excellent performance. This can be seen that finance is an important aspect of the level of absorptive capacity to individuals. The researchers have also made assumptions based on the average mean for the level of capacity of the use of new technologies among the contractors in the technology transfer process in the ETS project, as shown in Table 4.

Table 4 Overall score of measures to increase the level of absorptive capacity

Category	Average Total Mean	Level
Organization	4.14	High
Communication	**4.21**	**High**
Skills	**4.21**	**High**

5.0 CONCLUSION

This study has been conducted in order to explore ACAP among the contractors in the TT process, within the ETS project. The project that is chosen is due to the results of the study that have shown that organizational factors contribute to a significant influence on the level of absorptive capacity of the use of new technologies in the process of high technology transfer. Moreover, this paper is established to monitor the technology acceptance level among the contractors in the TT process. This research consists of 3 objectives, which are the ACAP factor in and among contractor TT, ACAP level among the contractors in TT process and the suggestion to enhance ACAP among the contractors in the TT process. The level of absorptive capacity that has been experienced by the respondents still has a good work performance. While communication and skills are the best way to increase the level of absorptive capacity, based on the findings of this study, the organizations, contractors, academics, and others need to be alert and to view one of these issues as an important problem, and to further cooperate in maintaining the level of absorptive capacity of new technology in the process of technology transfer in order to achieve optimal levels over time.

First, based on the conclusions for objective 1 that has been achieved, the findings of this study are in line with some of the findings of previous studies, that have been conducted by different academic members. This suggests that skills play an important role in the level of absorptive capacity of new technologies in the technology transfer process. Moreover, finances and equipment influencing the level of absorptive capacity in ETS projects are said to be the same when researchers have found that the factors that are contributing to the level of absorptive capacity are similar to the results of previous studies. This proves that this factor is indeed true in every contractor organization. Therefore, employers need to look at this issue more seriously in order to maintain the level of new technology absorptive capacity in the process of technology transfer among the contractors at the optimal level. Next for objective 2, it is shown that the level of absorptive capacity of new technologies in the technology transfer process in the ETS projects is not a new phenomenon in the construction industry. This indicates that the measurement of the level of skilled workforce, organization and technology also has an impact on the level of new technology absorptive capacity among the contractors in ETS projects. Therefore, employers must be vigilant and to always strive to ensure that the level of the employee capacity can be increased for the purpose of excellent work performance. Lastly, for objective 3, the main thing to further enhance the level of absorptive capacity of the use of new technologies in the technology transfer process among the contractors for the ETS project is skills and communication that can increase the level of absorptive capacity of the use of new technologies in other technology transfer processes. For example, organizations also play an important role in increasing the level of absorptive capacity in the technology transfer process.

Based on this finding, it is evident that the level of absorptive capacity of the use of new technologies in the technology transfer process in ETS projects should be taken seriously to ensure that the contractors can receive new technologies successfully. The researcher also concludes that the ACAP level in Malaysia Construction industry has clearly shown that the capacity of absorptive of new technologies in the technology transfer process is an important issue as technology is always changing. Hence, in order to maintain the level of capacity of the use of the new technologies in the process of transferring technology in the construction industry, each party has to cooperate, as those who are involved in such industries- organizations, contractors and academics, need to implement measures to control the problem of absorptive capacity that is experienced in the construction industry. With the cooperation of the various parties, the construction industry in Malaysia can improve with the existence of an excellent quality of work and can increase the level of absorptive capacity in the high construction industry.

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