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Proposing an Absorptive Capacity Framework of Small and Medium Sized Enterprises (SMEs) in Construction Industry

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Abstract: The demand of construction project is increasing from years to years. Therefore, to survive and growth well in the industry, technology and innovation need to be executed by the organisation as both aspects are known as a weapon which helps in enhancing competitive advantage. Consequently, organisation should have the awareness on absorptive capacity to allow such practice is possible. Absorptive capacity is known as a critical item within organisation in order to sustain, grow and compete in the market. In previous research, absorptive capacity had been used to analysis performance at different levels including individual, organisation, industry and country. However, many researchers focus only on large organisation rather than small organisation. Meanwhile, on the different dimension, many researchers outlined the current aspects in measuring absorptive capacity is focus on R&D orientation which is not suitable for small and medium sized enterprises (SMEs) construction organisation. Hence, this paper aims to identify suitable measurement in measuring absorptive capacity level among SMEs within construction industry. Based on the absorptive capacity measurement models synthesis, the researcher found that most of previous research used performance, employee abilities and organisation factors to measure absorptive capacity in the construction industry. This research also considered non R&D absorptive capacity measurement in manufacture sector due to limited reliable literature review in measuring absorptive capacity through its dimensions; acquisition, assimilation, transformation and exploitation. A proposed framework that represents absorptive capacity measurement among SMEs is established at the end this paper.

Keywords Absorptive capacity, construction industry, small and medium sized enterprises

1. Introduction

Organisations have come to depend on innovation and technology as it is known as main sources of competitive advantages (Omar et al., 2011). The attention on technology and innovations in promoting growth, development, and driving productivity and competitiveness also attracted many attentions in multiple sectors (Lagunes et al., 2016). Therefore, organisation should have the awareness of absorptive capacity to allow such practice is possible especially among small and medium sized enterprises (SMEs). Absorptive capacity among SMEs allow them to compete in complex market dimension and penetrate to international business arena (Kamal, 2013). However, absorptive capacity in certain industry is labelled as relatively weak which includes construction industry (Daghous, 2004). They consider weak absorptive capacity as friction, which slows or prevent the technology transfer process happened within organisation (Omar et al., 2012).

In addition, the innovation in construction industry is also hampering by its relative weak absorptive capacity compare to other sectors (Lawrance et al., 2016:1030). The issue become more critical especially to SMEs within

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construction industry due to number of factors challenges (Kamal & Flanagan, 2014). Hence, to improve the current performance among construction SMEs, the current level of absorptive capacity among the organisations need to be determine to allow managers monitor the level of absorptive capacity from time to time with proper aspects of measurement. According to Flatten et al., (2011) there are numbers of empirical studies on absorptive capacity measurement, but a valid measurement is incorporating with it vary dimension is not developed yet.

Most of researcher still relies on the R&D pattern and investment to measure the level of absorptive capacity buried the varieties of absorptive capacity dimension. In addition, Chauvet (2015) opines the current measurement focus the R&D and investment did ignore the prior on work. Lagunes et al. (2016) outlines those R&D and investment aspects also only suitable for large organisation only compare to SMEs. Lawrence et al. (2016) also adds the current measurement not suitable for construction industry due to need of innovation in the industries is not as high in manufacture sectors. Construction industry also has failed improving their current technology for the fact that the employees were too busy with their current and required tasks to deliver the project in time (Omar et al., 2011).

Therefore, to solve the issue, this paper will propose an appropriate absorptive capacity measurement that suitable for construction SMEs by considering the unique of the industry and firms' sizes by using the absorptive capacity dimension. Since this paper is a conceptual paper, reviewing for previous studies and models will be used to establish the appropriate absorptive capacity measurement that suitable for construction SMEs. This paper aims to establish a suitable measure for SMEs to enhance the absorptive capacity among SMEs and allow manager to monitor the absorptive capacity level from time to time within organisation.

2. Literature Review

The literature review will discussion on model synthesis from construction industry and SMEs to evaluate an appropriate aspect for measurement and model construction.

2.1 Absorptive Capacity Concept

The original concept of absorptive capacity was from macroeconomic which had found by Adler on 1965. Adler (1965) refers absorptive capacity as an ability of an economy to utilise and absorb external information and sources. The concept had been widened by Cohen and Levinthal (1990; 130) to have better understanding in organisational learning by define the absorptive capacity as an ability on organisation to recognise the value of latest external information, assimilate and apply to commercial ends. In current study, absorptive capacity is defined as ability within a firm to recognise value of, assimilate, transform and commercially exploit new external information (Lawrence et al., 2016). Absorptive capacity identified as crucial tools for firm to sustain, grow and compete (Bilau et al., 2015).

Absorptive capacity also considers a great business strategy, widen firm network and produce competitive advantages towards the firm (Camison and Forge, 2010). Absorptive capacity can be conducted in individual level and organisation level. The organisation absorptive capacity depends crucially on the individual skills and ability to absorb the relevant external knowledge (Chauvet, 2016). Despite the employee role, organisation also play important role to support the absorption process through motivation and provide facilities to allow absorptive capacity is possible to happen (Flatten et al., 2011). A higher level of absorptive capacity makes most dynamic company dedicated to innovating as it will be more likely to notice and investigate opportunities appear in the environment (Escribano et al., 2009)

There are few theories for absorptive capacity dimension and activities in research field, however, the most popular dimension which had introduce by Zahra and Geogre (Chauvet, 2015). According to (Zahra and George 2002), absorptive capacity consists of four dimension which are; acquisition, assimilation, transformation and exploitation. Each of dimensions play important roles and connected to each other and suitable for absorptive measurement (Camison & Forge, 2010). Zahra and George (2002) model also highlight that absorptive capacity dimension consist of the part: potential absorptive capacity and realised absorptive capacity (Camison & Forge, 2010). The model also highlights few aspects play important aspect towards the process including; organisation activation triggers and communication flow and personal ability (Zahra & George, 2002).

Even though the dimension had been established more than a decade but the measurement of absorptive capacity still relies on the old proxies which are R&D pattern and R&D investment value (Lagunes et al. 2016). Such measurement doesn't suitable for construction industry as the demand to innovate is not high compared to manufacture industry (Lawrence et al., 2016). Furthermore, the measurement also not suitable for SMEs as most of them had many difficulties to adopt new technology (Bilau et al., 2015). Thus, the current measurement leads many issues and not suitable for certain industry and organisation and may lead to no comprehensive measurement.

2.2 Absorptive Capacity Measurement in Construction Industry

The goal of this paper is to propose an appropriate measurement of absorptive capacity among construction SMEs. According to Kamal & Flanagan (2014) there are numbers of challenges of SMEs faced that become barrier to adopt technology including; financial issue, organisation support, human capital, lack opportunities, geographical aspect and education level.In addition, the innovation level in construction industry innovation is considering relatively low compare to other industry (Lawrance; 2016;1031). In most countries, there is a perception that the industry is not generally innovative (Omar et al., 2011).

Table 1- Absorptive Capacity Measurement Models in Construction Industry (Bakar & Tufail, (2012); Omar et al., (2012); Kamal & Flanagan (2014); Lawrance *et al*., (2016))

Author (Year)	Industry	Country	Measurement
Bakar & Tufail (2012)	Indigenous Contractor	Malaysia	• Organisation -History & Factors -Training Program • External -Type of Technology • Performance
Omar *et al.*, (2012)	G7 Contractors	Malaysia	• Individual - Motivation - Ability
Kamal & Flanagan (2014)	Rural Contractor	Malaysia	• External - Culture • Organisation - Communication - Networking (Supplier& customer) - Organisation Support - Organisation Routine • Performance
Lawrance *et al.*, (2016)	Construction Industry	United Kingdom	• Routine - Organisation Routine - Individual Routine • Project (Performance) - Key Performance Indicator - Client

Based on government reports commissioned in recent years have identified such problems as poor rates of investment in research and development (R&D), fragmented supply chains, and lack of coordination between academia and industry in research activities (Dulaimi et al., 2002). According to Omar et al., (2012) this issue happens due to client pressure in pursing accurate project delivery time rather than technology usage. Some of the researcher argue this issue happen due to financial problem within the industry which come barrier in technology investment (Kamal, 2013). However, in recent years the technology usage in construction industry had become bold topic to discuss in research field. The research also discusses many alternatives in order to measure the technology level within the industry (Bakar & Tufail, 2012).

Since the industry is unique and had different work demand from other sectors, the researcher had found different dimension and aspect in measuring absorptive capacity within the construction industry from the previous study. Table 1 shows four different models that had been constructed to measure absorptive capacity in that solely focus in construction industry. Based on the table, items that being consider and highlighted for measurement within the study are; organisation, employee, type of technology, external resources and performance.

Based on the first model by Bakar & Tufail (2012) which this model is focuses on measuring indigenous contractor absorptive capacity level in Malaysia. Almost 90% of indigenous contractor can be classified as SMEs as 90% of the SMEs operating in rural area (Kamal, 2013). Three dominant aspects being used to measure the technology adoption including organisation, type of technology and performance. The organisation focusses on the organisation background in technology adoption, organisation support to adopt which including the factors and courses provided to enhance the absorptive capacity level among employee. Next aspect is the external aspect; type of technology which highlights the concept of technology itself including company, industry and system specification. It's to identify to ensure the technology is possible to understand and manage by the indigenous contractors. In order word, to ensure the technology

level is same with absorptive capacity level of the employee. Lastly is the organisation performance to monitor the outcomes from all the investment in technology in facilities and training through improved of product, solving problem capability and overall organisation's performance.

Second model is by Omar et al., (2012), this model focuses on G7 contractor in Malaysia construction industry. The measurement is constructed to measure the technology transfer activities in the firm as technology adoption is require huge investment from the organisation. This model measures absorptive capacity in one dimension which is; individual level. This model emphasizes that motivational plays important roles in triggering absorptive capacity among employee. Motivational will leads in learning in organisation and increase the effectiveness of an employee. The measurement can be made through the employee ability and motivational level. The ability of employee will be measure in performance evaluation and training, meanwhile, the motivation is measure by the HRM practices.

The third model is from Kamal & Flanagan (2014) which this model focuses on SMEs in rural area within Malaysia construction industry. There are few aspects highlighted including; external, organisation and performance elements to enhance absorptive capacity among SMEs in rural area. Internally organisation plays important role in enhance the technology including the communication, support and routine to emphasize the practice on work place. Next is the external organisation such as supplier, manufacture or client where they can provide the latest relevant information to the organisation and trigger the needs to use technology which will clarify the needs of technology in the industry. Individual level also requires especially during transformation phase where employee will use their own capability and creativeness to design the knowledge into new output. Lastly is the performance to identify the progress on organisation.

Last model from Lawrence et al., (2016) discusses briefly regarding measurement aspect that usually overlook by organisation in measure absorptive capacity including the routine especially during construction phase. Based on the model, construction phase is the dominant phase where the learning process is takes places. Lee (2016; 97) also agree by stated that most of is SMEs apply "practice by doing" at construction site to learn new technique in the field. Therefore, this construction phase is required to be an appropriate aspect in measuring absorptive capacity. The aspect that measures in the phase is organisation and individual routine during the phase. The next aspect is the performance where it measures from all aspect including employee, organisation and client through profit, key performance indicator and client satisfaction.

Based on all the four models, researcher found that all the components in measuring absorptive capacity are valid components including individual, organisation, external, and performance in determine the level of absorptive capacity. Different researcher used different dimension to measure the particular component. However, to establish as proper measurement for SMEs, the characteristic of SMEs organisation itself need to take consider

providing the effective measurement tool. In addition, the dimension of absorptive capacity also is requiring considering allowing each dimension take place in the measurement.

2.3 Absorptive Capacity Measurement Among (SMEs)

Absorptive capacity usually associates with certain amount of cost and time as an investment from organisation for product quality improvement (Wales et al., 2012). Therefore, it is important for organisation to measure the level of improvement through absorptive capacity dimension in the organisation. However, many researchers argued, the measurement of absorptive capacity are only focus on R&D orientation which is only suitable for huge and strong establish companies with abundant amount of capital and resources. Due to the circumstances, most of measurement of absorptive capacity is not suitable to apply on SMEs in construction. Furthermore, there are limited researches in measurement with absorptive capacity relevant established (Flatten et al., 2011). In this session, latest measure of absorptive capacity from various studies will be discussing to get best measure of absorptive capacity for small and medium of company as shown in Table 2.

The first model is an organisational absorptive capacity which allows measuring the absorptive all size; micro, small, medium, and large of firm in all sectors by Camison & Forge (2011). This model used PACAP; (acquisition& assimilation) and RACAP; (transformation & exploitation) dimensions to measures the absorptive capacity level. The acquisition is focus on organisation support to explore knowledge and recognise the identification of R&D cooperation within organisation. Next, the assimilation is focus on organisation routine to understand the knowledge including; management, human resources and training. Meanwhile, transformation is a firm's capacity to develop and refine the internal routines that facilitate the transference and combination of previous knowledge with the newly acquired or assimilated knowledge through adoption abilities, transmission of IT based knowledge and technology information exchange rate. Lastly is the exploitation through; experience, pattern and technology usage.

Table 2 - Absorptive Capacity Measurement Models in SMEs
(Camison & Forge, (2010); Flatten et al., (2011); Omar et al., (2012); Chauvet (2015))

Synthesis of Technology Absorptive Capacity Measurement Variables

Author	Camison & Forge (2010)	Flatten *et al.*, (2011)	Omar *et al.*, (2012)	Chauvet (2015)
Country	Spain	German	Malaysia	France
Sector	All Sectors	Manufacture	Construction	SMEs Manufacture
Technology Absorptive Capacity Measurement Variables;	Measure by: Potential Absorptive Capacity (PACAP) 1. Acquisition -Organisation Practice - R&D cooperation -Competence development 2. Assimilation -Knowledge management -Human Resources -Training Realised Absorptive Capacity (RACAP) 3. Transformation -Adaption capacity -Transmission of IT based knowledge. -Renewal Capacity - Technology information exchange rate 4.Exploitation -Application of experience -Pattern Technology proactive	Measure by: 1.Acquisition -Management routine used external; resource to obtain information 2. Assimilation -Communication structure in company 3.Transformation -Knowledge Process routine -Employee ability 4.Exploitation - Product & Service improvement -Pattern -Technology used in organisation	Measure by: **1.** Capacity of employees -Performance evaluation -Employees training **2.** Employee motivation -HRM Practice -Performance based compensation -Merit Based Promotion	Measure by: **1.** Acquisition -Commitment to acquire -Sharing knowledge **2.** Assimilation -Knowledge Understanding 3. Transformation -Knowledge conversion -Knowledge internalisation 4. Exploitation -Knowledge use and implementation

Second model is measurement of absorptive capacity model from German by Flatten et al., (2011). This model focuses on non-R&D part at organisational level through all absorptive capacity dimensions in manufacture sector. In generally, this model focusses on organisation level through; routine, practice, communication, and support at acquisition, assimilation, and exploitation phase. However, each dimension model measures on different scope of organisation aspects. Acquisition measure the organisation support through the motivational to explore and routine. The assimilation is focus on knowledge understanding in the organisation through communication channel. Meanwhile on transformation, the model highlights on employee ability to modify and process the knowledge aspect. The satisfaction and readiness to used technology in future also will be measure on exploitation dimension.

The third model established to measure absorptive capacity in technology transfer projects in Malaysia by Omar et al., (2012). This model doesn't apply the concept of all dimension of absorptive capacity as the attention of absorptive capacity in the construction industry doesn't get much attention. This model measures in individual level which focusing in employee motivation and ability as employee is crucial human resource asset to company to ensure the absorptive capacity is possible to happen successfully. This model measure two dominant aspect; employee capability and motivation. The ability of employee will be measure in performance evaluation and training, meanwhile, the motivation is measure by the HRM practices.

The fourth model discuss on absorptive capacity measurement in SMEs through all four dimensions; acquisition, assimilation, transformation and exploitation by Chauvet (2015). All the variables are non-R&D related due to SMEs characteristic; fewer resources, limited skill employee, revenue, or asset is critical to innovate. This model measures also measure in individual level. In the acquisition phase, the researcher measures the knowledge routine among employee through personal employee initiative and the sharing process among the employee. On assimilation phase, to measure knowledge to understand through knowledge understands management. Knowledge management which identifies the current knowledge gather from external and internal resources, new colleagues, and new ideas arise. Transformation measures the ability of employee to improve the product, work method, and problem-solving aspect. Exploitation is the effect towards the employee itself through the knowledge use and implementation.

2.4 Proposed Conceptual Framework

Based on the previous literature review section, number of models had been discussed and synthesis from two different dimensions which are models for absorptive capacity measurement in construction industry and models for absorptive capacity measurement for SMEs. All those models will be used to development a model to determine absorptive capacity level among SMEs in construction industry accordance to all absorptive capacity dimensions. Based on the synthesis of models' absorptive capacity in the construction industry, researcher identified there are four dominant aspects to measure including; employee, organisation, external and performance. Whereas, based on the synthesis of models' absorptive capacity among SMEs, researcher identify there are three dominant aspect to measure including; organisation, employee and performance. Therefore, researcher used all three aspect to measures the absorptive capacity among SMEs in construction industry; organisation, employee and performance as shown in Figure 1.

Fig. 1 - Proposed framework to determine absorptive capacity among SMEs in construction industry

Next researcher is required to identify the measurement aspect for each dimensions of absorptive capacity by using all the aspect above. Researchers also are required to consider all SMEs characteristics to ensure the measurement can be done comprehensively based on each dimension on absorptive capacity; acquisition, assimilation, transformation and exploitation. Acquisition is referring to the firm's capacity to identify and acquire knowledge that is externally generated (Haro-domingues, 2007). Meanwhile, assimilation refers to routines and processes of firms that enable analysing, processing, interpreting, and understanding information obtained in external knowledge (Kamal and Flanagan, 2014). Transformation is a firm's capability to combine the acquired knowledge with the existing knowledge by adding knowledge, deleting knowledge or interpreting the same knowledge in different manner (Coyte et al., 2012). Exploitation is an organisational capability, which based on routines that allow determination, expansion and utilization of existing competencies or create one by combining acquired knowledge and transforming into operations (Bilau et al., 2015). Each absorptive capacity dimension is play in distinct roles but complements in explaining absorptive capacity affects towards organisation (Zahra and George, 2002).

For the acquisition phase researcher used organisation aspect to measure the ability organisation to identify and capture relevant external information. Organisation aspect will be used including organisation routine and motivation to explore the new knowledge (Camision & Forge; 2010; Flatten et al., 2011). Organisation routine and motivation also had been used in measuring technology in construction industry through organisation support, communication and motivational aspect (Tufail & Bakar, (2012); Kamal & Flanagan (2014)). Researcher eliminate the organisation history and factor as the aims instrument to measure the organisation capability for each dimension, but the factor of organisation had been considered during aspect being sort for the model. Next, organisation also used knowledge sharing routine as proposed by Chauvet (2015) as SMEs usually consist of small and limited number of employee (Kamal, 2013).

Next is assimilation phase which is an ability of organisation to get in depth understand in the new information. Most model used communication aspect, HRM practice and knowledge management but since SMEs is consists small number of employee and mostly has low education background, such sophisticated element is not suitable for the measurement (Kamal, (2013); Chauvet, (2015)). In this phase, researcher used the knowledge sharing aspect based on Chauvet (2015) models. According to Chauvet (2015) this measurement is more suitable for SMEs as the solely focus on the knowledge understanding practice and involve the level understanding of knowledge through both mediums including external and internally which during work period. Since this measurement is for construction industry practice, research found supplier, distributor and manufacturer can be part of external organisation for new input sources (Kamal & Flanagan, 2014). Whereas the internal input can be considered by activity on construction site and practice by doing method as this method is the most popular method to learn and understand work skill in applied in SMEs in Malaysia construction industry.

The third aspect is focus on employee capabilities to measure transformation level. Transformation is a firm's capability to combine the acquired knowledge with the existing knowledge by adding knowledge, deleting knowledge or interpreting the same knowledge in different manner (Coyte et al., 2012). Research found that all of models had same point of view in this aspect by measuring the knowledge process routine through conversation and internalisation. The employee ability also being used to measures in construction industry too. Most of researchers highlight the ability of employee to improve the product, work method, and problem-solving aspect on this phase (Camison & Forge, 2010; Flatten et al., 2011, Chauvet (2015)). Since researcher is focus on construction industry, the improvement will be considered on administration and construction site improvement as being opine by Lawrance et al., (2016).

3. Conclusion

Many frameworks that have been developed to measure the absorptive capacity are found to only emphasizing on R&D concept which limits to certain type or organisation or sectors only. Realising this, the paper attempts to develop a framework of absorptive capacity for SMEs in construction industry. The proposed framework had been developed from two different model synthesis to allow the research to get the measurement for the models. The first synthesis is aims to identify the frequent measurement used to measure absorptive capacity for construction industry. Based the absorptive capacity measurement models in construction industry synthesis, research found most of research used employee abilities

and organisation factors to measure absorptive capacity in the construction industry. Meanwhile, based on the absorptive capacity measurement models in SMEs model synthesis is to help research to get measure to allow research to develop absorptive capacity measurement model by comply all the dimensions. Based on the synthesis, researcher found all the models measures each dimension in different manner, but the measurement is aims to identify each ability in the dimension.

Referring on the outcomes from each synthesis, researcher comes out a proposed framework by consider all measurement from both model synthesis. Since this paper aim to provide a measurement for SMEs in construction industry, all the SMEs aspect will be considered including; limitation in financial and human resources. Furthermore, this model also focuses on non-R&D aspect due to the technology and innovation among the player and the industry itself is relatively. Hence, by using this framework, the measurement of SMEs among construction can be done in more accurate.

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