INVESTIGATION OF THE RELATIONSHIP BETWEEN THE KNOWLEDGE MANAGEMENT PROCESS AND PERFORMANCE OF A CONSTRUCTION COMPANY: AN EMPIRICAL STUDY

Mochamad Agung Wibowo*	Diponegoro University, Semarang, Indonesia	agungwibowo360@gmail.com
Rudi Waluyo	Palangkaraya University, Palangkaraya, Indonesia	rudiwaluyo30@gmail.com
Zhabrinna	Diponegoro University, Semarang, Indonesia	zhabrinnas@gmail.com

* Corresponding author

ABSTRACT

Aim/Purpose	This study aims to investigate the relationship between the knowledge management (KM) process and the performance of construction companies. The ultimate goal is to promote better efficiency and competitive advantage in the construction industry by making the best use of knowledge.
Background	While attention to KM is currently on the rise, as shown by the number of studies conducted, research on KM in the construction industry of Indonesia is still very rare. However, organizational learning as the implementation of KM provides an opportunity to improve the construction industry, and thus there is an urgency to conduct research on this topic.
Methodology	This study lasted for three months and used the survey method, with 100 questionnaires distributed to contractors of grade 6 and 7 on the islands of Java and Borneo in Indonesia. A total of 54 returned questionnaires were deemed complete and eligible for further analysis. Data analysis was performed using the structural equation modeling method with partial least squares (SEM PLS).
Contribution	This study helps to measure the relationship value of the KM process and company performance.

Findings	The results of this study indicate that the process of KM has a significant and positive influence on company performance, and there is a positive interaction in the process of KM and company performance as well.
Recommendation for Practitioners	Construction companies need to perceive that activities undertaken in a construction project should always be assumed to be a KM process in order to make strategic and effective decisions that can result in improvements to customers, finance, internal business, learning, and growth.
Recommendation for Researchers	Research on the KM process and information technology needs to be developed more, so that construction companies can apply this knowledge to explore problems and create solutions, resulting in methods to facilitate efficiency and effectiveness.
Impact on Society	This paper helps to understand that KM activities provide initial benefits and guidance for companies that want to apply KM.
Future Research	Innovative and new ideas to cultivate the KM process in the construction industry need to be explored and developed to improve the implementation.
Keywords	knowledge, knowledge management, corporate performance, construction

INTRODUCTION

Knowledge management (KM) can be defined as a systematic method to capture the knowledge assets of a firm that can be exploited for competitive advantage (Love, Fong, & Irani, 2005; Scarborough, Swan, & Preston, 1999). In some countries, the relationship between KM and organizational performance has been researched (Chen, 2007; Daud & Yusoff, 2010 Emadzade, Mashayekhi, & Abdar, 2012; Gholami, Asli, Shirkouhi, & Noruzy, 2013; Seleim & Khalil, 2007; Shabbakhsh, 2013), and it has been found that KM helps the organization to understand the overall process of its experience and procedures. The sufficient storage of the existing resources and knowledge can help the company to respond to the rapidly changing markets and can lead to a competitive advantage (Chen, 2007; Setiarso, 2005).

KM has been applied in various sectors, such as manufacturing, banking, retailing, trading, and services. In Japan, Hong Kong, and the United States, KM has been implemented for a long time (Fatwan & Denni, 2009). In the construction industry, however, KM is still a new concept, although it has been implemented in various sectors (Chen, 2007; Waluyo & Wibowo, 2011).

However, the number of KM studies in the architectural, engineering, and construction (AEC) sectors is limited because project-based firms generally do not have the necessary infrastructure to handle information exchanges. Moreover, projects in construction are unique and specific in terms of location, design, budget, and stakeholders. In addition, every stage of the life cycle is fragmented, and feedback from one stage to the next rarely happens. Thus, project team members have limited access to past decisions and experiences, and thus have less of a chance to learn.

A piece of knowledge based on professional practice is the basic factor of future success and professional expansion. The level of knowledge plays an important role in competitiveness, as it helps to hasten the development of staff. In Indonesia, construction firms tend to depend on skilled and well-educated personnel, who usually concentrate on temporary projects. The knowledge asset in the AEC industry is also not central, and so their performance is very dependent on employers' loyalty, and, consequently, it is vulnerable. For example, the record of subcontractors, suppliers, and methods conducted in executing certain specific projects contains related knowledge, and such knowledge will help avoid the process of "reinventing the wheel" and the recurrence of costly faults. Better and proper KM could lead to the enrichment of organizational resources and competence (Egbu, Sturges, & Bates, 1999; Lestari & Zulaikha, 2007; Love et al., 2005).

The purpose of this study is to analyze the relationship between the KM process and the performance of construction companies. The study could help researchers to understand activities in the KM process and its relationship with company performance, and provide some practical guidance for companies to implement KM.

THE KNOWLEDGE MANAGEMENT PROCESS

Knowledge is built with a set of information, a complex phenomenon that includes the understanding of the ways in which information is transferred between individual and group experiences. The combination of information, context, and experience is essential for the organization, and, in a way, it is beneficial to be included as a business aspect (Jennex, 2007; Rasli, 2005; Widayana, 2005).

Knowledge falls into two categories, tacit and explicit. The former is the sphere of human intellectual capabilities that includes insight, intuition, skill, experience, body language, belief, value, and rule of thumb. It is difficult to formulate or share tacit knowledge because it deals with the abstraction of human thinking. In contrast, explicit knowledge deals with knowledge that can be expressed through words and numbers, and it is more easy to transfer (Munir, 2008; Sangkala, 2007; Tobing, 2007; Yuliazmi, 2005).

KM acts as a medium to manage knowledge, create value, and enhance competitive advantage or company performance (Zuhal, 2010). The KM process is at the heart of KM, which includes a series of operations such as knowledge creation, knowledge sharing, knowledge acquisition, knowledge documentation, knowledge application, knowledge transfer, responsiveness to knowledge, and knowledge dissemination (Chen, 2007; Elitan & Anatan, 2009; Munir, 2008; Sangkala, 2007; Seleim & Khalil, 2007).

The KM process starts with knowledge creation, which is the initial stage to inject new knowledge into the system. It also deals with innovation and knowledge development (Hendrik, 2003). Sharing knowledge is the act of sharing information, experiences, and skills among individuals or groups in an organization (Setiarso, 2005, whereas the acquisition of knowledge is the act of gathering knowledge from different sources within the organization (Sangkala, 2007). Knowledge documentation is the storage of knowledge in a form of organizational memory, which is preserved for use in the future, and knowledge application refers to organizational activities to improve the main activities of the organization (Seleim & Khalil, 2007). Knowledge transfer is an activity to transfer knowledge among individuals or groups (Hendrik, 2003), whereas responsiveness to knowledge is an organizational way to respond to the type of knowledge accessed (Darroch, 2003). Lastly, dissemination of knowledge is a process of spreading knowledge (Echols & Shadily, 2000).

The KM process is an iterative cycle, or a spiral of tacit and explicit knowledge. According to Nonaka, Toyama, and Hirata (2008), this cycle comprises four iterative phases:

- *Socialization*: the transfer and creation of tacit knowledge directly by apprehending the reality of and experiencing, empathizing, and sharing tacit knowledge.

- *Externalization*: the articulation of tacit knowledge through symbolic language or dialogue and its translation into a concept or prototype.

- *Combination*: the collection and integration of explicit knowledge, the breaking-down of a concept and obtaining the relationship among concepts, and systemizing explicit knowledge and information to be applied.

- *Internalization*: the actualization of explicit knowledge through action, practices, and reflection so that this explicit knowledge can be internalized to enrich new tacit knowledge.

COMPANY PERFORMANCE

Company performance is a parameter of success for the manager. Performance refers to the outputs and results of processes, products, and services that are compared with other standards among organizations (Sadikin, 2008). Performance has many ways of being measured, i.e., profitability, finance, learning, and growth (Ellitan & Anatan, 2009). The whole process of KM in an organization will impact positively on the company performance (Jensen, Johnson, Lorenz, & Lundvall, 2007; Yang, 2010). The acquisition of an organization's knowledge is vital to raise up the capacities and competence of staff (Pai & Chang, 2013; Von Krogh, Takeuchi, Kase, & González, 2013), and the company's performance from a financial aspect is an activity that the organization must take to measure the economic or financial benefits of the action taken. The customer aspect is the activity that the organization should take to measure the market segment, whereas the internal business process aspect is an activity that the organization must take to measure internal business processes. Learning and growth aspects are activities that the organization must take to measure the company's infrastructure, which has been developed to create growth, including in the long term (Kaplan & Norton, 1996). Finances, customers, the internal business process, and learning and growth are prominent aspects of the company's performance of construction (Chen, 2007; Waluyo & Wibowo, 2011).

MODELING AND HYPOTHESES

MODELING

The model used in this study and its hypothesis is shown in Figure 1 and the descriptions of the various KM processes are highlighted in Table 1. The model description is obtained from the literature review between the KM and the performance reviewed in the previous section. The research model illustrates three relationships: (1) interaction in the KM process, (2) interaction in company performance, and (3) relationship between the KM process and company performance.

Table 1. Summary of the Knowledge Management Process

Author	KM processes
Waluyo & Wibowo (2011)	Knowledge creation, knowledge sharing, knowledge acquisition, knowledge documentation, knowledge application, knowledge transfer, responsiveness to knowledge, knowledge dissemination
Zaied, Hussein, & Hassan (2012)	Acquisition, conversion, application, storing, protection
Zwain, Teong, & Othman. (2012)	Knowledge identification, knowledge acquisition, knowledge storage, knowledge sharing, knowledge application
Gholami et al. (2013)	Knowledge creation, acquisition, sharing, storage, and implementation
Tubigi, Alshawi, & Alalwany (2013)	Creation and acquisition, modification, use, transfer, archiving, translating/repurposing, access, disposal
Sahebnazar & Dadfar (2016)	Creation, storage, sharing, application
Shaikh & Aktharsha (2016)	Knowledge acquisition, knowledge distribution, knowledge interpretation
Alrubaiee, Alzubi, & Hanandeh (2015)	Knowledge identification, knowledge acquisition and transferring, knowledge storage, knowledge sharing, knowledge application

Author	KM processes
Al-Hayaly & Alnajjar (2016)	Knowledge exploration, knowledge acquisition, knowledge evaluation, developing and discriminating knowledge, applying knowledge, knowledge accumulation
Novak (2017)	Knowledge creation, knowledge storage / retrieval, knowledge transfer, knowledge application

RESEARCH HYPOTHESES

Knowledge creation

Knowledge creation refers to the development of new knowledge or the replacement of existing content. The knowledge creation process highlights the ideas and actions taken to generate new ideas or objects (Mitchell & Boyle, 2010). Knowledge creation is defined as the capability of a company to generate new ideas and solutions for organizational activities, from managerial procedures to products/services and innovations in technology (Nonaka, 1994; Un & Cuervo Cazurra, 2004). Internally, information is created by knowledge workers, and external information comes from outsourcing or purchasing from an outside source. The mechanisms used in this stage include self-report, documentation, program, instrumentation, network, and knowledge engineering (Bergeron, 2003). Knowledge creation impacts organizational performance through this mechanism (Tubigi, Alshawi, & Alalwany, 2013). Thus, it can be hypothesized that the creation of new knowledge has a positive impact on a company's performance (**H1**).

Knowledge sharing

Knowledge sharing as a complicated but value creating activity is the basis of most strategies of organizational KM, which are assessable through unique information systems and communications between different organizational levels. Knowledge sharing depends on the process of transferring the appropriate knowledge to the people who need it at the right time, so that they can perform their work, and it is measured by information technology (IT) systems to facilitate the sharing process and the motivated work environment (Alrubaiee et al., 2015). Knowledge sharing is referred to as a social interaction culture, which involves the interchange of employee knowledge, skills, and experience through all departments in the organization (Al-Hakim & Hassan, 2012). By the value created by this activity of knowledge sharing, it is hypothesized that sharing positively and significantly influences the KM process (**H2**).

Knowledge acquisition

Acquisition is a process that comprises the actions of ensuring accessibility, gathering, and applying the acquired knowledge (Zaied, Hussein, & Hassan, 2012). Knowledge acquisition refers to the process of creation and formation of the knowledge and its components within the organization, and so implicit knowledge is transformed into explicit knowledge (Alrubaiee et al., 2015). Knowledge acquisition encompasses the process of obtaining and learning proper knowledge from diverse internal and external resources, such as relevant documents, experts, experiences, and plans. The most familiar techniques for knowledge acquisition are concept mapping, observing, interviewing, process mapping, laddering, training, and educating (Gholami et al., 2013). The acquisition affects organizational performance through program instrumentation, documentation, self-report, knowledge engineering, and networks (Tubigi et al., 2013). Thus, it is hypothesized that the acquisition positively and significantly affects the KM process (**H3**).

Knowledge documentation

Knowledge documentation processes include retention of knowledge, organizing, and facilitating access and retrieval. This process represents the organizational memory of the organization. Knowledge should be available at the proper time, and brief reports that are written in a language understood by workers will ensure that knowledge is more valuable and accessible. Knowledge documentation means the process of preserving the organizational knowledge. It is measured by the scope of the databases and information systems available, which save information and then undertake the requisite procedures to protect this knowledge from misuse or theft. The main idea of the KM approach relates to documenting useful knowledge in the organizational memory so that others in the organization can access it (Al-Hakim & Hassan, 2012). Storing is the process of saving knowledge inside the organization and covers both physical and non-physical resources (Zaied et al., 2012). By preserving the organizational knowledge for the future development of a company, documentation is supposed to affect the KM process positively and significantly (**H4**).

Knowledge application

Knowledge application means creating value for the company by making knowledge more active and relevant. Knowledge application can be in the form of guides, rules, procedures, and/or instructions to use knowledge in all organizational levels that are assessable according to these components in the organization. It is the final and most important stage of the KM processes. Knowledge application can be briefly described as practices and their benefits. This knowledge is applied on a daily basis at work and is assessed by authorized programs, and the initiations further use scales and indicators to examine the levels of the knowledge application (Alrubaiee et al., 2015).

The application refers to the process of actual use of knowledge, and it enables organizations to translate their organizational expertise into embodied products continuously (Gholami et al., 2013; Zaied et al., 2012). The result of the knowledge application is hypothesized to have positive and significant impacts on the KM process (**H5**).

Knowledge transfer

By taking the distributed nature of organizational cognition into consideration, an important process of KM in organizational settings is the transfer of knowledge to appropriate locations that require it (Novak, 2017). Knowledge transfer is the process through which one unit (e.g., group, department, or division) is impacted by the experience of another unit, and it is about the link that fundamentally depends on the choice made by individuals. Knowledge transfer can also be defined as the process to create and form knowledge and its components within the organization so that implicit knowledge is transformed into explicit knowledge (Alrubaiee et al., 2015). Knowledge transfer affects organizational performance through physical transfer and networks (Tubigi et al., 2013). Thus, knowledge transfer is hypothesized to have positive and significant impacts to the KM process (**H6**).

Knowledge responsiveness

Knowledge responsiveness is a form of responding or reacting to knowledge (Waluyo & Wibowo, 2011). Responsiveness to knowledge involves activities carried out as a response or reaction to suggestions, criticisms, and complaints from employees and customers to improve products, services, and work processes (Waluyo, 2014). As this result leads to the betterment of company performance, responsiveness is hypothesized to affect the KM process positively and significantly (**H7**).

Knowledge dissemination

Knowledge dissemination is an activity to disseminate or spread knowledge (Waluyo & Wibowo, 2011), including the knowledge possessed within a company (Waluyo, 2014). The dissemination is done to make sure that the organizational knowledge is received by all employees. Thus, it is hypothesized that dissemination positively and significantly influences the KM process (**H8**).

Interaction

a. Interaction in the KM process (H1-H8)

Conceptualization of the interaction in the KM process can be found in certain studies on the KM process or KM activities. Seleim and Khalil (2007) stated that the KM process has positive interrelationships. Knowledge acquisition was found to influence knowledge creation and knowledge application positively, while knowledge transfer was found to influence knowledge creation positively, and knowledge creation was found to influence knowledge application positively. Chen (2007) stated that the KM process has a positive interaction, in which knowledge creation and utilization became more intense through the increased demand for an effective KM process. Based on previous research (Valdez-Juárez, García-Pérez de Lema, & Maldonado-Guzmán, 2016), it can be seen that the KM process has a positive interaction. This expectation is formulated in the following hypotheses:

H1-H8: There is a positive interaction in the KM process.

b. Interaction in company performance (H1-H8)

Conceptualization of the interaction in company performance can be found in some research on KM and company performance. Within construction, company performance has four aspects: financial, customer, internal business process, and learning and growth. Based on previous research (Chen, 2007; Waluyo & Wibowo, 2011), company performance has a positive interaction. This expectation is formulated in the following hypotheses:

H10: There is a positive interaction between financial and company performance

H11: There is a positive interaction between customer and company performance

H12: There is a positive interaction between internal business process and company performance

H13: There is a positive interaction between learning and growth and company performance

c. The KM process and company performance (H9)

Conceptualization of the relationship between the KM process and company performance can be found in extant research of the two. Lee, Lee, & Kang (2005) stated that significant correlation happens between the KM processes of sharing, creation, and company performance. Seleim and Khalil (2007) stated that the KM processes of knowledge acquisition, documentation, transfer, creation, and application are related to organizational performance. Chen (2007) said that the KM processes of knowledge acquisition, responsiveness, dissemination, and utilization influence company performance of financial, customer, internal business process, and learning and growth. Based on such past research (Valdez-Juárez et al., 2016), it can be seen that the KM process and company performance have a positive relationship. This expectation is formulated in the following hypothesis:

H9: There is a positive relationship between the KM process and company performance.
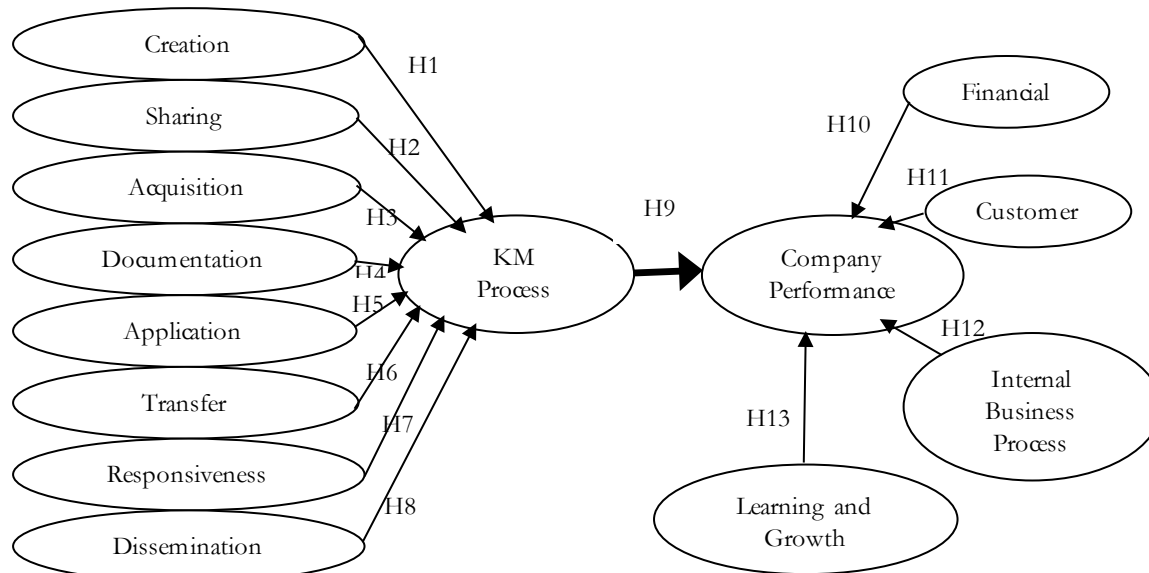
Figure 1. The relationship between the KM Process and Company Performance

RESEARCH METHODOLOGY

DATA COLLECTION

This research used the survey method, and data was collected by distributing questionnaires to managers of large contractors. Indonesian contractors are divided into three types: small contractors, medium contractors, and large contractors. This classification is defined by several factors, such as the size, the scope of work, the complexity of work, access to equipment, capital, technical skills and managerial capability. The data collected were used to test the hypotheses shown in Figure 1. The questionnaire consisted of three parts, with the first outlining the respondents' profile, the second part eliciting responses on the KM process, and the third compiling data about company performance. Respondents were asked to provide a level of approval to each statement in the questionnaire, using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaires were distributed at large contractors in several cities in Indonesia, namely, Jakarta, Semarang, Surabaya, Bandung, Yogyakarta, Palangka Raya, Samarinda, Balikpapan, and Banjarmasin. Respondents in this research are first, middle, and upper line managers. This study collected 60 questionnaires, but six of them were deemed unsuitable, and so the final total was 54 completed and eligible questionnaires.

ANALYSIS METHODS

The method of analysis used in this research is structural equation modeling (SEM). According to Sugiyono (2009), SEM can be described as an analysis that combines a factor analysis approach, structural model, and path analysis. Thus, in the analysis of SEM, three kinds of activities can be performed simultaneously, namely, checking the validity and reliability of the instrument related to confirmatory factor analysis, testing the relationship model between variables (related to path analysis), and activities to get a model suitable for prediction (related to regression analysis or structural model analysis). There are five stages of analysis using structural equation modeling partial least square (SEM PLS). Stage 1 is model conceptualization, stage 2 is determining the algorithm analysis method, stage 3 is determining the algorithm analysis method, stage 4 is drawing line charts, and stage 5 is a model evaluation. We employed SEM PLS analysis using Smart PLS 2.0 M3 software.

RESULTS

CONTRACTOR PROFILE

There are 54 large contractors who are members of this research. As illustrated in Figure 2, among these contractors, 3.7% have been in construction for 5-10 years, 31.5% have been in construction for 10-15 years, and 64.8% have been in construction for >15 years. Approximately 77.8% of the contractors have experience working on civil engineering projects, and 22.2% work on mechanical, architectural, environmental, and electrical projects. The contractors' work experience in civil engineering projects is described in Figure 3.
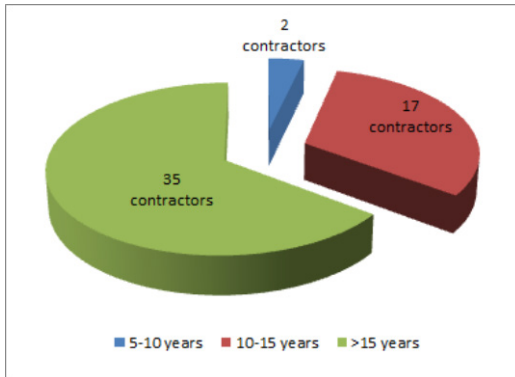

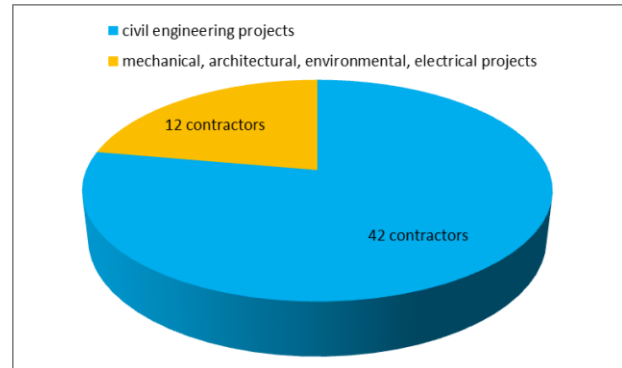**Figure 2. Contractor's Work in Construction**

Figure 3. Work Experience of Contractors in Civil Engineering Projects

Instrument validity test is assessed by a loading factor (correlation between item score and construction) indicator that measures construct. In this study, there were 44 indicators that measured KM relations and company performance. The indicator is numbered sequentially from number 1-44, without distinguishing variables and sub-variables. The results of the validity test show that 10 indicators are invalid (loading factor <0,50). These indicators cannot be used for further analysis.

In addition, a reliability test was used to measure the consistency of internal instruments. This test uses the method of composite reliability and Cronbach's alpha. The construction is said to be reliable when the value of the Cronbach's alpha is > 0.6 and the value of composite reliability is > 0.70. The results of the KM process reliability test and the performance of the construction company are shown in Table 2.

Table 2. Composite Reliability and Cronbach's Alpha

Construct	Composite Reliability	Cronbach's Alpha
KM process	0.929305	0.921206
Company performance	0.962153	0.957477

Table 2 shows that the KM process and the performance of construction companies have composite reliability values of >0.70 and a Cronbach's alpha that is >0.60 high. This result explains that the KM process construct and company performance are reliable. The result of the validity and reliability tests confirm that the KM process and company performance are valid and reliable.

ANALYSIS OF THE KNOWLEDGE MANAGEMENT PROCESS INTERACTION

Analysis of the KM process interaction was performed using SEM PLS, while evaluation of the KM process model was done by evaluating the outer and inner models. The result of the interaction analysis of the KM process is shown in Table 3.

Table 3. KM Process Path Coefficients

Constructs	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)	P-Value
H3: acquisition -> KM process	0.073091	0.073051	0.007511	0.007511	9.731108	0.025
H5: application -> KM process	0.214619	0.212620	0.014994	0.014994	14.313935	0.000
H1: creation -> KM process	0.117776	0.118025	0.009235	0.009235	12.753709	0.013
H8: dissemination -> KM process	0.186390	0.185039	0.008999	0.008999	20.712725	0.005
H4: documentation -> KM process	0.175527	0.175181	0.009864	0.009864	17.795139	0.009
H2: sharing -> KM process	0.051565	0.048830	0.006319	0.006319	8.159916	0.020
H6: transfer-> KM process	0.155396	0.159659	0.017405	0.017405	8.928031	0.011
H7: responsiveness -> KM process	0.258146	0.261721	0.015484	0.015484	16.671955	0.000

Based on the original sample value, t-statistics, and p-values in Table 3, the result of the hypothesis analysis on the KM process interaction is as follows:

1. Hypothesis 1: Creation of new knowledge has a positive impact on a company's performance with original sample 0.117776, t-statistics 12.753709 > t table=2.011, p-value 0.013 < 0.05, and significance level 5%. Thus, hypothesis 1 is accepted, which means that creation positively and significantly affects the KM process.

2. Hypothesis 2: Sharing positively and significantly influences the KM process with original sample value 0.051565, t-statistics 8.159916 > t table=2.011, p-value 0.020 < 0.05, and significance level 5%. Thus, hypothesis 2 is accepted, which means that sharing positively and significantly affects the KM process.

3. Hypothesis 3: Acquisition positively and significantly affects the KM process with original sample value 0.073091, t-statistics 9.731108 > t table=2.011, p-value 0.025 < 0.05, and significance level 5%. Thus, hypothesis 3 is accepted, which means that acquisition positively and significantly affects the KM process.

4. Hypothesis 4: Documentation positively and significantly affects the KM process with original sample value 0.175527, t-statistics 17.795139> t table=2.011, p-value 0.009 < 0.05, and signifi-

cance level 5%. Thus, hypothesis 4 is accepted, which means that documentation positively and significantly affects the KM process.

5. Hypothesis 5: Application positively and significantly affects the KM process with original sample value 0.214619, t-statistics 14.313935> t table=2.011, p-value 0.000 < 0.05, and significance level 5%. Thus, hypothesis 5 is accepted, which means that application positively and significantly affects the KM process.

6. Hypothesis 6: Transfer positively and significantly affects the KM process with original sample value 0.155396, t-statistics 8.928031> t table=2.011, p-value 0.011 < 0.05, and significance level 5%. Thus, hypothesis 6 is accepted, which means that transfer positively and significantly affects the KM process.

7. Hypothesis 7: Responsiveness positively and significantly affects the KM process with original sample value 0.258146, t-statistics 16.671955> t table=2.011, p-value 0.000 < 0.05, and significance level 5%. Thus, hypothesis 7 is accepted, which means that responsiveness positively and significantly affects the KM process.

8. Hypothesis 8: Dissemination positively and significantly influences the KM process with original sample value 0.186390, t-statistics 20.712725> t table=2.011, p-value 0.005 < 0.05, and significance level 5%. Thus, hypothesis 8 is accepted, which means that dissemination positively and significantly affects the KM process.

These results lead to the conclusion that there is a positive interaction with the KM process. Figure 4 shows the results of the KM process interaction analysis, which reaffirm the interrelationships between the KM process (Chen, 2007; Seleim & Khalil, 2007). This means that knowledge acquired from outside sources and transferred/shared within the company facilitates the creation of new knowledge and the application of such knowledge to improve company performance.
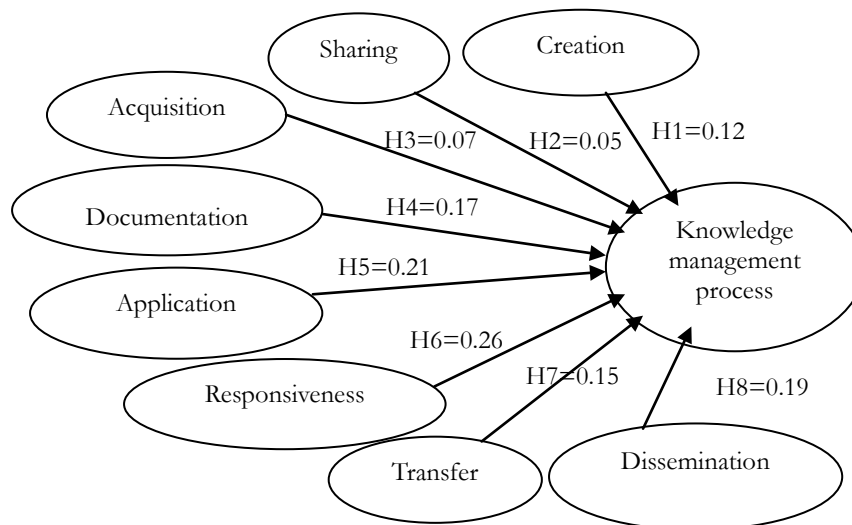

Figure 4. Knowledge Management Process Interaction

ANALYSIS OF COMPANY PERFORMANCE INTERACTIONS

Analysis of company performance interaction was achieved using SEM PLS, whereas the evaluation of the company performance model was done by evaluating the outer and inner model. The result of company performance interaction analysis is shown in Table 4.

Table 4. Company Performance Path Coefficients

Constructs	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)	P-Value
H10: Customer -> Company performance	0.369605	0.369760	0.007691	0.007691	48.057794	0.000
H11: Finance -> Company Performance	0.208756	0.207490	0.011282	0.011282	18.502602	0.000
H12: Internal business processes -> Company performance	0.189773	0.190720	0.007272	0.007272	26.096725	0.001
H13: Learn and grow -> Company performance	0.346220	0.345027	0.010369	0.010369	33.389534	0.000

Based on the original sample value, t-statistics, and p-values in Table 4, the result of the hypothesis analysis on company performance interaction is as follows:

1. Hypothesis 10: Customer positively and significantly affects company performance with original sample value 0.369605, t-statistics 48.057794> t table=2.011, p-value 0.000 < 0.05, and significance level 5%. Thus, hypothesis 10 is accepted, which means that customer positively and significantly affects company performance.

2. Hypothesis 11: Finance positively and significantly affects company performance with original sample value 0.208756, t-statistics 18.502602> t table=2.011, p-value 0.000 < 0.05, and significance level 5%. Thus, hypothesis 11 is accepted, which means that finance positively and significantly affects company performance.

3. Hypothesis 12: Internal business processes positively and significantly affect company performance with original sample 0.189773, t-statistics 26.096725> t table=2.011, p-value 0.001 < 0.05, and significance level 5%. Thus, hypothesis 12 is accepted, which means that internal business processes positively and significantly affect company performance.

4. Hypothesis 13: Learn and grow positively and significantly affect company performance with original sample value 0.346220, t-statistics 33.389534> t table=2.011, p-value 0.000 < 0.05, and significance level 5%. Thus, hypothesis 13 is accepted, which means learn and grow positively and significantly affect company performance.

With these results, it can be concluded that there is a positive interaction in the performance of the company. Figure 5 shows the results of the company's performance interaction analysis, which reaffirm the interrelationships between various fields in the performance of a construction company (Chen, 2007). This means that the performance of the company increases due to the application of the KM process in the company.
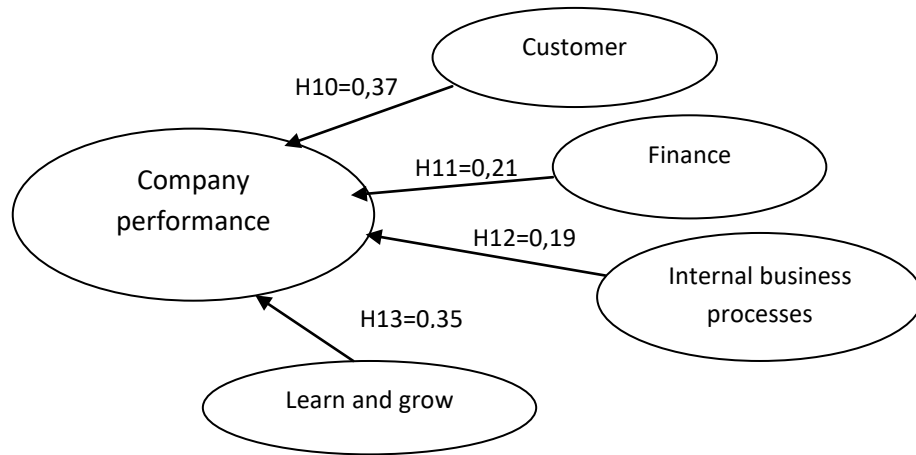
Figure 5. Interaction of Company Performance

ANALYSIS OF THE RELATIONSHIP BETWEEN THE KNOWLEDGE MANAGEMENT PROCESS AND COMPANY PERFORMANCE

The analysis of the relationship between the KM process and company performance was conducted using SEM PLS, while the evaluation of the relationship model was done by evaluating the outer and inner models. The results of the analysis of the relationship between the KM process and company performance are shown in Figure 6 and Table 5.
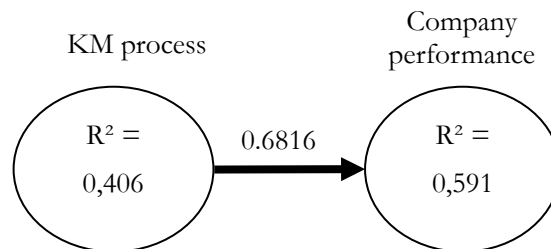

Figure 6. Relationship between KM Process and Company Performance

Table 5. KM Process Relationships and Company Performance Path Coefficients

Constructs	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)	P-Value
H9: Knowledge management process -> company performance	0.681630	0.678484	0.050434	0.050434	13.515413	0.000

Based on the original sample value, t-statistic, and p-value in Table 5, the result of the hypothesis analysis (H9) is that the KM process positively and significantly affects company performance with the original sample 0,681630, t-statistic 13,515413> t table=2.011, p-value 0.000 < 0.05, and signifi-

cance level 5%. Thus, hypothesis 9 is accepted, which means that the KM process positively and significantly affects company performance. These results reaffirm the relationship between the KM process and company performance (Chen, 2007; David & Yusoff, 2010; Emadzade et al., 2012; Gholami et al., 2013; Seleim & Khalil, 2007; Shahbakhsh, 2013).

DISCUSSION

The results showed that there was a positive interaction within the KM process elements, and also between the KM process and the company performance.

Knowledge creation has a positive interaction with the KM process. This finding supports that of Tubigi et al. (2013), who stated that new knowledge creation processes produce new ideas, solutions and knowledge. These findings also support Nonaka and Takeuchi's (1995) SECI model of knowledge creation, which establishes relations within the KM processes.

Knowledge sharing has a positive interaction with the KM process. This finding supports the work of Alrubaiee et al. (2015), who stated that knowledge sharing depends on the process of transferring appropriate knowledge to the people who need it in the right time to perform their work and is measured by IT systems to facilitate the sharing process and a motivated work environment. Knowledge sharing is referred to as a social interaction culture, which involves the interchange of employee knowledge, skills, and experience through all departments in the organization (Al-Hakim & Hassan, 2012).

Knowledge acquisition has a positive interaction with the KM process. This finding supports the findings of Alrubaiee et al. (2015), who explained that knowledge acquisition refers to the process of creation and information of knowledge and its components within the organization, and that implicit knowledge is transformed into explicit knowledge. Knowledge acquisition encompasses the process of obtaining and learning proper knowledge from diverse internal and external resources, such as relevant documents, experts, experiences, and plans. The most familiar techniques for knowledge acquisition are concept mapping, observing, interviewing, process mapping, laddering, training, and educating (Gholami et al., 2013).

Documentation knowledge has a positive interaction with the KM process. This finding supports that of Al-Hakim and Hassan (2012), who stated that knowledge document processes include retention of knowledge, organizing, and facilitation of access and retrieval. Knowledge should be available at the proper time, and reports should be brief and written in language that can be readily understood by workers, in order to be more valuable and accessible.

Knowledge application has a positive interaction with the KM process. This finding supports the work of Alrubaiee et al. (2015), who stated that the knowledge application is a practice that yields benefits. Knowledge is applied on a daily basis at work and is assessed by authorized programs, as well as by scales and indicators that examine the level of the knowledge application.

Knowledge transfer has a positive interaction with the KM process. This finding supports that of Tubigi et al. (2013), who stated that knowledge transfer is a process in which one unit (e.g., group, department, or division) is impacted by the experience of another unit. Knowledge transfer is about links that fundamentally depend on the choice made by individuals. Knowledge transfer affects organizational performance through physical transfer and networks, and it is the process used to create and form knowledge and components within the organization so that the implicit knowledge is transformed into explicit knowledge (Alrubaiee et al., 2015).

Knowledge responsiveness has a positive interaction with the KM process. This finding supports the work of Waluyo and Wibowo (2011), who explained that knowledge responsiveness is a form of response or reaction to knowledge. Responsiveness to knowledge is an action carried out as a response to complaints from employees and customers to improve products, services, and work processes (Waluyo, 2014).

Knowledge dissemination has a positive interaction with the KM process. This finding also supports the research of Waluyo and Wibowo (2011), who explained that knowledge dissemination is an activity to spread knowledge. Knowledge dissemination is an activity that aims to disseminate knowledge possessed within the company (Waluyo, 2014).

Financial, customer, internal business process, and learning and growth aspects have a positive interaction with company performance. This finding supports previous studies (e.g., Chen, 2007; Waluyo & Wibowo, 2011) that showed these four aspects have a positive interaction to construction company performance.

The KM process has a positive relationship with company performance. This finding supports the work of Lee et al. (2005), who stated that a significant correlation occurs between the KM processes of sharing, creation, and performance components. Seleim and Khalil (2007) stated that the KM processes of knowledge acquisition, documentation, transfer, creation, and application are related to organizational performance

The results show that knowledge responsiveness and knowledge application have the highest contribution factor compared with other KM processes. Through knowledge responsiveness and knowledge application, firms carry out responses and apply knowledge within the organization to improve the financial, internal business, and learning and growth aspects and to provide more services for customers as a measure of company performance indicators in Indonesia.

Other results indicate that the KM process of a construction company has a positive and significant effect on company performance in Indonesia (O=0,6818). In general, based on our findings, it can be argued that increasing the KM process could play an important role in improving financial, customer, internal business processes, and learning and growth aspects. In addition, the conclusions of this study indicate that the KM process is an important element to promote the performance of construction companies, and this can be done with the support of IT. When knowledge is known, acquired, and stored, construction companies can apply this knowledge to explore problems and create solutions, resulting in methods to facilitate efficiency and effectiveness. For example, effective concrete casting methods, effective formwork fixing methods, and foundation piling methods can be stored in a construction company repository so that they can be used in other projects later. This makes construction work more effective and efficient.

In today's dynamic and complex environment, construction companies need to acquire, create, share, store, and apply new knowledge to make strategic decisions that can lead to improvements in the business processes, finance, internal business, and learning and growth aspects of their company, as well as ensure improvements for their customers. Thus, construction company managers must commit to providing a supportive climate and culture that motivates employees and supervisors to implement the KM process, which will encourage the progressive results of construction companies in Indonesia. This can be done by proposing innovative new ideas in solving construction project problems or raising up-to-date topics in group discussions about KM processes. Each discussion activity conducted gives credit points to staff and, at the end of the year, affects the addition of income.

CONCLUSIONS

This study examines the relationship between the KM process and company performance, particularly the interaction between them. The paper shows that KM process activities provide initial benefits and guidance for companies that want to apply KM. Activities undertaken in a construction project should always be assumed to be KM processes. If this is considered important then it will always be recorded, stored, and delivered through the KM portal. The knowledge is then processed by the KM manager so that it can be used for different projects.

The KM process is an iterative process (KM spiral) of tacit and explicit knowledge with the aim of generating continuous knowledge improvement. Implementation of this process results in a compa-

ny's knowledge being well understood and kept as the value to develop company performance. Knowledge responsiveness and knowledge application are the two highest contributors in the KM process, and the analysis of the relationship between the KM process and company performance indicates that the former positively and significantly affects and interacts with the latter.

In modern dynamic and complex environments, construction companies need to create, share, acquire, document, apply, transfer, and respond to knowledge, as well as deploy and apply new knowledge in order to make strategic and effective decisions that can result in improvements in customers, finance, internal business, and learning and growth aspects of the company.

REFERENCES

Alrubaiee, P. L., Alzubi, H. M., & Hanandeh, R. (2015). Investigating the relationship between knowledge management processes and organizational performance: The mediating effect of organizational innovation. *International Review of Management and Business Research, 4*(4), 989-1009.

Al-Hakim, L. A. Y., & Hassan, S. (2012). The relationships among knowledge management processes, innovation, and organisational performance in the Iraqi MTS. *Proceedings of the Knowledge Management International Conference (KMICe) Johor Bahru*, Malaysia, 38-46.

Al-Hayaly, M. A. M. S., & Alnajjar, F. J. S. (2016). Knowledge management processes and their impact on organizational performance, the adoption balanced scorecard: The moderating role of quality assurance standards—An applied study on private Jordanian universities. *International Journal of Business and Management, 11*(6), 70-86. https://doi.org/10.5539/ijbm.v11n6p70

Bergeron, B. (2003). *Essentials of knowledge management*. Hoboken, NJ: John Wiley & Sons.

Chen, L. (2007). *Linking knowledge management to organizational business performance in construction* (Doctoral Dissertation, Griffith University). Retrieved from https://www120.secure.griffith.edu.au/rch/file/cc85fe61-3907-db5c-63b7-e2968f973879/1/02Whole.pdf

Darroch, J. (2003). Developing a measure of knowledge management behaviors and practices. *Journal of Knowledge Management*, *7*(5), 41-54. https://doi.org/10.1108/13673270310505377

Daud, S., & Yusoff, W. F. W. (2010). Knowledge management and firm performance in SMEs: The role of social capital as a mediating variable. *Asian Academy of Management Journal*, *15*(2), 135-155.

Echols, J. M., & Shadily, H. (2000). *Kamus Inggris Indonesia, An English-Indonesia dictionary.* Jakarta: PT Gramedia Pustaka Utama.

Egbu, C., Sturges, J., & Bates, M. (1999). Learning from knowledge management and trans-organisational innovations in diverse project management environments. *Proceeding of the Fifteenth Annual Conference of the Association of Researchers in Construction (ARCOM)*, Liverpool John Moores University, Liverpool, UK, 11-13 September.

Ellitan, L., & Anatan, L. (2009). *Manajemen inovasi transformasi menuju organisasi kelas dunia* [Management of innovation transformation towards world-class organizations]. Bandung: Alfabeta.

Emadzade, M. K., Mashayekhi, B., & Abdar, E. (2012). Knowledge management capabilities and organizational performance. *Interdisciplinary Journal of Contemporary Research in Business, 3*(11), 781-790.

Fatwan, S., & Denni, A. (2009). *Indonesian make study & lessons: Learned from The Winner.* Jakarta: PT Gramedia Pustaka Utama.

Gholami, M. H., Asli, M. N., Shirkouhi, S. N., & Noruzy, A. (2013). Investigating the influence of knowledge management practices on organizational performance: An empirical study, *Acta Polytechnica Hungarica, 10*(2), 205-216.

Hendrik, M. (2003). *Sekilas tentang knowledge management* [Overview of knowledge management]. Artikel Populer Ilmu Komputer.com.

Jennex, M. E. (2007). *Knowledge management in modern organizations*, San Diego, CA: San Diego State University. https://doi.org/10.4018/978-1-59904-261-9

Jensen, M. B., Johnson, B., Lorenz, E., & Lundvall, B. Å. (2007). Forms of knowledge and modes of innovation. *Research Policy, 36*, 680-693. https://doi.org/10.1016/j.respol.2007.01.006

Kaplan, R. S., & Norton, D. P. (1996). *The balanced scorecard: Translating strategy into actio*n. Harvard Business School Press.

Lee, K.C., Lee, S., & Kang, I.W. (2005). KMPI: Measuring knowledge management performance. *Information and Management, 42*(8), 469-482.

Lestari, B. A. H., & Zulaikha. (2007). Pengaruh information technology relatedness terhadap kinerja perusahaan dengan knowledge management capability sebagai variabel intervening (Kajian empiris pada perusahaan perbankan di Jawa Tengah) [Effect of information technology relatedness on company performance with knowledge management capability as an intervening variable (Empirical study on banking companies in Central Java)]. *Simposium Nasional Akuntansi X*, 1-33.

Love, P., Fong, P. S. W., & Irani, Z. (2005). *Management of knowledge in project environments*. Oxford: Elsevier Butterworth-Heinemann.

Mitchell, R., & Boyle, B. (2010). Knowledge creation measurement methods. *Journal of Knowledge Management, 14*(1), 67-82. https://doi.org/10.1108/13673271011015570

Munir, N. (2008). *Knowledge management audit, pedoman evaluasi kesiapan organisasi mengelola pengetahuan* [Knowledge management audit, guidelines for evaluating the readiness of organizations managing knowledge], Jakarta: PPM.

Nonaka, I. (1994). A dynamic theory of organisational knowledge creation. *Organisation Science, 5*(1), 14-37. https://doi.org/10.1287/orsc.5.1.14

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company*. Oxford: Oxford University Press.

Nonaka, I., Toyama, R., & Hirata, T. (2008). *Managing flow: A process theory of the knowledge-based firm.* New York, NY: Palgrave Macmillan Houndmills. https://doi.org/10.1057/9780230583702

Novak, A. (2017). Knowledge management and organizational performance – Literature review. *Management Knowledge and Learning International Conference 2017*, Lublin, Poland.

Pai, F.-Y., & Chang, H.-F. (2013). The effects of knowledge sharing and absorption on organizational innovation performance–A dynamic capabilities perspective. *Interdisciplinary Journal of Information, Knowledge, and Management, 8*, 83-97. https://doi.org/10.28945/1904

Rasli, A. M. (2005). Knowledge management framework for the Malaysian construction consulting companies. *IRPA Project vote no.7*, Faculty of Management and Human Resources Development, Universiti Teknologi Malaysia.

Sadikin, I. (2009). *Bunga rampai kriteria Malcolm Baldrige National Quality Award (MBNQA)* [Anthology criteria of the Malcolm Baldrige National Quality Award (MBNQA)]. Surabaya: Lembayung Center Indonesia.

Sahebnazar, D., & Dadfar, E. (2016). An investigation of the effect of knowledge management aspects on organizational performance (case study: sepah bank in Ardebil province). *International Journal of Scientific World, 4*(2), 33-36. https://doi.org/10.14419/ijsw.v4i2.6244

Sangkala. (2007). *Knowledge management, suatu pengantar memahami bagaimana organisasi mengelola pengetahuan sehingga menjadi organisasi yang unggul.* [Knowledge management, an introduction to understand how organizations manage knowledge to become a superior organization]. Jakarta: PT RajaGrafindo Persada.

Scarborough, H., Swan, J., & Preston, J. (1999). *Knowledge management: A literature review.* London: Institute of Personnel and Development.

Seleim, A., & Khalil, O. (2007). Knowledge management and organizational performance in the Egyptian software firms. *International Journal of Knowledge Management, 3*(4)*,* 37-66. https://doi.org/10.4018/ijkm.2007100103

Setiarso, B. (2005). Strategi pengelolaan pengetahuan (knowledge management) untuk meningkatkan daya saing UKM [Knowledge management strategies to improve the competitiveness of SMEs]. *Seminar Nasional PESAT*, Jakarta: Universitas Gunadarma Jakarta, E41-E50.

Shahbakhsh, B. (2013). Knowledge management and its relationship with organizational performance. *Interdisciplinary Journal of Contemporary Research in Business, 5*(2), 141-149.

Shaikh, A. A. I., & Aktharsha, U. S. (2016). Influence of knowledge management processes on organizational performance in service sector: An empirical study. *International Journal of Business and Management Invention, 5*(11), 28-35.

Sugiyono. (2009). *Statistika untuk penelitian* [Statistics for research]. Bandung: Alfabeta.

Tobing, P. L. (2007). *Knowledge management: Konsep, arsitektur dan implementasi* [Knowledge management: Concepts, architecture and implementation]. Yogyakarta: Graha Ilmu.

Tubigi, M., Alshawi, S. N., & Alalwany, H. (2013). Impact of knowledge management processes on organisational performance: A preliminary study. *Proceedings of the European, Mediterranean & Middle Eastern Conference on Information Systems (EMCIS)*, Windsor, United Kingdom.

Un, C. A, & Cuervo-Cazurra, A. (2004). Strategies for knowledge creation in firms. *British Journal of Management, 15*(S1), 27-41. https://doi.org/10.1111/j.1467-8551.2004.00404.x

Valdez-Juárez, L. E., García-Pérez de Lema, D., & Maldonado-Guzmán, G. (2016). Management of knowledge, innovation and performance in SMEs. *Interdisciplinary Journal of Information, Knowledge, and Management, 11*, 141-176. https://doi.org/10.28945/3455

Von Krogh, G., Takeuchi, H., Kase, K., & González, C. (2013). *Towards organizational knowledge: The pioneering work of Ikujiro Nonaka.* Basingstoke: Palgrave Macmillan. https://doi.org/10.1057/9781137024961

Waluyo, R. (2014). *Model hubungan antara culture, knowledge management dan performance di perusahaan konstruksi* [Model of the relationship between culture, knowledge management and performance in construction companies]. (Doctoral Dissertation, Universitas Diponegoro).

Waluyo, R., & Wibowo, M. A. (2011). Modelling of knowledge management, corporate culture and performance in construction firms. *Journal of Basic and Applied Scientific Research, 1*(11), 2286-2292.

Widayana, L. (2005). *Knowledge management meningkatkan daya saing bisnis* [Knowledge management increases business competitiveness]. Malang: Bayumedia Publishing.

Yang, J. (2010). The knowledge management strategy and its effect on firm performance: A contingency analysis. *International Journal of Production Economics, 125*, 215-223. https://doi.org/10.1016/j.ijpe.2010.03.012

Yuliazmi. (2005). *Penerapan knowledge management pada perusahaan reasuransi: Studi kasus PT. Reasuransi Nasional Indonesia* [Application of knowledge management to reinsurance companies: Case study of PT. Indonesian National Reinsurance]. (Doctoral Dissertation, Universitas Budi Luhur). Retrieved from http://riyogarta.com/downloads/tesis_yuliazmi.pdf

Zaied, A. N. H., Hussein, G. S., & Hassan, M. M. (2012). The role of knowledge management in enhancing organizational performance. *International Journal of Information Engineering and Electronic Business, 5*, 27-35. https://doi.org/10.5815/ijieeb.2012.05.04

Zuhal. (2010). *Knowledge and innovation platform kekuatan daya saing* [Knowledge and innovation platform strength of competitiveness]. Jakarta: PT Gramedia Pustaka Utama.

Zwain, A. A. A., Teong, L. K., & Othman, S. N. (2012). Knowledge management processes and academic performance in Iraqi HEIs: An empirical investigation, *International Journal of Academic Research in Business and Social Sciences, 2*(6), 273-293.

BIOGRAPHIES

Mochamad Agung Wibowo is an associate professor and lecturer in Universitas Diponegoro, Indonesia. He received his Master and PhD in Nottingham University, United Kingdom. He is currently the Dean of Engineering Faculty in Universitas Diponegoro. His academic interest covers Economic Engineering, Construction Law, Construction Management, Research Design, Modelling in Construction Management, Construction Management, Quality Management and Productivity, Supply Chain in Construction and Risk Management.

Rudi Waluyo is a lecturer in Universitas Palangka Raya, Indonesia. He received his Bachelor and Master Degree in Universitas Atma Jaya Yogyakarta. In 2014, he obtained his PhD in Universitas Diponegoro. His academic interest covers Construction Engineering and Management, Modelling and System Analysis, Value Engineering, Cost estimation, Waste Management and Waste Material, Supply Chain, and Knowledge management.

Zhabrinna received her BSc degree in Civil Engineering from Universitas Diponegoro. In 2017, she obtained her MSc degree in Construction Management from University of Birmingham, United Kingdom. She is currently a researcher in Universitas Diponegoro. Her research interests are mainly, but not limited to Construction Management, Building Information Modelling, Knowledge Management, Supply Chain Management and Sustainable Built Environment.