Evaluation of the maturity level and critical success factors of the knowledge management implemented in state-owned construction company in Indonesia

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Abstract. The implementation of Knowledge Management (KM) is considered a sustainable approach to overcome the challenges in the increasingly competitive construction field. This means there is a need to recognize the importance of this concept as a strategic asset to improve organizational performance in the industry. The purpose of this paper is to present an overview of KM implementation in State-Owned Construction Company (SOCC) in Indonesia. The research was conducted in three stages with the first focusing on the KM maturity level (KMML) while the second was on KM critical success factor (KM CSF). Both stages made use of literature review, expert validation, and questionnaires but KMML was developed using a spreadsheet to identify strengths and future development of KM factors while KM CSF was formulated with the use of descriptive analysis and Relative Importance Index to rank KM factors. Furthermore, the third stage involved recommended strategies to improve KM using literature review, gap analysis, and expert validation. The results showed the KMML of SOCC is at level 3 of 5 and 7 CSFs ranking based on the level of importance and the KM culture factor was recommended to be prioritized to improve KM implementation in SOCC in Indonesia.

1. Introduction
Infrastructural development is one of the focuses of the Indonesian government from 2014 to the present [1] and this is reflected in the efforts being made to accelerate the realization of projects considered strategic and of high urgency in a short period. The country currently has a total of 223 Projects and 3 National Strategic Programs (PSN) with a total investment value of 4,183 Trillion [2].

In the Indonesia Infrastructure Report Q4 2018 prepared by Fitch Solutions, the State-Owned Construction Company (SOCC) was observed to be dominating the construction of infrastructural projects in Indonesia with Wijaya Karya, Waskita Karya, and Pembangunan Perumahan holding the largest share despite the increasingly competitive tendering process. This is believed to be an opportunity for SOCC to stay afloat in the construction industry of Indonesia and also to become a market leader.

Several problems have been associated with the projects in the construction industry due to different reasons and an example is the project management methodology being used which involves planning, executing, and monitoring observed not to be contributing enough to the achievement of the desired goals [3]. Moreover, challenges from competitors are required to be overcome using different
approaches due to the increasingly complex and competitive construction industry caused by globalization and others [4] [5]. This was believed by several researchers to have led organizations to seek a sustainable approach which includes the implementation of KM [6,7]. The Project Management Institute has also added KM discussion to Chapter 4 of Project Integration Management in the sixth edition of the Project Management Body of Knowledge (PMBOK) [8]. This further supports KM as an approach to find solutions to the problems in the construction field. There are, however, limited discussions studies on KM CFS and the maturity level in the construction industry of Indonesia, therefore, there is a need for further research on the concept.

2. Literature Review

2.1. Knowledge Management

Several definitions have been associated with Knowledge Management (KM) in line with the development and diversity involved in understanding the concept. KM has been reported to be a management tool justifying the belief that knowledge is an asset to increase organizational capacity and the ability to work more effectively [9]. It is the process of identifying or creating, assimilating, and applying organizational knowledge to exploit new opportunities and improve performance [10]. The concept is about ensuring the skills, experience, and expertise of the project team and other stakeholders are used before, during, and after the project [8].

2.2. Knowledge Management Maturity Model (KMMM)

Maturity Model is a phased approach to improve business processes over a long period and has been observed to have several types such as InfoSys KMMM (2000), Siemens KMMM (2002), General KMMM, APQC, IAEA, etc. The International Atomic Energy Agency (IAEA) also uses a scale of 1-5 measurements [11] and 7 main KM elements have been identified to include policies and strategies, human resource planning and processes, training and improvement of human performance, document management, technical solutions (IT), approaches to obtain tacit knowledge, and KM Culture.

2.3. Knowledge Management Critical Success Factor (KM CSF)

KM CSF in the construction industry is recognized as an internal problem managed by companies in relation to the mobilization of limited resources to achieve the desired project management performance results [12]. Davenport et al. have identified eight KM CSFs which are industrial value, organizational infrastructure, standard flexible knowledge structures, culture, motivational practices, different channels for sharing knowledge, support from senior management, and language clarity and purpose [13]. Meanwhile, Wang et al. [14] and Zang [15] found 11 CSFs for public-private infrastructure organizations including leadership and support, information technology (IT), strategy and planning, culture, organizational infrastructure, KM resources, conferences, training and education, motivation tools, processes and activities, measurement, and human resource management.

Valmohammadi [16] also identified 12 KM CSF from different studies to include management leadership and support, organizational culture, information technology, KM strategy, performance measurement, organizational infrastructure, processes and activities, rewards and motivation, removal of limitation, training and education, resource management human power, and comparative analysis.

2.4. Relationship between KMMM & KM CSF

The maturity model helps organizations to develop, implement, and compare the successful implementation of KM [17]. It is used as a framework for organizations to measure the level of KM maturity and help them focus and prioritize areas to increase [18]. Meanwhile, CSF is related to more significant matters required by each organization or industry to concentrate based on its limited resources to succeed at a certain time or the elements deemed necessary for an organization to achieve its mission [19]. Several studies have shown KM maturity and KM CSF to be interrelated to achieve the desired level of KM implementation. This, therefore, means KMMM can be used to measure the
maturity level of KM currently being utilized while CSF determines the required elements to achieve the desired maturity level.

3. Research Methods
This study is divided into 3 research questions (RQ) and these include what is the KM maturity level in SOCCs in Indonesia (RQ1)? What are the CSFs needed to improve KM implementation (RQ2)? and What is the strategy to improve KM performance and consequently the organizational performance of SOCCs in Indonesia (RQ3)?

3.1. Data collection
The questionnaire was first validated by 5 experts with at least 15 years of experience to provide suggestions and improvements. This was followed by a preliminary survey respondents to provide input and correct questions before the main survey. The questionnaire was distributed to 9 SOCCs and 69 represented by 76.67% of the 90 distributed were returned but 2 were rejected due to the non-fulfillment of the requirements by the respondents. This means only 67 were used. The male respondents were 67% while women were 33%. The job positions were divided into 3 groups with the top manager discovered to be 61%, middle management was 24% while the staff was 15%. Moreover, the work experience was categorized into three, specifically <5 years, 5-10 years and 10-20 years with 1%, 81%, and 18%, respectively. Most of the respondents as represented by 84% have a Bachelor’s degree as their highest educational qualification while 16% have a Master’s degree.

3.2. Methods and measures
KM maturity assessment tools with a total of 39 indicators from 7 elements adapted from IAEA were used to answer RQ1 [11]. This involved determining the current and desired conditions. The current condition is the KM maturity level applied in the company while the desired level expected to be achieved to ensure optimal application and improvement in company performance. The indicators were scored on a five-point Likert scale with 1 indicating "not used at all", 2 "little extent", 3 "some extent", 4 "great extent", and 5 "very great extent". The data obtained were tested for validity and reliability using Pearson Correlation and Cronbach’s Alpha respectively and later calculated, grouped based on each rating scale, and the average value for each variable determined using Microsoft Excel. The results are presented using a radar diagram to make the differences of each variable in the current and desired conditions category visible.

The measuring tools with 71 indicators from 12 KM CSF adapted from Valmohammadi [16] were used to answer RQ2. The indicators were scored on a five-point Likert scale 1-5 based on the importance of applying KM. For the purposes of data processing, 12 factors were combined into 7 main factors to ensure the criteria used were the same with those in the Maturity Level RQ1 using the methods used in Valmohammadi [16] and Kozjek and Ovsenik [20]. The factors obtained were also validated by experts and were used as the KM CSF indicators after the data has been tested for homogeneity, validity, and reliability using the same method in RQ 1. This was followed by descriptive analysis to determine the distribution of variable data in the form of mean, median, and standard deviation after which each variable was calculated using the Relative Importance Index (RII) method to determine the rank of the KM factors.

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RII = \frac{\sum W}{A \cdot N} = \frac{5.n5+4.n4+3.n3+2.n2+n1}{5N}
\]

Where, \(W\) is the weighting associated with each factor by the respondent, ranging from 1 to 5. For example, \(n1\) = number of respondents for “not important at all”, \(n2\) for “little important”, \(n3\) for “quite important”, \(n4\) for “important”, and \(n5\) for “very important”. \(A\) is the highest weight which is 5 for this study while \(N\) is the total number of respondents.
The strategies to answer RQ3 include literature review and expert validation. This involved processing the results from RQ1 using Gap Analysis and linked to RQ2 results after which they were both analyzed and used to develop a strategy to increase the KM maturity level and subsequently organizational performance.

4. Findings
The validity was tested by correlating each item score to the total score using the Pearson Correlation technique and the questionnaire items were declared valid or confirmed to have the ability to measure the variables when the correlation coefficient \((r) \geq r_{\text{table}}\). The results showed the correlation coefficient value for each item was greater than \(r_{\text{table}}\) (0.2369), therefore, they were all declared valid.

The reliability was tested using Cronbach’s Alpha and the decision-making criteria require the Cronbach's Alpha coefficient value to be \(\geq 0.6\). The value for the items was observed to be more than 0.6 and they were all declared reliable.

4.1. RQ1 : KM Maturity Level (KMML) of SOCC in Indonesia
Table 1 and figure 1 show the KMML for each element of knowledge and its indicators. The "KM Culture" category was observed to have the lowest value with the current level being 3,14, while the desired level was 4,54. Meanwhile, the highest element was "Training and human performance improvement" with the current level found to be 3,46 while the desired level was 4,66. The KM Maturity Level in SOCC was discovered to be 3,35 and this means it is being currently used "to some extent" while the desired condition was found to be 4,58 and this means it is expected to be used "to a great extent" (IAEA).

| Indicators                                | Extent currently utilized | Extent desired |
|-------------------------------------------|--------------------------|----------------|
| Policy and Strategy for KM                | 3,33                     | 4,52           |
| Human Resource Planning and Processes     | 3,37                     | 4,57           |
| Training and human performance improvement| 3,46                     | 4,66           |
| Document Management                       | 3,44                     | 4,68           |
| Technical solutions (IT)                  | 3,44                     | 4,56           |
| Tacit knowledge capture                   | 3,30                     | 4,54           |
| Knowledge management culture              | 3,14                     | 4,54           |
| **Average Maturity Level**                | **3,35**                 | **4,58**       |
4.2. RQ2 : Critical Success Factors needed to improve implementation of KM

Table 2 shows the KM CSF to improve organizational performance in SOCC in Indonesia in general and the category with the highest level of importance was found to be “training and human performance improvement” with an RII value of 0.879 while “Document management” has the lowest with 0.816.

| Indicators                                      | Mean  | SD    | Med  | RII   | Rank |
|------------------------------------------------|-------|-------|------|-------|------|
| Training and human performance improvement     | 4,396 | 0,608 | 4,0  | 0,879 | 1    |
| Knowledge management culture                    | 4,391 | 0,526 | 4,0  | 0,878 | 2    |
| Policy and Strategy for KM                      | 4,384 | 0,613 | 4,0  | 0,877 | 3    |
| Technical solutions (IT)                        | 4,261 | 0,684 | 4,0  | 0,852 | 4    |
| Tacit knowledge capture                         | 4,184 | 0,688 | 4,0  | 0,837 | 5    |
| Human Resource Planning and Processes           | 4,109 | 0,737 | 4,0  | 0,822 | 6    |
| Document Management                             | 4,080 | 0,710 | 4,0  | 0,816 | 7    |

4.3. RQ3 : Strategies to improve KM implementation, so that improve organizational performance in SOCC in Indonesia

The strategy to develop KM implementation was obtained by analyzing KMML and KM CSF using the analysis to determine the biggest difference/gap between the current and desired conditions of KMML and this was confirmed to be "KM Culture" category with a difference of 1.40 as shown in table 3. This, therefore, means this category needs to be prioritized in order to improvise or raise the KM maturity level.

| Indicators                                      | Extent currently utilized | Extent desired | Gap |
|------------------------------------------------|--------------------------|---------------|-----|
| Policy and Strategy for KM                      | 3,33                     | 4,52          | 1,19|
| Human Resource Planning and Processes           | 3,37                     | 4,57          | 1,20|
The recommended strategies were to increase the KM maturity or minimize the gap to achieve the desired maturity level using KM CSF with the result from the gap analysis of KM ML (RQ1) and CSF in each category (RQ2) used as input after the results have been validated by experts. This study only discussed the categories to be prioritized for improvement and "KM Culture" was found. The recommendations validated to improve this category are, therefore, presented in the following table.

Table 4. Recommended Strategies for KM Improvement on SOCC in Indonesia

| Category need improvement | Maturity Level Gap | Rank | Recommended Strategies | RII |
|--------------------------|-------------------|------|------------------------|-----|
| KM Culture               | 1,40              | 1    | Leaders encourage the creation, sharing and use of knowledge | 0,910 |
|                          |                   | 2    | High level of trust among employees in sharing knowledge | 0,901 |
|                          |                   | 3    | Management acts as a role model to show desirable behavior | 0,899 |
|                          |                   | 4    | Employee motivation to seek knowledge | 0,899 |
|                          |                   | 5    | Tying a motivational approach as a job performance appraisal system | 0,899 |
|                          |                   | 6    | Collaboration between employees is important | 0,890 |
|                          |                   | 7    | Reward employees with an emphasis on group performance | 0,890 |
|                          |                   | 8    | Management of organizational change towards the adoption of KM through employees | 0,887 |
|                          |                   | 9    | Empower employees to explore new possibilities | 0,887 |
|                          |                   | 10   | Individual impulse to ask questions | 0,884 |

5. Discussion
The KM maturity level in SOCC in Indonesia is currently estimated at level 3 out of 5 and this means it is being used "to some extent" [11]. Meanwhile, Zain [21] showed the national construction service companies in Indonesia to be at level 2 and this means they use it "to a little extent" [11]. This is related to the strategies, processes, and discussions of KM identified in SOCCs while those in national private contractors are being developed [22]. The similarity between the two studies is observed from the IT Technical Solutions category which was recorded to have the highest current maturity level for both state-owned and private national contractors.
The category was observed to have the smallest value difference of 1.119 based on gap analysis and this means the respondents were quite satisfied with the IT system provided by the company in the application of KM, even though it was not optimal nor in accordance with the expected conditions. Moreover, the interviews with several SOCCs showed some systems have been designed such as integrated IT system applications for KM, Human Capital, etc. which are accessible from both laptops and mobile phones, and the employees were observed to be interested in using them to manage knowledge. This means information and communication technology has the ability to support the KM process by making it possible to quickly capture and transfer the knowledge obtained to others through different channels such as email, databases and other means such as Intranets, video conferencing, etc. [22,37], therefore, allowing project team members to learn, solve problems, and make decisions faster [23].

"KM Culture" with a difference of 1,400 has the biggest gap rank and "Example of a leader" variable was found to have the highest gap in the element. Meanwhile, despite the importance of leadership example in implementing KM [13], the process is expected to fail as long as the management does not understand its value as a promising alternative to existing techniques [24] required to achieve the expected project performance. This means a leader needs to show an appropriate leadership style while applying KM [25]. A strategy is, therefore, required to improve the KM maturity, especially in the Culture variable.

The element ranked first in KM CSF for both SOCC and National Private contractors in Indonesia is the same which is the “Training and human performance improvement but those in 2nd to 7th were different. This shows the element is considered very important by respondents and in line with a previous study which identified employee training as one of the important CSFs supporting the application of KM to achieve expected project performance [26]. This means the training budget is a strategic investment rather than a cost and its effect should be seen as a long-term action [27]. Moreover, learning increases interaction between employees and this further creates new knowledge for the organization [28].

The strategies considered very important and recommended for immediate improvement include "Leaders encourage the creation, sharing, and use of knowledge" followed by "High levels of trust among employees in sharing knowledge" and "Management acts as a role model to show desirable behavior". They are ranked based on their level of importance in the KM CSF analysis and are expected to be applied in KM implementation to be able to achieve the project results desired [29]. This is important because a clear identification of these internal CSFs allows construction managers to take proactive actions to avoid the negative impacts caused by project delays, poor quality, and high costs [30].

The "Leaders encourage the creation, sharing, and use of knowledge" strategy is very important due to the significant roles played by leaders of construction organizations in recognizing the value of KM and devising appropriate strategies for its implementation. This means strong leadership is needed to provide strategic direction, plans, and authority to achieve the goals and objectives of each project [31]. It is also required to apply the right KM strategy which allows a suitable environment to create, store, share, and use knowledge to ensure the effective functioning of project planning and successful implementation [32].

"A high level of trust among employees in sharing knowledge" strategy is very important due to the significance of the KM culture founded on trust, collaboration, and learning to enable project team members to think, behave consistently, and encourage the use of knowledge in project activities [33] without underestimating their skills.

"Management acts as a role model to show desirable behavior" strategy is also very important due to the need for the leaders to demonstrate the leadership style appropriate to achieve successful KM
implementation [34]. The role of the management is to empower and delegate responsibility to project managers towards maintaining the level of motivation required by the team members to set collective goals and share knowledge [35]. This, therefore, means management needs to continually search for methods to motivate the team members rather than concentrating on individuals and competitive goals [6,36].

6. Conclusion

The first objective of this research was to determine the current level of KM maturity achieved by SOCC in Indonesia and, after series of analysis using seven categories, it was found to be 3 out of 5 and this means it is being used "to a certain extent" (IAEA).

Relative Importance Index (RII) analysis was used to analyze 7 categories to obtain KM CSF. The highest level of importance was found with "Training and human performance improvement", followed by “Knowledge management culture”, “Policy and Strategy for KM”, “Technical solutions (IT)”, “Tacit knowledge capture”, “Human Resource Planning and Processes” and the lowest was "Document Management".

The strategies recommended to improve the application of KM were determined by combining the results obtained from analyzing the largest gap between the current and expected maturity level and those from the KM CFS analysis. The maturity level needs to be improved and, in this case, the "KM Culture" is prioritized with the three most important strategies recommended found to be "Leaders encourage the creation, sharing, and use of knowledge", "Management acts as a role model to show desirable behavior", and "Leaders act as catalysts for KM". They are recommended to achieve KM maturity according to the expected conditions and to enable organizations to react to environmental changes by considering the strengths and weaknesses of their environment to achieve the desired project performance.

Further research is expected to improve the recommended strategies of KM implementation from each knowledge factor instead of focusing on only KM culture. Moreover, a follow-up survey is needed after CSF KM is applied to the company to determine the level of increase in KM maturity based on the strategies recommended in this study. It is also possible for construction service companies in Indonesia to evaluate the maturity level of the KM application implemented and determine the key success factors to improve organizational performance according to the conditions and needs of each company.

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