Development of knowledge management in integration management systems in order to increase the organisational performance of construction companies

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Abstract. The previous research on integrated management systems has varied. Most of them used a structural equation model (SEM) or consisted of a literature review. These studies have not yet presented a relationship between integration management systems at the practical level in order to improve organisational performance. These studies have not included knowledge management in their implementation. Research on knowledge management is needed in order to minimise the inefficiency of an organisation. The level of maturity of knowledge management in construction companies is only about 50% (at the practiced level). The biggest obstacle to the realisation of an integrated management system is a lack of knowledge management. Knowledge management is a key standard in integrated management and sustainability reporting. This study aims to identify the most important variables needed in the context of the development of knowledge management and integrated management systems through RII analysis, including developing a job description through RAM RACI R (Responsible), A (Accountable), C (Consult), and I (Inform).

1 Introduction

Globalization means that organizations have to follow management systems that utilize international policy ISO:2015 and OHSAS. In the construction management discussion of the different management systems such as quality management, health and safety management, and environmental management systems, they are not integrated simultaneously. They are still executed independently, whereas, in reality, they engage the same processes throughout the PDCA cycle [1-7]. These common elements are combined by ISO:2015 through a high-level structure (HLS). This consists of common elements such as top management commitment, documentation, and recording control, notions of policy, goals and target planning, employee training, communication procedures, audits, control

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over non-compliance with quality, corrective and preventive action, and review management [1, 8-12].

In Indonesia, several management systems are used in construction activities, including quality management systems (QMS), environmental management systems (EMS), and health and safety management systems (OHSAS). The implementation of management systems is still below 50% according to Ministry of Public Works and Public Housing [13]. However, if a management system is not implemented, then the inappropriate use of quality can lead to construction failure. On the other hand, occupational health and safety can increase worker productivity, while the appropriate site selection for the project's activities can allow for the creation of an environmentally-friendly site plan [3, 14, 15].

The integration of management systems is ultimately seen of as a highly effective tool to use to optimize the function and procedures of quality and occupational health and safety management systems when implementing construction projects [16]. Through the management system overall, organizations try to improve product quality, the environment, worker safety, and other management practices [17, 18]. In practice, the integration of a management system still faces several problems, such as the definition of integrated management itself still being unclear [4]. There is also an absence of formal frameworks, procedures, and documents in and on integrated systems [4, 5]. The standards for quality, occupational safety and health, and the environment differ in their activity procedures while having the same structure and framework [3]. There is also a lack of information on the advantages of integrated systems at the leadership level [9]. The main obstacle in relation to integrated systems is the level of leadership [9]. Difficulties can arise in integrated management systems [2]. IMS's contribute to coordination among risk-based management systems [16]. There is a need for the development of a practice management system audit with a continuous progress process [1]. There also needs to be an evaluation of the steps involved in sustainable management system integration strategies [18]. The integration of the management system between quality, safety, and the environment is seen to bring in many benefits, particularly ensuring the reduction of document duplication, the removal of unnecessary procedures, reducing project administration costs, improving project, and enterprise efficiency [19-21].

In order to improve organization performance, it is necessary to develop knowledge about integrated management systems in relation to their application and the method of implementation [1, 22]. Knowledge management applied to construction companies in Indonesia is not well established around 54% are only in the "practiced" stage, approximately 36% of construction companies have reached the "managed" level and only 10% of companies have knowledge management in the continuous learning phase of "continuously improved" [15], as explained in Table 1. For the focus of this study, we have looked at eight construction companies that have a high risk of failure/ death accidents in Jakarta, Indonesia as the chosen location scope of this research.

Table 1. Maturity level of knowledge management at the construction company in Indonesia [15].

Construction company	Maturity knowledge management level	Percentage
30 Company	Practiced	54%
20 Company	Managed	36%
5 Company	Continuously Improved	10%

The research questions are: 1) How does knowledge management affect organizational performance in construction companies through integrated management systems? 2) What

are the most influential variables of knowledge management to improve the organization performance in construction companies through integrated management systems?

2 Literature review

2.1 Integrated Management System

In complex and large-scale organizations, it is considered that implementing an integrated management system is important [23]. In the organization, humans are the main factor that is most considered when managing an organization, as has been mentioned in a lot of previous research [15].

The integration of a new management system demonstrates that IMS can enable companies to benefit from the creation of synergy, that is not only designed to reduce the time and the associated costs, but also to improve efficiency. The complexity occurring in construction companies is not only due to the technological and process uncertainties: it also comes from the increasing influence of the organizational factors [24, 25].

The integration of several different critical factors contributes to the successful initiation of knowledge management and the effectiveness of the use of knowledge management systems [26]. Knowledge management is expected to support the realization of innovation. The creation of innovation is one result of the formation of integrated management systems [8]. Simon examined the relationship between integrated management systems and the performance of innovation management [7].

Therefore, IMS is becoming more popular as companies find it more sensible to integrate their MS's rather than managing them individually [5, 8, 27]. In addition to this, empirical studies on the scope of integration confirm the idea that companies prefer integration rather than disintegration [1, 28].

1.2 Knowledge management

The focus of knowledge management on organizational performance is increasing [29-31]. Open innovation is the key to improving knowledge management. Knowledge management is used to develop innovation and achieve sustainability. In this case, organizational performance plays a role in achieving the status of being a competitive company [32]. Knowledge management is defined as the ability to improve the skills of individuals to allow them to take effective action. Knowledge management is a process of capturing, distributing, and using knowledge effectively [33]. Knowledge management is grounded in ability, shaping the performance of the organization, and the associated management processes [34].

There is still a lack of adequate knowledge (tacit and explicit) on how to combine social, environmental and business aspects into the core processes of the organization and how to overcome existing barriers to encourage companies in the pursuit of their goals [3, 35]. As a consequence, interdisciplinary knowledge processes need to be investigated in the context of various fields in an integrative manner [36-38]. Integration is a very important feature of research and is debatable [32, 39]. The integration of knowledge is an important process in organizations [40-42]. The novelty of knowledge management in integrated management systems in construction companies has been shown in Table 2.

Table 2 describes the clauses/variables used in this research study based on the literature review. The table also shows the variables used by various researchers. The clauses are scope (SC), normative reference (NM), terms and definition (TM), context of the organisation (CO), leadership (LS), policy (PC), planning (PL), support (SP), operations

(OP), performance evaluation (PE), and improvement (IM). The methodologies used to describe the implementation of knowledge management are Task Action Responsibility (TART), responsibility assignment matrix using coding, accountable, consult and inform (RAM RACI), supply chain (SC), workflow (WF), and Agent-Based Modelling (ABM).

Table 2. Novelty of knowledge management in integrated management systems in construction companies.

Ref.	Clause/ Variable										Methodology				
	SC	NM	TD	CO	LS	PL	SP	OP	PE	IM	TART	RACI	SC	WF	ABM
[34]	-	-	-	-	-	-	-	-	-	-	-	√	-	-	-
[43]	-	-	-	-	-	-	-	-	-	-	-	√	-	-	-
[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	√	-
[44]	-	-	-	-	-	-	-	-	-	-	√	-	-	√	-
[29]	-	-	-	-	-	-	-	-	-	-	-	-	√	√	-
[45]	-	-	-	-	-	-	-	-	-	-	-	-	-	√	-
[31]	-	-	-	-	-	-	-	-	-	-	-	-	-	√	-
[46]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	√
[35]	-	-	-	-	-	-	-	-	-	-	-	-	-	√	-
[36]	-	-	-	-	-	-	-	-	-	-	-	-	-	√	-
[25]	-	-	-	-	-	-	-	-	-	-	-	-	-	√	-
[28]	-	-	-	-	-	-	-	-	-	-	-	-	-	√	-
[33]	-	-	-	-	-	-	-	-	-	-	-	-	-	√	-
[25]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	√
[38]	√	√	√	√	√	√	√	√	√	√	-	-	-	-	-
[39]	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-
[47]	-	-	-	-	-	-	-	-	√	-	-	-	-	-	-
[40]	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-
[48]	√	√	√	√	√	√	√	√	√	√	-	-	-	-	-
[49]	-	-	-	-	-	√	√	√	√	√	-	-	-	-	-
[11]	-	-	-	-	-	√	√	√	√	√	-	-	-	-	-
[50]	-	-	-	-	-	√	√	√	√	√	-	-	-	-	-
[42]	√	√	√	√	√	√	√	√	√	√	-	-	-	-	-
[1]	√	√	√	√	√	√	√	√	√	√	-	-	-	-	-
Ringgy Masuin	√	√	√	√	√	√	√	√	√	√		√			

2.3 Organization performance

Construction companies are a type of complex organization. An organization can be defined as a system of coordinated action among individuals who differ in the dimensions of interest, preference, and knowledge [51, 52]. The existence of organizations arises when people interact in order to increase organizational performance [52]. Organizations can also be defined as a knowledge system with and within an organizational structure. Mayo [53] explained that a social group is one of the basic forces which can be used to decide on the organizational operations. Organizational scholars focus on human factors and seek to humanize management [52]. There are theories of organization that is based on the human-machine relationship perspective [54].

Organizations need several elements to force the potential impact of organizational performance. Organizations have two dimensions, the institutional environment and the technical environment. Organizational performance can also be influenced by aspiration-level constraints that are based on the performance of profit, the performance of safety and the performance of productivity. The performance of the organization also can be seen from the resources that an organization produces at a given level of organizational output [55].

3 Methodology

Knowledge management in integrated management systems was examined using workflow (WF) and RAM RACI methodologies to describe best the activities conducted in the chosen construction companies. WF describes the activities as per the variables above. RAM RACI focused on accountability and responsibility, which is important when defining roles and responsibilities across organizations generally and within projects that the organizations deliver. To demonstrate this, we referred to a 2006/2007 attempt to determine accountability and responsibility using a RACI matrix. At the time, the latest (3rd) edition of the Project Management Body of Knowledge Guide (PMBok Guide) provided an example of a responsibility assignment matrix (RAM) using RACI coding – R (Responsible), A (Accountable), C (Consult), and I (Inform) [56]. The variables for knowledge management were substantial; 421. These variables then combine with the knowledge management descriptions, such as knowledge holder, knowledge organizer, knowledge user, and knowledge manager to ensure that knowledge management is accurately implemented.

This research will begin with the identification of the clauses/ variables used for knowledge management as the object of this research. The object of research is the implementation management systems of quality, safety, occupational health, and the environment in construction companies. A literature review of the previous studies on knowledge management related to integrated management systems was contained in the clauses. A construct questionnaire was created for knowledge management and validated in relation to construction companies dealing with quality management systems, safety, occupational health, and the environment. The validation clauses were the results of a pilot survey and the associated reliability and validity test.

The respondents were 19 construction company workers. This sample is representative of 8 construction companies that have a high-risk failure/ death rate in Jakarta, Indonesia. The characteristics of the respondents were that 10% had handled more than 30 projects, 40% of the workers had handled 10-30 projects and 50% of the workers had handled fewer than ten projects. 10% of the workers had worked for less than 5 years in the construction company, 45% workers for 5-10 years, and 45% had worked for more than 10 years in the construction company. The results of the survey respondents were analyzed using AHP methods.

4 Results and discussion

Not all studies will have a hypothesis for testing. For a research study that is an exploration, for a theory that is not significant or small, it is impossible to draw a hypothesis. To achieve the research objectives of this study, we have constructed a research question based on the literature review.

4.1 Mean

The formulation of the mean was as follows:

$$\mu_x = \frac{\sum_{i=1}^M x_i}{N}$$

(1)

We found that $\mu = 4.46$. This means that the respondents agree with all of the variables required in this research.

4.2 Validation

Based on the results of the validation of the content and constructs in the research methodology, we found that 10 clauses were valid for knowledge management content. The clauses used for the knowledge management context were scope (SC), normative reference (NM), terms and definition (TD), organisational context (CO), leadership (LS), planning (PL), support (SP), operation (OP), performance evaluation (PE), and improvement (IM).

Table 3. Validation.

N		19
Normal	Mean	4.45
Parameters ^{a,b}	Std.	0.811
	Deviation	
Most Extreme	Absolute	0.154
Differences		
Kolmogorov-Smirnov Z		0.672
Asymp. Sig. (2-tailed)		0.757

4.3 Results of RII

As we have a valid variable to measure, next, we found the variables that were important in relation to the integration audit. There was also normalization in the matrix and priorities. Some of the variables had the highest weight of X5.2 (leadership commitment when applying unity of purpose in the development of an integrated management system and implementation when done by a service user). These variables had the highest weight (4.06), which is more than X5.10 (the involvement of people activates an organization in the achievement of strategies, policies, processes, and resources), which was 3.57.

4.4 Result of RAM RACI

The lack of integrated management system implementation is related to knowledge management, so in this paper, we added the RAM RACI method to support the implementation of integrated management systems. The variables from the RAM RACI method that were found to be valid have been shown in Table 4.

Table 4. RAM RACI method in Integrated Management Systems.

	Knowledge holder	Knowledge organizer	Knowledge user	Knowledge manager
Clause 1 (Scope of Organisation)	C	R	I	Top Management (A)
Clause 2 (Normative Reference)	Law Development (A)	C	I	R
Clause 3 (Terms and definition)	C	I	Human Relation and Development(A)	R
Clause 4 (Context of organisation)	C	R	I	Top Management (A)
Clause (Leadership)	C	I	Human Relation and Development(A)	R
Clause 6 (Planning	C	Manager Planning (A)	I	R
Clause 7 (Support)	Team Support (A)	I	R	C
Clause 8 (operational)	Engineer (A)	I	R	C
Clause 9 (Performance Evaluation)	C	I	R	Auditee (A)
Clause 10 (Improvement)	C	I	R	Quality Assurance/Quality Control (A)

Table 4 describe that in each of clause their was accountable person that singed the document, responsible person that are doing the job, consult person that are willing to give consultation and inform person that have to achive the information. In setting the scope of organization, top management have the accountable to signed what document and activity is necessary for scope of organization. The job preparing the document is set up by knowledge organizer who I respsibel for the analyse scope of organization. Knowledge

holder is consultative person that have experience in knowing scope of organization. Knowledge user is distributed and inform so they can act based on sope of organization that already signed.

Clause normative reference documentation and activity is prepare by knowledge manager, what normative reference needed in construction company, the legislation of normative reference used in construction company is done by law development, consult to knowledge organizer and inform to knowledge user. Clause terms and definition documentation and activity prepare by knowledge manager and consult with knowledge holder. Terms and definition that used in costruction company is signed by human relation and development, and socialized/informed to knowledge organiser. Clause context of organization should be signed by top management as knowledge manager that already consult with knowledge holder. Context of organization that already signed should be informed to knowledge user.

Clause leadership is must be responsible and supported by knowledge manager. Documentation and activity in clause leadership is signed by human relation and development. Documentation and activity is informed by knowledge organizer and consult to knowledge holder. Documentation and activity in clause planning is set up by knowledge manager and signed by manager planning as knowledge organizer. This planning consult to knowledge holder and inform to knowledge user.

Knowledge user responsible for preparing documentation and activity in clause support and consult with knowledge manager. This documentation and activity is signed by team support as knowledge holder and informed to knowledge organizer. Documentation and activity in clause operational is responsible by knowledge user an signed by engineer as knowledge holder. Documentation and activity in clause performance evaluation is signed by auditee as knowledge manager with consult to knowledge holder. Documantation and activity that already signed informed to knowledge organizer. Knowledge user is responsible to prepare the documentation and activity.

Preparation of documentation and activity in clause improvement is responsible by knowledge user with consult to knowledge holder. Documentation and activity is signed by quality assurance/quality control as knowledge manager and informed to knowledge organizer.

5 Conclusions

The clauses/variables used for the knowledge management context were scope (SC), normative reference (NM), terms and definition (TD), organisational context (CO), leadership (LS), planning (PL), support (SP), operation (OP), performance evaluation (PE), and improvement (IM). For the clauses, we found that some of the variables had the highest weight of X5.2 (leadership commitment in applying unity of purpose in the development of an integrated management system and implementation when done by the service user) is 4.06, which was more than X5.10 (involvement of people activates an organization in the achievement of strategies, policies, processes and resources), which was 3.57. The clause used for knowledge management in integrated management systems can best be described through RAM RACI coding. For future research we will develop standard operational and procedur based on RAM RACI to develop documentation and activity should be manage by knowledge manager in construction company.

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Supplementary data

Supplementary data is available from this link:

<https://drive.google.com/file/d/1jDDKAYwdJZQXu5uCKhdu7GjX8zhjSRGw/view>