INFLUENCE OF ORGANISATIONAL CULTURE ON KNOWLEDGE MANAGEMENT IN A BIM ENABLED ENVIRONMENT

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Abstract

Knowledge Management (KM) is increasingly recognized as a flourishing discipline within the Architecture, Engineering, Construction and Operation (AECO) industry as the rapid change in the industry can only be handled through a coherent approach to KM. The enriched information and communication technologies such as Building Information Modelling (BIM) and responded soft issues as culture, people and work environment are the main approaches to KM. Hence, the research is directed at the cultural influence on the KM in a BIM based environment to embed the individual's knowledge in projects to increasing organisational cohesion and performance. A comprehensive literature analysis was conducted on currently available scientific knowledge in reliable sources such as indexed scientific journals, conferences, edited books and the most congruent facts were constructed in a logical order to realise the influence of organisational culture on KM in a BIM enabled environment compared to a traditional construction environment. It was established that construction project activities are knowledge incentive and knowledge could be stored in databases commonly known as Knowledge Management Systems (KMS), once the subject experts validate it. The implementation of a suitable organisational culture, where knowledge sharing, shared learning and collaboration were entrenched, was acknowledged as essential to KM.

Keywords: Building Information Modelling (BIM); Knowledge Management (KM), Organisational Culture.

1. Introduction

Construction project activities are knowledge incentive and it has encouraged the construction organizations to manage knowledge effectively and efficiently. Lin (2014) emphasized that the involved engineers and the experts in AECO industries can share and reuse their knowledge to improve the construction process cost relating issues and the time escalations.

Queries has been raised about the current KM in practice due to the limitations to the physical and knowledge infrastructure since knowledge is not treated as an asset and is only shared informally among staff through tips or lessons learned in organisations (Succar, 2015).

Nevertheless, arguments against the AECO industries are contended by Brewer and Gajendran (2011) stating that the industry has been evolved with Information and Communication Technology, which provides a variety of technical solutions to standardize and rationalize the process of design, construction and operation of built assets. Within this context, modern technologies such as BIM facilitate KM implementation. According to Succar (2015), the emergent technical and procedural shift in the AECO industries has been accelerated through BIM.

Yet, most of the expensive software implementations, critically inconsistent as they are not customized according to the strategic orientation and the personnel interaction within the particular industry because the culture is overlooked (Beckett et al., 2000). According to Construction Industry Council BIM Protocol (2013), a strong culture facilitates achievement of objectives. For an instance, the requirement of a separate electronic data exchange agreements among members of the project team is seized by removing the primary risks in relation to the provision of electronic data corruption by improving the trust base of the culture (Bouazza,Udeaja, & Greenwood,2015).

Therefore, the significance of BIM as a multidisciplinary implementation to integrate the processes in the concept, design, construction, and operation stages of the construction projects have been highlighted in this study in relation to the influence of organisational culture on KM.

2. Knowledge Management

A well-established definition for knowledge is that it is "justified true belief" (Nonaka & Takeuchi 1995, p. 87). It has been elaborated as a condition or point of knowing where knowledge formulated through understanding gain through study or experience, perceived or discovered (Schubert & Selz,2013, p. 618-620).

Subsequently, Lin (2014) has expressed KM as the organization, creation and the transferring of knowledge while BIM being the platform of visual knowledge retrieval and sharing. The earliest authors, Nonaka and Takeuchi (1995), and Dalker (2011) have possessed and presented similar opinion, that KM was an organizationally and systematically definite process of sharing, transferring, creating using and storing knowledge of employee to enhance organizational performance.

2.1 KNOWLEDGE MANAGEMENT IN TRADITIONAL CONSTRUCTION ENVIRONMENT

Construction project activities are knowledge incentive and it has lead the construction organizations to manage information and knowledge more effectively and efficiently. Lin (2014) highlighted that the engineers and the experts can share and reuse their knowledge to improve the construction process cost relating issues and the time escalations.

Moreover, the transfer of organisational knowledge across projects facilitates the opportunity to exploit and leverage the invaluable lessons learned and avoidance of repetitive mistakes in a project base setting. In 2008, Kivrak, Arslan, Dikman, and Birgonul conducted a survey-based research to investigate the tactic and explicit knowledge captured, shared, used and stored for the future use for the coming projects and major barriers and drivers of KM.

Nevertheless, in order to solve the knowledge sharing problems within construction organizations, research had been carried out to implement a web-based KMS). Zang, Mao and Abourisk (2009) had proposed a value engineering KMS expecting a more organized, systematic and problem focused designing stage to construction projects.

2.2 KNOWLEDGE MANAGEMENT PROCESS MODEL

The knowledge in the AECO industries had been utilized with different perceptions. The need for innovative KMS, change and best practice in the industry have been highlighted where KM is known to be a major constituent. International Organization for Standardization (ISO,2016) has identified the Knowledge Management Process Model (See Figure 1) by Botha, Kourie, and Snyman (2008) in ISO 9001:2015 Clause 7.1.6 *(Knowledge Management)* for its practicability and simplicity.

It distinguishes people focused and technological oriented management processes. Knowledge creation, sensing, organizing and capturing were considered as human focus steps and knowledge sharing and dissemination as technology focus steps (Botha et al., 2008).

3. Building Information Modelling (BIM)

In AEC UK BIM Protocol (2013), BIM was defined as "the creation and use of coordinated, internally consistent, computable information about a project in design and construction" (p.7). Further, it is elaborated by Succar (2015) as a set of processes, technologies and policies allowing integrated design, construct and operation to the different stakeholders.
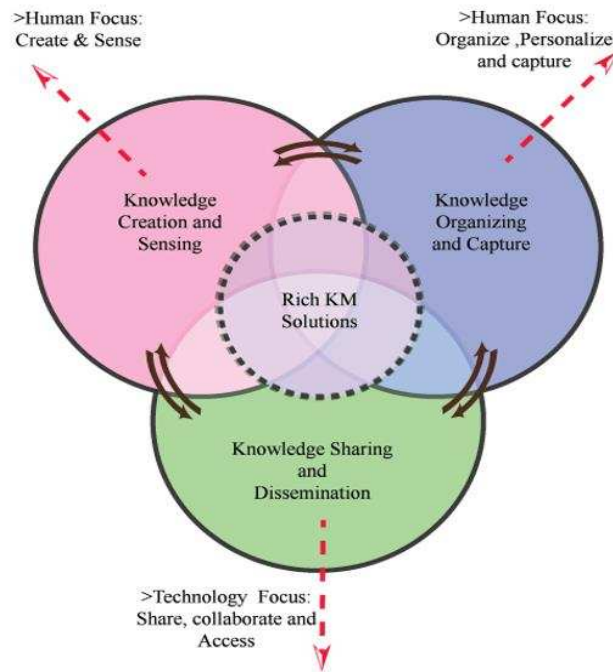
Figure 1: Knowledge Management Process Model
Source: (Adapted from Botha et al.,2008)

3.1 APPLICATION OF BIM FOR KM SOLUTIONS

The facilitating BIM characteristics for achieving sustainability through KM has been identified in the Table 1. The availability of a central database, ability to add for industry specific applications and collaboration are the main features. Since, knowledge creation, sensing, knowledge organisation, and capturing are human focused KM features, the sustainable solutions for KM and AECO disciplinary is achievable by integrating the different professional knowledge through BIM.

Table 1: BIM Characteristics Facilitating the KM Process

KM feature	Reference	Facilitating BIM feature	Reference
Knowledge creation and sensing	Botha et.al,2008	Data and information of model can be stored in databases to facilitate collaboration	Lin,2014
Knowledge organizing and capturing	Botha et. al,2008	Changes to these data bases can be managed such that a change in the data base affects all the part of model	Lin, 2014
Knowledge sharing and dissemination	Botha et al, 2008	The information model can be captured and preserved for reuse by adding industry specific applications	Lin, 2014

Thus, it is evident that BIM has characteristics, which are required to implement effective KM solutions. Similarly, In this context, the cultural influence is significant to establish the connection among people and the technology.

4. Organisational Culture

The organizational culture is widely considered as the most important impediment to the transfer and management of the knowledge (Ajmal & Koskinen, 2008). The most denoted definition for the organizational culture had been provided by Schein (2004) as, "a pattern of shared basic assumptions, which is learned by a group as it solve problems of external adoption and internal integration. Since, they worked well enough to be considered valid and, they are taught to new members as the correct way to perceive, think, and feel in relating to those problems." In the latest studies, Schien and Dawsonera (2010) distinguished the key cultural elements; artifacts, basic assumptions, and espoused values.

4.1 ORGANISATIONAL CULTURE IN TRADITIONAL CONSTRUCTION INDUSTRY

Matinaro and Liu (2017) argue that lack of cultural management in the AECO industries hinders innovativeness. Howbeit, responses to many other external factors are influenced by the culture in traditional construction environments in construction organisations. Arditi, Nayak, and Damci (2017) instated that it surpassed the factors such as market presence, corporate strategy and technological advancement.

The culture was viewed as a commanding resource of common identity, organisational purpose flexible guidelines (Ahmady et al., 2016) which reflected about projects and time to communicate the output inside and outside the teams (Mueller, 2014).

4.2 ROLE OF ORGANISATIONAL CULTURE TOWARDS KM

Haqiqat-Monfared and Hooshyar (2010) have emphasized that a suitable organizational culture is one of the mostC significant factors for a successful management of knowledge activities. Similarly, Mueller (2014) has highlighted, the major manifestations of the culture as trust, collegiality, output oriented evaluation, openness and high learning orientation, which influence knowledge sharing.

Kathiravelu et al. (2014) has stated that managers' commitment, emotional intelligence, fear, the presence of hierarchy in the organizational structure, shortage of resources, conflict of motives, lack of social network, uncertainty, under estimation of lower levels, conflict avoidance and the general environment at work were factors that had influence on KM.

5. Findings and Discussion

The findings of the study is based on a comprehensive literature synthesis on currently available scientific knowledge in reliable sources such as indexed and non-indexed scientific journals, indexed conferences, edited text books were thoroughly investigated and the most congruent facts were constructed in a logical order to feature the research gap. The lack of availability of BIM implemented projects in the local context limited the study to a literature review. A case study approach might have facilitated an in-depth study of the organisational culture, yet the result would not expedient to generalize for the context, which is one of the objective of the study. Howbeit, the cultural factors that has been considered in the study are inherent to any construction organisation in the local context. Thus, the result from the study is justifiable to any construction organisation.

5.1 INFLUENCE FROM ORGANISATIONAL CULTURAL FACTORS ON KM IN TRADITIONAL CONSTRUCTION ENVIRONMENT

As elaborated by Ahmady et al. (2016), Professor Daniel Denison considered cultural properties of an innovative and effective organizational culture under 12 factors. The Table 2 recognizes these cultural factors and their influence on KM in traditional construction environment. These factors indicate the influence on KM considering the main three areas explained in Knowledge Management Process Model.

Table 2: Cultural Factors and the influence of them on KM in a traditional construction environment.

Mission		
Strategic direction and intent	Organisational purpose on which the individuals act upon in long term. The plans and other statements about the desired future directions of organization, which include the KM directives, and the use of KM in decision-making.	Haqiqat-Monfared&Hooshyar,2010; Mantere & Sillince, 2007
Goal and objective	Purposes integrated with strategy and vision of an organization. Reflect the strategy to adopt learning culture or enhance knowledge creation through education, mentoring and training which in return enhance the organisation performance by improving the employees' engagement and commitment.	Abubakar, Elrehail, Alatailat, & Elçi, 2017 ; Shafee et al., 2010

Outlook	The vision about the future, forming core values of the entity. Developing a strong vision and adaptability of the employees to that conceptualization enhance the occurrence of effective knowledge creation, knowledge sharing, external knowledge acquisition and knowledge documentation.	Haqiqat-Monfared&Hooshyar,2010 ; Younis, 2013
Compatibility		
Core value	A set of values forming identity and expectations of an organisation, which define for uniformities in behavior. The strategic thinking of use of cognitive surplus in opportunities through the strategic alignment of KM.	Imani,2012
Agreement	The method of stakeholders come to agreement in a conflict. Due to the different knowledge build up through different norms, people agree in different issues. Include agreement with managerial level and the subordinate level	Angouri & Locher, 2012; Metaxiotis, Ergazakis, & Psarras, 2005
Coordination and integration	Willingness to integrate operations with the other project stakeholders. Include the collaborative working of the employees in knowledge sharing, mentoring, and creation of knowledge especially in changing environment.	Imani,2012
Involvement		
Empowerment	An active motivation-oriented characteristic creating a possessive and responsible sense of one's work which, mediates to the relationship between technology and knowledge seeking. Increase the knowledge contribution and knowledge sharing.	Imani, 2012 ; Kang, Lee, & Kim, 2017
Group orientation	Group work to achieve a common purpose in conditions where using the integrated knowledge in the group is beneficial than spending time seeking information beyond group boundaries.	Haqiqat-Monfared & Hooshyar,2010;
Capability development	Providing skills and needs to perform in the competitive arena. Capability development in terms of expertise knowledge which gains through formal education and experience, documentation of knowledge by repository support for clarity of meta data, standardization, comprehensiveness of taxonomies.	Demchig, 2015, Imani, 2012
Adaptability		
Creating change	Respond to need through taking innovative actions. The continuous refining of organisational knowledge leads to the need of change. The change process directly intervened with knowledge where first the non-confirmed data create imbalance, then the connection of the change to the existing knowledge ideals and finally psychological comfort through the full knowledge of change.	Gamble & Blackwell ,2001; Haqiqat-Monfared&Hooshyar,2010; Heier & Strahringer, 2006
Customer focus	The level of focus on the final output than on the process. The knowledge on the perceptions of customers leads to be more output focused than the construction process.	Shafee et al., 2010; Walker, 2000
Organisational learning	The level of the motivation to learn through mistakes. Generation of new knowledge at a speed to create new ideas, untried solutions and proposals which enable the sustainability in the long run. Transform knowledge in the environment to core residual knowledge.	Imani, 2012 ; Mishra & Bhaskar, 2011

The tables introduce the organisational cultural factors considered with in a traditional construction environment while explaining the influence of the cultural factors on KM.

5.2 INFLUENCE OF ORGANISATIONAL CULTURE ON KM IN A BIM ENABLED ENVIRONMENT COMPARED TO TRADITIONAL ENVIRONMENT.

Alternatively, the Table 3 demonstrates the summary of the literature synthesis, which provides the influence of the 12 cultural factors on KM in a BIM, enabled environment.

Table 3: Influence of the 12 Cultural Factors on KM in a BIM Enabled Construction Environment

Mission		
Strategic direction and intent	There is a necessity to take a step backward to understand how to combine BIM technology to KM via the organizational strategy. The strategic direction and intend is directly associated with the future directions of the organisation, which may include KM directives, BIM directives and long-term sustainability in construction.	Kapogiannis &Sherratt ,2018; Manthere and Sillince (2007),

Goal and objective	Knowledge creation, capturing and sharing through a KMS may be reflective through the goals and objectives, but the nature of tacit knowledge causes limitations in the objectivist KM in construction in BIM environment.	Addis (2016)
Outlook	KM can easily be incorporated to the strategy if BIM or technological use is within the outlook of the organization. Yet, the disinterest to develop long-term relationship with trading partners to adapt return of significant investment is an issue when considering investing in BIM	Motamedi, Hammad, & Asen, 2014
Compatibility		
Core value	Knowledge in a perspective of a "state of mind", which involved upgrading the user learning and understanding through provisions of information and therefore, using BIM is encouraged for KM considering the benefits to individuals and organisation.	Alavi and Leidner, 2011
Agreement	The lack of standard conditions of contact that specifically address the conflicts raised by use of ICT. The need of guidelines, frameworks and tools that allowed the AECO industries to shape its culture to integrate the human aspects in the dynamic environment of advance technologies is explicit.	Fong & Kwok,2009; Trigunarsyah, 2017
Coordination and integration	The practice of using multiple online systems introduced by the different project participants may strongly established in the culture, which make it easier to use BIM for KM and the coordination and integration among different disciplinary will be facilitated through federated and central BIM models	Motamedi, Hammad, & Asen, 2014
Involvement		
Empowerment	The knowledge creation, organisation and sharing is facilitated through BIM, addressing fragmented issues in the project team to improve performance related to The infringement of the transparency and trust among the project team members. BIM implementation utilize knowledge for better scheduling improved to JIT deliveries, coordinating the as built models to asset information models, soft landing or any other knowledgeable forecasting activities using the BIM models as a pioneering tool for visualizing construction process.	Brewer &Gajendran,2011; Ding, Zhou, Lou, & Wu ,2012 ; Trigunarsyah, 2017
Group orientation	Stakeholders from different disciplinary backgrounds such as designers, contractors, quantity surveyors and facility managers may had different usage patterns, which necessitated different standard interfaces in BIM, yet it collaborate these direct stakeholders together by model simulations. BIM influenced the deployment of a collaborative culture during all stages of the project, which in return share tacit knowledge among group members.	Kapogiannis &Sherratt ,2018; Singh et al., 2011
Capability development	The cultural values to be adopted by the AECO industries were similar to the desired cultural values for an ICT facilitating optimised environment, thus capabilities regarding technology, and human are developed when BIM is implemented as stated in the knowledge management process model	Botha et al., 2008; Brewer &Gajendran,2011
Adaptability		
Creating change	Lack of cultural management in the AECO industries hinders innovative change. Thus, BIM is resisted within the industry. Nevertheless, BIM can be integrated into construction SC to promote information flow and KM between the stakeholders throughout the construction project life cycle.	Konukcu & Koseoglu, 2012 ; Matinaro & Liu ,2017
Customer focus	Literature conceptual framework of Knowledge-based BIM (K-BIM) combining BIM, KM, and facility management ontologies to aid the effective management of facilities by with the focus on customer. Similarly, the BIM model enable visualization of the performance analysis of the project.	Alshawi, 2015 ; Charlseraj,2014
Organisational learning	Constructability analysis, future business case analysis and cost analysis, which contributed with embedded knowledge to make informed decisions using BIM model are outcomes of KM where knowledge should be effectively managed to the continued advancement.	Alshawi, 2015Park, Lee, and Kwon ,2010

When comparing the content of the Table 2 and Table 3,a clear notion can be explicated, regarding their influence in BIM enabled environment and a traditional environment. There are arguable cultural factors as agreement, core value, which suggest a weak influence on KM in a BIM, enabled environment whereas other factors have a significant influence on KM in BIM environment compared to traditional environment.

5. Conclusion

The AECO industries has been evolved with ICT, which provide a variety of technical solutions to standardize and rationalize the process of designing, constructing and operating of built assets. The emergent technical and procedural shift has been accelerated in the AECO industries through BIM. According to the findings the cultural factors such as coordination and integration, empowerment and organisational learning, strongly influence the KM in a BIM enabled environment when compared to their influence in traditional construction environment.

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