Improving Buildings Facility Intelligence in Higher Education Precinct: A SocioBIM Approach

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Abstract

Higher education institutions (HEIs) infrastructure asset is a complex and massive investment, with high operational and management cost. The functionality of this infrastructure facility is paramount to the performance and well-being of its users. The effective and efficient operation and management of this facility required adequate knowledge and collaboration of all stakeholders. This study is a preliminary part of a research aim to adopt socioBIM for HE facilities users and facility management (FM) section, to interact with their learning environment and enhance collaborative practice to improve facility intelligence. The study method explores the advancement in building information modelling, decision support systems, and integrator networks. Conceptually, the adoption of socioBIM reflects an enhancement of users' facility literacy, stakeholder's participation and FM organisational intelligence within HEIs. These will culminate to stakeholder's satisfaction and competitive advantage. Further study is also needful on the efficacy of socioBIM adoption.

1 Introduction

The impact of education in the recent knowledge economies cannot be overestimated. Higher education institution's (HEIs) play a vital role in educational knowledge dissemination that have contributed to the advancement of the society. Tellingly, knowledge generated from HEIs drives and support practice and innovation (Mowery, 2004), and also boost human capital development (Asteriou and Agiomirgianakis, 2001). This knowledge dissemination occurs most time within the HEIs' precinct. The conduciveness of the precinct, determine the level of the influence the HEIs objectives has on the stakeholder (students and staff) achievement (Picus et al., 2005) and effectiveness (Temple, 2008).

Hence, it can be inferred that HEIs precinct (learning space) must scaffold its envisioned objectives. But, increment in student enlistment, rate of utilization, maturing of buildings and poor FM hone have resulted to increase in facilities problems within HEIs precinct (Lavy and Bilbo, 2009; Olanrewaju, 2012). Unfortunately, higher education (HE) building facility has been concurred less consideration (Riley et al., 2010) and it's failing to meet users prerequisites (Olanrewaju, 2012). Therefore, facility knowledge or the intelligence is needful within the educational precinct for an effective facility management (FM), to maintain a functional conducive learning space.

The state of facility intelligence among the HEIs stakeholder is poor. As indicated by Lavy and Bilbo (2009), there is inadequacy in facilities data in most institutions, because their FM practice for collecting facility condition is inappropriate. In addition, poor quality or fragmented data is a torment of FM practice (Jylhä and Suvanto, 2015).This data deficient has culminated into additional work execution, wasted time, and potential lost in FM administration (Jylhä and Suvanto, 2015), which can add up to organizational catastrophes (Choo, 2005). Facility intelligence sharing is vital within the HEIs to be able to attain the desired facilities performance. Invariable, intelligence is much needful in the conduction of post occupancy evaluation (POE) of the buildings.

The intelligence gathered can improve FM decision making (DM). In addition, learning space facilities information collection technique's and its exactness is basic (Blanchette, 2010), to enhance FM services. Lavy and Bilbo, (2009) acknowledge the fact that facility data integrity can be accomplished with a collaborative FM practice to meet stakeholders needs evaluation and fulfilment. Hence, the development of a platform that can assist and improve intelligence of the facility manager's and other stakeholders is essential in time of dwindling budget, and particularly in public institutions' like the HEIs (Lavy and Bilbo, 2009).

Fortunately, building information modelling (BIM) has been seen as a platform for intelligence sharing within a collaborative forum. Olatunji and Akanmu (2015) stated that BIM enables the integration of multidisciplinary collaborative practice, rather than the formal fragmented FM practice due to its functional characteristics. Also, BIM intention is to facilitate stakeholders contribution and involvement throughout project lifecycle (Motawa & Almarshad, 2015). Hence, a social interaction of facility intelligence sharing among the stakeholders on a BIM platform is vital for the HEIs to maintain functional facilities despite the massiveness of the infrastructure edifice. Therefore, this research aims to conceptualize how socioBIM can be employed to improve facility intelligence among stakeholders in HEIs.

2 SocioBIM

BIM recently is only applicable to the professional stakeholder and the clients'. BIM adventures covers ability to form usable data and information for simulations and visualizations, and scaffold the collaboration of stakeholders throughout facilities lifecycle by updating facilities data in the model. But, managing built facilities is complex and requires further input from the basic users to inform FM decision making and future designs. Surprisingly, the FM professional have not been fully integrated

on the BIM forum during design stage, while the users consideration is beyond the reach. However, to easy the process of POE and performance of built facilities, and to increase users satisfaction, then users integration on BIM forum is needful. This intention lead to the advancement of socioBIM.

SocioBIM is seen as an effective methodology for building users to interact with their building and give profitable remarks and feedback to the building adminstration, because the achievement of asset management and sustainable facility operations, is basically determine by the users, owners and stakeholders (Shoolestani, Shoolestani, Froese, & Vanier, 2015). Further, (Grover et al., 2015) stated the need for a BIM-to-Public platform purposed for integrating users interaction in design and facilities operation. SocioBIM approaches is not just endeavor to make data from BIM available to the public/users for utilization but also to collect input from users, by connecting BIM innovation with technologies of social interaction network (Shoolestani et al., 2015). The information provided assist in operational efficiency of the facilities. According to Shoolestani et al. (2015) socioBIM gives the users capacity to:

- Comment on functionality, performance and usability of any building elements

- Comment on the condition and maintenance of the building

- Comment on the design and adminstration levels

- Comment on the indoor and socio environmental condition

- Express their well being and working condition (health issues and productivity)

- Proposed and suggest solutions to facilities problems

- Comment on the asethetic and apprearance

- Give their apparent value of sustainability highlights

- Make suggestions for upgrades and improvement, with attach significant videos and voice updates, photos or any needful document to the remarks.

The accomplishment of these tasks in HEIs will approximately improve facilities intelligence and POE in the sector. It will also support and ease all FM functions.

3   Facility Intelligence and SocioBIM

The purpose of the socioBIM for HEIs is to give more precise facilities knowledge to the students, staff, visitors and vendors operating in the precinct. Facilities utilization optimization is paramount. The lack of facilities knowledge compromise the effective utilization and performance of the facilities,

invariably affecting users behaviour and performance. The understanding of how facilities function, when they function, where they are located, and why they function in a particular way, of each elemental part of a building necessitate a need for a communicative and collaborative platform for intelligence sharing. In addition, facilities history, manufacturer instructions, key performance index, and other valuable information will assist facility managers in decision making, while other users can interact more with the learning space intelligently.

Intelligence is the ability to learn quickly and cleverly, collect information and solve problems. Facility intelligence is the combination of the ability to learn, recognised, collect facility data and solve facilities' problems. Its incorporates informal and formal learning from education, experience and training, defining facilities problems clearly, fashioning products, and accomplishment of facilities complex tasks and projects (OTEC, 2007) . Facility intelligence is also the application of knowledge or enablement to integrate the people, workplace, and facilities for effective performance. Furthermore, facility intelligence is the custodian, sharing and appropriate use of facility data/information within an organisation.

The need for building facilities information is vital. But, facility data is lacking for management decision in most HEIs (Lavy & Bilbo, 2009). In fact, design and construction of HEIs space has not been informed by input from appropriate users (Germany, 2014), due to inadequate communication flow. Lehtonen (2006) opined that poor communication may cause unfavourable impact on user's satisfactions and relationship with services providers'. This mandate the need for intelligence networks among the stakeholders to enhance organisation effectiveness through socioBIM.

3.1   SocioBIM Integrators

Building information model (BIM) and game engines**:** The BIM platform is the major coordinating interface of this integration. The platform will allow the forum for the collaborative practice between all the stakeholders. The BIM will facilitate visualisation, identification and space planning and so on. Addition of gamification platform will allow users interaction within the 3D view (Edwards et al., 2015).

Smart devices and social media: Smart phones and tablet computers integrated with BIM gives simplicity of way-finding, location identification, and visualisation of components (Kim, Lim, Kim, & Kim, 2013). Social media tools such as online forum, social network, video sharing and blogging can also be employ to engage users with BIM (Grover et al., 2015).

Graphical users interface (GUI): GUI enables the integration of occupants/users of the building into the POE platform to improve collaborative practice. The GUI platform creates a mode of communication between the users and the facility manager. The communication cycle comprises of check and control of facility performance by the occupants and their feedback to the facility manager. Furthermore, GUI usage concede occupants access to the acquired hourly data with analytical and graphical capacities on a web-based network (see Göçer, 2014).

Energy information system (EIS) and sensors: Intelligent adaptability that encourage the progressive, bi-directional interaction between the occupants and the building is possible with EIS (Göçer, 2014). In addition, EIS facilitates a proactive approach to manage energy utilization by the observation of building performance and accurate data sharing among stakeholders (Göçer, 2014). Diverse sensors have also been employed to gather real time data in buildings to complement BIM (Coates et al., 2012).

4 Impact of SocioBIM on Higher Education FM Organisational Intelligence

One of the focus of the socioBIM networks in our research is to improve the FM intelligence within HE organisations. To achieve this, we developed a conceptual model based on intelligence theories to illustrate part of the envision impact of sociaBIM in HEIs as shown in Figure 1. Organisational intelligence (OI) is the ability of an organisation to understand and conclude knowledge significant to its business endeavour, so it is the collective intellectual capacity of the entire system. OI is "an organisation's capability to process, interpret, encode, manipulate, and access information in a purposeful, goal-directed manner, so it can increase its adaptive potential in the environment in which it operates" (Glynn, 1996). Much have been said about the inability of the building not to meet user's satisfaction and the lack of feedback from users. Besides, it has been shown that FM organisation remain solitary (Kamaruzzaman, Zawawi, Shafie, & Noor, 2016), which means not intelligence sharing oriented. These networks will allow the participation of the user's in the operation of the building's and giving real time and authentic feedback to FM section. Since all facilities users will be equipped with smart devices, a continuous communication is established for information exchanged on the platform. In addition, users can learn and be conversant with diverse building elements characteristics from the curated BIM model increasing their facility literacy. Further, users can lodge in complains and opinions about any elements which the FM can process as a POE data for decision making (DM). Defects are also easy to identify and indicate on the platform. This openness in data, knowledge and intelligence sharing culminate to the empowerment of the organization, its staff and stakeholders (Schoech, Fitch, MacFadden, & Schkade, 2002).
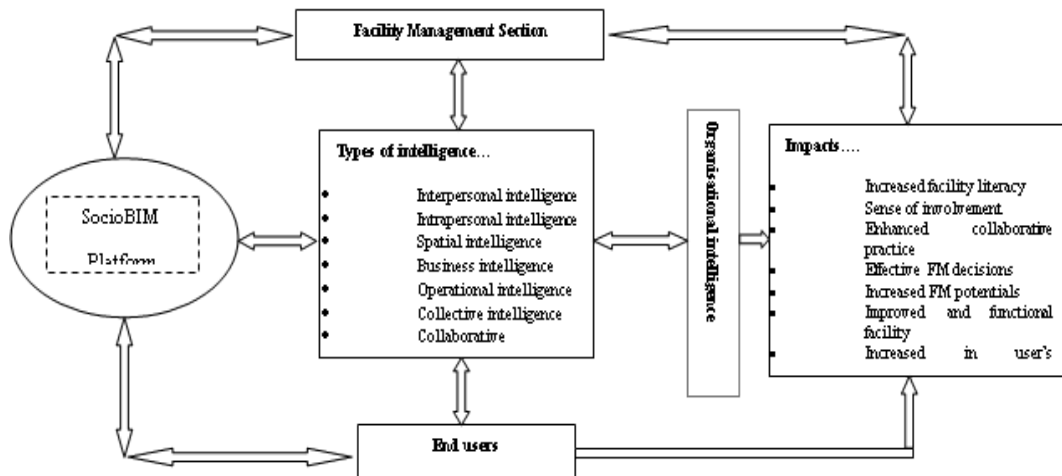
Figure 1 The impact of socioBIM on organisational intelligence and performance.

We envisaged that the deployment of socioBIM can improve the following intelligence in HEIs as illustrated in Figure 1:

Inter/Intra personal intelligence: This is based on Gardner (1983) theory. The platform will make users understand facility elements with their forms and interact with each other's concerning it (people smart about facility). It will also foster interpersonal relationship within the stakeholders where facility debate and discussion is encouraged for better decision making. It will drive intrapersonal intelligence by allowing users to express their interests, objectives and needs in HEIs facilities that gives them satisfaction (people self-smart about facility). This will boost user's satisfaction, sense of involvement and facility literacy.

Spatial intelligence (SI): SI concept is based on Gardner's theory. The proposed socioBIM will enhance the stakeholders the capacity to know where they are with respect to a fixed location, and to fulfil tasks requiring three-dimensional visualisation and arrangement. This will enhance the users to advice the FM better on how they want their workplace arrange and request necessary features needful. It will also easy the problem of way and direction findings within the precinct and FM literacy.

Business intelligence (BI): BI is a characteristic outgrowth of a progressive of past frameworks intended to bolster DM (Negash, 2004). The concept of socioBIM serve as a decision support system (DSS) to enhance FM BI based on the incorporation and examination of organisational data assets to improve FM business DM. It will also aid simplification of facility data storage, examination and identification of FM information in enhancing facility information quality for DM in the HEIs FM business. Hence, achieving functional and improved facilities.

Operational intelligence (OI): OI is the utilisation of integrated business management system to enhance internal processes and fundamentally support customer services (Dickinson, 2016). The proposed socioBIM will complement building management system to improve internal procedures and fundamentally boost FM service to users, and position the FM to successfully manage rapid change, and yet maintain positive business change via continuous self-improvement. It will provide real-time elements that conveys visibility and understanding into information which can inform operational directions and motivational tool for FM business.

Collective intelligence (CI): The proposed socioBIM if integrated with web 2.0, crowdsourcing and some social networks tools in gathering collective facility intelligence for decision making gives a task-oriented elements, real-time (or ad hoc) collaboration, and integrate distributed intelligence or knowledge ontologies (Bonabeau, 2009). The collection of facility condition data from users will save time and ease FM functions thereby increasing FM potential.

Collaborative intelligence (CI): The socioBIM will enhance the ability of the facility managers to build, input to and oversee control of networks of stakeholder's interactions to create intelligent FM results. It will facilitate collaborative FM practice. Also create a social collaboration among group of users whose intelligence can be incorporated (Bonabeau, 2009) in FM DM. It will also induce competitive advantage.

The utilisation of socioBIM in HEIs will facilitate the intellectual capacity of the stakeholders in relation to the learning space facilities and it management collectively. According to Charlesraj (2014), Knowledge based BIM can advance the efficiency and effectiveness of FM system. We believed that the implementation of socioBIM in HEIs will addressed many FM intelligence challenges in HEIs.

5 Conclusion

This study focuses on the conceptualisation of how socioBIM can improve facility intelligence in HEIs precinct. The various facility intelligence envisions to be improved are inter/intra personal, spatial, business, operational, collective and collaborative intelligence. As known, HEIs infrastructure facilities management is information intensive, which needs a high-level intelligence input not just from the FM officers but also from users and other technological devices. SocioBIM platform will enable FM collaborative practice in the sector. The awareness of user's contribution to FM decision making (DM) can catalysed individual level and collaborative facility intelligence development. Basically, user's participation increased the efficacy of facility data used for FM DM. Hence, SocioBIM serve as an indicative technology that can improve facility intelligence in HEIs, thereby influence their organisational intelligence, users level of satisfaction and sense of belonging. These attributes culminate to organisational excellence and competitiveness. The conceptual model can be used to inform additional benefits of socioBIM. Also, further study is needful to implement socioBIM in HEIs and validate its efficacy.

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