EXPLOITATION OF KNOWLEDGE MAPPING BENEFITS IN THE FACILITIES PERFORMANCE EVALUATION PROCESS: A CONCEPTUAL FRAMEWORK

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Previous studies in various fields have identified numbers of knowledge mapping tools and techniques that are widely used. Knowledge mapping tools and techniques assist with information and knowledge flow throughout an organization. However, for a knowledge map to be useful it must serve the purpose for which it is intended. This imposes some constrains upon which map forms are suitable and for what purpose. In the same vein, facilities performance practices is developing and evolving with change in technology, business needs and users' expectation. Hence, the evaluation of facilities performance is arguably moving from a "primitive" financial perspective to a broader view such as users' (customer) satisfaction, environmental and sustainability perspectives. This paper identifies various task in evaluating facilities performance, and explores the potential of knowledge mapping tools and techniques that might be of benefit to facilities management organizations. Most of what is put forward in this paper is based on an going research project as part of a PhD programme. The discussions are therefore grounded on a thorough review of literature accomplished as part of the research project. In addition, a conceptual framework for the exploitation of benefits of knowledge mapping in various stages of performance evaluation is presented and discussed. The paper concludes that facilities management organizations, by and large, are of the view that knowledge mapping is important and some have initiated and implemented tools and techniques of knowledge mapping in evaluating facilities performance. The study also revealed that the main benefits of knowledge mapping in evaluating facilities performance are: improvements in decision making process, problems identification and problem solving by providing quick access to critical information, knowledge gaps and island of expertise.

Keywords: facilities management, facilities performance evaluation, knowledge mapping, process.

INTRODUCTION

Knowledge management (KM) related issues in facilities management (FM) context have been advocated by various authors such as Amaratunga *et al.*(2002), Wong and Dettwiler (2008), Pathirage *et al.* (2008), Fong and Lee (2009), Das *et al.* (2009), Waheed and Finch (2008), Sapri and Pitt (2005), Then and McEwan (2005), Olomolaiye *et al.* (2004), Puddy *et al.* (2001), Nutt (2000) and Carder (1995). There is also the view that the rich source of "wild thrive" knowledge in facilities management

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is either within the process or within the people in organization; and need to addressed in an orderly manner.

According to Nutt (2000), the FM knowledge trail starts from a position that relies largely on borrowed management concept, and on imported technical expertise from other professional field of activity. FM has three main sources of knowledge i.e. knowledge of property and construction, FM knowledge and knowledge of facilities design and use (Nutt 1999a) while Kincaid (1994) cites that the FM emerged with the integration of three main strands of activity: property management, property operations and maintenance as well as office administration.

Knowledge gaps in facilities management organization and literature reviewed in facilities management field exhibit trends towards the needs of implementing knowledge mapping. Sink (1991) suggests that performance measurement is "a mystery…complex, frustrating, difficult, challenging, important, abused and misused" function. In the same vein, Alexander (1996) identifies that measuring facilities performance as one of "three essential issues for the effective implementation of a facilities strategy". These, highlight the rationale and significant of implementing knowledge mapping in the facilities performance evaluation process.

Understanding knowledge mapping

Knowledge mapping is defined as the process, methods and tools for analysing knowledge areas in order to discover features or meaning and to visualize in a comprehensive, transparent form, such as clearly highlighted business-relevant features (Speel, 1999). Vail (1999) as cited in Berg and Popescu (2005) viewed knowledge mapping as techniques and tools for visualizing knowledge and relationships in clear form in such a way that relevant features are clearly highlighted. Vail III (1999) as cited in Folkes (2004) identifies knowledge mapping as the process of associating items of information or knowledge, preferably, visually, in such a way that the mapping itself also creates additional knowledge.

Knowledge mapping is considerably a new field in knowledge management (Fisher cited in Folkes, 2004) and the right metaphors, algorithms, and conventions are continuously evolutionary. Over the years articles and papers have been written about knowledge mapping and its use; Grey (1999); Wexler (2001); Eppler (2001); Huijsen *et al.* (2004). Those literatures show that the significant importance of knowledge mapping as one of the knowledge management approaches. Despite its newness, the role and benefits offered has long been exploited by individuals and organizations of various filed. The focus on knowledge mapping comes into attention of organization only when awareness towards knowledge management has taken place.

A knowledge map portrays the sources, flows, constrains and sinks (losses or stopping points) of knowledge within an organization (Liebowitz, 2005). Well developed knowledge maps help identify intellectual capital (Liebowitz, 2003), socialize new members, and enhance organizational learning (Wexler, 2001). The specific roles and benefits of knowledge mapping will be discussed later in this paper.

Updated tools and techniques for mapping knowledge

Knowledge mapping tools are referred to Information Technology related software which helps in conveying, sharing, linking, sourcing and manipulating data and information. An example of knowledge mapping tools are on-line databases, intranet and specialist software. On the other hand knowledge mapping techniques referred to specific protocol or modus operandi to map the knowledge. It is learnt that knowledge mapping tool is able to be manipulated to enable the techniques in mapping

knowledge. Jafari *et al.* (2009) suggest that in mapping organization knowledge various techniques use set of tools, approaches, objectives, and specific characteristics.

Folkes (2004) and Egbu *et al.* (2005) have had a comprehensive list of knowledge mapping tools and techniques and its uses in organization. The example of knowledge map types and its uses are as shown in Table 1. Jafari (2009) suggests the selection of tools and techniques of knowledge mapping could be compared from a various perspective and criterion.

- Used tools for data gathering (Vestal, 2005).
- Used tools for knowledge map evaluation (Vestal, 2005).
- Mapping objectives (Lecocq, 2006).
- Knowledge Maps characteristic and capabilities (Lecocq, 2006).
- Determination of knowledge map elements (Lecocq, 2006).
- Knowledge mapping approach (Jenning, 2006) such as process based, relationship based and project based (Jafari, 2009).
- Top-down or bottom-up approach; top-down map championing process usually have those at the top of the hierarchy championing map. Bottom up knowledge map processes are seen by the dominant coalition of the organization as the most political (Wexler, 2001).
- Static or dynamic knowledge map.

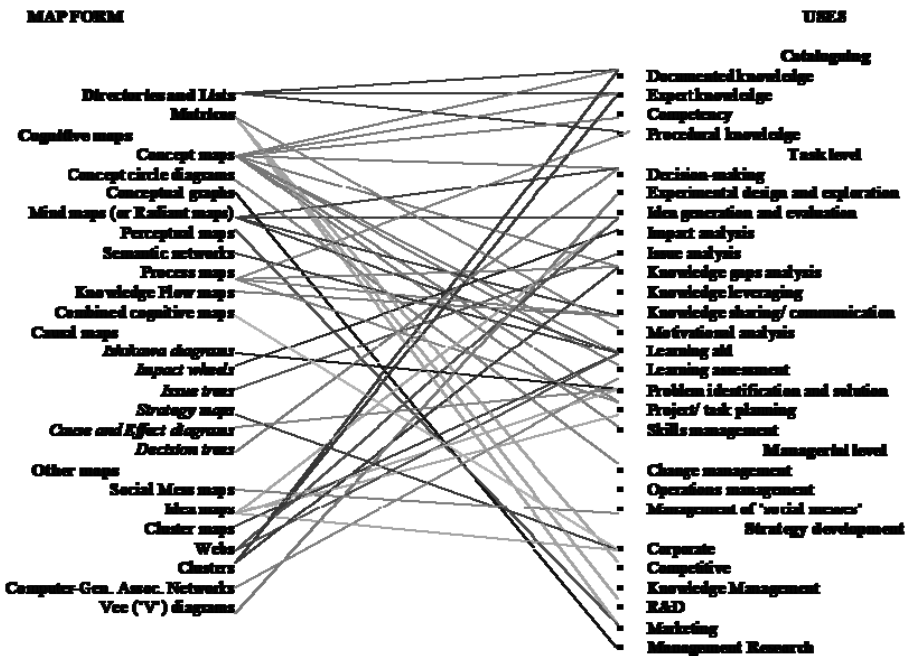

Figure 1: Mapping 'Knowledge Map' Forms and Uses (Source: Folkes, 2004)

METHOD

This paper draws from an ongoing PhD research project and based on a thorough and extensive review of literature. This paper researches the exploitation of knowledge mapping benefits and conceptualized those benefits in the context of facilities performance evaluation process framework.

ARTICULATING FACILITIES PERFORMANCE EVALUATION PROCESS

The activities, modus operandi, tools and detail content of the evaluation process differ between one to another, depending on the unique characteristics of the facilities, strategy deployed by the facilities management team, the purpose and specific level of evaluation. However, Preize and Schramm (2002) are of the view that in order to be able to evaluate buildings in their different settings, the need exists to develop state-of-the-art building performance evaluation. Initiative from HEFCE (2006) to produce a guide to conduct facilities performance evaluation for higher education to standardize the practice and outlines the performance evaluation for universities in UK. Centre for Health Assets Australasia, University of New South Wales has developed a standard practice for health project and assets performance evaluation in Australia. In US the work for standard practice and procedure for conducting Post-occupancy Evaluation (POE) for correction jail centre was initiated by Wener (1994) from Polytechnic University Brooklyn. For office building, the guidelines were developed by British Institute of Facilities Management in 2006 (as cited in Yasin and Egbu, 2009).

Guide to Post Occupancy Evaluation (2006) published by Higher Education Funding Council for England (HEFCE) suggests that in principles of conducting performance evaluation for building facilities, the evaluator should refine the existing established method to suits the needs of that particular facilities. There are many evaluation methods applied in the FM practices called by different names and on different parameters. However, as suggested by Yasin and Egbu (2009) on whatever method applied, there are similar characteristics such as systematic and synchronized appraisals, computer aided evaluation and analysis, combination of qualitative and quantitative data analysis and field observations by multidisciplinary team.

Physical and virtual tools are significantly important for collecting data of the evaluation. The examples of physical tools that enable the collection of data have been listed by Chambers (2003) as follows.

- visual inspection.
- surveys.
- interviews.
- working observations.
- maintenance records.
- expert evaluations, testing, etc.
- check lists.
- analysis tools.
- digital photos.
- as-built (record drawings).
- energy use records.
- recording instruments.
- remote video cameras.

The examples of virtual tools that enable the data collection and analysis of data such as web search, internet, intranet and specialist software.

To explain the variety of approach in evaluating facilities performance Barrett and Baldry (2003) have divided the methods into two categories.

- User-based system – building's occupants to evaluate the suitability of a building for their particular needs.
- Expert based system – relies on experts' assessments and typically covers broad areas such as provision for information technology, organizational growth, changes in staff work style; and energy efficiency.

In practical innovative evaluation, it is an advantage if the evaluators successfully triangulate both. Reliance solely on user's perspective does not represent accurate position of facilities performance and merely subjective to measure individual satisfaction. In contrast, expert based evaluation merely focused on specific elements of broad set of facilities disregarding the user's perspective. This is where the emerging of knowledge to be systematically harnessed in the organization and in the evaluation process.

Preizer *et al.* (1991) propose common process in evaluating facility performance, which involves the facility users and expert evaluators. Three levels of effort are proposed in the model. The process selected depends upon finances, time, manpower and the required outcome. However, each level contains the same procedures of planning, conducting and applying as shown in Figure 2 below.

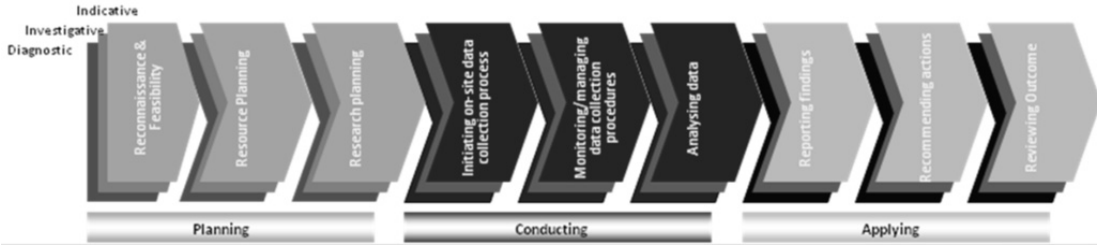

Figure 2: Evaluating facilities performance process model (adopted from Preizer et al., 1991 and Barrett and Baldry, 2003).

The indicative level is where symptom on obvious criteria of the particular elements of the facilities is being identified. In common practice, it is normally carried out by an experienced evaluator, who is familiar with the building type being evaluated and is completed in a minimum time span. The findings are usually presented in short report, outlining the purpose of the evaluation, the data collection method used, findings and recommendation. The result at the indicative level often brought forward to investigative level for more detail investigation and evaluation. Barrett and Baldry (2003) suggest, at investigative level, evaluators should rely on more sophisticated data collection methods and benchmarking with the similar building being assessed.

Finally at diagnostic level, a specific context of facilities element such as energy consumption efficiency, structural defects, space usability, thermal comfort are being assessed. The diagnostic evaluation is likely to take several months at a minimum to complete depending on the breadth and depth of the evaluation.

LITERATURE ANALYSIS OF KNOWLEDGE MAPPING KEY BENEFITS IN ORGANIZATION

As the focus of the facilities performance evaluation facing the needs should be more agile, to anticipate threats and opportunities, to react faster, and to be more cost effective throughout the process. To meet these aims, the evaluation team is expected to be able to capture relevant knowledge that is continuously evolving, and to capture it in all forms such as text, picture, stories, archival data and models. The evaluation

team must then be able to exploit this intellectual capital by making knowledge accessible to others in the organization in the most appropriate forms of display.

Before knowledge mapping benefits be exploited, it is important to understand the perspective of knowledge mapping created. Ebner *et al.* (2006) suggest that it comprises of the following visual framework.

- The function of the map (including coordination, motivation and the elaboration).
- The knowledge types (know what, know how, know why, know where, and know who).
- The recipients (individual, group, organization, network) and
- The visualization type (sketch, diagram, image or map)

It is also important to look into the form of the map (virtual or physical) as more comprehensive and large scale mapping exercise could benefit most from computer software rather than physical map.

In articulating the knowledge mapping benefits in organization setting, Wexler (2001) grouped them in four categories of returns such as economic returns, organizational cultural returns, structural returns and knowledge returns. Economic returns encompasses financial benefits that may be gained by the organization by harnessing knowledge mapping. The approach also seems as a catalyst in coordinating other knowledge management approach in organization by creating additional values and culture. Knowledge maps also helps in dealing with the greater complexity of independencies that arises from new structural arrangement such as joint venture, outsourcing, subcontracting and project management. Another significant benefit of knowledge mapping is to provide a knowledge return to the organization in the form such as accelerating learning curve to the employee by helping to locate an effective route of the processes, prevent repetitive and overlapping activities and identify new knowledge and new focus of the emerging quest for actionable information.

EXPLOITATION OF KNOWLEDGE MAPPING BENEFITS IN FACILITIES PERFORMANCE EVALUATION

The discussion of knowledge mapping benefits mainly the organizational setting but in the context of this paper, the facilities performance evaluation is an embedded process in the organization, so, as such benefits also have correlation with the process. The literature review on facilities management as discussed earlier in this paper indicates that the needs of knowledge in the facilities management area to be structurally synchronized and managed with the knowledge management approach. Knowledge mapping is identified as a key pre-requisite for effective KM (Kautz and Thaysen, 2001; Speel *et al.* 2000), therefore, as proposed by Eppler (2001) and Lui and Hsu (2004) the under develop management area such as facilities management and its process; knowledge mapping is a key fundamental resource for successful KM.

In exploiting those benefits as discussed in previous section, holistic view on the facilities performance evaluation process in Figure 2 needs to be considered.

- Re-use information and ideas throughout the evaluation process: As a recurring process, new knowledge captured during the process could be used for the next process for improvement, innovation and generating new ideas.

	USAID (2003)	Folkes (2004)	Vestal (2005)	Egbu et all (2005)	Key Benefits
1	Identify opportunity to reuse information	-	Re-use information and lesson learned	Re-use ideas and process	Re-use information and ideas throughout the process
2	Locate internal and external resources	Internal & external knowledge guide	Identify and locate knowledge	Locating knowledge and its flow	Identify knowledge location and flow
3	Locate naturally-occurring knowledge stewards	-	Highlight key human, social and structural knowledge	Linking experts	Highlight and link knowledge owner
4	Identify knowledge dependencies within cross-functional work groups	Knowledge and people locator	Internal & external expertise locator	Highlights island of expertise	-As above-
5	Categorize value-added information resident within organisation	-	-	Quick information's finding	Rapid access to information
6	-	-	Highlight knowledge assets	Provides an inventory intellectual and intangible assets	Knowledge assets inventory
7	Precursor to developing formal COP	-	Develop bodies of knowledge: formal COP	-	Developing COP
8	-	-	-	Legal process and protection associated with knowledge exploitation	-
9	-	Assist in general problem solving	Improve organisation's performance	Improve decision making & problem solving	Improve decision making & problem solving
10	-	Visual overview of the organisation's knowledge	-	Provides insight into corporate knowledge	-As no 6 above-
11	Create a knowledge tool that helps users find what they need	-	Create knowledge tool	Ease access to knowledge	Access to Knowledge
12	Identify knowledge sharing opportunities	Helps in developing knowledge management strategy	Identify knowledge sharing opportunities and barriers	-	Identify knowledge sharing opportunities and barriers
13	-	-	Locate grassroots knowledge stewards	-	-As no. 3 above-
14	-	Assist in corporate strategy development.	-	-	-
15	-	-	-	Improve organisational awareness	-

Table 1: The analysis of knowledge mapping roles and benefits

- Identification of knowledge location and flow: knowledge mapping enable the tacit and explicit knowledge being located and the flow of the knowledge being captured. It enables the evaluation team or individual evaluators to locate that knowledge and the path of its flows.
- Highlight and link the experts and island of expertise: Performance evaluation of facilities typically being carried out by a group of expertise team with different area of specialization. Knowledge map helps in the form of providing "yellow pages" while indicating their area of specialization and provide link between them.
- Rapid access to information: as it's providing link to the tacit and explicit knowledge within organization or across organization, in the form of virtual maps and/or physical map provide quicker access to the information.
- Knowledge assets inventory: Provides inventory of the intellectual and intangible assets. The inventory also helps in defining the gaps in the organizational knowledge.
- Developing community of practice (COP): Developing a group of multi expertise in a common domain, with a genuine interest in each other's expertise based on their own practice. Involvement of core group as an experienced facilitator and junior evaluators sustaining the organization knowledge structure.

- Improve decision making and problems solving: by providing applicable information comprehensively, quickly and accurately will lead to robust decision making, recommendation and in providing solution for the problematic issues in evaluation.
- Provide access to knowledge: made the various form of knowledge accessible for exploitation within the organization or across organization, exceptionally on classified areas.
- Identify knowledge sharing and barriers: Acknowledged the knowledge sharing opportunity and its possible barriers. On the other hand, knowledge mapping is only considered successful if the knowledge being mapped are effectively shared and exploited.

Despite the benefits Vestal (2005) suggested four main barriers in harnessing knowledge mapping in the organization; (i) lacks of understanding of knowledge flow process inside the organization, (ii) not having the right team members on a knowledge mapping team, (iii) the classical "knowledge is power" syndrome that prevent knowledge to be successfully shared; and (iv) failure to understand the business process.

CONCLUSION

To bridge the gaps that prevent the facilities management organization in exploiting knowledge mapping benefits, related training and workshop on guidelines of harnessing knowledge mapping and exploiting the benefits is necessarily important. The changes in technology such as IT software and hardware and building and its content, techniques for evaluating facilities performance as few examples, imposed the challenge to the facilities management practice in harnessing knowledge mapping and tap benefits from it. From the other angle, knowledge mapping is a dynamic process and requires a sound and robust strategies to exploit its benefits. Some knowledge may be replaced over time with superior and/or state-of-the-art knowledge, and some knowledge become irrelevant. The full exploitation of knowledge mapping techniques is also depends on a wider range of factors and the main purpose of their use. Research in this area has great potential to contribute to an improved understanding of how to continue to exploit knowledge mapping in evaluating facilities performance and facilities management field in general.

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