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INTRODUCTION

Transition from a project-centric construction industry to a final-product-oriented and integrated discipline is substantial to producing more efficient buildings for the eventual users i.e. society and private owners (Rezgui, Hopfe & Vorakulpipat 2010). Since the very ultimate goal of the entire process – from the society’s point of view - is to supply firms and organizations with facility assets that underpin their business processes, improved performance of the buildings during their operation time should be envisioned as the primary objective of the project from the beginning. This entails a shift from project-centric to product-centric construction settings (Karrbom Gustavsson, Samuelson & Wikforss 2012). Such a holistic approach demands, first and foremost, information management systems that warrant a sustained collection, analysis, and flow of information across the diversity of organizations and disciplinary roles throughout a building’s lifecycle (Tarandi 2011).

According to a study by the US National Institute of Standards and Technology (NIST), 12.4 percent of the total annual mean expenditures in the facility management and operation (FM&O) phase are caused by insufficient interoperability among different information systems (Gallaher et al. 2004). Interoperability can be defined as “the ability that data generated by any one party can be properly interpreted by all other parties.” (Shen et al. 2010). Building information modeling/management (BIM) technologies demonstrate promising potential for reducing the costs in the FM&O sector incurred by insufficient interoperability (Eastman et al. 2011; Khemlani 2011; Jordani 2010; Ding et al. 2009).

Challenges to this vision can be divided into the three major categories of IT provisions, business processes, and contracts (Parsanezhad & Tarandi 2013; East, Nisbet & Liebhich 2013). According to a recent report by Mac Grawhill Construction, over 50% of the owners in North America are still beginners in using BIM technologies (Bernstein 2012). The majority of the research on implementing BIM for facility management and operation has so far been focused on the technical requirements (Cahil, Menzel & Flynn 2012; Parsanezhad & Dimyadi 2014; Schevers et al. 2007; Shen et al. 2010; Shen, Hao & Xue 2012; Tarandi 2011; Tarandi 2012); whereas the importance of efficient BIM procurement methods and optimized working procedures have been frequently uttered by scholars and practitioners (Foster 2012; Howard & Björk 2008; Teicholz 2013).
This paper aims to provide the theoretic basis for more focused studies on existing and desired processes in the FM&O sector and their associated information transactions. This study is basically the initial phase of a broader research project investigating information transactions within two specific activities common to FM&O firms: area management and maintenance work order management.

General types and taxonomies of activities and processes carried out within the FM&O phase as well as the information needs of the diversified disciplinary actors involved in those activities are presented. Academic literature as well as empirical studies in the subject area of building information management and workflow processes of the FM&O sector are consulted and analyzed for this purpose.

In Section 2 and 3, it is clarified how the terms building information management and facility management and operation are approached in this paper. Section 4 is an overview of the types of activities carried out within the FM&O phase. Section 5 looks more closely into the FM&O sector and identifies disciplinary actor groups and common processes. Section 6 is a review of the information needs of the FM&O sector; and in Section 7, the plan for a forthcoming empirical research to complement the outcomes of this paper is briefly explained.

2 BUILDING INFORMATION MANAGEMENT (BIM)

The terms data, information and knowledge are often used interchangeably. It is thus important to clarify what the “I” (information) component of the BIM concept stands for. For the sake of this study, “data” are regarded as numeric basic information or quantifiable outcomes of observation; “information” is data that have relevance and context (such as unit of measurement) i.e. processed data; while “knowledge” refers to a subset of information which is useful and meaningful for a specific purpose i.e. authenticated information (Rezgui, Hopfe & Vorakulpipat 2010; Smith 2001). From these assumptions, it is inferred that data may undergo a sequence of evolutionary stages and be consecutively transformed into information and knowledge (Fig. 1).

This clarification is designated by the term “information” as intended in this study as the content that is captured, analyzed, stored and supplied by building information systems. Moreover, the “M” component of the acronym BIM implies “management” rather than “modelling” here. With regard to the scope of this study, BIM is defined as “a business process for generating and leveraging building data to design, construct and operate the building during its lifecycle” (buildingSMART 2012).

3 FACILITY MANAGEMENT AND OPERATION

The OmniClass Construction Classification System (OCCS - ISO 12006-2) provides distinct definitions for the terms Facility Management, Facility Operation and Maintenance, and Facility Operations. Facility Management mainly implies the administrative activities for guaranteeing a safe and functioning building; Facility Operation and Maintenance is defined as both oversight and maintenance of the systems and services within facilities; while the term Facility Operations is designated to refer to the act of providing services to support operation within facilities (OCCS 2013 - Table 33 - Disciplines). We have nevertheless preferred to use the term Facility Management and Operations (FM&O) which encompasses all the aforementioned concepts so as to facilitate addressing the information management tools and processes in this context.

FM&O is also defined as a discipline that “encompasses all of the broad spectrum of services required to assure that the built environment will perform the functions for which a facility was designed and constructed” (Sapp 2013). The following definition by the International Facility Management Association (IFMA) puts more emphasis on the actors who contribute to this sector: FM&O is “the practice of coordinating the physical workplace with the people and work of the organization” (IFMA). The next step is a taking a closer look at the activities within the FM&O sector.
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4 GENERIC ACTIVITIES WITHIN THE FACILITY MANAGEMENT AND OPERATIONS SECTOR

The OmniClass system defines the operation phase of the building as a phase “in which owner or a designated agent occupies, uses, and manages and maintains a facility, which may also include partial or whole facility renovation, repair, reconditioning or remodeling activities as part of the project use lifecycle” (OCCS 2013 - Table 31 - Phases) and offers a detailed hierarchical list of FM&O activities. Figure 2 demonstrates another exemplar classification of FM&O activities developed within the Finnish development project, COBIM (Jokela, Laine, & Hänninen, 2012). The two major categories of activities in this breakdown structure are “operative property management” activities and “end-user services”. Activities in the former category are basically aimed to sustain the quality of a the main asset (facility) which constantly underpins execution of the activities in the latter category.

Sandesten (2003) articulates the three major categories of FM&O activities as “organization’s core business processes”, “organization’s leadership processes” and “organization’s support processes” (Fig. 3). Figure 4 demonstrates an alternative classification of the FM&O activities based on several classification systems including the preceding ones. The two major categories here are “facility/property strategic management” and “facility/property operational management”. The core activities of the organization are excluded in this taxonomic structure so as to keep the focus on the generic types of activities common to all asset owners. The strategic management activities are planning-like tasks of a long-term and nature; while the operational management activities are in principle more detailed and project-specific tasks of a short-term character. Financial administration, maintenance activities and performance and condition evaluation of properties are common to almost all FM&O firms.

5 ACTORS AND PROCESSES WITHIN THE FACILITY MANAGEMENT AND OPERATIONS SECTOR

Any general activity within a firm is carried out through a number of processes. A process is described as “a specific ordering of work activities across time and place, with a beginning, an end, and clearly identified inputs and outputs: a structure for action” (Davenport 1993). Business processes are assigned to and executed by actors within the firm. The purpose of all information technologies deployed in the FM&O sector including BIM tools is to supply the right information as a critical input to business processes, on the right time and spot, in the
right format and to the right actor (Schevers et al. 2007). For realizing this and thus truly embracing the advantages offered by information management tools, traditional business processes and work flows should also be enhanced accordingly. Practitioners often emphasize the urge for developing and implementing new FM&O processes that enable organizations to leverage the full potential of BIM technologies (Aspurez & Lewis 2013).

Re-engineering processes should be necessarily preceded by accurately describing current processes (Lundgren & Björk 2004). Since the FM&O tasks are executed by different disciplinary actors within firms, they are the most eligible sources of knowledge about how those tasks are carried out. The main actors within the FM&O sector according to the Swedish Association of Local Authorities and Regions are facility manager, facility administrator, facility operator, operation engineers and facility assistant (SKL). The FM&O organizational roles introduced by OmniClass are not much different: facility use roles, facility manager, facility maintenance, facility engineer, facility service roles, and custodian roles (janitor or housekeeper) (OCCS 2013 - Table 34 - Organizational Roles).

The number of FM&O staff dramatically varies from one organization to another. Here are some examples: a sole FM&O agent who supervises the tasks that are performed by external consultants (Lewis 2013a); a team composed of a project manager, a heating-ventilation-and-air-conditioning (HVAC) technician and an electrical technician (Al-daham et al. 2013); a work order administrator together with a shop manager and a work order technician (Beatty, Eastman & Kim 2013); and numerous examples of professional FM&O firms with hundreds of staff. Each of these actors can be an administrator, contributor, or consumer of information at each workflow sequence (Aspurez & Lewis 2013). Workflow processes within the FM&O sector likewise vary a lot from one organization to another. Figures 5-7 demonstrate the workflow process of three common examples of FM&O tasks. Activities that involve some type of information transaction are marked by red circles. Those are in fact the procedural bottlenecks where lack of information in the right time, right spot or right format causes delay, disturbs the organization’s core activities, and leads to loss of resources.

6 BUILDING INFORMATION REQUIRED FOR FACILITY MANAGEMENT AND OPERATIONS PROCESSES

As evident in Figures 5-7, so many activities within an exemplar FM&O workflow process involve either querying or publishing information. Intrinsic needs of every single activity for the tacit and implicit knowledge required for executing that specific activity (Smith 2001) are yet not considered here since they do not lie within the scope of this study.

The types of the information needed by practitioners vary a lot throughout the lifecycle of the building. The extensive need of designers for graphical formats to represent the building diminishes over time and is gradually replaced by a greater interest in attribute data in the operation phase (Teicholz 2013; Aspurez & Lewis 2013). The FM&O sector needs the construction-intent or as-installed models rather than the design-intent or as-designed ones. Yet even not all contents of the construction model are relevant for facility managers. Specifications of concrete forms, the size of rebar within concrete components and pipe and duct hangers for instance, should be excluded from the models. This necessitates data cleaning procedures prior to information hand-over to the FM&O team (Aspurez & Lewis 2013; Lewis 2013a).

Asset information may be sourced from the manufacturer, the vendor, or the installation contractor of the asset. The most common asset information fields in the FM&O relational databases are asset name, provider, purchase price, installation date, commissioning data, asset location, serial number, bar-code number, expected useful life (EUL), warranty terms, equipment preventive maintenance plans, startup and shut-down procedures, guaranty information, and spare and consumable parts information, and performance units (Lewis 2013b; East 2013). The majority of preventive maintenance tasks are performed on HVAC system, plumbing systems, and elevators which demonstrates the greater need of information on those assets (Lewis 2013a). From a strategic perspective, FM information about assets and equipment such as warranty data and asset cost data are needed for estimating the life time of the asset, optimized timing of recapitulation, security, etc. (Jordani 2010). Prospects of integrating real-time sensor information with FM systems (Cahil, Menzel & Flynn 2012; East, Bogen & Rashid 2012) envisions even more advanced capabilities for FM information management systems. There is however still a wide gap among visions and reality. Figure 8 depicts the range of forms and formats of the FM&O information deployed across the sector. In this diagram, the more recent BIM formats are aligned with their corresponding BIM maturity level as defined by the UK Government Construction Client Group (CCG 2011).

Common practice for collecting relevant and required information on facilities in the majority of FM&O firms is still gliding through a mix of digital and paper documents including submittals, product datasheets, warranty manuals, part diagrams, and installation instructions (Teicholz 2013). This leads to delayed, sluggish, iterative, and error-prone data entry procedures, and lack of current and complete
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Figure 5. Work flow diagram of an exemplary FM&O work order process (after Forns-Samso, 2010)

Figure 6. Work flow diagram of a traditional FM&O routine (after Aspurez & Lewis, 2013).

Figure 7. Swim-lane flow diagram of FM&O tasks in a health center (after Beatty et al., 2013).

Figure 8. Spectrum of forms and formats of FM&O information.
equipment data in Computerized Maintenance and Management Systems (CMMSs). Consequently, preventive maintenance (PM) planning is postponed, warranties are voided and the intended service life of the equipment cannot be achieved (Aldaham et al. 2013; Foster 2012).

Development and deployment of standardized information formats such as IFC (buildingSMART) and COBie (East, Nisbet & Liebich 2013) together with their complementing initiatives such as ifcXML, aecXML, BLIS-XML, bcXML (J. Beetz, J.P. van Leeuwen & B. de Vries 2005) will pave the way for more interoperability. Nevertheless, the FM&O sector will not fully benefit from such progresses unless business processes within the FM&O sector and their information needs are fully acknowledged and enhanced.

7 FUTURE WORK

This study provides the theoretic basis for a more focused study on the FM&O workflow procedures so as to more closely investigate existing and desired information transactions within the sector. For the sake of clarity and concision, the study will be delimited to two specific activities common to FM&O firms: area management and maintenance work order management. The former is often considered as a means for strategic decision-making processes and executed within computer-aided facility management (CAFM) systems; while the latter deals with day-to-day operative activities of the FM&O team and is often managed by CMMS’s. The information elicited from actors within an organization which operates research and education facilities will be used to reconstruct both generic and detailed business processes and identify their information needs. The bottlenecks triggered by inefficient or tedious information acquisition routines will be then identified and – when applicable - associated with deficiencies and limitations of the prevailing workflow processes. Finally, suggestions will be provided on how workflow processes can be optimized for embracing BIM-based FM&O technologies.

8 CONCLUSIONS

Efficient and reliable information management tools and routines could substantially reduce the losses in the FM&O sector. Timely and effective implementation of such systems, however, entails adjustments in actual FM&O practices. This, in turn, calls for better acknowledgement of FM&O activity types, business processes, disciplinary actors and their information needs. Both major categories of activities in the FM&O sector i.e. strategic and operational management rely on information about buildings and their performance. Although development of new information technologies and corresponding standards is a strong drive towards a more efficient and profitable FM&O sector, it is similarly important to meticulously identify what types of information, in which manner, and to what extents need to be supplied to different business processes and involved disciplinary actors.

9 REFERENCES


buildingSMART. 2012. The BIM Evolution Continues with OPEN BIM. buildingSMART.


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IFMA. IFMA Orange County - What is FM? http://www.ifmaoc.org/about/what_is_FM.shtml (30 October, 2013).


