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A STRATEGY TO ARTICULATE THE FACILITY MANAGEMENT KNOWLEDGE CATEGORIES WITHIN THE BUILT ENVIRONMENT

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Abstract

Security is applied in the built environment and this requires a close relationship with facility managers. Therefore, this study puts forward an approach to establish the facility management knowledge categories within the built environment. In part, the significance of the study stemmed from research undertaken into the compliance to Australian fire door maintenance within nursing homes, which demonstrated 87 percent non-compliance. This high level of non-compliance appeared to identify a lack of facility management knowledge, among other issues (Doleman & Brooks, 2011).

The article uses a method to test the supposition of facility management knowledge construct in a three-phase Grounded Theory analysis. Phase-one examines international tertiary Facility Management courses, where course content is critiqued through linguistic analysis to extract the knowledge categories. Phase-two of the study further analyses these findings through the use of multidimensional scaling to present underlying conceptual knowledge interrelationships. The final third-phase uses experts in order to validate the findings of the previous two phases. A pilot study identified 18 common knowledge concepts, for example project management, space planning, budgeting and principles of facility management.

The study outcomes will improve the understanding of building knowledge requirements within the built environment, resulting in a framework of facility management knowledge categories. Such an outcome will support the consensual development of a facility management body of knowledge. The specific outcomes put forward for this research includes establishing the primary knowledge categories found within the Facility Management Industry. In addition, the outcomes will support the consensual development of a facility management body of knowledge, support policy, education and the relationship with security.

Keywords

Facility management; body of knowledge; built environment

INTRODUCTION

Security is applied within the built environment, resulting in a close relationship with security management. The built environment refers to the man-made structures in our towns and cities that provide environment for human activities, ranging in scale from personal residential structures to major city infrastructure. The built environment is a material, spatial and cultural product produced by people for living, working and leisure, characterised by a combination of physical elements and energy in systems necessary for people to conduct their living experiences. The health of the population in a built environment needs to be considered, with a *feeling of safety* for the population being important. To some degree, the management of security within the built environment has the function of producing that *feeling of safety*.

Therefore, this study considers the establishment and further validation of Facility Managers' primary knowledge categories by identifying their involvement within the life cycle of a building. The research was driven by an initial study undertaken by Doleman (2008) into the compliance of owners and operators to maintain fire and smoke doors in compliance with Australian Standard AS1851-17:2005, which found a high level (87%) non-compliance. The research established that the needs of the elderly are much greater than that of a younger demographic, not only from lack of mobility but also from the nature of the facility. Nursing homes are required, by their very nature, to provide a high degree of safety and security. To establish such a large level of non-compliance rate allowed several assumptions to be made. One such assumption identified a lack of suitably qualified and experienced owners and operators within the aged care facility industry (Doleman & Brooks, 2011).

The purpose of the current in-progress research is to develop a framework that identifies the Facility Managers knowledge categories in the built environment. In addition, to examine the way that knowledge develops

throughout the building life in an attempt to identify knowledge shortfall within the Facility Management industry. Such an outcome will also provide better articulation between the security and facility management in their roles and responsibilities.

Significance of the study

The theoretical challenge of this study will be to identify the Facility Management (FM) knowledge categories and the role that knowledge plays within the different stages of the buildings life cycle. According to Lehtonen and Salonen (2006), FM has gradually become accepted as a service profession within the property and construction industries during the early 1980s. Nevertheless academic research, publications and theoretical investigation into FM did not start until the 1990s (Price and Akhalghi, 1999) and it still remains under-researched (Nutt, 1999), while procurement and relationship management are becoming increasingly important in academic FM publications (Salonen, Lehtonen & Ventovuori, 2005). The restricted and often non-consensual nature of a defined body of knowledge and the past findings of knowledge shortfalls within aged care facilities (Doleman, 2008) substantiated the significance of the study.

The outcome of the study will lead to a better understanding of how Facility Management knowledge categories and subordinate concepts influence the management of buildings. This approach provided a study goal of deepening the understanding and role of FM knowledge categories within the life cycle of a building context. The dissemination of the information to a wider audience within the Facility Management industries will allow a better understanding of the role Facility Managers within the process and the mechanics behind the knowledge interaction within the build environment.

Study Objectives

The objectives of the study were to consider the core knowledge categories of Facility Managers, informed by the posed Research Questions:

1. Can the Facility Manager's knowledge categories be identified and their role be established within the life cycle of a building context?

2. What are the knowledge categories and subordinate concepts and their interaction and interrelationships within the Facility Management domain as measured by Multi Dimensional Scaling?

FACILITIES AND FACILITY MANAGEMENT

The life cycle of a building falls into a number of substantive stages, namely design, construction and occupancy. The mechanics behind how the Facility Management knowledge categories interact within the buildings life cycle and the way knowledge collaboration is developed and used within the Facility Management domain is considered. The practitioners and their knowledge categories found throughout the different stages are varied, with the Facility Management (FM) becoming involved towards the end of the construction stage and throughout the occupancy stage.

According to Lehtonen and Salonen (2006), FM performs an important role within the service sector accounting for 30-40 percent of an organisation's annual budget. FM adds value to an organisation by improving delivery of service, resource control and supply chain (Amaratunga and Baldry, 2002), while Fearon and Bales (1995) note that FM services are the most important service category in terms of volume. Facilities management is a general term covering a broad spectrum of services from real estate management, building maintenance, financial management, health and safety, and contract management (Atkin & Brooks, 2000; Amaratunga, Baldry & Sarshar, 2000). The role of FM can be defined as a key function in managing facility resources, support services and the working environment, supporting the core business of the organisation (Tay & Oi, 2001; Chotipanich, 2004).

Knowledge Communities

Understanding the way in which Facility Management (FM) knowledge is produced within the life of a building cycle, as well as understanding the relationship between the FM organisational strategies, knowledge accrual and the management of the knowledge, is critical. The ability of organisations to obtain and deploy knowledge over their specific domain is seen by Hahn and Subramani (2000) as being vital in maintaining a competitive advantage. The term *knowledge* has been a topic of discussion for some time. Bhatt (2002) refers to knowledge as being intangible and fuzzy in nature, while Novak and Gowin (1984) consider that knowledge is constructed

as layers on previous knowledge, using and expanding on existing concepts. Davenport, Long and Bears (1998, p. 207) refer to knowledge as a "combination of information combined with experience, context, interpretation, reflexion and perspective".

The convergence of different knowledge groups in a communal forum is a significant practice within large organisations. Ras, Avram, Waterson and Weibelzahl suggests that knowledge needs to be shared and is best undertaken by the acquisition and storage of knowledge in knowledge bases, following by countless and costless sharing (2005, p. 396). Wenger, McDermott and Snyder (2002) refers to this bringing together as *communities of practice*, describing it as a group of people who share a set of problems or a passion about a topic and who deepen their knowledge and expertise in this area by interacting on a continuous basis.

Australian Legislation

One such method to gain common knowledge is through legislation and standards. Within Australia there is both Federal and State legislation that is involved within the life of a building cycle. Such direct and indirect legislation includes the Building Regulations Act 1989, *Local Government (Miscellaneous Provisions) Act 1960,* Fire Brigade Act 1942, Occupiers Liability Act 1985, Occupational Safety and Health Regulations 1996 and perhaps most important, the Occupational Safety and Health Act 1991. The Australian federal system allows powers to be divided between a central government and regional governments, the Commonwealth Government and States by the Constitution. Specific areas of legislative power such as taxation, defence, foreign affairs, postal and telecommunications services were given to the Commonwealth Government, (Australian Government, 2005). A difficulty of this form of divided legislative control is the integration of the laws and regulations with each other, referred to as legislative harmonisation (Brown & Furneaux, 2007).

Leebron (1997) refers to Harmonisation as a way of reducing differences in laws and policies between two jurisdictions overcome by adopting similar laws and policies. Brown and Furneaux, 2007 (1992) go on to state that complete harmonisation can only occur if agreement is made on the central benchmark for use and that the best known example of harmonisation within the construction industry in Australia is the Building Code of Australia, which seeks to set a minimum standard of performance for buildings and building materials across Australia. The existent to which the involvement to which the Commonwealth and State Governments are involved within the building life cycle stages varies between each state and phase.

STUDY METHODOLOGY

As a research method, Grounded Theory was considered a suitable technique that would allow credible research to be undertaken within the context of this study. The study is divided into three distinct phases (Figure 1). Phase one considers the body of knowledge found within 15 international tertiary undergraduate Facility Management courses. The findings will be examined through a linguistic analysis of the course content, coded with the findings examined by ten experts to establish the validity of the findings. Phase two involves the examination of the phase one findings through the use of multidimensional scaling, allowing the interrelationships to be extracted. Phase three involves semi-structured interviews of 25 industry experts in order to validate the findings from the previous phases.

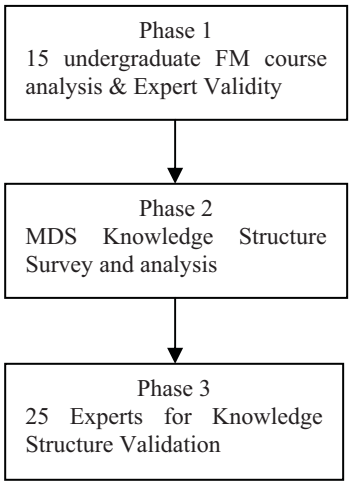

Figure 1 Study Design

Grounded Theory

Grounded Theory has been successfully employed in other disciplines including sociology, organisational science marketing and information sciences (Mansourian, 2006; Sornes, 2004), and has found extensive acceptance in research since it was first introduced by Glaser and Strauss in the early 1970s (Stern & Covan, 2001). Flinders and Milles (1993, p. 9) refer to Grounded Theory as being a complex process of both inductive and deductive, guided by prior theoretical commitments and conceptual schemes. They further state that the approach is not simply a methodological scheme for initiating and guiding enquires, as it requires prior educated understanding.

From an organisational stance, organisations are often referred to as having cultures embedded within them. Morey (1986) refers to organisations as not being a culture but operates "as if" they were cultures. Orlikowski (1993, p. 312) states the use of a Grounded Theory approach is well suited to organisational settings because the complexities of the organisational context have to be incorporated into an understanding of the phenomenon, rather than be simplified or ignored. Further justification for the use of Grounded Theory within the building's life cycle knowledge categories can be demonstrated by Sornes (2004), who asserts that Grounded Theory is appropriate in the study of information communication technologies within organisations, in particular, when generalised content relevant to organisational and management science are identifiable.

Expert Knowledge

The study will use experts' to develop and support its outcomes. Nevertheless, the exact nature and performance of an expert is not readily defined (LaFrance, 1997 cited in Brooks, 2008). Expert performance may be defined as consistent performance on a domain specific representative task (Ericsson & Charness, 1997), although expertise cannot be so easily quantified. Expertise requires a number of abilities that includes problem solving skills, conceptual understanding, domain knowledge and experience. Simon and Chase (1973) suggest experts see and know the world but only in their domain, in ways that a fundamentally different to a lay person stemming from a difference in perception, knowledge and knowledge organisation.

STUDY APPLICATION

Phase 1: Facility Management Knowledge Extraction

Phase one involves the investigation and critique of 15 international tertiary undergraduate courses in FM. The course selection will be made initially on the strength of the FM related concepts found within the title of the course; however, validated by an expert group. The findings from the course content analysis will then be subject to a linguistic inquiry and word count to develop the knowledge categories for Facility Management.

Francis and Pennebaker (1993) developed and validated a computer-based text analysis program called Linguistic Inquiry and Word Count (LIWC) as a practical method for studying the emotional and structural components present in individual's language. LIWC analyses written text files to contrast against dictionary matches on a word by word basis by calculating the percentage of words in the text that match (Pennebaker & Francis, 1999). It was considered that the study did not require a full linguistic analysis to be used.

A sample of size 15 was considered appropriate due to the method date of selection and criteria of Facility Management courses, although the sample size is not a random mathematical sample of the larger community (Krejcie & Morgan, 1970). To further support the selection process and reliability, the universities were selected from the European Facility Management Education Guide 2009 that identified 30 Bachelor courses in 15 European countries (EuroFM, 2009) and the North American Facility Management Degree Guide 2009 that identified 21 institutions from North American States (IFM Foundation, 2009). A 10 member expert panel to validate the above courses was considered appropriate due to the non-probability nature of the expertise available.

Phase 2: Multidimensional Scaling

The knowledge categories Phase one will then be inserted into multidimensional scaling (MDS) survey instrument (Table 1) to gain an understanding of their interrelationships and relevance. According to Bennet and Bower, (1977), MDS is a way in which an analysis of similarities in judgements can be made to allow

dimensionality to be identified and is one of the best known grouping techniques (Kerlinger, 1970). Classical multidimensional scaling, also known as Torgerson Scaling or Torgerson-Gower scaling, (Borg & Groenen, 2005) examines the dissimilarities between pairs of items producing an output matrix that minimises the loss function or strain. Non-metric analysis is seen as more appropriate for the study of social sciences (Kruskal, 1964) and according to Markham, Mintzes and Jones (cited in Brooks, 2009) the use of MDS increases the reliability of knowledge maps.

Table 1: Sample of the multidimensional scaling knowledge category survey

when compared to			Unrelated	1	2	3	4	5	6	7	8	9	10	Very related
Management		Facility												
Management		Change												
Management		etc												

The Phase two use of MDS meant that the sample size as indicated by Borg and Gall (1997) could be selected on a work-up rather than work-down approach, which combined with non-probability sampling, removed the need to define the sample size based solely on population (Brooks, 2008). Cohen, Manion and Morrison (2002) consider 30 to be the minimum sampling size for MDS analysis, which is supported by similar studies that had used MDS analysis (Cheng, 2004; Martinez-Torres, Garcia, Marin, & Vazquez, 2005).

Phase 3: Expert Knowledge Structure Validation

The third and final phase of expert knowledge structure validation will involve the assessment of the results from Phase two, using 25 experts from a cross section of the facility management industry. A semi-structured interview will be conducted, with the process being audible recorded and transcribed. According to Wuest (cited in Munhall, 2007), the interview starts with an overview question, with some follow up probes, that are essential for opening a broad line of questioning (Wuest, Ericson & Stern, 1994). The opinions of each respondent will allow assumptions to be made for comparison. This process will also allow internal validity to be examined by triangulation (Figure 2) of the research findings.

The validity of Phase three will be assessed through face validity, being expert judgement. Pre-constructed response coding will be utilised to maintain consistency and maintain reliability and assessable using expert judgement.

Reliability and Validity

Reliability as stated by Guildford (1950) as a certain instrument applied to certain population that is the extent to which the same measurement of individuals obtained under different conditions yield similar results. By presenting all the subjects in a survey research as a standardised stimulus it goes some way towards eliminating unreliability in observations made by the researcher (Babbie, 1992, p. 279). The study will establish trustworthiness as Padgett (1998) refers to reliability through a variety of strategies include prolonged engagement, triangulation, peer debriefing, member checking, negative case analysis, audit trail and reflexivity (Creswell, 1998, 2003; Horsburgh, 2003; Johnson and Waterfield, 2004).

According to Babbie (1992), the degree to which an instrument measures what it is supposed to measure and the extent to which the empirical measure adequately reflects the real meaning of the concept under consideration is the definition of validity. Construct validity refers to the representativeness of the content of the instrument used in the study and the degree to which the measure covers the range of meanings including concepts and calls for the continued accumulation of information from various sources (Babbie, 1992, p. 133). While Cooper and Schindler (1998) refer to content validity as being the degree to which the content of the items adequately represent the universe of all relevant items under consideration. Instrument validity was assessed through face validity and convergence, with face validity assessed by expert judgment.

In addition, the study is using triangulation between study phases (Figure 2). As Cavana, Delahaye and Sekaran (2001) state, triangulation is a cross-validation or verification methodology in qualitative research and not a theoretical approach. Nevertheless, Glesne and Peshkin (1992**)** assert that use increases confidence in the research findings and this will support the various study phases and analysis methods.

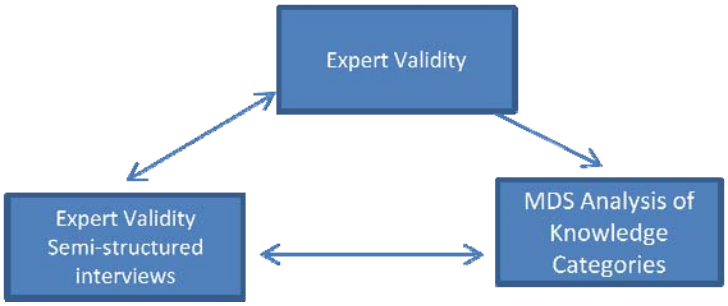

Figure 2. Study triangulation between phases

(Adapted from Mc Millen & Schumacher, 1993)

CURRENT RESULTS

The study has applied the methodology, with progression through the primary study. Phase 1 has extracted Facility Management knowledge categories from three international tertiary institutes, with validity provided by four Facility Management experts. The tertiary courses were selected as a cross section of the overall list of proposed universities that offer an undergraduate course in Facility Management. The tertiary institutions chosen were one from the USA, one from the United Kingdom and the third from The Netherlands. 2,157 facility management knowledge concepts have currently been extracted from the three course contents examined, with concepts ranging from *management* through to *zoning*.

During the linguistic analysis (Francis & Pennebarker, 1993) phase several semantics issues had to be considered to ensure reconciliation for consistency. In the context of the tertiary course content overviews the word *plan* was considered to be the same as *planning*. In addition, *facilities* was considered the same as *facility* and *service* the same as *services*. During analysis, the context in which the concept appeared was also considered. The 24 most used concepts (Table 2) resulted and were selected for review by the Facility Management experts. These concepts will be further analysed in the proceeding phases using multidimensional scaling and additional experts.

Table 2: Phase One 24 most common facility management knowledge categories

Knowledge Categories			
Management	Business	Product	Environment
Facilities	Organisation	Systems	Organisational
Change	Analysis	Financial	Customer
Planning	Quality	Interior	Marketing
Development	Communication	Process	Materials
Service	Skills	Research	Design

EXPECTED OUTCOMES

The study seeks to develop an understanding of what knowledge categories of Facility Managers are involved within the life cycle of a building. By reviewing the Facility Management knowledge requirements developed during the life cycle of the building, it is expected to gain significant insight into the Facility Managers role and responsibilities. The specific outcomes expected from this research study include:

- Establish the way in which the Facility Management knowledge categories within the life cycle of a building affect the buildings outcome.
- Define the roles of Facility Management within the life cycle of a building and correlate the relationship and the areas of responsibility.
- Identification of factors that promote the exchange of subordinate knowledge concepts within the Facility Management domain.
- Improve the understanding of the Facility Management knowledge requirements and understand areas that

may be lacking within the building life cycle.

- Provide a framework for Facility Management knowledge categories within the life cycle of a building to provide a better platform where Facility Management knowledge interaction is involved.
- On the basis of the results obtained during the course of the study and through data analysis, shortcomings in Facility Management knowledge categories may be identified and strategies for moving forward offered.

CONCLUSION

The apparent restricted nature of centralised knowledge content for undergraduate tertiary Facility Management (FM) courses has been established as the premise behind this in-progress study. Such a lack of consistency is reflected with the issue that of the 38 US tertiary undergraduate FM courses only nine are accredited with the IFMA and 14 are members. These issues may be combined with the absence of tertiary undergraduate Facility Management course in many other countries which adds strength to the significance of the study. To begin to address this issue the article has put forward a methodology to consider the knowledge structure of FM.

The methodology of the research is split the study in three distinct Phases. Phase one assesses international tertiary undergraduate courses in FM, which are validated by experts. The principle behind Phase-two is to apply additional underlying analysis through the use of multidimensional scaling (MDS) knowledge structure survey from phase-one, to gain an understanding of their interrelationships and relevance. Phase-three will assess the results from Phase-two by experts from a cross section of the industry.

The intent of the study is to establish and define the roles of the FM knowledge categories within the life cycle of a building. Such understanding will identify factors that promote and improve the exchange of knowledge within the FM domain. Nevertheless, the prime focus of the study is to present an FM framework of knowledge categories within the built environment. Such outcomes will support the understanding of roles and responsibility that the facility management applies within the built environment, supporting the function of providing a safer environment in support of the security manager.

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