Knowledge Engineering Application In Facility Planning

Halimah Che Hassan

Nilai Polytechnic, Enstek City, Negeri Sembilan

hchp23099 @ yahoo.co.uk

Abstract. Fragmentation of knowledge in construction industry has resulted in a situation where no single construction industry professional has all the knowledge needed to design a complex physical facility. Technical institutions are complex facilities which were planned and designed using an array of processes including the documentation of end user requirements in a Project Brief (PB) document. There is no framework for end user documentation process which leads to difficulties in preparation process of PB document for the use of knowledge-base planning of such facilities. A quality PB contains adequate and relevant information that support an architect at the early stage of designing. This difficulty leads to plans not well designed and optimized, and decisions on physical facilities specifications not fully supported. There have been studies that focussed on documentation process and methods of information gathering from client by the facility designer. However, the focus was not on the use of PB by the architects as a communication tool with the user clients. This situation has led the architect to produce an output that does not address the operational needs of the end user. As such, a research on documentation process of PB and knowledge organisation for the planning and physical facility specifications during the preparation of the PB document is needed. The objective of the research is to suggest development of a technical institution facility project briefing framework for coordination of institution’s facility planning document preparation. In this research, document search method, case study and interview were adopted to explore and understand the existing documentation process of PB as a basis for development of preparation process framework of documenting PB. The planning of polytechnic facilities in Malaysia had been used as cases in this multi-case study. Relevant knowledge reflect the operational strategic activities carried out in the facility to be developed. The methods employed and problems in the present production process of BP was explored during the process of document analysis and case study. The analysis of data uncover the weakness in the present production process of PB apart from recognising the elements suitable for the framework for production of PB document. These elements lead to the development of a new framework with the inclusion of taxonomy and ontology elements. The resulting framework comprised of processes for knowledge management, collaboration of planning experts and decision making.

Keywords: facility planning, knowledge management, collaboration, decision making
INTRODUCTION

Generally, facility management cycle starts from macro preliminary planning, document preparation, design, construction, procurement process, operational and maintenance. Facility planning (from preliminary planning to design) involves management of knowledge, collaboration and decision making in diversified planning activities. Document preparation such as Project Brief (PB) for a complex facility has to undergo a thorough process so that all requirements of the facility user are well understood by the facility designer. A proposed framework integrates Knowledge Management System (KMS), collaboration and decision making process. Technical education facility planning is used as the case because the facility is usually complex, multi-functional with multi-users. Therefore, planning knowledge is vast and knowledge engineering is applicable to simplify the planning process. The complexity of planning knowledge requires taxonomy and ontology concepts to organise the relevant knowledge needed by the facility designers. Artificial Intelligence (AI) language, PROLOG was used in a simple prototype to validate the proposed framework for facility planning.

Problem Statement

Many individuals are involved in the planning processes such as users, stakeholders, architects, consultants, government agencies and local authorities. Extensive planning processes involving homogeneous and heterogeneous CoP members complicate the processes. A tool is needed to simplify planning processes to a certain extent in order to produce a quality Project Brief (PB) for the designers. Facility designers claimed that there are PB which could not serve as communication medium between them and facility users. Research on preliminary planning is inadequate and still on going as knowledge on facility planning development is vast and complex. This research explores the possibility of using ICT concepts to simplify facility planning for the preparation of PB document with adequate and relevant contents.

Objective of Study

The main objective of the study is to develop a framework to assist facility planning and enhance the planning process by using knowledge engineering (KE) technology. The research explored the possibility of using KE technology to develop a knowledge-base (KB) as part of the proposed framework.

Background and Literature review

The issue of handling knowledge is critical factor in every stage of facility planning especially in area of space planning and identification of user needs. Facility planning normally involves six phases – preliminary planning, document planning, schematic
drawing, detail planning, construction planning and operational planning. Management of knowledge on user needs creates the gap and problems in communication between facility users and facility designers. Below are some fundamental concepts that the researcher tried to put forth the idea of managing relevant knowledge in producing quality planning documents.

A. Cyclic Model of KMS

Literature review showed several models comprised of varied number of elements in the system. In summary, six elements distinctively make up the KMS cycle (Turban, 2001) as shown here:

- Capture knowledge
- Refine knowledge
- Store knowledge
- Manage knowledge
- Disseminate knowledge
- Create knowledge

Proposal of solution for the above problem through this research is approached through a development of a framework that can develop a strategy to combine the three interrelated elements:

- human and expertise (expertise to be retained in the system)
- technology and knowledge management
- decision making in planning processes

The strategy that can allow flexibility in planning and design (in the case of technical education facility, flexibility in planning is needed due to dynamic change in curricula).

B. Decision making model and Planning Framework

In a knowledge intensive environment — a multistage decision making system, scientific method combined with mathematical method where necessary is appropriate such that:

- Stage 1: generate alternatives
- Stage 2: decide one alternative
Decision Process Framework model (retrieve, filter, share, use and update) and are in line with the above two stages and the features include:

- Goal oriented and multistage decision-making for optimisation
- Use of AI rules and Knowledge base (within KMS environment)

The subsystems of the framework take care of the policy checks, criterias and decisions when planning the facility documents.

**METHODOLOGY**

A combination of qualitative methods was employed in this research. Document search, case studies and interview methods were used appropriately for data collection as below:

a) Document search: Planning documents were analysed for TVET facility projects spanning five years’ projects. Through comparison of these projects’ data, processes of contents gathering and presentation were determined.

b) Case Study: Development and planning of technical education facilities in Ministry of Education Malaysia was chosen as the case study. Data, information and knowledge gathered through participatory observation for three TVET institutions were analysed to trace the processes involved in facility planning.

c) Knowledge and information on TVET facility planning were acquired from 17 personnels involved in the TVET development projects through interview sessions carried out to validate the proposed framework. Application of knowledge engineering was used during the validation of the framework by creating knowledge base in the planning framework using taxonomy and ontology elements.

**RESULTS**

The output of this research is a framework incorporating a knowledge-base for facility planning. The planning framework is summarised as a three main steps process i.e. pre-documentation of PB, documentation process and post-documentation process. This is similar and in line with other quality processes as a process cycle. Knowledge engineering is capable of using contents from the knowledge base to produce contents of PB documents and enabling updating process for future projects.
Knowledge Base

Pre-documentation of PB (input gathering, refine and save)

Post-Documentation of PB (manage feedback knowledge, disseminate, use the output and generate new knowledge)

Documentation Process of PB (repeating refine process, use, decision making through collaboration, record, save decisions)

Knowledge Base

Figure 1. Knowledge Management System for Technical Institution Project Briefing Process.

Prototyping

Analysis of knowledge management tools, collaboration tools and integration of decision making capabilities is expected to be able to produce simulation of the framework under study by feeding the test data. Information on technical facility planning were arranged in ‘axiom’ format to become small pieces of information to become part of the contents in the knowledge base. The prototype developed using PROLOG was able to show the capability of the planning framework in order to prepare a PB suitable for the consumption of facility professional such as an architect who will be involved in the facility development.

Validation of results

Interviews were conducted on the usage of framework through the use and demonstration prototype. The interviewee were planning professionals among the facility users and administrators. From the interview series, in summary: decision making in knowledge intensive environment use more than one stage of decision making.
The second stage decision making either using mental judgement from experience or brainstorming through collaboration i.e. meeting and uses much less of technology. Decision making using step-by-step is a multi-stage procedure. Technology was partially used in all stages of KMS including decision making. 90 percent of respondent agree with the framework of planning process being developed and also agree with the test results from the prototype.

CONCLUSIONS

The development of the new planning process framework enable the documentation process of Project Brief to be enhanced in terms of:

- Ensuring more accurate input of specifications
- Enabling easy updating after receiving new inputs and feedbacks
- Minimise cost and time for planning through reduction in using too many personnels.
- Simplifying document preparation
- Knowledge management aspects such as knowledge engineering plays major role in planning processes and procedures

Data from this multi-case study strengthened the development of a planning framework for the production process of BP.

REFERENCES


