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Facility Planning for Biotechnology Program Using Semantic Relationship

Halimah Che Hassan[a], Ahmad Yazid Abd Rahman[a]*

[a]*Research and Innovation Unit, Nilai Polytechnic Negeri Sembilan*

Abstract

Facility planning for a technical education diploma program is a complex process. Proper and flexible planning strategy is needed especially when the institution undergoes program expansion or program change. An appointed person-in-charge needs clear information and knowledge to suggest a set of user requirements and specification for the design of this complex facility. The problem in planning is in the capturing of adequate and relevant knowledge in biotechnology training and its delivery during designing stage. Decisions on physical facilities specifications and requirements need to be made by program expert in biotechnology. All decisions made are documented in a project brief (PB) document that should address the operational needs of the end user. In this paper, a user requirement assessment framework was proposed by the biotechnology planning coordinators to capture and organize relevant knowledge using semantic relationship concept so as to simplify the documentation process of PB. A combination of qualitative methods and non-participatory observation were used to uncover the hidden relationships of relevant data and draft PB were produced using semantic relation and algorithm. A simple decision making process was incorporated in a prototype to showcase the user requirements and decisions made from the captured and stored knowledge. The findings of this paper contribute to the development of a meaningful and functional PB for the enhancement of Biotechnology Diploma Program in the institution.

Key-word: - User requirement, project brief, semantic relationship and decision making

* Halimah Che Hassan. Tel.: +0192135660 ; fax:
E-mail address: halimah@pns.edu.my.

1. 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 Biotechnology Diploma Program is complex, therefore the process needs to be thorough 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. Biotechnology experts need to be involved to provide relevant data and as person-in-charge or planning coordinator in this case to simplify the planning process. The complexity of planning knowledge requires taxonomy and ontology concepts to organise the relevant knowledge needed by appointed facility designer or architect. Artificial Intelligence (AI) language was used in a simple prototype to produce a PB as a planning document.

2. Problem Statement

Many individuals are involved in the Biotechnology Diploma Program facility 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 complex and experts are needed. This research explores the possibility of using ICT concepts to simplify facility planning for the preparation of PB document with adequate and relevant contents from the experts, in this case biotechnology experts.

3. Objective of Study

The main objective of the study is to develop a framework to assist Biotechnology Diploma Program facility planning and enhance the planning process by using ICT and semantic relationships in managing relevant data. The research explored the possibility of using semantic theory to develop a knowledge-base (KB) as part of the proposed framework.

4. Background and Literature Review

In executing planning activities, the issue of handling knowledge is critical factor in every stage of facility planning especially in area of space planning and identification of biotechnology educators' and students' needs. Facility planning normally involves six phases – preliminary planning, document planning, schematic drawing, detail planning, and 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 preparing quality planning documents for Biotechnology Diploma Program.

5. 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 and 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 which are human and expertise (expertise to be retained in the system), technology and knowledge management and 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, criteria and decisions when planning the facility documents.

6. Methodology

A combination of qualitative methods was employed in this research. Document search, case study , observation 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 present Biotechnology Diploma Program facility in Ministry of Education Malaysia was chosen as the case study. Data, information and knowledge gathered through 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. The framework includes the creation of knowledge base through usage of semantic theory using taxonomy and ontology elements .

7. Results

The output of this research is a framework incorporating a knowledge-base built through usage of semantic relations such as shown in Table 1 below. The content of the table shows learning spaces coded and asserted as related to biotechnology program.

Table 1 A list of learning spaces required for Biotechnology Diploma Program (Represented in ontological expressions or axiom statements)

Biotechnology Learing Spaces (CODES)	**Axiom in Ontological Language**
General	
1. Mini Lecture Theatre (MLT)	ClassAssertion(a: biotech_learning a:MLT)
2. Class Rooms (CR)	ClassAssertion(a: biotech_learning a:CR)
3. Presentation Room (PR)	ClassAssertion(a: biotech_learning a:PR)
Laboratories	
1. Microbiology Lab (MBL)	ClassAssertion(a: biotech_learning a:MBL)
2. Agro-Biotechnology Lab (ABL)	ClassAssertion(a: biotech_learning a:ABL)
3. Bioprocess Lab (BPL)	ClassAssertion(a: biotech_learning a:BPL)
4. Biochemistry Lab (BCL)	ClassAssertion(a: biotech_learning a:BCL)
5. General Lab (GEL)	ClassAssertion(a: biotech_learning a:GEL)
Others	
1. Chemical Storage Room (CSR)	ClassAssertion(a: biotech_learning a:CSR)
2. Chemical Waste Room (CWR)	ClassAssertion(a: biotech_learning a:CWR)

The first expression indicates that MLT is a learning space in Biotechnology Diploma Program and so are the rest of the expressions .

Table 2 Categorisation of learning spaces required for Biotechnology Diploma Program (Taxonomy of knowledge)

Learning Spaces in Biotechnology (CODES)

General	**Laboratories (followed by modules)**					**Others**
	Microbiology	Agro-Biotech	Bioprocess	Biochemistry	General	
Mini Lecture Theatre(MLT)						Chemical Storage Room (CSR)
Class Rooms (CR)						Chemical Waste Room (CWR)
Presentation Room (PR)						
	Microbiology	Genetics (GE)	Cell and	Chemistry	Biology of	

...continued

(MB)		Molecular Biology (CM)	(CH)	Organisms (BO)
Industrial Microbiology (IM)	Cell and Tissue Culture Technology (TC)	Techniques in Recombinant DNA Technology(TR)	Physical Organic Chemistry (PO)	Laboratory Technique and Management (LB)
	Food Biotechnology (FB)	Instrumentation in Biotechnology (IB) Enzymology (EN) Bioprocess Technology (BT)	Biochemistry1 (BC)	

The framework is similar and in line with other quality processes as a process cycle. Semantic relationship in the gathered knowledge and information were used to build the knowledge base and develop PB document, hence enabling updating process for future projects.

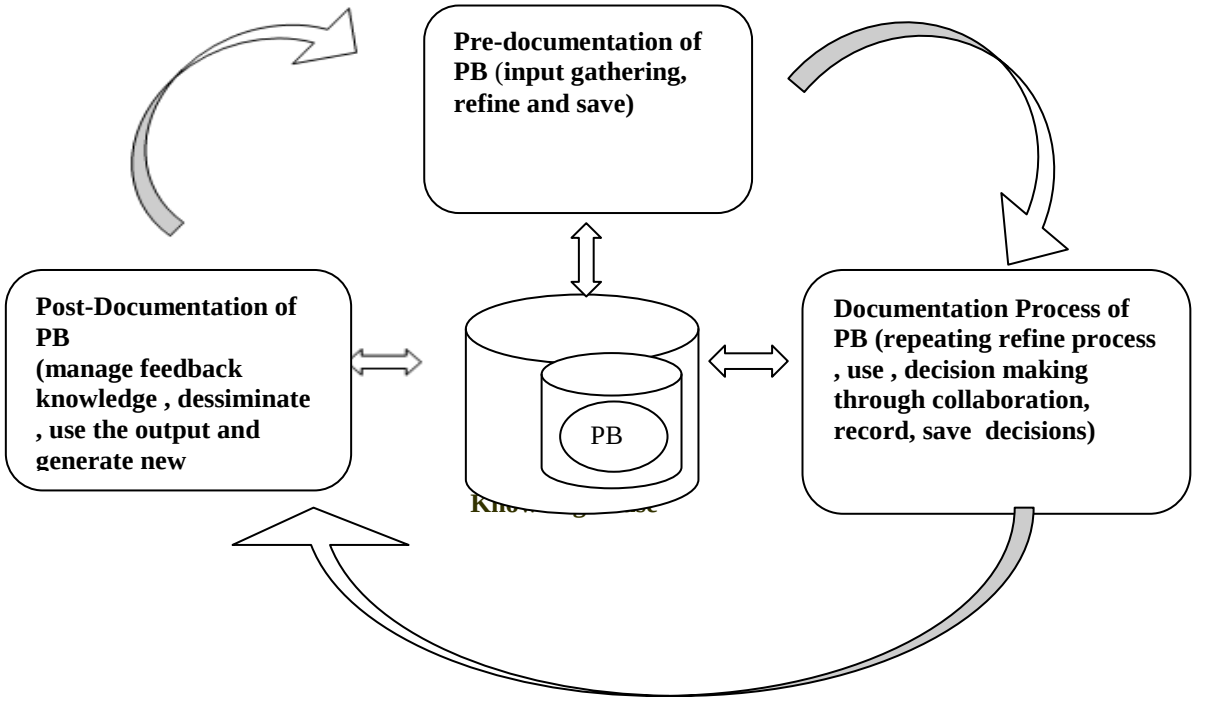

Figure 1 Knowledge Management System for Biotechnology Diploma Program Facility Briefing Process.

8. Prototyping and Validation

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 Biotechnology Diploma Program 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 using semantic relationships of relevant data in the planning framework in order to prepare a PB suitable for the consumption of facility designer such as an architect who will be involved in the Biotechnology Diploma program facility development. 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. Semantic relationship was used in knowledge base development and decision making process. 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.

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