AN IT TOOL FOR MANAGING THE PRODUCT DEVELOPMENT PROCESS

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ABSTRACT

Throughout the last two decades a number of improved product development processes have been suggested that illustrate and clearly define the nature, scope and holistic representation of the issues involved in understanding and managing the product development process (PDP). The degree to which they have actually added value in the industry, even when lean principles have been incorporated, has been debated by many authors. Many agree that one of the main reasons for the above is that those processes/models are rarely implemented fully or the integrity of the embedded philosophy has been diluted through wrong adaptation. One such model of an improved PDP is the Process Protocol.

This paper presents how the development of an IT tool can enable the easy and fast adaptation of the Process Protocol Model without loosing the integrity of the holistic approach and without diluting the Philosophies on which it was based. The IT tool adopts the Process Protocol model as a template with enough information that makes it appropriate but flexible enough to allow individual company innovations to be part of the model in a non-prescriptive nature.

KEY WORDS

PDP, process management, process modeling, IT

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INTRODUCTION

The British Property Federation Survey (British Property Federation, 1997) identified that one third of major UK clients are dissatisfied with contractor and consultant performance. Similarly, The Egan Report, Rethinking Construction (Egan, 1998), stated that the industry also suffers from low and unreliable profitability, insufficient research & development, and a lack of customer focus. Moreover, these problems typically relate to the industry's adversarial nature, and a profound co-ordination and communication system between the parties is much needed.

The Generic Design and Construction Process Protocol (GDCPP) was developed by the University of Salford in 1998 in an attempt to improve the prevailing situation. It is a high-level process map that aims to provide a framework to help companies achieve an improved design and construction process. The map draws from principles developed within the manufacturing industry that include stakeholder involvement, teamwork and feedback, and reconstructs the design and construction team in terms of Activity Zones rather than in disciplines to create a cross-functional team. These Activity Zones are multi-functional and may consist of a network of disciplines to enact specific task of the project, allowing the 'product' to drive the process rather than the function as in a sequential approach. Luck and Newcombe (1996) argue that traditional roles and responsibilities change from project to project, often resulting in ambiguity and confusion; the use of zones potentially reduces this confusion and enhances communication and co-ordination (Kagioglou et al, 1998). The Activity Zones contain high-level processes spanning the duration of a project from inception, through design and construction, and including operation and maintenance. The responsibility for completing the processes may lie with one Activity Zone or be shared.

Furthermore, the Process Protocol aims "to map the entire project process [PDP] from the client's recognition of a need to operations and maintenance" (Kagioglou et al, 2000). The protocol takes the form of a framework detailing the generic design and construction processes within a construction project. The intention was for construction firms to take the map and to use it as a framework to help them to improve their business and through industry interest and acceptance, further funding has been committed to continue the research. It was envisaged that the generic protocol would not be an ad hoc activity, but an ongoing and planned one. Therefore, the framework should not be so prescriptive as to restrict or stifle creativity but be easily adapted and tailored to suit the individual project. This brings the generic protocol down to a secondary-level (Level 2) or product-specific level, which itself can be broken down further to more detailed levels to create sub process maps of the eight Activity Zones within the Generic Design and Construction Process Protocol Model (see Figure1 for a short illustration). The Process Protocol Level II project[7] subsequently aimed to identify such sub processes, however, the implementation of the framework (Kagioglou et al. 2002) also highlighted some issues:

- Due to the complexity of the construction project, the process model will become very complicated. It is almost impossible to manage all the processes manually.

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[7] In collaboration with Loughborough University and eleven industrial partners

- Companies might only adopt part of the Process Protocol model, depending on the nature of the project.
- Some companies have their own working process and are not willing or able to accommodate a new approach.
- The individuals who are responsible for the process modelling and management of a project need detailed knowledge of the Process Protocol.
- The opportunities presented by Internet technology for organisations to improve the performance and more effectively reach the parties involved in the project is now being used and the Process Protocol needs to adapt to the technology.

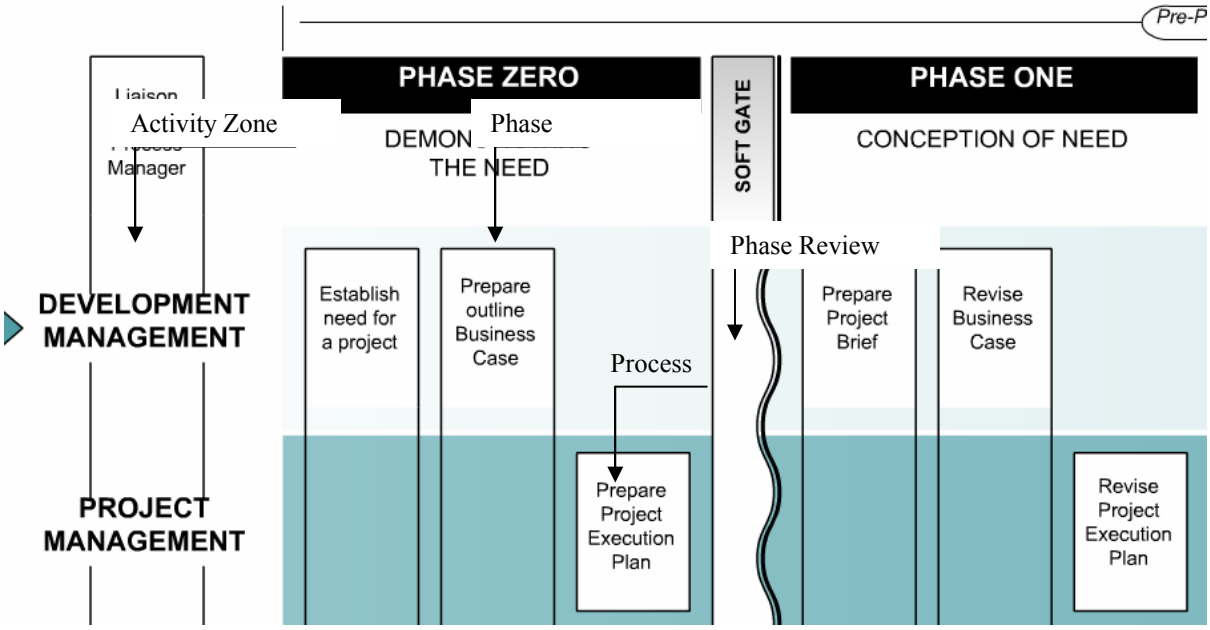

Figure 1: Process Protocol Framework

An IT solution, the Process Protocol toolkit, is needed to resolve theses issues. It is being developed under the Process Protocol Level II project. The tool aims to assist the creation of the process model and to manage the processes based on the Process Protocol framework, and will be discussed in detail later in this paper.

PROCESS PROTOCOL

PROCESS PROTOCOL FRAMEWORK

The Process Protocol framework consists of the following major elements:

Process

A set of activities undertaken by multifunctional team is to produce information for other processes or deliverables. For example, 'establish need for project'.

Deliverable

As output of the process, deliverables represent documented project and process information, such as Stakeholder List, Statement of need, project brief, etc.

Phase

There are 10 Phases (see Kagioglou et al. 1998) that have been defined in the Process Protocol map to represent the different stage of the whole lifecycle of a construction project.

Activity Zone

Nine activity zones in the Process Protocol Map represent the different group of participants involved in a construction project, namely Development Management, Project Management, Resource Management, Design Management, Production Management, Facilities Management, Health & Safety, Statutory and Legal Management and Process Management.

Phase Reviews

They are conducted by a multifunctional senior management group and representatives of the project team. The work is in the form of deliverables as described in the Process Protocol and are assessed in the Phase Review meeting. The Phase Review report will include key deliverables for the appropriate phase as identified by the project process map.

PROCESS REPRESENTATION

The processes and sub-processes are denoted by using the symbol shown in figure 2,

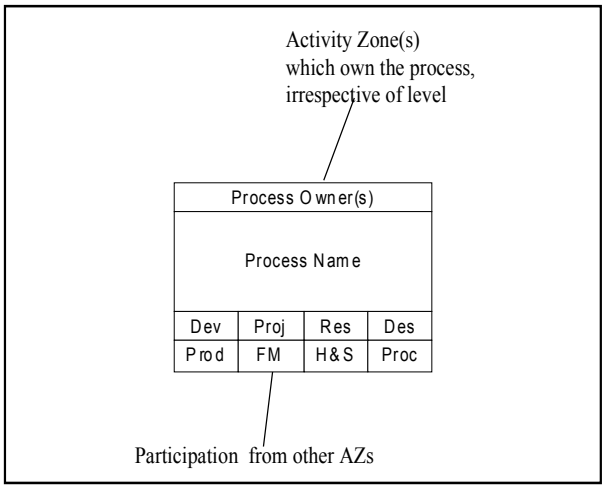

Figure 2: Process representation

Process owner(s)

Process name (potentially including some description for clarification where required). An indication of likely/potential participation from other activity zones in the process.

Inputs

For clarity, inputs to a process are only shown where they form a logical dependency from another process at that level on the same diagram (see figure 3). All other inputs from different phases or Activity Zones are not shown, but are traceable through the modelling database.

Outputs and deliverables

All processes by definition have an output. Some of these can be called 'deliverables', where the information is in a form (or document) that should be named for easy reference and use in other processes. The outputs to be named as deliverables are defined later in the Process Protocol framework.

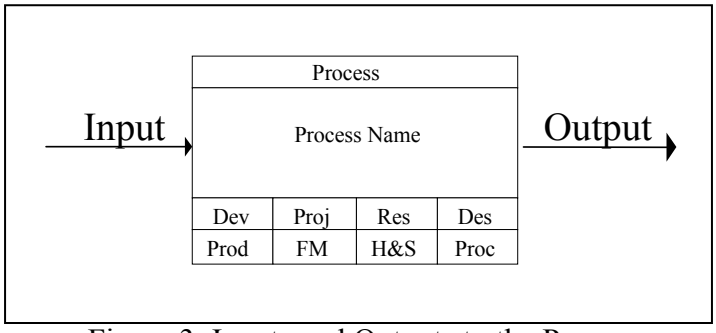

Figure 3: Inputs and Outputs to the Process

Process levels

The maps contain three levels:

- Level I contains the high level processes and their deliverables as identified in the Process Protocol Map
- Level II contains the sub-processes of the main process at level I (i.e. what the Level I process consists of) and how those sub-processes interact with each other (i.e. how is the Level I process undertaken)
- Level III contains the sub-processes of the processes at level II (what the Level II process consists of) and how those sub-processes interact with each other (how is the Level II process undertaken)

PROCESS PROTOCOL TOOLKIT

Having explained the Process Protocol framework and its mapping methodology, the way in which the Process Protocol Toolkit can support the Process Protocol mapping and its principles can be outlined. The Process Protocol toolkit is composed of two major components; process map creation tool and process management tool. To develop this toolkit, it is vital to understand the information relationships between the major elements of the

Process Protocol framework. Data model of the Process Protocol framework was produced to illustrate the relationships.

The methodology for the data modeling is Entity Relationship Diagram (ERD), which was introduced in the 1970's by Peter Chen to model the design of a relational database from a more abstract perspective. (Chen 1976).

An Entity relationship diagram (ER diagram) uses three major abstractions to describe the data. They are:

- Entities, which are distinct and major elements in the business; i.e. map element 'activity zone'.
- Relationships, which are meaningful interactions between the entities; i.e. entity 'activity zone'. and entity 'process', the relationship between is 'One activity zone has one or more processes.'
- Attributes, which are the properties of the entities and relationships, i.e. name, description of entity 'activity zone'.

The entity relationship diagram in figure 4 represents how the major elements of the Process Protocol framework are interacted each other and how the information associated with them can be stored.

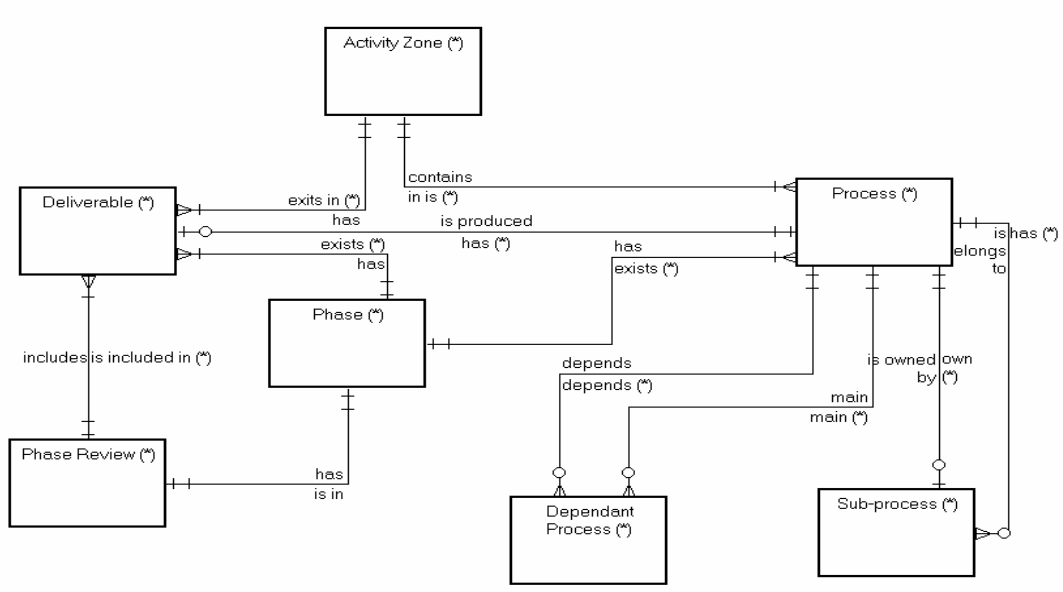

Figure 4: Entity Relationship Diagram for Process Protocol framework

This ERD model is turned into a database by mapping the entities and relationships as database tables to hold the data of project process map created by the process map creation tool.

PROCESS MAP CREATION TOOL

The process map creation tool is a process-mapping tool specially designed for the creation of the project process map based on the Process Protocol framework. It automates the map creation process and guides the user who might lack of the knowledge of the Process Protocol to create a project process map at early stage of the project. Users will be able to tailor and customise the process map to suit their own project and company requirements.

To some extent, process map creation tool is very similar as process modeling tools that have been available on the software market for years. Many companies have adopted a process-oriented view of their business operation, replacing the traditional functional viewpoint to achieve a better integration of operation (Hammer & Champy, 1993). Therefore, software tools to assist such approach have been developed and they can be categorized into two major types, paper based diagramming tools and software enabled analysis tools.

Paper based diagramming tools primarily offer the integration of diagrams and illustrations, together with a wide variety of other features and abilities. Most of the tools provide drawing support with templates or shapes, which can be customized to suit individual requirements. The industry standard modeling languages, such as IDEF (Integrated Computer Aided Manufacturing Definition), Data Flow Diagram, Entity Relationship Diagram, have been incorporated into these products.

Software enabled analysis tools are more commonly called BPR tools or CASE (Computer Aided Software Engineering) tools and usually encompassed built-in event simulator, static analysis, dynamic modeling and standard database support. These tools are able to produce a descriptive model that attempts to represent the business "as is" or "as to be". Such model can be composed of a number of process definitions including goals, business rules, actions and resource requirements, and expresses the flow of activity between the processes with a combination of diagrams, text and performance measures. Typically, the business model is built using a process modeling (built-in) tool, and they then may simulate the running of the process. However, most tools focus on IDEF methodology and several are based on the Data Flow or Entity Relationship Diagram. Although these process tools provide powerful functions, they cannot be effectively used as an IT support for the Process Protocol, because the aim of the toolkit is to help the industry implement the Process Protocol and not to analyze the construction process. In addition, the Process Protocol has its own process modeling methodology which was developed with the industry to facilitate their own simple requirements, though this is not discussed in the extent of this paper. All of the intelligent tools only support standard accepted modeling methodologies, like IDEF, data flow diagram and therefore, the Process Protocol Toolkit needs to be developed to fulfill the role in the project.

The prototype of the process map creation tool has been developed under the Process Protocol II project. It enables the production of a project process map based on the generic Process Protocol framework. There are three major components in the tool, which are main creation tool, generic processes data store and project process data store.

The main creation tool provides the functions for data retrieval, map creation and map customization. Users will be able to define their processes, and create the project process map by referring to the generic processes provided by Process Protocol. All the generic processes developed in the Process Protocol project are stored in the generic process data store that has

been built according to the Process Protocol data model. The project process map created by users is stored in the project process data store, which becomes the basis of the process management tool.

Figure 5 is a screen shot of the prototype of the process map creation tool. It is a standalone MS Windows application developed using Microsoft Visual Basic programming tool. Its interface consist of three main parts:

Process Tree

On the left side of the window, Process tree is used a similar windows file explorer style to show the decomposition structure of the process map. Processes in three different levels represent in process tree hierarchy respectively. Processes in the process tree are selectable, they can be selected by mouse click and the corresponding process in process map will be highlighted. In Figure5, the process "identify space requirements" is selected and the same process in process map is highlighted.

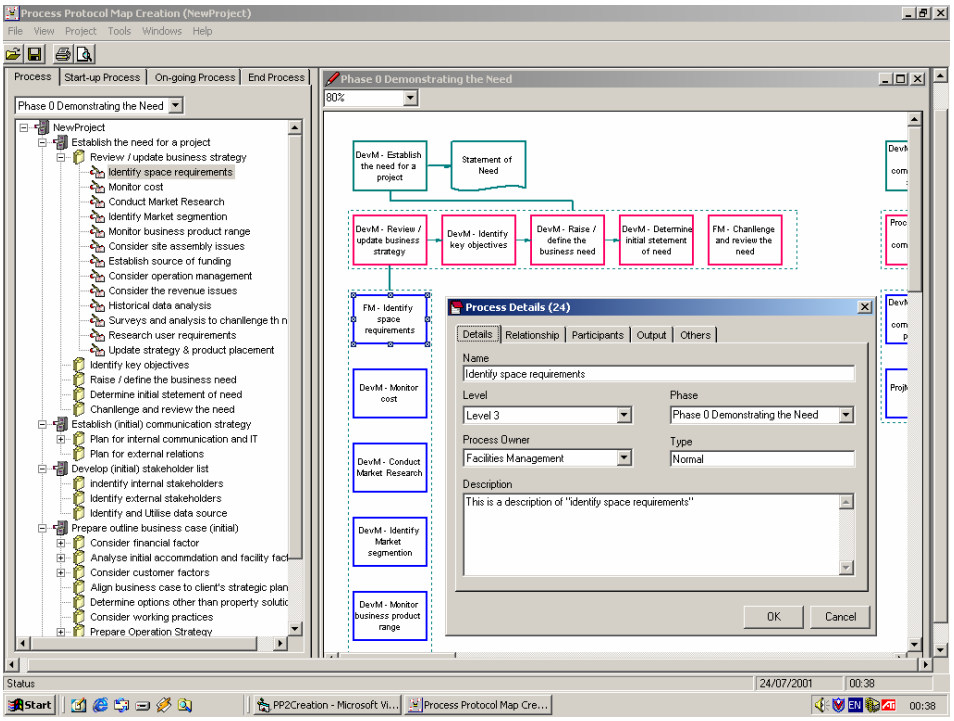

Figure 5: Process Map Creation Tool

Process Map

Process map is a visual representation of the Process Protocol Map, it interacts with the process tree on the left. Processes in different levels are represented in different colors. In this case, Process "identify space requirements" is level 3 process and it is in blue.

Process Details

All the information associated with each process is shown in process details dialogue box. It includes name, process level, process owner, description, type etc. Figure 5 shows the detailed information of process "identify space requirements".

PROCESS MANAGEMENT TOOL

The process management tool is a web based project information management system by integrating the process as a core information structure. It provides functionalities for project management and workgroup collaboration in a virtual environment, such document sharing, document and drawing management, online publishing, user control, etc. Project team can secure and centralise the engineering and project information for all that need to see it. In this environment, teams can reduce costs and save time as they gather and disseminate information throughout the project lifecycle. Furthermore, the integrated project process map will become the route map to help and guide the project management team to monitor and track project progress, documents, etc. The centralised the project information can be reused in the future project as reference.

The proposed process management tool stores all the project document and information according to the project process, which is created by the Process map creation tool. The project process effectively becomes the information structure of the project. Users are still able to search the information in traditional way, but more important, users can follow the project process to locate the information they might need. That is major difference between the process driven management tool and current project extranet.

The proposed system architecture of process management tool is presented in Figure 6. It is composed of three layers, they are the web based project collaboration system layer, the information Management based on project process layer and the project information repository layer. The web based project management system provides all the usual functionalities, such as document management, user control, messaging service and collaboration service. It also has an interface for viewing project process maps, navigating project process. It is front-end the process management tool to guide the users to manage the project process and project information. The Information Management layer includes project process information created in Process Map creation tool. It is a mechanism to archive the project information according to the project process. It provides data management facilities for the project information repository. The project information repository is a database system to hold the information of the project, including the document, drawings, program information, cost data, etc.

CONCLUSIONS

IT has become one of the crucial factors to the success of business and there is no exception in the construction industry. With the industrial interest of the Process Protocol project, the Process Protocol Toolkit aims to provide an IT solution to manage the project information throughout the product development process based on the Process Protocol framework. However, the current solution only focuses on the project document rather than the information within the document, also other IT systems like CAD system, 3D modeling, cost estimate, project planning system which are widely used by the industry, have not been

incorporated into the Process Protocol framework. The ultimate objective is to bring all type of IT and lean systems such as Last planner, together working along with the Process Protocol framework sharing information between each other. Technologies, such as XML, to achieve such objective are available now. Further research has been committed to develop a true integrated system to improve the business of the construction industry.

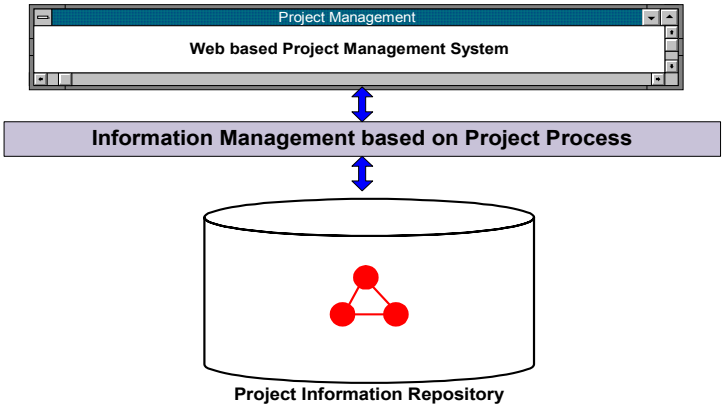

Figure 6: Process Management Tool System Architecture

An improved Product Development Process is one that integrates existing systems, retains integrity whilst being flexible enough to allow innovation, and enables the management and implementation of the PDP process.

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