POPIM: Pragmatic Online Project Information Management for Collaborative Product Development

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Abstract

POPIM (Pragmatic Online Project Information Management) is a prototype web-based platform for managing collaborative product development projects within an extended enterprise environment. A suite of facilities are provided for geographically dispersed project team members to communicate, share, and collaborate on a project in a common workspace where they enjoy online access to the most up to date project information and maintain a high-level data consistency and accumulate experience and knowledgebase. In addition to standard project management functionality such as defining work structure breakdowns, determining work schedules, teaming up with specialists, and allocating resources, POPIM incorporates workflow management (including dependency management), and deliverable management (document management if documents are considered as one kind of deliverables). Individual members have their personalized accounts according to their skills and roles/responsibilities in a project. A project team and its members may maintain their own journals/records. More application-specific functions such as product design review and engineering change management can be implicitly performed through online document forms.

1. Introduction

Collaborative Product Development (CPD) has been an area for intensive research for two decades. Among the many success factors are the teamwork, better communication, better project management, better information sharing and consistency.

One direction has been to develop methodical techniques or tools that reinforce these success factors. Quality Function Deployment (QFD), Failure Mode and Effect Analysis (FMEA), and Design for X (DFX) are just three examples. The other direction is to computerize these methods or techniques to enable better application of the methods or techniques in practice. As a result, majority of these methods are computerized.

Paradoxically, significant inconsistency exists between these two directions. Let us consider the example of evaluating concepts in early product definition. On the one hand, methods such as QFD, FMEA, DFX, etc have the tenet of nurturing teamwork as well as requiring teamwork for their successful applications. On the other hand, however, their computerized systems have mostly been standalone. Standalone systems defeat their original tenet of teamwork because they do not allow simultaneous access from multiple users from geographically dispersed locations.

This research has been conceived based on the above observation. A web-based framework, called POPIM (Pragmatic Online Project Information Management), is under development to promote and facilitate the management of collaborative product development projects in the extended enterprise environment. The focus of this paper is not on how to develop web applications for formal methods and techniques to overcome the limitations of standalone systems. Instead, the emphasis is placed on how such web applications and their uses and results can be incorporated dynamically into both strategic and tactical management of product development projects.

This paper summarises the results of the initial investigation. Section 2 briefly reviews the related literature along three dimensions of project management, product data management and workflow management. Section 3 presents the overview of the POPIM methodology and framework. Section 4 demonstrates the POPIM facilities through an illustrative case study. Section 5 briefly summarises implementation issues. Some of the important insights learnt from the research are highlighted in the final section.

2. Literature Review

There have been enormous efforts in developing computerized systems for supporting the management of collaborative product development projects [2]. A large number of research and commercial systems have now appeared [3-7]. In the context of this research, three categories of systems are most relevant. They are

computer systems for project management, workflow management, and product data management.

Early computerised project management systems were mostly standalone while most of the commercial systems on the present market have adopted the client-server architecture. They have overcome many of the problems and difficulties faced with paper-based approach. However, the geographical barrier, especially at the international level, has not yet been adequately addressed. This leads many to investigate into web-enabled or web-based systems that are capable of resolving the time and space barriers. Some of the notable systems are as follows:

- SquareWorks is a web-based suite of tools for IT project development enables all team members to contribute more efficiently to planning projects, tracking defects, and resolving time-critical problems (http://www.squareworks.com/).
- Account4 is yet another web-based project management system for an enterprise to initiate, receive, evaluate, process, and assign current and forecasted project and activity requests.
- OnProject.com is a service provider where organizations and individuals can create their projects and maintain all the relevant information at the web site at a rental cost.

In addition to computerised project management systems, most PDM (Product Data Management) systems offer functionality related to project management, together with workflow management, and document (hard copy, electronic copy or online form) management. Product Data Management (PDM) is also widely known as Document/Drawing Management (DDM), Engineering Data Management (EDM), Enterprise Data Management (EDM), Product Information Management (PIM), and so on. More recently, the term Knowledge Management is used to cover wider scope.

The PDM technology is no longer new. It enjoyed rapid developments in the 1990s. There have appeared hundreds of research and commercial PDM systems in various forms for various industrial sectors. The functionality provided by these systems and the technology used for implementing these systems are similar to large extent. During this period of expansion, some companies have implemented PDM systems to accelerate product development cycles, improve time-to-market, improve quality and reduce costs. However, the majority of these implementations were in pilot tests which only recognized the great potentials but siginificantly limited the scope of functionality. Very few reports exist on companies that have fully implemented PDM systems.

However, previous investigations into various what can be called first-generation PDM systems [10] have identified a number of factors that limit the widespread use of the PDM technology in industries. Although the usefulness of PDM systems has been confirmed, their useability has been a major problem. The level of complexity of the comprehensive PDM functionality and system administration have almost eliminated the useability. Although PDM systems are supposed to enhance communications and information access between geographically dispersed locations to facilitate teamwork, the traditional client-server architecture used for implementing these systems fails to maximize such potentials. Systems such as SmarTeam are primarily not web based although some facilities are provided for web access. On the other hand, systems such as onProject.Com [5] are 100% web-based but their functionality and business model are limited.

After the period of expansion in the 1990s, the PDM developments seem to enter a perod of consolidation at the turn of this century. One of the most significant developments is the use of the web technology in implementing PDM systems. However, recent evidence in this direction is that only web-enabled approach has been demonstrated while 100% web-based approach has not yet been widely used by leading software developers.

Based on the above analysis, the following aspects must be adequately addressed before the technology can take grass-root in industrial practice:

- The balance of usability and usefulness must be achieved. A sophisticated system with poor usability will not be adopted without substantial investment in training and start-ups.
- The integration of facilities for project management, workflow management, data/knowledge management, and user skill management is essential. Product, process, and resource data are just treated as different types of information in the system.
- The system must be very easy to maintain and administer without specialist skills or knowledge.
- The system must be wide accessible from different locations and at different times by users with varying roles in the projects.

3. The *POPIM* Framework

This proposed project is mainly concerned with the development and implementation of a 100% web-based framework for managing product (both manufactured and service product) development projects among geographically dispersed team members. The main aim of the framework is to integrate functionality usually provided in separate systems such as project management, PDM (Product Data Management), and workflow management. Emphasis is placed upon the pragmatism

256

and usability of the system while the functionality is not compromised.

The project management methodology underlying the POPIM system follows what is generally available in the literature or practice [9] although some customization has been done. However, the discussion in this paper focuses on the web-based implementation of the method and its application in a product development project.

3.1. POPIM System Architecture

The prototype system called POPIM has been developed after our initial efforts. Figure 1 shows an overview of the POPIM system. The figure shows a typical 3-tiered model of the web-based application:

The right-hand part of Figure1 is the data services tier. It provides a device – independent interface to data storage devices way be physically distributed throughout the network. Repositories of all run data and configure data include data of works, users, resources, documents, and so on.

The middle part of Figure 1 is the business services tier. It is divided to two parts to implement business process. One is based on IIS (Internet Information Server) that is responsible for receiving input from the presentation tier, interacting with the data services to perform the business operations that the application was designed to automate, and sending the processed results to the presentation tier. Some components such as Work, Gantt chart, Teaming, Resourcing, Setting up deliverables, Online forum, are built on the web server. The other is a DCOM server that is responsible for providing a remote object named Workflow for

application client and controlling the information communication between various tiers.

The left-hand part of Figure 1 is the client tier that runs on the web browser with which the users connect to POPIM system. The client side of Workflow is embedded to web page.

All of these three tiers may be physically distributed among different machines at different locations.

3.2. Case Study

To simplify the discussion, a case study of using POPIM is presented to support collaborative product development. The case is taken from a textbook (Roozenburg and Eekels, 1998). A project was based on an assignment for the sales department of a major producer of shoe-care products, leather paint, and insoles. For keeping the market leader position, the company decided to develop a new product. A new shoe polish in combination with a new packaging is considered. The whole process of the project to design and develop a shoe polish packaging was summarized in the textbook. The project took almost 10 weeks to implement the plan. It consisted of 5 sub-works: Product planning; Clarification; Conceptual design; Embodiment design; Detail design.

This case study is borrowed here to demonstrate how the POPIM system can be used for defining and executing the project. The project team members are the primary users of the system. The project manager is a super-user who has the overall access authority while the other member users have the access authorities appropriate to their individual roles.
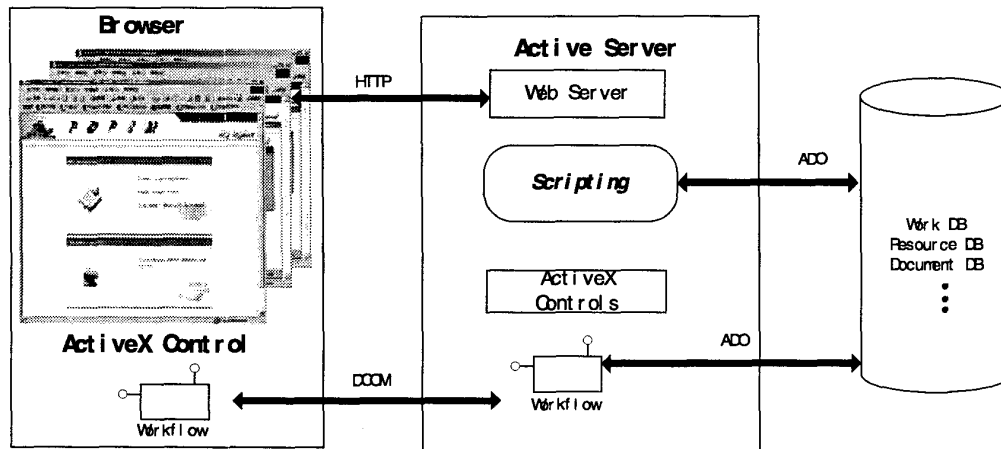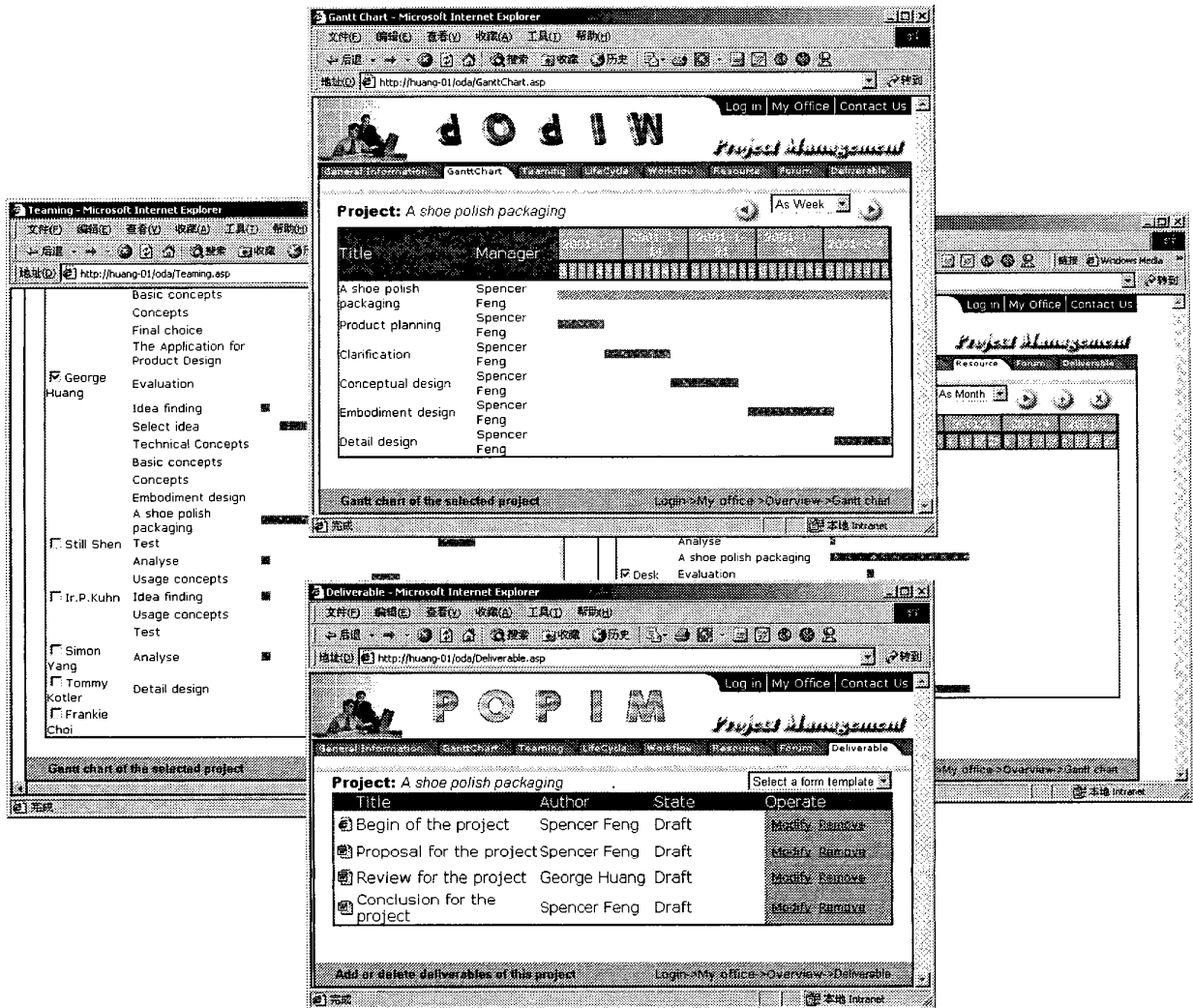

Figure 1. POPIM architecture.

257

Figure 2. Defining the project.

3.3. Procedure of Defining a Project

The POPIM system itself provides some facilities for managing the lifecycles of important objects including the projects and their works. For example, the lifecycles of a project include "proposal", "definition", "execution", and "completion". The following discussions will focus on the definition stage only, involving defining the work structure breakdown, determining the workflow (dependency), identifying the personnel, allocating resources, specifying deliverables, and finally presenting the project plan in the Gantt chart form.

3.3.1. Starting a New Project and Activities

A new project must be created in the POPIM at the beginning. This is a straightforward task, just the same as adding a new work to an existing project with the Project Explorer. Information needed at this stage is very general and more detailed to be determined later.

A new Product Development project usually includes a series of activities or work packages. In POPIM, projects, activities, and work packages share the same "work" data structure. Therefore, their definition is exactly the same.

The project definition is represented as a tree-like work breakdown structure. The user may choose one item to proceed into the next step of project definition.

3.3.2. Scheduling

Once the work breakdown structure of a project has been defined, it is the time to determine the start and due dates for the project and its works.

In the POPIM "work" data model, these dates are treated as properties of the data object, just like other descriptions. Therefore, the process of scheduling the start an end dates of the project works is an extension of the work definition. This time-related information is displayed in the Gantt chart.

3.3.3. Teaming up

Organizing a project team is an dynamic process. The membership of the project team may change from time to time depending on the nature and progress of the project works. Initially, a team must be established anyway. The following considerations must be taken:

- The requirement of the work
- The expertise of the candidate
- The availability of the candidate during the specified period.

POPIM provides some facilities for the project manager to carry out the above tasks. Firstly, the work requirements are matched onto the skills of the personnel in the database. A list of the candidates is produced for further consideration. The work requirements are defined in the template of the specific work while the human skills are described in their profiles.

Next, the candidate list is further reduced by considering the personnel availability. The project manager is able to look at the loading profiles of all the candidates and choose one eventually from the list.

3.3.4. Resourcing

The human resourcing aspect has been dealt with during the process of teaming up for the project. This step of resourcing is mainly concerned with allocating material and equipment resources to project works. Resources of a company are shared.

The process of allocating equipment resources to project works is basically the same as allocating human resources. Firstly, the equipment capabilities stored in the equipment profiles must be compared against the work requirements defined in the equipment profiles. Next, the loading or capacity of the matched equipment must be considered.

3.3.5. Setting up Deliverables

Deliverables are visible outcomes from project works. If all the deliverables are delivered satisfactorily, then the project work is considered completed successfully. Although most commercial project management computer systems do not support deliverable-based management, POPIM places heavy weight on this aspect.

When defining a project, POPIM allows the user to define deliverables for any items in the project work breakdown structure. The definition of work deliverables includes the name, the description, the author, and the format of a deliverable. Three kinds of format are provided in pop-down list. They are online form that a URL needed to be specified, Word document and Adobe Acrobat document. The last two kind of deliverable will be upload to database after the user submits it.

Project deliverables are often not documents. Instead, physical product prototypes, test rigs, etc. are some of the common forms of deliverables. However, POPIM only captures their descriptions in the form of document.

3.3.6. Putting Together in Gantt Chart

Gantt charts are commonly used to present project plans. Most of the project work definition information can be displayed concisely and systematically in this chart. Figure 2 shows one snapshot of the Gantt chart prepared in the case study. This chart can be used in the following steps of project execution and monitoring.

3.3.7. Online Forum

POPIM provides online Forum facilities as a multi-purpose project loggers/journals. Any comments or notes can be recorded in the POPIM database regarding a project or its works. Such notes can be private to the current user only, shared by the project team, or made public to all the users. While the private property is selected, only the user himself can read the article. Thus the Forum could be a personal logger. When the team sharing property is selected, only team members can read the article. Thus the Forum could be a team logger. When the public property is selected, all users can read the article.

4. Concluding Discussions

This paper has discussed how a web-based framework such as the prototype POPIM system can be used to manage collaborative product development projects within an extended enterprise environment. The framework provides a common workspace for geographically dispersed project team members to communicate, share, and collaborate on a project through online access to the most up to date project information so that a high-level data consistency can be maintained, and experience and insights can be accumulated to form the knowledgebase. In addition to standard project management functionality such as defining work structure breakdowns, determining work schedules, teaming up with specialists, and allocating resources, POPIM incorporates workflow management (including dependency management), and deliverable management

(document management if documents are considered as one kind of deliverables). Individual members have their personalized accounts according to their skills and roles/responsibilities in a project. A project team and its members may maintain their own journals/records. More application-specific functions such as product design review and engineering change management can be implicitly performed through online document forms.

Let us now return to the issue of gap between the methods and their computerized systems. The POPIM framework resolves ths issue by first of all incorporating the methods into web applications, and then relate these web applications to deliverables in project management. These deliverables are outcomes and results of the web applications, usually related to product, resource and process information usually managed in Product Data Management (PDM) systems.

The resulting framework has its balanced features, mostly reflected by the three keywords "Pragmatic", "Collaborative Design Management", and "World Wide Web". By "Pragmatic" it is meant that the methodology and system must be affordable and usable by the targeted users and for the intended functionality. By "Collaborative Design Management" it is meant that majority of the useful and usable functionality such as Project Management, Workflow Management, and Document (Project Deliverables) management provided in the traditional PDM systems have been integrated into one framework. By "World Wide Web" it is meant that this POPIM fully relies on the innovative use of the Internet and web technology. Our emphasis is on 100% web-based and low-cost, in contrast with other expensive and web-enabled systems on the market.

5. Acknowledgements

6. References

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