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An Overview of a Collaborative Project Management Approach and Supporting Software

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AN OVERVIEW OF A COLLABORATIVE PROJECT MANAGEMENT APPROACH AND SUPPORTING SOFTWARE

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Abstract

Project management (PM) is vital to the survival of many organizations. Traditional PM focuses on a single project at a single location (Evaristo and Fenema 1999) and is more concerned with project inputs and outputs than with project process (Turner 2000). The PM paradigm has begun to change due to the increasing number of distributed projects (Jonsson et al. 2001). Current and future PM will be more concerned with project process, explicit communication, and efficient and effective information sharing among contributors. High-levels of collaboration will become essential for distributed project success. This article provides the rationale for a collaborative PM approach, explains major components of such an approach, identifies corresponding functions that PM tools should support, and presents an analysis of some collaborative PM supporting software. The objective is to present a collaborative PM framework and identify future trends in product development and implementation that can serve to guide further research.

Keywords: Collaborative project management, explicit communication, explicit knowledge representation, project process management, collaborative project management software

Introduction

Project management (PM) is vital to the survival of many organizations. Ineffective PM can result in budget and schedule overruns, poor quality products, or even project termination. On the other hand, successful PM may shorten product or service time to market, save development resources, or increase product or service quality. All of these advantages may increase organizational survival opportunities and competitive advantages. The importance of PM is illustrated by the rapidly increasing membership of the Project Management Institute (PMI), rising numbers of project-related job opportunities, and a large, growing future market for PM software.

Project management in the past implied projects were conducted with a top down view. Project managers are usually information keepers and decision makers. Project members' participation in the PM process is very limited (Graham and Englund 1997). However, this style of PM only works in repeat product and process environments (Graham and Englund 1997). The assumption that projects are conducted within repeat product and process environments is no longer valid for most projects today, due to rapid technology advancement, business globalization, high personnel turn over, and distributed team membership (Evaristo and Fenema, 1999; Graham and Englund, 1997; Jonsson et al. 2001; Romano et al. 2002)

PM for simple and co-located projects may not be a major concern, however PM for complex and distributed projects can be a huge challenge. Distributed projects impose at least three major challenges for PM: collaboration (e.g. supporting high levels of communication, coordination, and interaction); knowledge management (e.g. representation and sharing of explicit knowledge);

and work processes (e.g. analyzing task interdependence and work flow). High-levels of collaboration will become essential for the success of distributed projects.

We argue that the new PM paradigm required adoption of a collaborative PM approach. In this paper, major components of a collaborative approach are identified, their implications for system features are discussed, and the criteria necessary for comparison of PM software are developed. We then present a sample comparison of some PM software to illustrate the current trend and possible future development. The rest of the article is organized into 5 sections: Section 2 briefly introduces project related concepts, a project typology, and their implication for PM. Section 3 discusses the PM paradigm change and its challenges. Section 4 proposes a collaborative PM approach and its implication for PM software. Section 5 analyzes some PM software and identifies areas for possible future improvements. Section 6 concludes with a discussion.

Projects and Project Management

This section discusses project related concepts, the importance of projects and PM, a project typology, and their implications for PM.

Projects

Different people define projects from different perspectives. Webster defines a "*project*" as a process:

> "*Project:…a temporary process composed of constantly changing collection of technicalities/operations involving the close coordination of heterogeneous resources to produce one or few units of a unique....The essential characteristic of the process by which a project is performed is the progressive elaboration of requirements/specification*." (Webster 1994: p. 22 – 8; Thomas 2000)

Lewis (2001) p.2 defines a project as a job with certain parameters. "*A project is a one-time job that has definite starting and ending points, clearly defined objectives, scope, and (usually) a budget*". One of the most well known definitions is given by the non-profit organization, Project Management Institute (PMI): "*[A] project is a temporary endeavor undertaken to create a unique product or service*" (PMI 1996:4, Engwall 1998).

Others have their own definitions of the term project and there is no agreement for the definition of a project. However, it seems that people agree that several features are common to projects: 1) a project has a time span, it is temporary with starting and ending point; 2) a project is to produce a product or service; 3) every project is unique given that it has a certain starting and ending point, even though some tasks or activities in projects may be repetitive (Engwall 1998). This article discusses projects that involve more than one person.

Project Management

Lewis (2001) p.5 defines PM as "*the planning, scheduling, and controlling of project activities to achieve performance, cost, and time objectives, for a given scope of work, while using resources efficiently and effectively*."

There may be other definitions of PM. However, it seems that the essence of PM is somewhat identical. 1) Management of a projects' inputs such as human, material, and financial resources; 2) Organization, planning, and control of the project process; 3) achievement of certain project objectives (e.g. performance, quality) within 4) certain constraints (e.g. time, budget, scope). The overall goal of PM is time and cost reduction and process and quality improvement (Maurer 1996).

Pervasiveness of Project in Organizations

This section explains why projects exist and why they are important in organizations. Projects exist mainly for two reasons: projects are solutions to many business problems and projects are the strategy for business survival and competitive advantage. Soderlund (2000) p.64 asserts that the project is a response to business problems when he summarizes the projects nature specified

by Goodman and Goodman (1976). According to Soderlund (2000) p.64, projects are "*responses to, among other things, problems concerning the activities, the task's uniqueness, the lack of standardized procedures and the temporary nature of the task*."

Organizations utilize projects to exploit opportunities to gain competitive advantages. Business pressures also create an increased need for projects, such as the need for innovative products due to shortening project life cycles (Lundin 1998), and the need for product customization because of the market for personalized products (Graham and Englund 1997) p 17. Projects are also a convenient mechanism to engage all the personnel with necessary expertise to achieve a common goal.

The pervasiveness of projects makes the project an important business constituent (Lundin and Hartman 2000). In fact, researchers, managers, and consultants have begun to discuss "*project-based*" rather than department-based organizations, and some tend to think that project-based organizations may be a trend in the near future (Soderlund 2000). In some articles, the terms "project", "temporary organizing", and "temporary organization" are used interchangeably (e.g. Soderlund 2000). Whittington et al. (1999) discuss the rationale for project-based organizations and the increased use of projects in Europe. They found, in a survey of 450 large and medium sized European companies, that project-based organization had increased by 175% between 1992 and 1996 and that the trend seems to be continuing (Whittington, Pettigrew et al. 1999; Soderlund 2000). Furtherfore, Soderlund (2000) p. 61 analyzed the work by Hobday (1999) and Weick (1996) and concluded that "*the studies of projects and temporary organizations provide more fruitful avenues in order to increase the knowledge of the processes and structures of organizing in the new economy*."

The trend toward an increased number of project-related jobs in North America in recent years has also received support. Direct data on project prevalence is not available, so researchers have employed indirect measures. Eriksson (1997) studied seven different indicators ranging from the number of papers presented at professional conferences over the years to the frequency of newspaper advertisements about project related jobs. All seven indicators demonstrated that project prevalence is a rising trend. Another sign of the widespread project phenomena is the increasing membership of the non-profit professional organization PMI. The membership has doubled in the last few year (Lundin and Hartman 2000) and is now over 100,000.

PM is becoming increasingly important because of the widespread use of projects. Not all projects are alike, different types of project may require different PM approaches. The next section discusses a project typology.

Project Typology

A project typology may help explain substantial differences among different types of projects, and reveal requirements for effective PM for the various types.

Manual, Machine, and Mind Projects

Whittaker (2000) proposed three types of projects based on how the product or service is produced: Manual, Machine, and Mind. Good examples of manual projects are the Great Wall of China and the Egyptian Pyramids. These projects were carried out primarily through manual labor. Coordination for this type of project is straightforward. Manual project managers can easily tell whether a worker is working or whether he/she is working right by simply watching them work.

Machine projects are characterized by use of technology, technical personnel, and specialized skills. Manual projects may also involve using technology, however, technology usage is not the focus. Automobile production is a good example of a machine project. One feature of Machine projects that distinguished them from manual ones is higher task interdependence due to complexity and uncertainty. Coordination among members is more difficult, yet more important than in manual projects. Manual project managers can still monitor the process by watching project members work.

The third project type is Mind. Architectural design and software development are Mind projects. The project capital is "*mind*" instead of "*hand*". People use machines for this type of project, however the focus is on information and knowledge. One important feature is that the output is the result of thinking and may not be tangible. It is nearly impossible to decide whether the project process is correct or not by simply observing. Therefore, Mind projects require more explicit communication, timely information sharing of project process, and concerted collaboration among individuals for project success. Mind projects require a collaborative PM approach.

Co-located vs. Distributed Projects

Traditional projects are mainly co-located. Distributed projects refer to projects that are carried out at more than one site. If we classify Manual, Machine and Mind projects into either traditional or distributed projects, it may be more appropriate to classify Manual projects as single-site projects. Machine and Mind projects may be either traditional single-site projects or distributed projects.

There are both advantages and disadvantages associated with single-site and distributed projects. The most obvious advantage of single-site projects is the face-to-face (FTF) communication and direct coordination. The disadvantage is that a single-site project may not have the necessary resources or expertise to successfully complete the project, which is a main reason why distributed projects are employed. Distributed projects can use project resources and expertise from different organizations, or different locations of same organization. The project may be done in a more cost-effective way or in a shorter time by utilization of time zone differences. However, benefits of distributed projects come with an expense. The most obvious disadvantage is that FTF interaction will be greatly reduced or eliminated, coordination of project process among different sites are more important and yet more difficult to adequately execute. The next section discusses how the PM paradigm has been shifting in recent years towards the distributed end of the spectrum.

Project Management Paradigm Changes

Over the past decade, the project landscape has undergone a major change. Due to international mergers, market globalization, shortened time to market, and changing labor costs, more and more projects involve professionals from locations distributed geographically (Evaristo and Fenema 1999). Distributed projects are a new business phenomenon. Distributed projects are also called "*virtual*" projects. Some people use the terms "virtual project" and "virtual organization" interchangeably.

Distributed projects are different from single-site projects in several aspects: a) distributed projects lack FTF communication and have reduced communication frequency; b) cultural differences among different sites may create communication and coordination problems; c) advanced information technology and infrastructure are needed to support remote communication and cooperation (Fenema and Kumar 2000).

Distributed projects impose higher demands for more effective PM, which in turn call for more research and education into PM. The need to learn more about PM is illustrated by the trend towards standardization and certification within PM practice. This article proposes a collaborative PM approach for Machine or Mind projects that are conducted in the distributed mode in order to provide guidance to direct this future research into PM.

A Collaborative PM Approach

There are a variety of management functions that project managers need to accomplish. We group major PM functions into five components or types of support: Basic Project Support; Network View of PM Effort; Explicit Communication and Knowledge Representation; Project Process; and Project Meetings.

Basic Project Support

Basic project support is essential for managing all types of projects and includes activities such as scheduling, task analysis, resource, time and budget management, simple status tracking, and reporting. PM software at this level typically provides Gantt charts, calendaring; work-breakdown-structure, task dependencies, critical path analysis and a variety of charts, tables, and files for reporting.

Network View of PM Effort

Distributed PM changes the role of project managers and members. Project managers are more oriented to the role of coordinator rather than information keeper and disseminator. Distributed PM takes a flattened "*network view*" of a project (Whittaker 2000). Project members share project information, decision-making power, and responsibility for project processes and outcomes.

Information flow is in all directions. To support this network view of a PM effort, software needs to have an Internet-based interface to allow project contributors to access project information any time and any place. Information overload can be managed and information security can be enforced by role-based information access. Project members become responsible to document, update, edit, and store their task-related information in the system in real time, so that project status can be ascertained throughout the project lifecycle.

Explicit Communication and Knowledge Representation

Such support may not be necessary for simple, co-located project, but it is critical for complex, and/or distributed project success. One advantage of co-located PM is that it is easy for project members to develop a high level of awareness about project context and progress by informal discussions and FTF meetings. Misunderstandings of project information are easy to detect and correct. For example, people may use same term for different things, or they may use different terms for the same thing. If people are present at the same site they may consciously or subconsciously converge their understandings for a given term for different contexts. This is more difficult to achieve for distributed project members due to reduced frequency of communication, minimization or elimination of nonverbal cues, and time lags between communication events. A collaborative PM system must facilitate distributed project members with developing high levels of project awareness through explicit communication and knowledge representation. Phone calls and email may still be needed, however knowledge needs to be captured and stored permanently for easy and fast retrieval. The following four components may help distributed project members gain a better shared-understanding of project context.

1) Project dictionary. Where key terms, concepts, jargon, and methodology are defined and clarified.

2) Business Rules and Policies. Project members can explicitly specify project related rules and policies for all sites. For example, meetings notes should be taken for all meetings and should be available for all sites to review. Rules and policies allow project members to follow agreed upon standards for project activities and document these activities for later retrieval and use.

3) Project Context Information. Project members have to be familiar with project context to be productive in the long run. Project background, boundary, objectives, and available resources (e.g. time, budget, equipment, and personnel) need to be documented and shared with all project members initially and when and if they change during the project lifecycle.

4) Complete Capture. All other project related information that can be captured must to be captured, stored, kept up to date, shared, and available for later retrieval and use.

An electronic document repository or project repository is needed to support explicit communication. The document repository needs to be Internet-based to enable uploading, downloading, updating, searching, and browsing from any site. The project repository can be part of the PM software, or it can be a separate application. When it is a separate system, it may be referred to as an enterprise content management system or document management system.

Project Process

One problem with PM practice is that people often ignore process management, as a result, there is little written about how to manage the work process of a project (Turner 2000). If people only manage project inputs and outputs, the process remains a black box and project members don't know something has gone wrong until it may be too late to correct the problem without causing large amounts of rework or unanticipated costs and delays. Project process management is especially important for "*Mind*" projects that produce intangible deliverables. Collaborative PM efforts need to focus on project process tracking at a fine level of granularity to increase the project process visibility and thus increase the probability of project success.

Collaborative PM software needs to support work flow management, issues management, action items management, and provide a change notification mechanism, deadline alert, and electronic discussion forum or message board so that project contributors can post information for feedback. Workflow management concerns the core components of the project and may be conducted in repeated patterns for specific project types. Templates may be used for workflow management. Issues can be a broad term for problems emerging in the project process such as conflicts and risks. Project members need to discuss issues and make decisions about them. Action items are different from tasks and may not represent core project components, however they can prevent

project members from finishing certain tasks. Action items are likely to be one-time jobs. An issue can become an action item once project members decide the action to be taken to resolve the issue. Discussion forums provide threaded discussion in a formal or informal manner. Most often, it is electronic informal chat, similar to hallway or coffee break chat in a FTF situation.

Project Meeting Support

Meetings are an important aspect of PM; because projects involve teamwork, effective meeting is a critical factor for teamwork success: "*No skill is more critical to the overall success of a team than the ability of its members to conduct focused, effective meetings*" (Holpp 1999) p.109. For co-located projects most meetings are conducted in FTF mode. However, for distributed projects, most meetings may be conducted virtually through technology such as video-or audio-conferencing, or Group Support Systems (GSS). A collaborative PM approach should have a very effective distributed meeting mechanism in place. Different meeting mediums fit different meeting situations. Ideal meeting software would allow participants to engage both divergent thinking (e.g. brain storming) and convergent thinking (e.g. voting, sorting ideas, and build consensus) and to permanently document meeting content. Discussion forums and electronic message boards are not "true" meeting systems; because they only allow for information sharing and do not support more complex modes of interaction such as consensus building (organize ideas, voting on ideas, and sort ideas according their priority).

Summary of Major Components of Collaborative PM Approach

All of the above-mentioned collaborative PM components are summarized in table 1. We could not find any single PM system in the market that provides support for all these five key components. Most PM systems support only basic functions and information sharing via the Web or Internet. The other three components, explicit knowledge representation, project process management, and project meeting support are more complex and full support may require separate systems. Realization of explicit knowledge representation and communication may require that organizations use enterprise content management or document management systems. Project meeting support may require GSS. Section 5 identifies typical PM systems for each component.

A Sample Comparison of PM Supporting Software

PM Support Systems

There is not an existent well-acknowledged definition for a PM system. Our literature review and Web search indicated that the term PM system is used in both a broad sense and a narrow sense. Broadly speaking, any software that helps with the PM effort can be classified as PM software. This overly broad understanding may be problematic. For example, spreadsheet and word processing packages are used by some small business to conduct PM, however, we do not think they should be classified as PM systems. From a narrow perspective, only systems that facilitate management of time, cost, task analysis, resource allocation, and status tracking should be classified as PM systems.

Our understanding of PM system takes a somewhat narrow perspective and we define a PM system as a system that is designed to support the PM effort through at least some basic PM functions identified in this article and may support other more advanced PM functions. According to this definition, stand-alone document management systems and GSS would not be classified as PM software, since their primary purpose is not for PM, and they don't support basic PM functions. However, we include them here for comparison based on the fact that they are being used to facilitate PM. Three major types of software are included in the comparison: typical PM software, document management systems, and GSS. We use the term PM supporting software for all of them.

The objective of the comparison of PM supporting software is to illustrate: a) currently offered PM support systems; b) considerations for future software development; and c) research areas for further PM research. It is not to assess the quality of the PM systems. It is hope that the information gained from our framework of collaborative PM and software analysis will further PM research as well as PM practice.

Table 1. Five Major Components of Collaborative PM Approach

Components	***Descriptions***	***Functions***
Basic Support (stand alone or Internet-based)	scheduling task analysis task allocation resource management budget management status tracking reporting	calendaring / Gantt Chart Work-Breakdown-Structure task dependencies, PERT chart resource management budget management status tracking reporting
Network View of PM Effort (Internet-based)	project members share project information power of decision making responsibility of project processes & outcomes information flow is in all direction	project information sharing any time any place Web-based role-based info access
Explicit Comm. & Knowledge Representation (Internet-based)	develop high levels of project awareness project dictionary business rules & policies project context info all other project-related documents	electronic doc repository with functions of uploading/downloading updating searching browsing document version control
Process Management (Internet-based)	conduct project tracking and increase project process visibility	work flow management issues management action items management change notification electronic message board
Project Meeting Support (FTF: standalone distributed: Internet-based)	conduct project meeting in synchronous & asynchronous mode	divergent thinking (e.g. Brain storming) convergent thinking (e.g. voting, sorting) group writing

We conducted a Web search for PM support systems and found a variety of systems, some of which are stand-alone applications and others that are web- or Internet-based. Some were developed for a specific profession or industry, and others are more general. It is impossible for this article to provide a comprehensive list of all the PM support systems on the market rather we illustrate the current market trends and possible future directions. The selection criteria for PM systems is 1) systems are web or Internet-based (except MS Project), because this is required for distributed PM mode. 2) PM system homepage has clear PM function specifications.

Table 2 presents the product information, and Table 3 lists a PM feature comparison for all products.

Table 2. PM Product Information

Product Name	Organization Name	Software Type	Application/Industry
MS Project 2002	Microsoft.com	PM	General
Asta Powerproject	Astadev.com	PM	Construction
BPMS	Bpms.com	PM	General
4i eBusiness Platform	Documentum.com	Doc mgmt	General
DocuManagement Central	MatrixOne.com	Doc mgmt	General
Cognito	GroupSystems.com	Meeting	General
Xcolla	Axista.com	PM	General
Bizwall	Bizall.com	PM	General
Project Center	Bricsnet.com	PM	Construction
Critical Path Suites	Cpts.com	PM	General
Devcycle	Devcycle.com	PM	General
Defect Manager	Tierasoft.com	PM	Software
GigaPlan	Gigaplan.com	PM	General
ActiveProduct	Frametech.com	PM	General
EPM.Ensemble	Inventx.com	PM	Software

Table 3. PM Product Features Comparison

Product Name	Time mgmt	Task mgmt	Resource mgmt	Cost mgmt	Status tracking	Web-based	Process mgmt	Doc mgmt	Meeting support
MS Project 2002	x	X	x	x	x				
Asta Powerproject	x	X	x	x	x	x			
BPMS	x			x		x			
4i eBusiness Platform						x		x	
DocuManagement Central						x		x	
GroupSystems Cognito						x			x
Xcolla	x	X			x	x		x	
Bizwall		X			x	x	x	x	
Project Center	x	X				x	x	x	
Devcycle	x	X			x	x		x	
Critical Path Suites	x	X	x	x	x	x	x	x	
Defect Manager						x	x		
GigaPlan	x	X	x	x	x	x		x	
ActiveProduct	x	X			x	x	x	x	
EPM.Ensemble	x	X	x	x	x	x	x	x	

Summary of PM Supporting Software Features

Tables 2 and 3 illustrate that the market provides many different PM systems solutions. Based on our review of the systems we broadly classified them into several types: Stand-Alone Basic PM; Web-based Basic PM Support; Web-based Support for Document Management; Project Meeting Support; Project Process Support; and Web-based systems with advanced PM functions. Each type is discussed below.

Stand-Alone Basic PM Support

These are PM applications that provide basic PM support. MS Project 2002 is the most popular. It keeps track of project status, but does not support issue, action item, or workflow management.

Web-Based Basic PM Support

These are systems that support some or all basic PM functions and can be run over the Web or Inernet. Examples include Asta Powerproject and BPMS. The primary advantage of this type of system over stand-alone systems is that distributed project members can easily access project information. However, such information sharing is usually very limited.

Web-Based Support for Document Management

Systems that support only document management, such as 4i eBusiness Platform and DocuManagement Central. The primary purpose of this type of system is to provide full support of document management: uploading, downloading, editing, updating, browsing and searching documents; version control of documents; automatic document life cycle support: creating, editing, approving, archiving, and deleting. This type of software can be very helpful if the project is complex, distributed, or has a multi year span.

Project Meeting Support

These are GSSs that are designed to support generic complex group processes and electronic meetings. GroupSystems Cognito is an example. This type of software usually has sophisticated features to support distributed large group meetings, and can be personalized to support project meeting.

Project Process Support

Systems mainly support project process such as Defect Tracker.

It tracks software development defects in a daily basis. This type of software is usually developed for a specific profession or industry, with some workflow management features.

Web-Based Systems with Advanced PM Functions

The rest of software belong to this type. However, individual software has different focus of its PM support, some is more oriented for task and process support such as Project Center and Bizall. Others have more focus on basic functions and document management such as GigaPlan. Some PM software producers adopt a different approach, they provides a suite of tools to manage the project instead of a single unified tool. Critical Path Suites is such an example.

Discussion of PM Tool Features

PM systems are beginning to incorporate more advanced support functions. We define a collaborative PM system as web- or Internet-based system that supports at least time management, resource management, task management, cost management, process

management, and knowledge management (explicit communication & knowledge representation). The only feature excluded from our definition is meeting support, since it is a very distinctive facility and may warrant a separate system.

Our collaborative PM approach implies that project members select PM support systems that will adequately meet their needs. Selection of a PM support system is a strategic business decision based on several factors including project complexity, software cost, training and maintenance cost, and return-on-investment. A small co-located project conducted in a repeated manner may be managed using spreadsheet; while a multi-million dollar, multi-year project conducted in a distributed mode may need a web-based system to provide all PM effort.

The trend is toward web-based PM systems that provide all basic PM support and also include more advanced features. However, it seems unlikely that the PM systems will incorporate a full-fledged electronic meeting facility. Perhaps, the meeting system itself is a complex system that is hard to integrate with other systems.

Conclusion

During the past decade the PM paradigm has evolved as more and more organizations have been conducting projects in a distributed mode. We propose that a collaborative PM approach needs to be adopted in light of the new PM paradigm in order for organizations to successfully manage complex, distributed projects. This article explains the major components of our approach, and their implications for PM tools.

Our collaborative PM framework provides ample opportunities for PM researchers to study this new and evolving area of practice. Some example research questions are provided. How can Group Support Systems be customized and utilized to facilitate distributed project meetings? How can PM processes be streamlined and standardized to automate them through information technology? Does explicit communication and knowledge representation facilitate PM in general and distributed PM? To what extent can explicit communication and knowledge representation benefit a project? We believe that answers to these and similar questions will help project researchers and practitioners further PM research and improve PM practice.

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