

8-16-1996

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Recommended Citation

McGuire, Eugene G., "Coordination of Distributed Teams in Process Driven Systems Development" (1996). *AMCIS 1996 Proceedings*. 101.
<http://aisel.aisnet.org/amcis1996/101>

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Coordination of Distributed Teams in ProcessDriven Systems Development

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Introduction

Many organizations are establishing teambased, processdriven systems development environments to compete effectively in a rapidly changing world. These environments are characterized by flatter hierarchies that are based on layers of integrative, crossfunctional teams; working relationships governed by functional interdependencies rather than organizational boundaries; virtual work spaces; and flexible, reconfigurable information infrastructures made up of interconnected webs and matrices of information and integrated data bases. The new organizational architecture that grows to support this environment integrates teams with new information technologies such as groupware and the World Wide Web and includes work processes and practices, social relationships, and culture.

This paper examines the use of groupware systems such as Lotus Notes and the use of internal Web sites to support geographically distributed teams (and their customers) in modular, concurrent software development. In addition, this technology also supports the process focus of these teams as they comply with the level 2 and 3 key process area requirements of the Software Engineering Institutes's Capability Maturity Model (CMM).

The Networked Organization

Sproull and Kiesler (1991) defined the networked organization as "one in which people are connected to one another in diverse forums to exchange ideas and other resources". The importance of their definition is that it emphasizes the human aspects of an organization and not the technical infrastructure. By making people and information universally accessible resources, network and network-based applications like groupware and web pages form the foundation for new forms of work.

One of the primary impacts of computer networks on the team concept is that networks enable the formation of far larger and more diverse resource pools. Team composition in non-networked organizations is often limited by geographical proximity. Communication and coordination are key to team performance, and non-networked organizations offer limited tools for accomplishing these tasks when team members are geographically dispersed. This results in a limiting of team membership to resources that are physically co-located. With the aid of network-enabled tools such as groupware and the world wide web, however, organizations can reach beyond their immediate and physical limitations to maximize the capabilities of all available resources.

Networked organizations have the capability to go beyond the traditional team concept not only because they enable distributed teams to work together but also because they have the capability to provide team members with instant access to all project information that has been recorded by any member of the team. The universal access to all team members and all project information can foster a strong sense of community and promote greater team responsibility, accountability and cohesiveness as well as higher product quality.

Effects of Groupware and the World Wide Web on Work

As organizations strive to become more efficient, they are attempting to adopt flatter vertical organizational structures which can quickly react to the changing business environment. To accomplish this task, many organizations are exploring the use of groupware technologies. Groupware has its roots in three distinct but overlapping application areas: electronic messaging, information management, and workflow/process automation.

Groupware technology was developed to assist people collaborating in work that spanned time and geographic distances. Effective collaboration under these conditions needed automated tools that would support the organization of activities, creation of products, sharing of information, and tracking the progress of activities. Groupware technologies are designed to support planning, coordination and tracking, communication, knowledge and information sharing, discussion, document creation, and decision making. Groupware provides people with tools for configuring work teams, defining responsibilities, scheduling work, tracking progress and monitoring group interaction.

Internal web sites can offer much of the same functionality as groupware to project teams in organizations. Information can be managed and disseminated by and to all project members and links to related material can be provided to make the web site most productive and efficient. It is important to note that the introduction and use of these technologies has dramatic effects on the way work is structured and managed. A major focus of technology-enhanced change such as involves groupware and the web must be centered on self-directed teams and employee empowerment, both of which require a new leadership style.

Many aspects of the old leadership paradigm (Kezsbom, 1994) will have to be reevaluated. This includes assumptions such as:

- * The project manager is the technical expert, defines the job, and decides how it will be accomplished.
- * The organization is structured hierarchically.
- * Teams are formed only when needed.

Instead, elements of a new leadership paradigm are emerging which include:

- * Employees are considered experts, and possess unique knowledge and skills. They do not have to be tightly controlled by management and are empowered to take action.
- * Controls are set collectively. Team members, project managers and customers routinely and continually collaborate.
- * Employees participate in goal setting and defining how work should be accomplished.
- * Organizations are flatter and more flexible. Layers of managers are reduced and exist only if they add value to a product or process.
- * Change is seen as a normal process. Change management strategies become institutionalized.
- * Customers assume a larger role in monitoring and contributing to quality throughout the lifecycle of the project.

Distributed Project Coordination

Groupware systems and the internal home pages can be used to track all activities, processes, and schedules for the project and are intended to facilitate dissemination of development information so the development

team (and customers) can remain tightly coordinated despite being geographically apart. One organization which was studied as part of this research included the following information on their internal web site:

- * Directory Hierarchy for Software Development Information
- * Development Participants
- * Software Development Files
- * Software Development Processes
- * Software Development Tools
- * Document Outlines and Templates
- * Software Development Standards
- * Software Development Metrics
- * Project Progress and Schedule
- * Artifact Review Comments
- * Global Design and Implementation Decisions

Software Development Processes and procedures which are included in the above repository are for the overall development process, requirements traceability, common type definitions, configuration management, requirements change management, design review, code review, unit test, integration test, and acceptance test. These processes are specific to be in compliance with the CMM. Schedule and progress information for the project is enhanced through the inclusion of meetings minutes, monthly status reports and a project diary. In addition review comments are maintained on the system for all code and document reviews for each module and subsystem in the project. E-mail discussions between project team members and between the team and the customer are also maintained.

The overall result of this merging of teambased structures with anytime/anyplace technologies is that tightly coordinated, rapid cycletime software development can occur using a virtual, networked, boundaryless team. This team includes the off-site customer who has participated substantively and regularly with the full support of the project team.

Benefits of Electronic Coordination

The use of groupware and world wide web technologies has a number of potential advantages for the organization.

Team-based culture. Teams operating in a virtual, networked environment can become the primary organizational work unit. Project information can be updated in real-time and be accessible to everyone. Accountability of individuals as well as the entire team is more easily tracked. Team members are more easily cross-trained to develop multiple skills and fill in for each other. In addition, organizations are better able to reward team performance because of the visibility of the projects activities and progress.

Increased communication with customer. When the customer has access to the networked information the customer becomes a true member of the team and can participate not only at scheduled meetings but continually as the project progresses. The team is in direct and regular contact with the customer.

Customer-driven quality and performance. When the customer is directly and continually involved with up-to-date information as a member of the team, the team is better able to keep the customer satisfied in terms of quality and performance.

Flattened organizational hierarchy. When the teams are able to update, control and access all project information anytime and anyplace the need for layers of managerial supervision, control and coordination greatly diminishes. Responsibility and decision-making authority is placed within the team. As a result, tasks are in less danger of being fragmented and work that fails to add value is more easily eliminated.

Process Improvement Focus. The project information that is maintained on the system can be mapped to the key process areas of the Capability Maturity Model particularly if this mapping is designed into the structure of the system from the outset. The electronic project information provides an excellent source of historical data for the organization to utilize for future project planning.

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The full version of this paper may be obtained by contacting the author.