ELSEVIER

International Journal of Industrial Ergonomics 32 (2003) 251–264

International Journal of
Industrial
Ergonomics

www.elsevier.com/locate/ergon

Listening to users in a manufacturing organization: a context-based approach to the development of a computer-supported collaborative work system

Melroy E. D'Souza[a], Joel S. Greenstein[b,*]

[a] *Windows Server Systems User Experience Group, Microsoft Corporation, One Microsoft Way, Redmond, WA 98052, USA*
[b] *Department of Industrial Engineering, Clemson University, 110 Freeman Hall, Clemson, SC 29634-0920, USA*

Received 13 August 2002; received in revised form 11 November 2002; accepted 2 April 2003

Abstract

This paper reports the findings of a field research effort to develop a computer-supported collaborative work (CSCW) system in a power tool organization and provides an overview of the features of this system. It presents the customer-driven, context-based methodology that was used to capture the workflow and the critical issues that must be addressed by the CSCW system. It also describes the evaluation techniques and performance measures that were used to compare the resulting system with the existing product development system in the organization. It was found that a combination of ethnographic and human-centered design methodologies is a powerful approach for capturing information about stakeholder needs and using it to develop a CSCW system in such organizations. Through evaluative ethnography it was possible to determine tasks that were feasible and others that were inappropriate for integration into the CSCW system. This methodology also identified issues that hindered the adoption of the CSCW system, permitting strategies for adoption to be proposed that might serve as guidelines to designers of future CSCW systems. Lastly, this development, implementation, and evaluation of a CSCW system in an industrial environment demonstrate its effectiveness to other similar organizations that could benefit from the use of CSCW systems.

Relevance to industry

This paper describes the development of a computer-supported collaborative work (CSCW) system in an actual manufacturing organization using a human-centered, context-based design methodology. The evaluation of the resulting CSCW system demonstrates the effectiveness of the methodology employed, as well as the potential CSCW systems have to address the needs of product development organizations.

Keywords: Computer-supported collaborative work; Groupware; Human-centered design; Contextual design; Cross-functional product development teams

1. Introduction

Current trends in product development are characterized by a rapid evolution of product

*Corresponding author.
E-mail address: joel.greenstein@ces.clemson.edu (J.S. Greenstein).

0169-8141/03/$ - see front matter
doi:10.1016/S0169-8141(03)00066-0

and process technology, coupled with greater access to information technology. Not only must the product design meet customer requirements, but it should also result in a product that can be cost-effectively manufactured within the organization's processes. Manufacturing organizations must increasingly cope with leaner cost structures, shorter product life cycles, product diversification, minimal inventories and buffer stocks, extremely short lead times, shrinking batch sizes, and concurrent processing of multiple products and orders (Schmidt, 1991; Bernstein, 2000; Reed, 2001).

1.1. Improving internal collaboration

In the mid-1990s many organizations adopted a concurrent engineering approach to reduce design cycle time and improve product value (Duffy et al., 1995). Concurrent engineering is based on the integrated design of products and their manufacturing and support processes. This approach, however, introduces new difficulties. First, not all team members can attend all product development meetings due to "time–place" constraints. This may lead to information bottlenecks, which result in increased design time, production delays, and extra costs (Forsythe and Ashby, 1996). Second, non-team members may feel neglected and excluded from the product development process, making it difficult to obtain valuable information from them. Further, most engineering change control systems are paper-intensive, bureaucratic, complex, and slow (Erhorn and Stark, 1994). This can result in processing durations of days or weeks, even though the actual processing time might be only a few minutes or hours. Information must be available to users when they need it or valuable time is lost. These problems are further exacerbated today by the globalization of manufacturing and the physical dispersion of product teams. A more cooperative effort involving faster and more simultaneous processing of information is required. There is a need for enterprise-wide electronic archives that are readily and efficiently accessed by all functional areas throughout the product development project.

A recent survey of mid-sized manufacturing companies in North America ("Survey reveals manufacturers' challenges," 2000) found that for 60%, improving productivity on the plant floor was the most important issue facing them and 33% of those companies planned to invest in new technologies to accomplish improved workflow customization. Although information technology has impacted many areas of business organizations, the areas of manufacturing and product development have lagged behind other areas, such as human resources and sales and marketing, in adopting networked systems, such as intranets (Lai, 2001). However, this is starting to change, and some instances of computer-supported collaborative work (CSCW) are now being used in manufacturing applications. For example, Reed (2001) discusses the use of electronic work instructions to provide plant floor operators the information they need to do their jobs, where and when they need it, and states that this can lead to increased productivity and effectiveness, as well as alignment of plant floor activities and corporate strategy.

1.2. CSCW: background

CSCW examines how people work together in groups and how "groupware" technologies can support collaboration (Ishii et al., 1994). "Groupware" is a label for computer-based systems explicitly designed to support people working together. Examples of groupware include e-mail, electronic bulletin boards, group scheduling systems, group decision support systems, collaborative authoring tools, and screen sharing software. Designing tools for collaborative work systems is a challenge, because our understanding of these systems is still fairly limited, and even less so in a manufacturing environment, as most of the literature addresses the application of groupware to other domain areas. Further, most reports either describe the features of a CSCW system or discuss the theories associated with CSCW and groupware (for example, see Olson et al., 1993; Berg, 1998; Ackerman, 2000; Bernstein, 2000). Few studies, such as those by Kensing et al. (1998), and Symon (1998), present the methods used to