Empirical Investigation of Sociotechnical Issues in Engineering Design

by
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ABSTRACT

To compete in today's global economy, organizations are under pressure to improve their product development processes. The engineering design process is an important component of the overall product development process. This research considers the relationship of both social and technical variables to the engineering design process. The theoretical foundation of this research is sociotechnical systems theory. This theory states that optimum performance is achieved by jointly considering the technical and the social subsystems. The application domain of the theory is called macroergonomics.

A technical variable considered by this research was engineering design process methodology. Two methodologies were considered: sequential engineering and concurrent engineering. Another technical construct considered by this research was the use of computer-supported cooperative work technology (CSCW) or groupware.

The social variable considered by this research was group size. Two sizes were considered: large groups of six people and small groups of three people. This research sought to determine the optimum combination of technical and social variables that would result in highest performance.

There were two phases of this research. In the first phase, a laboratory experiment was conducted using 180 engineering and building construction students as subjects. The experiment required that a system be conceived, designed, manufactured, and tested by student teams. The experimental design was a 2 x 2 x 2 factorial, between subjects design with five teams in each cell. In the second phase, the results of the first phase were provided to recognized industry and academic experts for their critique. This two-phased approach facilitated the identification of causal relationships among social and technical variables with higher external validity.

In the laboratory experiment, there was no significant difference in performance between concurrent engineering groups and sequential engineering processes. Small groups significantly outperformed large groups in all conditions. CSCW did not significantly improve the performance of large or small groups. Participants in the experiment were equally satisfied with all conditions. The external survey strongly endorsed the superiority of concurrent engineering as compared to sequential engineering.

There was no statistically significant optimal combination of variables that resulted in the highest design performance.

Dedication

This work is dedicated to my wife Susan
for her contribution and patience.

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Any endeavor of this magnitude requires the council, patience, and tolerance of others. I am indebted to Dr. Paul Torgersen, who didn't laugh when I asked if I might pursue a doctoral degree. Rather, he encouraged me and was supportive at every step of the way and served on my committee.

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Table of Contents

List of Tables

List of Figures