

Empirical Investigation of Sociotechnical Issues in Engineering Design

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Dissertation submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
in
Industrial and Systems Engineering

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March 31, 1997

Blacksburg, Virginia

Sociotechnical Systems, Macroergonomics, Engineering Design, Teams

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.

Acknowledgments

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.

Dr. Brian Kleiner, chairman, friend, accepted the challenge of mentoring a non-traditional student through the process. I respect him. I am also grateful that he knew when to treat me as an adult and when to treat me as a student.

My other committee members also provided encouragement and guidance. I would still be looking for participants if Dr. Yvan Beliveau had not agreed to make his building construction students available to my experiment. Dr. Harold Kurstedt is one of the best teachers I've ever had in the classroom. I thoroughly enjoyed listening and learning from his lessons from his experience. Dr. Pat Koelling's positive attitude and perspective on the research process was invaluable.

My family tolerated my unavailability and helped in numerous ways. My wife, Susan, learned how to do a SYMLOG analysis and then watched over 100 hours of videotape. She never complained and did a superb job. My daughters Andi, Kathy, and Sarah, helped conceive the experiment, participated in alpha testing, helped with participant recruiting, and edited some of the material.

The staff of the Corporate Research Center, especially Mr. Rodd Hall, Dr. Paul Fleming, and Ms. Linda Cridlin, also supported me in my absences, provided computer consulting when needed, and did their usual outstanding job of running the park.

I am also appreciative of Dr. Jeanne Gleason of New Mexico State University for providing a hundred videotapes for my use.

I also wish to thank Dr. Ann Echols for her help with statistics and statistics software.

My classmates who ran the laboratory were outstanding. Shane McLaughlin, Sam Thepvongs, and Arnolde Cano kept the equipment and software running and were willing to drop what they were doing to come to the lab on a moments notice to fix whatever was broken.

Thanks are also due to Dr. Marla Hacker who set the pace and figured out the process.

I also want to acknowledge the last team that participated in my experiment. They braved snow and ice just because they knew that getting the last data were important to me. I appreciated their sacrifice.

Finally, I would like to acknowledge my parents who always taught me that you can do anything that you want to.

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