

**WIP: Team Satisfaction: A Assessment of
Events Defining Team Satisfaction in Engineering Design**

**Robert Knecht
Design (EPICS)
Colorado School of Mines
Golden, CO 80401
303-273-3592
rknecht@mines.edu**

Context

The balance between task (product oriented) and networking (team oriented) functions plays a key role in effective decision making (Eberhardt, 1987 and Jones, 1999). Deliverables from most engineering exercises, however, measure team performance in terms of quality of the product. This study addresses factors that measure team performance in terms of team satisfaction.

Improving individual skills, developing effective working relationships, and completing projects govern students' attitudes towards team experiences (Levi, Rinzel, Cadiz, and Cacapit, 1998). Team members express satisfaction if the team successfully completes the project (Hare, Blumberg, Davies, and Kent, 1994). Team satisfaction comes from team members' perceptions (Hanna and Wilson, 1991):

- a. Concerning freedom to participate on the team (expectations)
- b. Concerning team progress toward goals (task functions)
- c. Concerning a sense of belonging with the team (networking functions)
- d. Concerning the leader(s) on the team (leadership)

These parameters set the stage for analyzing the impact on team satisfaction.

This study is a component of the research agenda emphasizing team dynamics in engineering design promoted by Design – Engineering Practices Introductory Course Sequence (EPICS) at the Colorado School of Mines. An engineering design course with a nationwide reputation for its quality, EPICS provides hands-on, classroom-controlled “experience” with sound engineering practices that incorporate creativity and inventiveness, technical thinking, decision-making, communication skills, and team dynamics. Students work in teams to formulate and to solve open-ended problems that are solicited from industry, community and government.

Research Questions

Findings from a study sponsored by the National Science Foundation (Knecht, Lasich, and Moskal, 2001) focused on identifying parameters impacting team satisfaction following completion of an engineering design project. Satisfaction with performance was related to perceived satisfaction with team interactions and leadership. These findings informed the staff about the importance not only of a quality product but also of team interactions. The research questions should equip the staff with evidence to inform students concerning functions that improve satisfaction with engineering teamwork.

The first question addresses personal satisfaction: *What are key factors in an engineering design experience that shape personal satisfaction?*

The second question focuses on perceived satisfaction: *What observations differ between personal and perceived satisfaction?*

The first question addresses personal satisfaction while the second question addresses satisfaction of the team. Since the survey represents the opinion of individual students, findings concerning the team are perceived satisfactions.

Theoretical Framework

Two sets of functions lead to optimal team operations in open-ended problem solving situations (Eberhardt, 1987). *Task functions*, critical to achieving product quality, focus on implementing tasks aimed at the overall team goal. *Networking functions*, critical to achieving team satisfaction, focus on the communications network aimed at a team-centered approach to solving problems. Application of these functions is rooted in research first conducted through the National Training Laboratory (NTL) in Group Development in 1947 (Benne and Sheats, 1948). The functions, however, have been recognized as critical aspects of teamwork (Bales and Strodtbeck, 1951, Bennis and Shepard, 1956, Tuckman, 1965, and Fisher, 1970).

Authors (Applbaum, 1992 and Jones & Bearley, 1994) differ in their views about phases that teams go through during decision-making processes; they, however, agree that both sets of functions are necessary to successfully complete a project. Synthesis of both sets of functions has been recognized as important for successful problem solving (Jones, 1999). Eberhardt (1987) teaches observers to record behaviors they see during problem-solving discussions, and then provide feedback to team members.

Methodology

No matter what processes we assess, whether it is a chemical facility or an engineering design course, there are two major sets of parameters that determine performance:

- Input/output characteristics and
- Factors within the process that change performance

This model, represented schematically in Figure 1, depicts team interactions that occurred during



Figure 1: Interactive Relationships between Input and Output Factors in an Open-ended Problem Solving Situation

team resolution of an open-ended engineering design project. A similar model can be a useful framework for studying issues related to teamwork (Stewart, Manz, and Sims, 1999). This study, using an empirical method, examines personal and perceived satisfaction following the completion of an engineering design project.

The survey addresses two aspects of satisfaction for team members: 1) satisfaction with self (personal satisfaction) and 2) satisfaction of team members (perceived satisfaction).

PROCESS QUESTIONS
1. How well does the planning and organizing prepare the team to accomplish its tasks?
2. How well does the team define and solve the problems it faces?
3. How well does the team meet the goals and objectives it establishes?
PERSONAL SATISFACTION
4. How satisfied are you with yourself on the project?
5. How satisfied are you with the people with whom you work?
6. How satisfied are you with how the project is managed?
7. How satisfied are you with the way the team is led?
8. How satisfied are you with your team's performance?
PERCEIVED SATISFACTION
9. How satisfied are team members with the team's performance?
10. How satisfied are team members with the direction the team is headed?
11. How satisfied are team members with the interactions within the team?
12. How satisfied are team members with the way work gets done?
13. How satisfied are team members with the way the team is lead?

Students participating in the study consist of first-year engineering students and represented approximately 5.5 percent of the class. 235 students representing 52 teams were surveyed over a five-year period. The Registrar enrolls these students creating a random sample. The population contained 24.7 percent women representative of the average number of women enrolling over the five-year period. The same faculty member mentored teams, eliminating mentor factors from the study. The study group, therefore, adequately represents first-year students enrolled in the engineering design program at the institution.

Findings and Conclusions

Students' attitudes coming into a project influence how the team approaches the problem and how it defines functions that play a role in the team's perception of performance. Students' observations at the end of the project reflect their satisfaction with the process(es) and identify changes to improve the process(es).

Students expressed a high level of satisfaction, except for personal satisfaction with self and perceived satisfaction with the direction of the team. High values were measured for the team's ability to define and solve (leadership) and to plan and organize (management). Satisfaction with the leadership relates to personal satisfaction with performance and with perceived satisfaction with interactions, replicating observations from the NSF study. Satisfaction with management relates to perceived satisfaction with leadership.

Productive teams tended to be satisfied with self and less satisfied with management. A second category of teams was personally satisfied with the leadership, but perceive the team was not as satisfied. In the other areas, these teams had higher perceptions of satisfactions than personal satisfaction. The third category of teams was satisfied with performance but not leadership, management or interactions. These teams were satisfied with product but not as satisfied with self and networking.

Addressing the first question, personal satisfaction comes from a perceived satisfaction with team direction, which translates into satisfaction with both management and leadership. Team members identified management as an important attribute for leadership. Satisfaction with leadership (ability to define and to solve and to interact) is a function of how well the project was managed (ability to plan and to organize, how work gets done, and performance). To illustrate this trend, a strong correlation evolved, illustrated in Figure 2, in which perceived satisfaction with the lead increased as satisfaction with how well the project was managed. Leadership represents networking and vision, whereas management represents tasking and action.

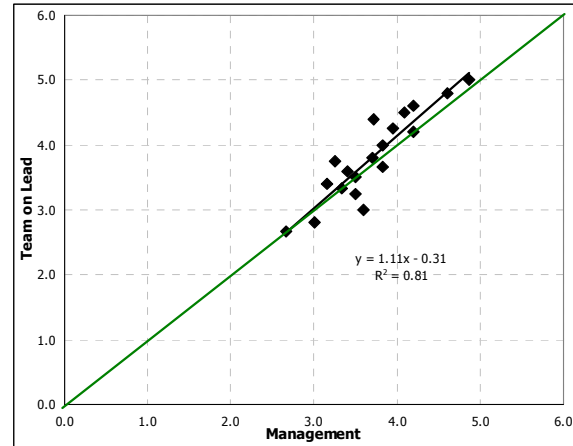


Figure 2: Perceived Satisfaction with the Lead and Personal Satisfaction with Management

Assessing the second question, management (plan and organize) evolves from the ability to lead (define and solve problems). Management further relates to perceived satisfaction with performance. Performance relates to the perceived satisfaction with interactions. Interactions as well as perceived satisfaction with how work gets done ultimate fall back to the perceived satisfaction with the lead. In summary, team perception of the direction the team was headed relates back to the perception of leadership.

A balance evolves between leadership and management in order to successfully complete the project. Leadership is a function of the team’s ability to define and to solve problems and team performance. Satisfaction (both actual and perceived) with leadership relates to performance and interactions within the team. Management is a function of the ability to plan and to organize or how work gets done. Satisfaction with its ability to plan and organize relates to the lead and team performance. Therefore, we observe a balance between leadership and management of the project through performance or ability to produce a quality product as integral to team satisfaction.

Recommendations

This work, a work in progress, initiated the study of satisfaction as part of the research agenda defining teamwork in engineering design. The assessment identified a balance between leadership and management as key for determining team satisfaction during the engineering design process. Knowledge about the roles of task and networking functions contributed to our understanding of both leadership and management. They inform the staff concerning scheduling and contract activities to improve the focus on teamwork.

Future analysis should take a more detailed look at the other events that influence satisfaction. Satisfaction with performance, with interactions and with how work gets done may strengthen the observations concerning the relationships between leadership and management.

Future analysis should also examine relationships and correlations between parameters. The purpose should emphasize trends that define team satisfactions. Ultimately, the findings should suggest metrics to inform curriculum reform to include mentoring teamwork applicable to engineering design projects.

References Cited

- Applbaum, R.L. (1992). *Structure in group decision making*. Small Group Communication: A Reader. Edited by R. S. Cathcart and L.A. Samovar, 6th edition, Wm. C. Publishers, Dubuque, IA.
- Bales, R.F. and Strodtbeck, F.L. (1951, 485-495). *Phases in-group problem solving*. *Journal of Abnormal and Social Psychology*, 46.
- Benne K. and Sheets, P. (1948). *Functional roles of group members*. *The Journal of Social Issues*, 4(2).
- Bennis, W.G. and Shepard, H.A. (1956. 415-437). *A theory of group development*. Human Relations, 9.
- Eberhardt, L.Y. (1987). Working with Women's Groups. Vol. 1, Whole Person Association Inc, Duluth, Minnesota.
- Fisher, B.A. (1970, 53-66). *Decision Emergence: Phases in Group Decision Making*. *Speech Monographs*, 37.
- Hanna, M. and Wilson, G. (1991). Communicating in Business and Professional Settings. McGraw-Hill, New York, New York.
- Hare, A.P., Blumberg, H.H., Davies, M. F., and Kent, M.V. (1994). Small Group Research: A Handbook, Ablex Publishing Corp, Norwood, New Jersey.
- Jones, J.E. (1999). *Productive and Counter Productive Role Behaviors of Team Members*. Organizational Universe Systems, Valley Center, California.
- Jones, J. E. and Barley, W.L. (1994). *Group Development Assessment*, HRDQ.
- Knecht, R., Moskal, B., Lasich, D. and Scott, S. (2001). "*Gender Composition and Engineering Team Process*" *A Refinement of Focus and Strategy Based on Research and Goals*. Report for NSF Grant HRD-0080669.
- Levi, D., Rinzal, L., Cadiz, D., and Cacapit, M. (1998). *Effects of education and team projects on student attitudes toward team work*. ERIC: ED421072.
- Stewart, G.L., Manz, C.C., and Sims, H.P. (1999). Team Work and Group Dynamics, John Wiley and Sons, Inc., New Your, New York.
- Tuckman, B.W. (1965, 384-399). *Developmental sequence in small groups*. *Psychological Bulletin*, 64.