

An Investigation of the Attributes Contributing to Team Effectiveness of Engineering and Science Faculty

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Abstract - *This study examined the effectiveness of engineering and science faculty when working in teams. Engineering and science faculty members participating in the Foundation Coalition, a National Science Foundation educational reform initiative, were surveyed regarding their attitudes toward teamwork. In addition to examining faculty members' attitudes, this study sought to identify the strengths and weaknesses of faculty work teams, to prioritize parameters affecting team effectiveness and to determine if there is a difference in perceived team success based on team functionality or concentration.*

Introduction

Teams in the work place are not new. Formally or informally they have existed for hundreds of years [2]. Gustafson and Kleiner [8] argue that teams have been around as long as man and are not a new phenomenon.

As organizations in the United States search for ways to improve their overall effectiveness, no topic has garnered more discussion as an option than that of teams. The results from the use of teams are numerous. Teams are often recognized as an effective way to manage change, improve overall effectiveness, reduce costs, increase productivity and increase employee satisfaction. Teams have been key organizational elements in the design and execution of strategic management initiatives [4].

Although teams have been around for years, their usage has occurred primarily in manufacturing organizations. The 1997 Industry Report, Workplace Trends Section [1], reports that in addition to manufacturing organizations, the following types of organizations are using some type of teams: transportation, wholesale, finance, health services, educational services and public administration.

The report specifically shows that 41% of educational services are transitioning to a team-based structure. As the new millennium approaches, this trend will continue to increase. Unfortunately, many educational service organizations are not equipped to fully embrace teams and teamwork.

The emergence of teams in the academy is expected to cause an increase in the administrative responsibility of faculty, redistribution in the power and authority of faculty members and a reprioritization of workload and philosophy about teams.

The culture of higher education and the background of engineers and scientists further suggest that teams comprised of these individuals will not perform well and may not be well received in the academy.

The Faculty Culture in Higher Education

The faculty culture is strongly individualistic [13] and unfortunately the reward system was not designed with teams in mind and yet more and more institutions of higher learning are encouraging faculty to collaborate.

Faculty should not bear the blame for the individualistic mindset and the difficulty they may experience when functioning as a team. The nature of higher education is to place emphasis on the accomplishments of the isolated individual rather than on team effort [12].

Individuals not teams dominate the cornerstones, research and teaching, of the faculty culture. When faculty members collaborate it is usually in pairs or threesomes, but rarely in teams. The closest faculty come to teamwork is serving on committees, such as curriculum, search and promotion. Much of the time, committee members try to persuade each other of the correctness of their own views, not to obtain synthesis.

In addition to the individualistic nature of the faculty culture, the personality traits of engineers and scientists suggest these types of individuals will experience difficulty working on teams. The personality traits that characterize a majority of engineers and scientists can also interfere with their ability to be effective contributors to a successful team venture [15]. Shannon [14] characterizes scientists and engineers as people who:

- Are highly individualistic.
- Desire challenging work.
- Are self-directing.
- Seek approval from peers.
- Desire to share their knowledge.

These traits play a major role in the rejection of teamwork amongst faculty members. Faculty members reject teamwork because they are asked to function in a role that is typically foreign to them. Although faculty teams seem destined for trouble, a number of institutions are implementing a variety of faculty work teams.

Under the auspices of continuous improvement, continuous process improvement, continuous quality improvement, administrators and faculty in the higher education setting have tried to implement aspects of total quality management. In a 1994 survey, a number of engineering deans felt that total quality was very important for teaching and research as well as for university administration, but they also felt that their own faculty were much less convinced [13]. The concept of teamwork is a difficult concept for faculty to embrace. Unfortunately, teamwork is a fundamental element of total quality [7].

The primary reason that faculty members resist teamwork has to do with the expectation of individuality in the academy. Even in fields like medicine, where journal articles have long lists of co-authors, faculty research and teaching is dominated by individuals, not teams [13].

Resistance to teamwork among faculty members is unfortunate as the use of teams has been credited with improving communication and employee morale, better organizational adaptability and flexibility, increased productivity, improved quality, enhanced employee quality of work life, and reduced conflict.

The incentive to try major teaching innovations is relatively weak. Faculty members are thought to be too independent, too powerful and too stubborn to heed directions from the top. Universities are not hierarchical and faculty can be expected to respond negatively (at times, violently) to edicts from above. The tenure system flattens the organizational pyramid and empowers the faculty to “just say no.”

In cases where faculty have agreed to give teams a try, it is imperative to measure the overall effectiveness of the team and to capture the faculty members sentiments about the experience.

Team Effectiveness

Team effectiveness is a measure that embodies performance, attitudes of team members and behavior outcomes [5], [9]. Examples of performance include productivity, efficiency, cost, and quality. Examples of attitudes of team members include trust, commitment and satisfaction. Examples of behavior outcomes include absenteeism and turnover. Cohen and Bailey [5] propose that effectiveness is a function of environmental factors, design factors, group processes and psychosocial traits. Each of these functions impacts the others and overall effectiveness.

Hackman [10], a leading authority on team and group effectiveness, presents a model of team effectiveness that conceptualizes the impact of organizational context on teams in terms of three main influences: (1) the design of team and its task, (2) the transfer of information, resources and rewards to the team, and (3) the existence of process assistance that can be provided to facilitate the work of teams. These three factors define the contextual domain and incorporate it within

a general model of the effectiveness of work teams that also includes team processes and task outcomes [6].

For this study, team effectiveness will consider performance outcomes, attitudinal outcomes and behavioral outcomes. Performance outcomes, are outputs that meet the standards of quantity, quality and timeliness of those who use the product or receive the service. Attitudinal outcomes monitor the process of carrying out the work enhances the capability of members to work together interdependently in the future. Behavioral outcomes contribute to the growth and personal well being of team members.

The Study

Engineering and Science faculty participating in the Foundation Coalition were the participants for this study. Ten teams were studied from four of the Foundation Coalition institutions, as was the National Management Team. Table 1. summarizes the teams studied in this study.

Table 1.
Teams Surveyed

School Name	Team Name
Rose-Hulman Institute of Technology	Local Management
	IFYCSEM (Integrated First-Year Curriculum Science, Engineering, and Mathematics)
	Sophomore Team
	First Year Team
Texas A&M University	Freshman Team
	Sophomore Team
Texas A&M University, Kingsville	Freshman Team
	Sophomore Team
University of Alabama	Local Management
	Freshman Team
No Campus	National Management Team

A total of 120 surveys were distributed and 78 were completed and returned. This represents a 65% response rate. Of the 78 surveys completed only 74 were scored, resulting in a 61.7% response rate. The average number of respondents per team was 6.7. The average tenure of team members was 32.4 months or 2 years and 8.4 mos.

The gender distribution heavily favors men, 83.8% (N=62) vs. 6.7% (n=5) for women. The average age for all respondents was 45.5 years. Sixty-one (82.4%) of the respondents hold doctorate degrees, while three have masters', one was an undergraduate student and eight respondents did not indicate their educational background. Engineering

faculty account for 58.1% (n = 43) of the respondents and science faculty account for 35.1% (n=26) of the respondents.

This study was conducted using a mixture of quantitative and qualitative data collection techniques. The purpose of the qualitative component was to supplement the quantitative results by gathering data describing team members' experiences and attitudes about teamwork. The purpose of the quantitative component of this study was to identify which parameters have the most impact on team effectiveness.

Several qualitative methods were used to assist in answering the research questions previously presented and accepting and rejecting the hypotheses. Those methodologies include individual and group interviews with faculty members, observations, focus groups with students, review of Coalition Year End Reports, and review of Site Visit Reports written by National Science Foundation reviewers.

The qualitative data collection suggests that the faculty members surveyed view their teams as successful and are enjoying teamwork. The following strengths were among those most commonly cited:

- competent leadership and skilled team members.
- team members offering to help one another when needed.
- willingness to work out differences in an honest and healthy way.
- well-organized meetings.
- clear overall team purpose.
- sufficient material resources.

The following list represent the weaknesses most commonly found in the responses:

- unclear understanding of team performance.
- poor communication system with individuals outside the team.
- current focus is on too many activities, which inhibits effectiveness.
- Unable to fully participate in all aspects of teamwork responsibilities posed distractions.
- lack of organizational support of the team and its mission.
- few rewards for performing well on a team.

difficulty reaching decisions.

Quantitative data was collected from teams using The Campbell-Hallam Team Development Survey (TDS). The TDS, a 72-item, commercial survey, was developed to give teams feedback on their strengths and weaknesses on 18 scales related to team effectiveness [3]. This information was invaluable for teams looking to celebrate strengths and improve weaknesses.

The TDS instrument also provided feedback to teams on their attitude about four categories contributing to team effectiveness. Within these categories, a number of scales were identified to measure the strengths and weaknesses of teams. The categories and their scales are summarized in Table 2.

Table 2.
Scale Groupings Based on TDS

Resource	Efficiency	Improvement	Success
Time and Staffing	Mission Clarity	Team Assessment	Satisfaction
Information	Team Coordination	Innovation	Performance
Material Resources	Team Unity	Feedback	
Organizational Support	Individual Goals	Rewards	
Skills	Empowerment		
Commitment			

The developers of the instrument found that one way for a team to increase its effectiveness is to assess its resources and then look for ways to build, expand or improve them, which is why resources is shown first in the heuristic. The second way a team can improve is by using its resources more efficiently. Building resources and using them efficiently are not enough to guarantee successful teams. During the team development process members must attend to continuous improvement. The success category is comprised of performance and satisfaction. Performance without personal satisfaction will not produce successful teams. If team members do not feel good about their team experience their performance will suffer.

Summary

The results of this study suggest that engineering and science faculty work teams are effective and that most faculty enjoyed working on teams. The following scales when used together have the potential to increase team effectiveness: empowerment, feedback, leadership, mission clarity, rewards, skills, team assessment and team coordination.

Success is attributed to a combination of factors, including leadership, team assessment, empowerment, skills, feedback, team coordination, mission clarity, and rewards. For organizations wishing to implement faculty work teams the findings of this investigation are sufficient to consider the development of a predictive model for team effectiveness.

Though the higher education infrastructure does not support teamwork, faculty members in the Coalition, working on teams are happy and excited about their experiences. This finding is encouraging as more and more universities will transition to teams.

References

- [1.] Anonymous, "1997 Industry Report," *Training*, vol. 34 no. 10, October 1997, pp. 39-75.

- [2.] Bennett, F. L., *The Management of Engineering: Human, Quality, Organizational, Legal, and Ethical Aspects of Professional Practice*, New York: John Wiley & Sons, Inc., 1996.
- [3.] Campbell, D. and G. Hallam, *Campbell-Hallam Team Development Survey*, Minneapolis, Minnesota, NCS Assessments, 1994.
- [4.] Cleland, D. I., *Strategic Management of Teams*, New York: John Wiley & Sons, Inc., 1996.
- [5.] Cohen, S. G., and D. E. Bailey, "What Makes Teams Work: Group Effectiveness Research from the Shop Floor to the Executive Suite," *Journal of Management*, vol. 23 no. 3, 1997, pp. 239-290.
- [6.] Dension, D. R., Hart, S. L., and J. A. Kahn, "From Chimneys to Cross-Functional Teams: Developing and Validating a Diagnostic Model," *Academy of Management Journal*, vol. 39. No. 4, pp. 1005-1023.
- [7.] Goetsch, D. L. and S. B. Davis, *Introduction to Total Quality: Quality Management for Production, Processing and Services*, Upper Saddle River, New Jersey: Prentice Hall, 1997.
- [8.] Gustafson, K. and B. H. Kleiner, "New Developments in Team Building," *Work Study*, vol. 43, Dec. 1994, pp. 16-19.
- [9.] Hackman, J. R., "The Psychology of Self-Management in Organizations," in *Psychology & Work: Productivity, Change, and Employment*, Eds. M. Pallack and R. Perloff, Washington: American Psychological Association, 1986, pp. 89-135.
- [10.] Hackman, J. R., *Groups That Work (And Those That Don't): Creating Conditions for Effective Teamwork*, San Francisco: Jossey-Bass, 1990.
- [11.] Hoerr, J. and M. Pollock, "Management Discovers the Human Side of Automation," *Business Week*, September 29, 1986, p. 74.
- [12.] Mohrman, S. A., Cohen, S. G. and A. M. Mohrman, Jr., *Designing Team-Based Organizations: New Forms for Knowledge Work*, San Francisco: Jossey-Bass, 1995.
- [13.] Roberts, H. V., *Academic Initiatives in Total Quality for Higher Education*, Milwaukee, Wisconsin: ASQC Quality Press, 1995.
- [14.] Shannon, R. E., *Engineering Management*, New York: John Wiley & Sons, 1980.
- [15.] Thompson, J. W., "Engineers Don't Always Make the Best Team Players," *Electronic Engineering Times*, vol. 921, September 1996, pp. 124-152.