Managing without authority; the effect of leadership style on team dynamics and leadership strategies for the engineering manager

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Introduction

The practicum in engineering management is a new course run by the Mechanical and Industrial Engineering faculty at the University of Minnesota Duluth. Four Master of Science in engineering management (MSEM) candidates managed two senior design teams tasked with the performance of an "industry-style" project with actual industrial clients, project goals and limitations. In other words, the practicum provided managerial experience for MSEM candidates who had little or no prior exposure. In order to fulfill objectives and meet deadlines while achieving specified levels of quality or performance, it is often necessary that companies deviate from traditional organizational structures – in which working relationships are explicitly defined – to form problem specific cross functional project teams.

A project is a multitude of activities requiring the performance of tasks geared toward the achievement of set objectives within a well-defined time span and budget (Badawy, 1995.) Resource requirements of project teams often make it economically unfeasible to attempt incorporation with the traditional organizational structure, thus, matrix organizations are formed in which inter departmental teams are utilized. However, the knowledge and expertise sharing that makes matrix organizations increasingly attractive blurs responsibility-authority relationships.

With the inevitable emergence of intra-team leaders and faculty who intrinsically lean toward detailed interactions with students, the "senior design experience" afforded MSEM candidates the opportunity to manage blurred authority-responsibility relationships. Badawy (1995) traces the origin of matrix organizations to the use of cross-departmental or functional teams in the aerospace program about 40 years ago. These teams were created to provide "small-company flexibility" in a "large and complex organization." He defines matrix organizations as an "overlay of management systems whereby… project managers share facilities and manpower with functional departments" (Badawy, 1995.) It follows that the efficiency afforded by this organizational structure has made for high industrial utilization, thus its use in this practicum.

Theoretical Background and Application

Below is a review of published research that serves as a basis for the evaluation of leadership traits and future work on the role of effective engineering managers in matrix organizations. Along with each theorem is a discussion of its application during the practicum. The discussion is focused on the ability of managers to influence decisions and actions toward the realization of organizational goals in the absence of authority – responsibility parity.

Leadership

Hirtz, Murray, and Riordan (2007) define leadership as "the process by which managers influence subordinates to work toward organizational goals." It is "a social influence process in which [one] seeks the participation of individuals in an effort to [attain] organizational objectives" (Donnelly and Kezsbom, 1994) and involves active employee motivation aimed at influencing behavioral patterns to satisfy organizational requirements (Shainis and McDermott, 1988). Managers were encouraged to "get to know" team members and develop rapport that would allow for task accomplishment without coercion. The success of this approach was highly dependent on team dynamics and individual personalities. There was the tendency to invest more time and energy on teams that were more welcoming of the project manager. This was counteracted, following discussions with other managers, by scheduling one-on-one meetings with members of the less receptive team to discuss individual progress and perceptions of the project as a whole. Information from such meetings was then taken into consideration in task assignment and overall interaction with the team. Such gestures of active interest increased team motivation and receptiveness to managerial input.

Bass and Avolio (1994) discuss two concepts of leadership – transformational and transactional – which imply varied levels of managerial involvement, as shown in Figures 1 and 2 below. They express the reliance of transactional managers on contingent reinforcement, which could be in the form of positive *contingent reward* (CR), or *management-by-exception* (MBE). The Cognitive Reward system involves allocation of rewards to employees based on achievement of desired managerial goals. Management-By-Exception, on the other hand, is generally negative and could be an active system (MBE-A) in which the leader micro-manages tasks and takes "swift corrective measures" to ensure timely goal achievement, or a passive one (MBE-P) in which the manager becomes involved in monitoring activities solely to correct deviations from the prescribed path (Bass and Avolio, 1994 p.4). Transformational leaders, on the other hand, aim to influence subordinates by eliciting admiration and a desire for emulation – they lead by example and are interested in subordinates' well being.

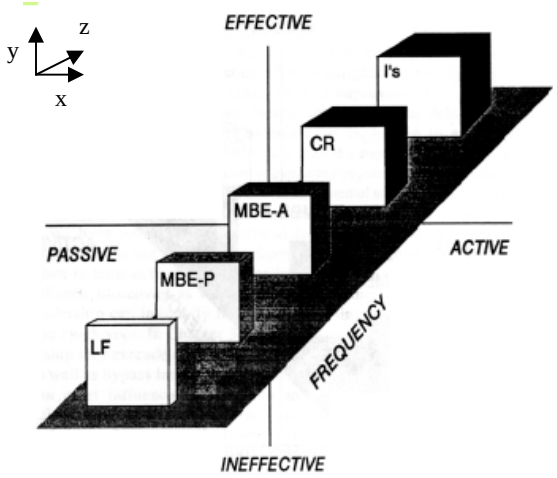

Figure1: Optimal Leadership profile.

(Adapted from Improving organizational effectiveness through transformational leadership by Bernard M. Bass, and Bruce J. Avolio, 1994. p 5)

Figure 1 depicts Bass and Avolio's management styles by cubic blocks. Progression along the z-axis indicates the frequency of display of a leadership style. The y-axis predicts resultant performance measures from the application of corresponding leadership styles. Figure 1 depicts a transformational leader while Figure 2 shows the transactional leadership model.

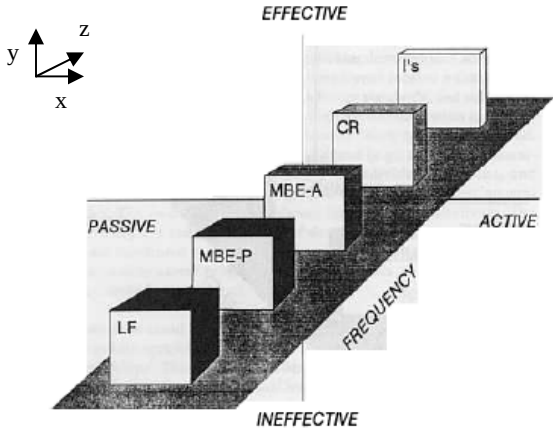

Figure 2: Sub-optimal leadership profile

(Adapted from Improving organizational effectiveness through transformational leadership by Bernard M. Bass, and Bruce J. Avolio, 1994. p 5)

Typical senior design teams are motivated by the desire to attain passing grades in order to graduate. Their performance is, thus, less heavily dependent on interactions with project managers than would be the case in industry. However, "transformational teams" were notably more receptive to managerial suggestions and better able to discuss obstacles to project progress, thus, allowing for timely goal satisfaction, or deadline adjustments where required, with sufficient warning to all stakeholders. Purely transactional dealings with one team resulted in defensive team members, who were constantly guarded and suspicious of the project manager's motives.

Influence without Authority

In her paper on "The Human Side of Teams…," Alice E. Nichols (1991) discusses the industry-wide realization of, and apparent reluctance to undergo the paradigm shift necessary to reduce, problems that arise from managing without authority. Nichols states the need that the engineering manager understand the "exchange of currencies" that constitutes the workplace. There were few "traditional currencies" in dealings with the senior design teams, as project managers had limited influence on final grades. Positive feedback, however, proved a powerful motivational tool. Nichols draws on work carried out by Cohen and Bradford (Influence without authority, 1990), to demonstrate the importance of elements like goal clarification, diagnosis of the other individual's "world," and identification of individual currencies, to effective managerial influence.

A team member who showed up sporadically was to be removed by his team members. This was discussed with the project manager, who called meeting in which it was learnt that the team member in question lived far away from the university and had had frequent vehicle breakdowns. The team agreed to a new task division that allowed him carry out and submit his work remotely.

Leadership skills

In order to influence project decisions and outcomes as described above, a manager must possess and be able to effectively employ leadership skills. These skills entail "actively guiding and motivating others while operating in non-authority situations." Shainis and McDermott (1988) discuss the requirement that engineering managers in such authority-responsibility situations understand and "speak to" the feelings and problems experienced by a group or an individual. Some of the skills discussed include *empathy, self-awareness, self-confidence, enthusiasm* and *effective communication skills*. In the practicum, these skills became essential after a client decided that a team had satisfied his objectives half way through the semester. With advice from weekly discussions with other managers and professors, the project manager directed the team toward fresh brainstorming sessions. These yielded a broader scope that included market surveys, more stringent budget restrictions, finite-element analysis, and greater decision making responsibilities that afforded the team a richer overall experience than would have been, otherwise, possible.

Team building and motivation

In her paper on "the effect of top performers on project teams, Marla Hacker (2000) discusses the positive correlation between student GPA and project team performance. She goes on to describe GPA (or employee productivity) as an indication of student (or employee) motivation and overall interest; one could argue that all students at any one school have equal resources at their disposal. A comparison of final grades from senior design teams involved in this practicum with managerial styles should reveal the effect of the additional layer of management/leadership on motivation.

Methodology

The practicum was conducted in conjunction with the senior design course in Mechanical and Industrial Engineering at the University of Minnesota Duluth. With aim to provide engineering management (EM) students with practical managerial experience, each EM candidate was assigned two senior design teams of three to four students. The teams were assigned "open-ended" problems (problems to which there existed a wide variety of possible solutions) and functioned as engineering consultants to external firms like Andersen Windows and the Minnesota Department of Transportation. Final grades were dependent on the project outcome and presentation of final solution in a detailed report at the end of the semester.

In order to determine the effect of leadership styles on team performance and dynamics, team members were invited to fill out questionnaires. Questions were aimed at identifying links between leadership qualities and follower performance, as effective leadership is, theoretically, essential to successful goal achievement.

Other variables like the number of people on a team and the level of organization with respect to clear task delineation, were also considered. The application of expected theoretical relationships of these variables to team performance was considered with regard to teams motivated by final passing grades, graduation and employment prospects.

Results

The survey posed questions concerning team size and dynamics, the nature and quality of interactions with management, and overall satisfaction with the standard and completion of assigned tasks.The survey, shown in the appendix to this report, was handed out to all 29 students enrolled in the senior design course. With a 66 percent response rate, the results are shown below and are considered according to group size and client location.

The teams were graded on clarity of problem statement, level of analysis, evaluation of alternatives, factual support of recommendations, presentation style, technical content, and satisfaction of objectives. While project managers were discouraged from providing direct solutions to problems as they arose, one can gauge the level of influence exerted, or guidance provided, toward satisfactory project completion by comparing the average grades obtained by the senior design class of spring 2007 to those of spring 2006 and fall 2006.

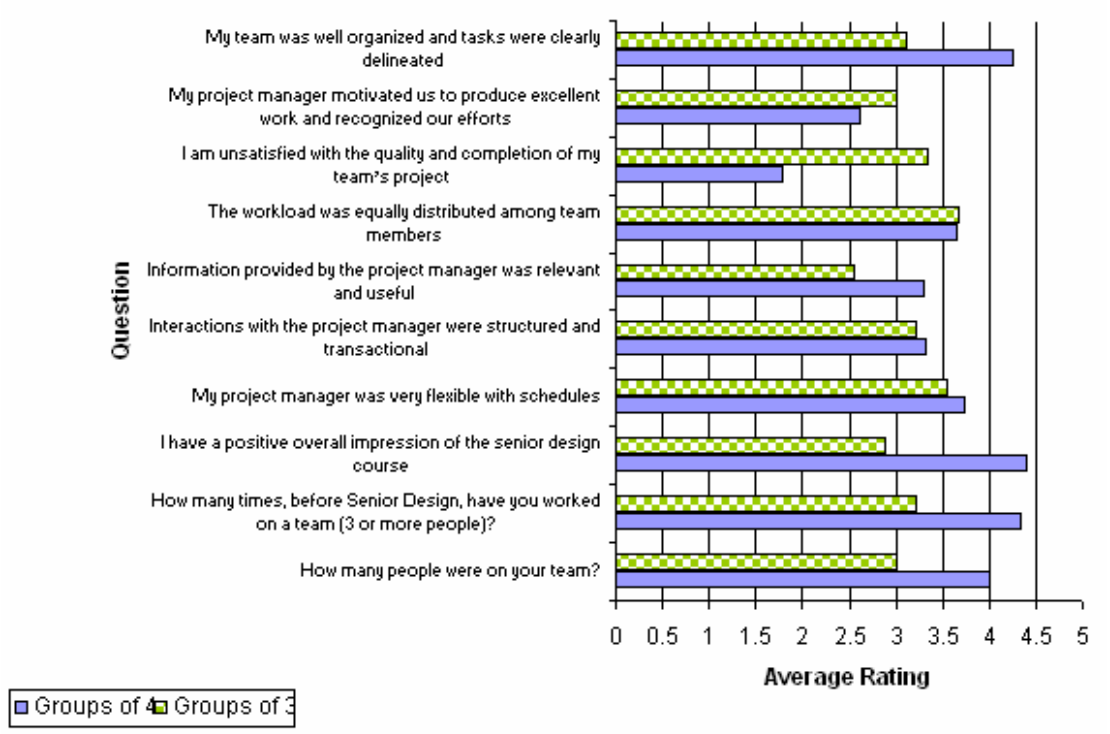

Figure 4: Effect of Group Size on responses

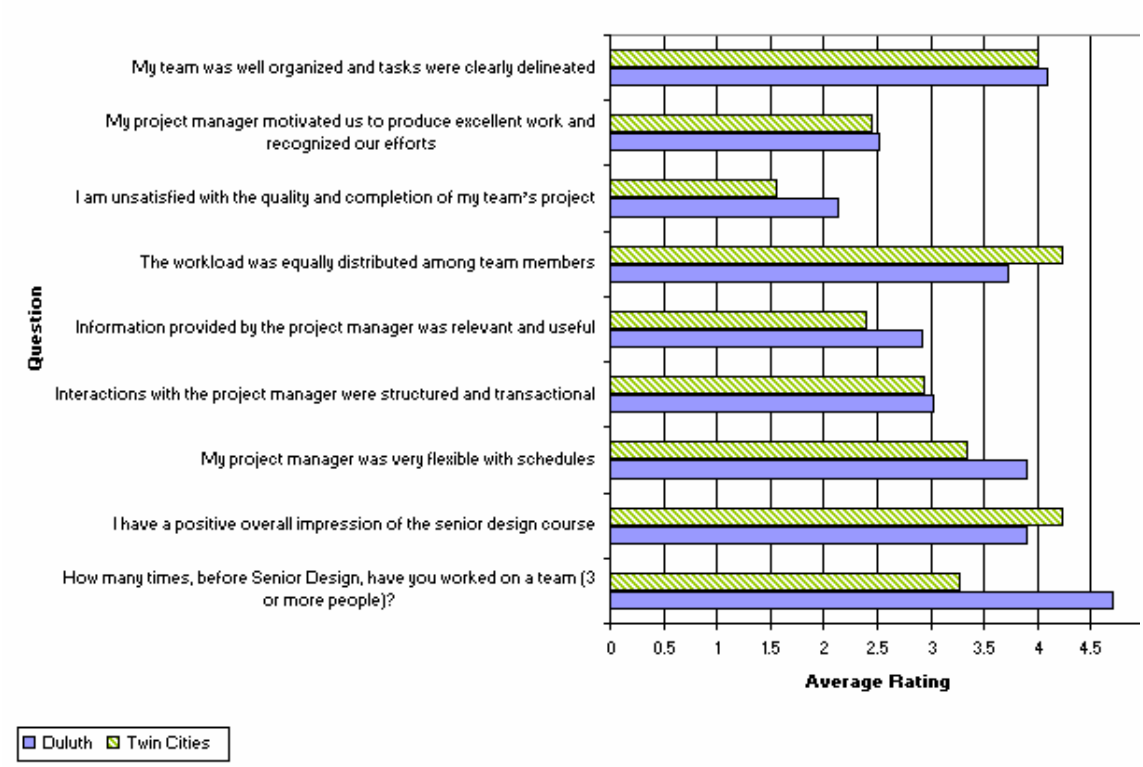

Figure 5: Effect of Client Location on responses

Discussion

With an average of 89 percentage points, there is a modest improvement in mean scores from the fall and winter 2006 session, which had mean scores of 88 percent and 75 percent respectively. As was discussed earlier, students were equally motivated by the desire to graduate with grades that would ensure promising employment prospects. It would, however, be useful to have had team specific data in order to pair teams with respective managers and more effectively make comparisons between leadership styles, perceived team motivation or commitment, and eventual outcome; grades were not made available with names of recipient teams.

Group Size

In their research on the effect of workgroup characteristics on team performance, Campion ET Al (1993) discovered positive correlations between group size and performance levels. As attempts were made to ensure equal time commitments from all teams (equal workload), Campion's findings appear to hold true in this study. This is shown in figure 4, in which students on groups of three were less satisfied with group performance levels and subsequent results than their counterparts on teams of four. They also tended to be more critical of their managers than students on teams of four.

One could argue that whereas low performers can go unnoticed for longer periods in larger teams, smaller team sizes necessitate greater individual involvement and accountability for performance. Consequently, figure 4 shows that teams of three were less satisfied with the overall quality of their final report than their counterparts on larger teams. While this might be resultant of available manpower, it should be noted, as is shown in figure 4, that teams of four had more teamwork experience than students on smaller teams. This was unintentional and might have contributed to issues in team organization and conflict resolution. A comparison of final grades to student perception, as indicated in responses to the questionnaire, would allow for the determination of trends. Privacy issues prevented the release of such detailed grade information.

Client Location

As project managers resided in Duluth, greater interaction was had with clients in the Duluth area than with Andersen Windows, or Midwest Rubber (Twin cities clients). Due to coursework and research constraints, managers were limited to one or two visits to the Twin Cities locations over the course of the project and relied on information provided by the teams during weekly meetings and in bi-weekly progress reports for progress evaluation.

It follows that "Duluth teams" deemed information provided by the MSEM candidates of higher relevance than did "Twin Cities groups." There was an absence of managers' in-depth knowledge and as such, authority accrual through "expert power" (Badawy 1995) could not occur.

Also of interest in Figure 5 is the greater dissatisfaction, albeit by a small amount, of "Twin Cities groups" with eventual project outcomes than "Duluth teams." One might argue that the groups from the Twin Cities, unbeknownst to them, had a richer project management experience than their Duluth counterparts who did not require the same level of detailed plans and execution per trip to client locations. The twin cities groups were, thus, arguably more involved and better equipped at the end of the exercise and were less satisfied with the outcomes as greater time commitments might have produced higher final product expectations than were realized. Again, having team specific grades would clearly support, or disprove this hypothesis.

Recommendations

This report has detailed the outcome of an experimental practicum in engineering management at the University of Minnesota Duluth. Future research would be better served by teams that more closely mirror conditions in industry with regard to work schedules and interaction with project and senior managers.

Conscious and consistent use of chosen managerial styles would make for better evaluation of effectiveness and comparison (of effect on performance) with theoretical outcomes. Some managers in the practicum adopted different levels of involvement with their teams to study the effect of management by exception, but subconsciously adopted different strategies as the semester progressed.

There is a need for greater interaction with top management in order to avoid contradictory action plans. Professors naturally prefer a "hands-on" approach in the supervision of senior design and other practical courses. While this is possible in matrix organizations, working closely with the EM students would achieve unity of command as discussed by Badawy (1995) and reduce conflicts.

Summary and Conclusions

The practicum in Engineering Management at the University of Minnesota Duluth afforded Engineering Management students, who had little or no managerial experience, an opportunity to supervise project teams and gain concrete experience through actively experimenting with theoretical concepts. The practicum reinforced healthy managerial practices by allowing students experience the pitfalls of managerial failure.

An important lesson learned from this experience was the need for clear goal communication to team members via multiple mediums. A team was consistently late in submitting bi-weekly reports and discussions during meetings failed to produce changes. The introduction of electronic meeting minutes, circulated by e-mail, along with an explanation of negative repercussions for untimely reports, resulted in timely submissions for the remainder of the semester.

The client for a second team was satisfied with the ideas generated by the baseline report and decided to implement the team's ideas using his own staff. This was a valuable lesson in employee motivation as the project manager's task evolved to include work creation and morale improvement. Discussions with the team involved intentional transformational leadership in informal settings. This led to fresh idea generation and a redefinition of the project scope to include market research, finite element, and other analyses in an attempt to run the project as an independent company. This was a much wider scope than would have been afforded under the external client and resulted in a richer senior design and practicum experience.

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