

## Engineering Leadership Styles Used in Industry Today

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## Background

Attempts have been made to identify qualities of engineering leaders, but a specific definition has not been identified [1-3]. Nevertheless, industry and academia agree that an understanding of engineering leadership is needed [1-3]. In general, engineers are hired for their ability to apply mathematics, science, and engineering to solve complex problems [2-3]. Historically, lack of leadership and personal skills is often the downfall for young engineers [2-3]. This is because, though the technical skills of engineers hold great value, personal skills are important for the maintenance of a competitive edge in the constantly changing and adapting world of technical developments [2]. Although it is widely agreed upon that engineers need leadership and management skills, engineering graduates continue to lack these skills [2], [4-7].

Currently, education in engineering leadership covers a very broad range of leadership skills with little specificity [3], [8]. Studies have been conducted with the aim of improving engineering leadership education by determining what leadership qualities companies seek in new engineering employees [1], [3-4], but further research is crucial. A past study suggests that leadership is the “largest gap of all ‘the perceived gaps in the value of the organization versus preparedness for the new BS engineers’ [9],” [4]. This study aims to contribute to this knowledge gap by exploring the leadership behaviors of engineers within an engineering context.

To effectively complete this study, an overview of different leadership theories and the associated styles is required. Three major leadership theories for which there exist extensive volumes of descriptive literature include behavioral theory [10-20], situational theory [21-23], and power and influence theory [24-26]. Under each of these theories fall numerous leadership styles, many of which share various elements and behaviors. Some theories also depend on specific factors that were not considered in this study, particularly the developmental level of the employee being led in the case of situational theory [21-23].

To simplify categorization while still considering a wide variety of leadership styles, this study focuses on behavioral theory, which considers the actions of leaders and their orientations toward leadership, particularly whether they focus on tasks, people, promoting change, or providing resources [10-15]. The behavioral theory offers a broad range of leadership styles which may be employed. Some studies on behavioral theory suggest two leadership styles are prominent. These two styles are employee-centered leadership and production-centered leadership [10], [12-15]. These styles suggest that employee-centered leaders focus on supporting employees while production-centered leaders focus on productivity and are more directive [10], [12-15]. Other studies include two additional leadership styles: change-centered leadership and functional leadership [11], [16-20]. Change-centered leaders promote new ideas, establish vision, and are not overly cautious [11]. Change-centered leaders do not have major concerns with structure and make quick decisions to promote rapid change [11]. Functional leaders support and provide resources to an organization to ensure success [16-20]. Examples of support and resources include mentorship, motivation, and providing teams with tools needed to be successful [16-20]. A major theory that breaks down these behavioral leadership qualities

even further, providing a selection of five major styles under behavioral leadership theory, is the Blake Mouton Managerial Grid [27]. The development of this grid starts by considering the two major employee-centered and production-centered styles, referred to in this case as concern for people and concern for production. These styles are further broken down into five major categories: accommodating or “country-club management” style, which focuses greatly on people and little on production; sound or “team management” style, which focuses greatly on both people and production; status quo or “middle-of-the-road management” style, which splits focus evenly between people and production; dictatorial or “produce-or-perish management” style, which focuses greatly on production and very little on people; and indifferent or “impooverished management” style, which focuses neither on people nor production [27-28]. This grid offers a well-organized summary of the behavioral leadership styles associated with the Blake Mouton Managerial grid.

Though engineers have long been perceived as socially awkward, self-serving individuals, there is much more to the profession than meets the eye [29]. In addition to technical skills, some prized skills and qualities of engineers include creativity, leadership, teamwork, and innovative thought [29-30]. Further, the nature of engineering work requires that engineers be aware of the social and cultural states of the world and the ways in which their work affects others [30]. Therefore, exploring leadership behaviors of engineers would lend insight into the nature of leadership within the engineering context. The primary research question in this study is as follows: Which leadership styles are experienced by current engineers? This exploratory study reflects an effort to describe the lived experiences of current engineers and their observations of leaders with whom they have worked.

## **Methodology**

The purpose and research question associated with this study situate it as a qualitative approach in which the researcher uses inductive and deductive analysis to determine patterns and themes [31-32]. The qualitative approach to the current study is described as a multiple in-depth interview study using informational interviewing techniques. These techniques are purposeful in interpreting meaning within a particular phenomenon and provide descriptions by which patterns of categories emerge from contextual factors [33-35]. This approach supports the exploratory research question to observe leadership styles in the engineering context. A semi-structured informational interview protocol was developed to allow for exploration by the researcher based on participants’ experiences and stories. Using this protocol, interviews were conducted with eight engineers. Purposeful and convenience sampling were used for this study to select participants with potential to provide information-rich data to illuminate and inform understanding of the central phenomenon of the study [31], [36]. The engineers interviewed for this study were all former graduates of an engineering leadership minor at a large institution. These participants were selected because they had an educational background in leadership due to their completion of this coursework. The interviewees come from various backgrounds and work at diverse levels within their companies. Table 1 provides a demographic summary of the interviewees.

Interviews were recorded and used to collect qualitative information, consisting of accounts of leadership styles practiced and/or experienced by the interviewees in the workplace.

Transcripts of the interviews were then analyzed using an open and axial coding strategy to develop codes based on the descriptive data provided by participants. During the open coding phase, the researchers reflected and recorded interesting findings based on the data. The axial phase translated initial findings into conceptually similar concepts and resulted in the codebook found in Table 2.

**Table 1. Engineering Participant Demographics**

	Company Size	Leadership Level	Engineering Background
Participant 1	Large	Project Engineer	Civil Engineering
Participant 2	Large	Upper Lvl Mngmnt	Computer Engineering
Participant 3	Large	Mid Lvl Mngmnt	Civil Engineering
Participant 4	Large	Project Engineer	Automotive Engineering
Participant 5	Large	Upper Lvl Mngmnt	Industrial Engineering, MBA
Participant 6	Small	Upper Lvl Mngmnt	Manufacturing, Regulatory Compliance
Participant 7	Large	Project Engineer	Engineering Science, Industrial Systems
Participant 8	Unknown	Upper Lvl Mngmnt	Mechanical and Environmental Engineering

Each of the researchers conducted 2-3 interviews and completed the corresponding transcriptions. In order to analyze data consistently among team members, a codebook was developed. This was based on the initial analysis of several interviews and the identification of common key words and phrases, or “codes.” Each interview transcription was read with these codes in mind, and quotes aligning with each code were identified and tabulated. Codes which appeared in a greater number of interviews were determined to indicate more significant elements of the data, and representative quotes accompanying these codes were used as support for conclusions. The codebook used is shown in Table 2.

**Table 2. Code Book with Definitions and Associated Leadership Styles**

Code	Definition	Leadership Style Association(s)
Active listening	Showing empathy, care about opinions of employees, etc.	country-cub management team management

Hands-off approach	Allowing employees to be autonomous, reach goals on their own (usually providing support if needed)	impoverished management middle-of-the-road management
Shared Vision with Employees	Establishing common goals and clear direction for the company	team management
Teamwork	Group responsibility, working together	team management
Lead by Example	Treating employees how you want to be treated and showing the values and work ethic you hope to see in your employees; showing authenticity	team management
People-centered	Understanding that the job is important, but the well-being of the people performing the job is more important	country-club management
Empowerment	Instilling confidence in employees and emphasizing that their opinions matter and their ideas are important	team management
Feedback	Providing both teams and individuals with feedback to know what they are doing well and need to improve on	team management
Recognition	Recognizing both teams and individuals for their efforts and not taking all the credit; may provide rewards	country-club management team management

## Results and Discussion

Some common words and phrases that emerged among interviews with engineers centered around the idea that good leaders are people-centered, practice active listening, promote teamwork, empower employees, provide employees with feedback and recognition for efforts, develop a shared vision with employees, and lead by example in a hands-off approach. Frequencies and associated percentages for each of the codes as well as the corresponding leadership style are shown in Table 3.

**Table 3. Codes in Order of Frequency**

Code	Engineers (0-8)	Leadership Style Association(s)
<b>Empowerment</b>	7, 87.5%	team management
<b>Hands-off approach</b>	7, 87.5%	impoverished management middle-of-the-road management
<b>Teamwork</b>	7, 87.5%	team management
<b>Active listening</b>	6, 75%	country-cub management team management
<b>Shared Vision w/ Employees</b>	5, 62.5%	team management
<b>Recognition</b>	4, 50%	country-club management team management
People-centered	3, 37.5%	country-club management
Feedback	2, 25%	team management produce-or-perish management

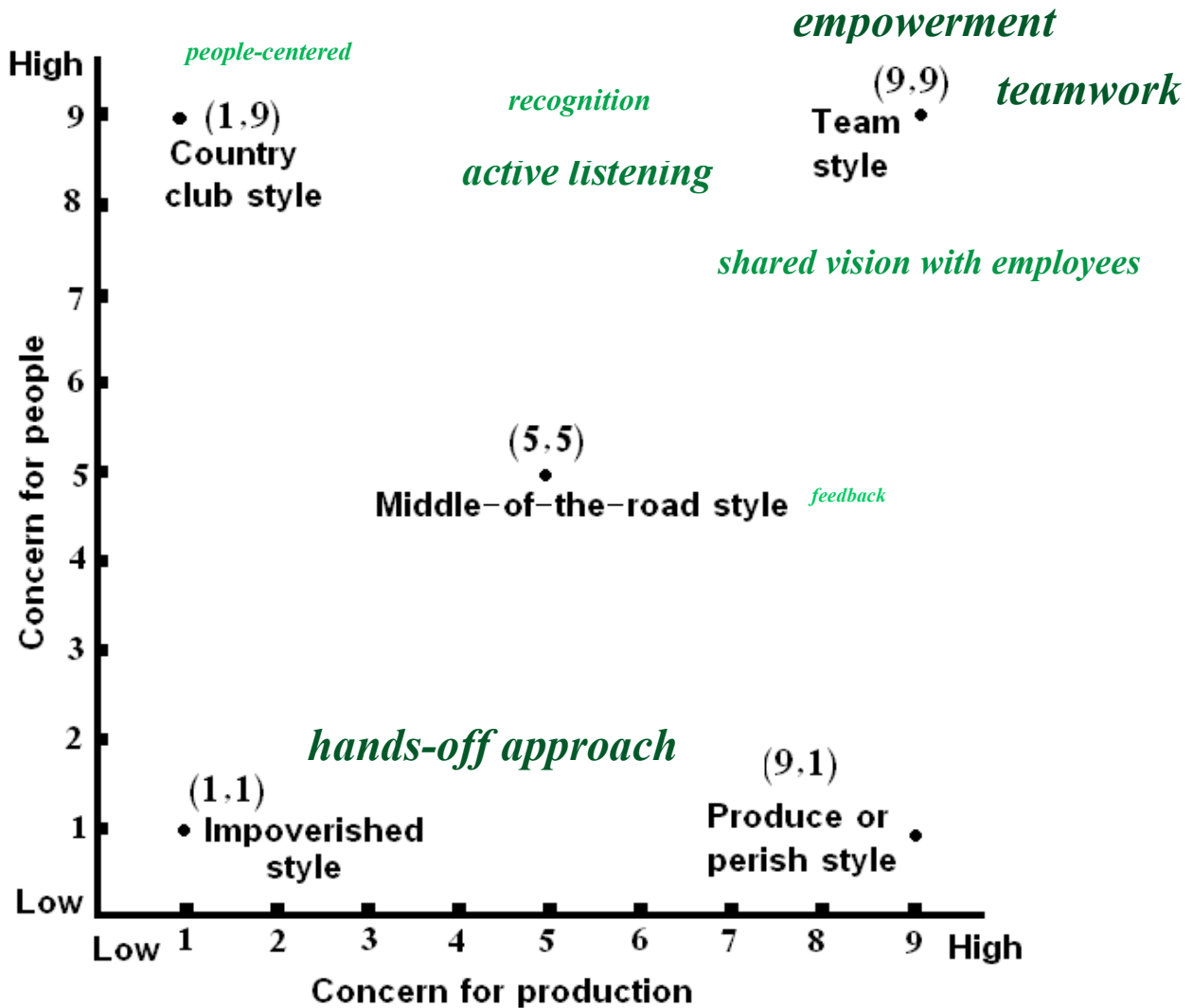
\***Bold text** indicates frequency of 50% or greater

Some of the codes occurring with the highest frequency among interviews include empowerment, hands-off approach, teamwork, active listening, shared vision with employees, and recognition. In order to organize these codes in a meaningful and reader-friendly way, they were mapped to the Blake Mouton grid as can be seen in Figure 1. The Blake Mouton grid plots the leadership styles on an x-y coordinate system with the x-axis indicating concern for production rated from 1-9 and the y-axis indicating concern for people rated from 1-9. Each of the five behavioral leadership styles within the theory are plotted on the grid with their corresponding levels of concern for production and people shown in parentheses. The codes from this study are placed in a general location on the Blake Mouton grid to roughly illustrate the connection of the engineering leader behaviors to the broader behavioral theory.

In terms of active listening, one engineer mentioned that an important quality of a leader is “being able to actively listen,” while another engineer mentioned that a poor leader “really didn’t listen to what [an employee] had to say.” Similar quotes were seen from engineers regarding the top six codes listed in Table 3. One engineer combined many of the common codes nicely in a cohesive statement. The engineer stated that good leaders “...did three things: they set the direction in the beginning, they always took a hands-off approach, but at the same time made themselves available if I raised my hand.” This quote alone emphasizes the importance of the

establishment of shared vision, a hands-off approach, empowerment, and active listening, four of the six most prominent codes appearing in the data.

**Figure 1: Placement of Frequent Codes on Blake Mouton Managerial Grid**



Note:

\*Larger, darker text corresponds to higher frequency of code appearance in interviews;

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Some of the more frequent codes, most notably that of the hands-off approach, were implied to be preferred over their opposites in discussions of negative leadership experiences, even when the codes themselves were not explicitly mentioned. In other words, several individuals mentioned that the worst leaders they have encountered were micromanagers rather than stating that the best leaders were hands-off. However, by noting an aversion to the antonymous micromanagement style, the engineers indicate a preference for the hands-off approach. For example, one engineer stated that “Letting people come to their own conclusion is

what good leaders are able to do,” suggesting a preference for a hands-off approach, while another engineer observed that one of the worst leaders “was a micromanager,” suggesting (but not explicitly stating) a preference for hands-off leadership.

Statements such as these indicate that various styles of leadership are present in industry today, some being polar opposites of one another, though generally one is perceived as more favorable than the other. The hands-off style falls under the behavioral styles of impoverished management and middle-of-the-road management, whereas the micromanaging style corresponds to the produce-or-perish management style. From the data collected in this study, a preference was seen for the former of these styles, consistent with the preference for hands-off styles found in a previous study [3].

Using the Blake Mouton grid, the behavioral themes emerging from this study suggest positive opinions regarding leadership behaviors with high people and high task orientations (team management style). These behaviors reflect empowerment, recognition, active listening, and sharing a vision. A team orientation to leadership balances the needs of the engineer (person) with the needs to complete tasks. The hands-off approach, while treated as a positive aspect within the current study, may be positioned in the lower quadrant indicating a low regard for task and people. In some cases, the hands-off approach may result in a leader who appears to not care and does only what is needed to keep a job. In this study, the hands-off approach was described as an opposite to high task orientations which are described as produce-or-perish or micromanager behaviors. It is likely that the hands-off approach and teamwork codes were frequent in the engineer interviews because of the nature of work done by these individuals [29-30]. In engineering environments where new ideas are consistently being considered and developed, recognition for individual ideas and efforts is highly motivating [29-30]. The findings of this study position the leadership behavioral themes for current engineers within the diagonal of the grid, indicating themes aligning with both people and task orientations, with a strong culture of autonomy.

In addition to the major codes identified in this study, it was found that engineers look to their leaders to be experts in the technical aspects of the field. One engineer stated, “We really look to our leaders to be technical,” emphasizing that “managers that have interpersonal skills but no technical skills aren’t as well-respected as managers that have both.” Other engineers echoed this notion, stating that engineering leaders may take “different approaches in solving problems in technical matters,” and that an engineering leader often “has a specific framework by which they would... address a problem.” Another engineer stated that “you have to be a subject matter expert in your field to be the leader,” because “if you want to motivate the folks under you in support of a common purpose or goal, you have to understand their line of work.” However, the engineers do recognize the human aspect of leadership as well and appreciate the need for a balance between the technical and the social. One engineer reflected on this, stating that, in an engineering context, “obviously some more technical things come into play, but I also think from what I have been exposed to in my career a big part of that would also be kind of a social responsibility that comes into that as well.”

A limitation of the use of the Blake Mouton grid is the inability to account for different types of workers. One engineer identified this challenge, saying “I think there is difference



between the best leadership style and the best leadership style for me. Because I am a different person, you know, for you, for my wife or someone else. And one person's leadership style maybe more appropriate or more fitting for certain people or certain types of organizations.” This also demonstrates that, in terms of leadership, engineers are very diverse. This diversity is important to know and understand as a leader to effectively lead in an engineering context. Different situations also require different leadership behaviors. The nature of engineering work positions an engineer as a problem-solver with ill-defined parameters and a constantly changing environment. A leader may require a different behavior to adapt to various situations. Further iterations of this study could explore specific leadership behaviors associated with different challenges faced within the engineering workplace. Regardless, the insights from this exploratory study indicate the need to educate engineers on styles and behaviors that support people and tasks. Engineering educators and trainers can use this information to develop curricular structures that support learning and development of both high task and high people orientations.

## **Conclusion**

This study focused on exploring which leadership styles are experienced by current engineers. The results indicate positive associations with behavioral styles that balance people and task orientations and include autonomous working environments. With the hope of developing engineers who can lead within today's engineering domain, educational programs should develop a curriculum that stresses the importance of integration of task and people orientations for leaders. Further understanding of engineering leadership allows for academia and industry to ensure they are creating leaders who are prepared for the work of engineering. This study adds to the literature seeking to define engineering leadership to better align industry training and educational initiatives for leader development. Some limitations of the study include small sample size and the selection of engineers who were alumni from a leadership minor. A more diverse perspective would enhance the quality of the interview data. Also, though insight was gained into engineering leadership styles, it is unknown to what extent these styles compare to those employed in other disciplines. In order to improve upon this study, a larger sample of engineers as well as individuals in additional disciplines could be considered. Using a quantitative approach, established leadership assessment tools could be used to determine differences in leadership behaviors across disciplines. This comparative approach may serve to further enhance the understanding of leadership within an engineering context.

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