

Prevalent Technical Leadership Styles and Impact on Early Engineering Careers

Connor Eigelberger
Southern Illinois University Carbondale
eigelberger@gmail.com

Bruce DeRuntz
Professor
Southern Illinois University Carbondale
bruce@siu.edu

Harvey Henson
Associate Professor
Southern Illinois University Carbondale
henson@siu.edu

Abstract

This study explores prevalent leadership styles found in industry from an engineering student's internship experiences. Over the course of four years of internships, observations and interview responses were recorded to address three questions: What is the dominant industrial leadership style? What is the dominant leadership style in the broader engineering sector? What is the dominant leadership style entry-level engineers should know in order to be successful? Reflections on personal experiences within the engineering industry suggest an ideal leadership style which can be utilized by an entry-level engineer or a similar technical individual. Previous research on leadership and success formed a basis for claims as to which techniques of leadership can lead to success for an entry-level engineer. Further, this study builds upon prior research on the correlations between leadership skills taught in college and the resulting success beyond the classroom. Leadership styles are ranked in order of their utilization in the industry and corresponding value to entry-level engineers. They are: Pacesetting, Authoritative, Democratic, Coaching, and Delegating. The study concludes with suggesting a correlation between knowledge in leadership and both the subjective and objective success of entry-level engineers. Ideally every engineer should be taught a multitude of techniques, and recommendation is that engineers strive to learn many leadership styles whether they intend to hold a position of leadership or not.

Introduction

Leadership is a skill which may be intuitive, learned experientially through the trials and tribulations of life, or learned through academic training (Allen et al., 2017). Many novice engineers aspire to be leaders such as Elon Musk and Bill Gates, who are constantly at the center of attention. This trend is particularly obvious within engineering as successful leaders are

continuously innovating and pushing the limits of what they and their teams can accomplish (Gordon, 2011). Researchers search for the commonalities that might explain how the success of these innovators created such great results (Eby et al., 2003). This study used a simple strategy to learn about leadership directly from technical leaders. These technical leaders were observed and analyzed for the leadership styles and routines they utilized. Learning from the leaders of today is needed now more than ever during this current critical shortage of technical leaders (Gordon, 2012; Gordon & Silevitch, 2009; Holdren & Lander, 2012; Malcolm & Webster, 2014).

Further research into the current state of engineering leadership within the industry could produce many examples that would aid in exploring the lack of leadership training engineers undergo during their undergraduate studies (Gordon, 2012). For it is in this area of leadership and soft skills development that “the industry believes our educational system is lacking” (Knight, 2012). Companies create job descriptions when looking for entry-level hires which require different leadership traits (Hartmann et al., 2017), and as many studies point out these “companies still struggle to find applicants with these clearly defined traits” (Hartmann & Jahren, 2015). Additionally, Hartmann and Jahren (2015) call for further research to resolve this dilemma and suggest more partnerships and interventions are needed.

Research Design

This study used a qualitative research design to gather and analyze data about leadership styles at three companies. More specifically, the study sought to understand the dominant leadership styles that entry-level engineers might expect to encounter at the start of their career. As a recent graduate of mechanical engineering, the principal author had a unique vantage during internships over four years to observe, ask questions, and interpret information gathered to address the research question regarding leadership styles in engineering. The opportunity to learn about leadership on the job from coworkers and from those who understand, and practice leadership is a crucial opportunity. Newly employed engineers strive to combine and reconcile such experiences with the training received as an engineering student. Novice engineers look to answer this same question about leadership and endeavor to progress through the professional challenges in their careers.

Two qualitative data collection strategies were utilized in this study. First, the author observed three leaders at each of the three companies while serving as a temporary employee or an intern. These observations were recorded in a notebook and later analyzed to determine the leadership style. The observation data were coded for leadership characteristics and divided into common themes and categorized by dominant leadership style. The data were also peer (parallel) analyzed using an independent *constant comparative analysis* strategy (Fram, 2013; Glaser & Strauss, 1967; Lincoln & Guba, 1985; Maykut & Morehouse, 1994), and the results were integrated to determine the leadership style exhibited.

Secondly, all nine leaders were questioned separately about their leadership background, experiences, and perspectives using a *semi-structured interview* protocol with open-ended questions and discussion (Creswell, 2007; Kvale & Brinkmann, 2008). Their responses were recorded and transcribed for coding and thematic analysis. As was done for the observation data, a comparative analysis approach was used to compare and verify the results and to determine the dominant leadership style (Kolb, 2012; Maykut & Morehouse, 1994). The outcomes provide

insight into common leadership styles and characteristics which these leaders frequently employed to lead extremely successful organizations. Next, a case-by-case discussion of leadership styles and project results is presented. Individuals and company names have been replaced with pseudonyms and fictitious labels to ensure confidentiality.

Leadership Styles Defined

This study used the six styles of leadership developed by the Collegiate Leadership Competition (CLC) (Allen et al., 2017) which are listed below (in no order of importance):

1. Authoritative style is defined as leading with a clear description for the path ahead or all the knowledge needed to succeed.
2. Coaching style, also known as teach and coach, describes the process a leader uses to pass knowledge and information on to their team. Although time consuming, this builds the team for the long run and can produce future leaders.
3. Coercive style, also known as the yell, tell, and the hard sell, takes place when the leader pushes the group hard to do the task their way, ensuring the group complies.
4. Democratic style involves the leader seeking wisdom and knowledge from the group and using this input to build ownership moving forward.
5. Pacesetting style, commonly known as energize and push, is highly defined by time constraints or defined results. The leader may need to “raise the heat” as they push their teams work to the next level.
6. Delegating style, implies giving each member of the team a set of tasks. This is great to allow team members to do tasks in their own manner and accomplish more with less time.

Findings

Results from Observations and Interviews

Through shadowing and interviewing leaders in the industry the authors followed a systematic process of qualitative data collection and analysis as described earlier. Both observation and interview data were documented and categorized into one of the respective leadership styles referenced above. These results are summarized below to provide accounts from the leaders with whom the author interacted at each company.

Company 1. Located in the southeastern United States, this company is one of the largest manufacturing facilities in the world. Company 1 produces beverages for almost half of the United States. Throughout a six-month internship the author learned what it takes to run the facility and what their leaders do to enable the company to remain successful.

Person A. The Assistant Facility Manager at Company 1 was an extreme leader who utilized the Coercive style or “yell, tell, and the hard sell” (Allen et al., 2017). His employees were constantly in fear with his presence and some were frustrated. This form of extreme leadership performed well within the union environment. However, it was quite overwhelming for many of

the other non-union managers under Person A. All employees wanted a sense of accomplishment, but this was almost impossible when they always felt as though they were in a losing battle.

Person B. The General Manager at Company 1 had a Pacesetting style (Allen et al., 2017) and was often the one to bring all the energy into the room. Most GM's choose to share their vision, he instead went beyond this by providing new information and timelines to constantly keep pushing the team. The company, currently one of the top beverage manufacturers in the world, had one goal, which was to stay on top. As such it was everyone's responsibility to keep that up. This led to a very fast-paced and exciting day-to-day work environment.

Person C. The lead chemist and director of the internship program always relied on Coaching and Pacesetting. He was aware that Company 1 needed to reduce the number of managers and understood that hours of teaching and training were required to help employees become more self-sufficient. He developed a coaching strategy to accomplish this task. However, he was also strong on the Pacesetting style. For example, when the team was having a long week, he would simply reward employees with things like luncheon's or leaving early on a Friday if possible. When employees only needed more energy, he would quickly shoot out a message congratulating them on how close they were to completing a task or what a great job they had done.

Company 2. This corporation is a mechanical contractor located in the Midwestern U.S. This company is a mid-sized firm that other larger companies hired to expand and improve their existing technical capabilities. The leadership styles utilized at Company 2 included the following.

Person D. The Vice President for the firm relied on two styles of leadership: Coaching and Pacesetting. He was highly involved with training. The coaching part of leadership stood out in times when he took trainees around the workplace showing them how things ran day-to-day. Perhaps most importantly, leader D took time to explain the why behind the way tasks were to be completed. As the team learned more, he listened to their questions and quickly used this engagement to move them into the activities which allowed them to further their learning. Person D was fond of engagement and was always waiting to reward excellent work. Consequently, when work was subpar or behind, he sometimes postponed this reward. If motivation was needed, he rewarded the team before the completion of their tasks. This early reward often gave the extra push needed to finish the job on time. Pacesetting was ever-present as all contracts had deadlines and budgetary requirements associated with meeting key dates.

Person E. The Senior Project Manager, utilized the Delegating and Pacesetting styles. (Allen et al., 2017). He performed the role of interacting with the team the entire day and seeing that the day-to-day tasks were completed. It was his job to be sure the crew had all the tools required to do the job. He made sure the best team members were assigned to each job to enhance overall efficiency. He was responsible for delegating tasks and consequently he was very good at conveying why these tasks were important or why such deadlines were necessary. Rather than simply dictate to employees what to do, he communicated how it needed to be done and what the end reward was, thus he used the Pacesetting style (Allen et al., 2017) to get each team member back on pace and working toward a unanimous goal.

Person F. The Safety Manager on site at Company 2, performed her job by employing the Coaching style. Through mandatory safety talks, walks, demonstrations, and luncheons she was able to demonstrate the Coaching style well. Her job became easier and easier the more she taught each employee. As people became more educated on keeping themselves safe, they required less formal teaching. She then relied on simple refreshers to maintain safety standards and the result was increased awareness and safety. The Coaching leadership style used by F was in and out of the classroom. She demonstrated efficiency by training people to do tasks correctly in the classroom first rather than having to always learn by experience in the workplace. This effective strategy should be promoted more in today's engineering classrooms and within industry as young engineers enter the workforce.

Company 3. This up and coming architecture firm in the Midwestern U.S. was created through a partnership of friends in a field that uses many kinds of engineering. At the beginning of this research, the firm had just opened and was beginning to experience the growing pains of a new company when they had decided to bring on their first intern. This resulted in a firsthand experience of how a small business struggles to get off the ground and what style of leadership it takes to do so successfully. The accounts of three leaders at this company are documented as follows.

Person G. The owner of the firm made the entire staff feel like family through the use of the Democratic and Pacesetter leadership styles (Allen et al., 2017). This family atmosphere and use of the Democratic style (Allen et al., 2017) was an extremely effective way to run the firm. He also knew how to have fun and energize this family environment. The Pacesetter style (Allen et al., 2017) was also one of Person G's fortes. If things started to feel stagnant, he simply dressed up the workplace or took employees on a site visit. These small changes allowed the team to push themselves to be much more effective.

Person H. Person G's assistant, and one of the firm's best architects, saw the value each employee could add to the team and took the time each day to utilize the Coaching style in combination with the Delegating style (Allen et al., 2017). Without her style of leadership, many employees never would have known what they were doing in the architectural world. Person H was great at delegating and she would send employees on site visits to bring back information about the project site. Many employees learned the most while on their own which illustrated the importance of delegating. This strategy empowered coworkers to work independently and forced them to figure out how to complete the given task. The Delegating style (Allen et al., 2017) was very effective for both the employees and the firm.

Person I. An architect hired by the firm often used the Democratic and Authoritative styles (Allen et al., 2017) to assist in working with the client. This is how the firm avoided conflicts by having him listen to the clients' issues and assisting in finding solutions. As the old saying goes, 'the customer is always right' and this was Person I's viewpoint with his clients. After listening to the clients' wants and needs, he would go even further using problem-solving. If their ideas did not coincide with the proposed project design, he would convincingly communicate the reasoning behind the design, and that was when he employed the Authoritative (Allen et al., 2017) leadership technique. He never shut them down completely, but instead communicated effectively where

these somewhat simple edits would result in significant and beneficial changes to the project in the end.

Quantified Results

This study examined the leadership styles from the viewpoint of a leader within a company as well as that of the company as a whole. All of the qualitative data discussed above was filtered for leadership characteristics and arranged into common themes and divided by dominant leadership style displayed in the graphics and tables found below.

Figure one summarizes the study results and reveals which leadership styles were observed. The data from the nine leaders indicate that 33 percent of these leaders utilized the Pacesetting style, 27 percent used the Coaching style, 13 percent used a Democratic or Delegating style, and only 7 percent manifested Authoritative or Coercive leadership styles. It is perhaps no surprise that Pacesetting (33%) was the most utilized style of leadership, followed closely by Coaching leadership at 27 percent. Due to the fast-paced and straightforward nature of the engineering environment these are effective leadership styles for the novice engineer to effectively detail and implement a plan of action in a timely manner.

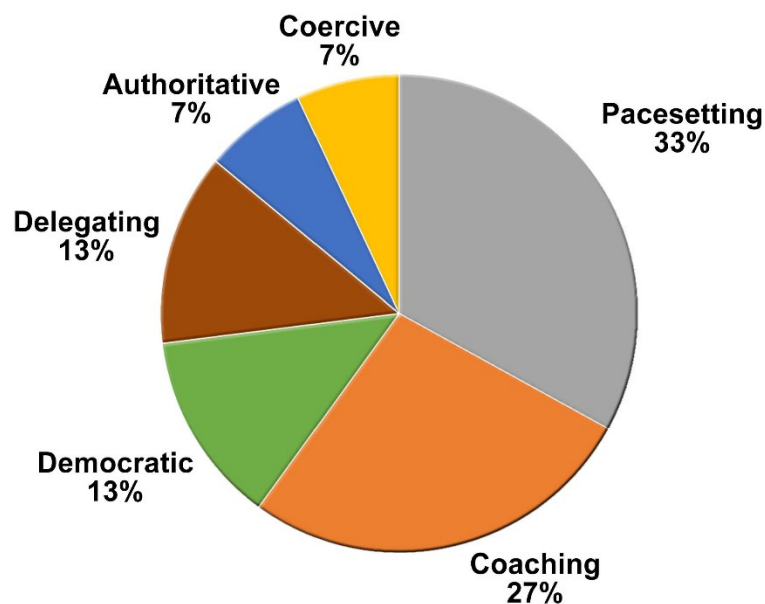


Figure 1. Leadership styles observed in nine leaders from three companies.

Table one summarizes the leadership styles evident in the results of this study. Considering the above definition of career success, each leadership style is ranked as to how useful they are in the engineering industry. As seen above in table one, each leader prefers a different style, and within

most well-run companies a variety of leadership styles seem more effective and appealing to increasingly diverse teams and employees. These leaders successfully applied different leadership styles for different tasks and situations (i.e., situational leadership), or according to their own preference. Table one documents this along with the overall company leadership style observed to be used most frequently.

Table 1: Leadership styles usage.

Company	Leader	Style Utilized
1	A	Coercive
	B	Pacesetting
	C	Coaching & Pacesetting
2	D	Coaching & Pacesetting
	E	Delegating & Pacesetting
	F	Coaching
3	G	Democratic & Pacesetting
	H	Coaching & Delegating
	I	Democratic & Authoritative

Data used in table one, was reconfigured in figure two to show how many styles were observed per company for each of the nine leaders. Each set of three leaders was pooled to display how many leadership styles were exhibited cumulatively for each company (figure 2). Results displayed in table one and figure two show that even amongst a sample of only three leaders per company there are many different styles used. On average there is between one and two leadership styles per each respective leader which benefits the company and its employees alike. Additionally, leadership across companies varied. As shown in figure two, Company 2 and Company 3 had a diverse number of styles with three each. However, the leaders in Company 3 exhibited the most leadership diversity with five different styles used and six leadership styles cumulatively across the three employees.

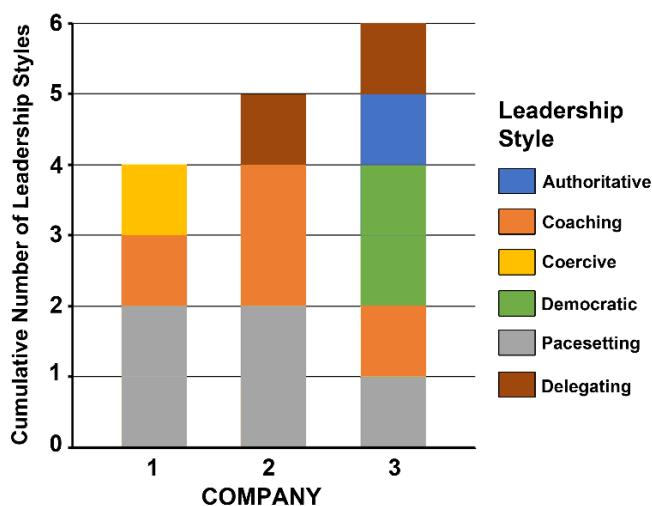


Figure 2. Leadership styles observed in three companies.

Discussion

Idealistic Leadership in Engineering

Engineering and leadership are far more integral than people may realize and the examples above show how engineers and leaders can be one in the same. While CEOs of many companies were business majors; as is the case with Company 1, many organizations were created or are currently led by an engineer. Even at a conglomerate like Company 1, which had a CEO, COO, and other top executives who were non-engineers, many engineers remained in leadership positions at their global level. This emphasizes the importance of current and future engineers learning to utilize leadership skills (Gordon, 2011; Gordon, 2012). However, which leadership skills are most useful in industry?

Looking at this question from a singular perspective, the definition of “Success” must be presented and considered. Career success defined by Robyn Paul and Lynne Cowe Falls (2015), Professors at the University of Calgary Schulich School of Engineering, includes not only considering constructs of “objective success” (salary, upward mobility, and managerial level), but also includes agents of “subjective success” (self-defined aspirations, values, need, standards and career stages). Examining success through this holistic lens is essential and can impact which leadership styles one should utilize to achieve overall success. In their paper titled: *Comparison of Career Success Competencies and Engineering Leadership Capabilities*, Paul and Falls (2015) delve into how the results of “an engineer’s career successes are directly impacted by leadership education”. All these leadership traits correlated to success competencies and thus:

This indicates that teaching engineering students’ skills in leadership would have a positive impact on their career. These results are valuable to all engineering students, not just those who plan to pursue a career in leadership. (p.6)

Students must strive to learn and develop leadership in its entirety and be able to apply leadership in varied instances throughout their careers.

Leadership Observed and Lessons Learned

First and predictably, the Pacesetter style was used most often in this rapidly changing world where innovative teams can’t afford to become stagnant. The ability for a leader to push their team without burning them out is imperative in this style of workplace. This is the one style used most often, and leaders must know how to utilize this technique at a moment’s notice.

Second was the Coaching style. For entry-level engineers, “being able to learn and develop the characteristics of a lifelong learner is a must” (National Academy of Engineering, 2004). Fundamentally, anyone has the potential to coach others, especially with general tasks or at the most basic levels of an organization. All that is needed is the experience and knowledge of how to complete a task and the desire to help someone learn. In the workplace this can be as simple as coaching an employee who was unknowingly performing an unsafe act. It is common for people to forget simple things and a coaching session can remind everyone and refresh their previous knowledge.

Third was the Democratic leadership. In a technological world, one might assume people would not question decisions, but humans are not robots. A leader may “share a vision” (Allen et al., 2017) and state why employees are doing each job, but the employees will likely still have questions about when, where, or how they are to get the job done (Eby et al., 2003). They might not verbalize their questions if the leadership style is ineffective or prohibitive. This is where the Democratic style can be effective. When people want to share their input to better the product, the leader should always provide the opportunity and listen to their thoughts. Every organization is better when everyone can communicate their ideas openly as was observed many times in each workplace documented above. Even the newest or least experienced employee can have a bright moment when empowered, and it is the leader’s responsibility to take these ideas and utilize them for the collective good.

Fourth was Delegating, perhaps the easiest leadership style to use but the hardest to perfect. Initially, it seems easy to give orders and make each team complete the job. However, in order for delegation to be truly successful, the leader must make sure each team understands the ‘why’ behind each task and stay on pace to complete the task.

Fifth was the Authoritative style. It is impossible to get a team working efficiently without strong direct leadership. It is paramount the leader clearly communicates such that each team member understands the reason for performing each task. Employees, managers, co-workers, and leaders all need to feel useful and participate in the communication. Understanding why they are performing each job provides insight towards the end goal and gives them a purpose for showing up and putting forth extra effort every day.

Lastly, the Coercive style is one that can often be used incorrectly and come off negatively or seem aggressive. For engineers who are largely self-driven, being told exactly what to do is not the most positive experience. They would rather be able to come up with their own unique solutions. As observed, there are instances when this style is effective, but the leader needs to be cautious to not degrade team morale.

Summary

It is important to remind engineering students and educators that leadership is in many ways a learned routine that transcends the career space. Diverse and effective leadership will benefit the professional engineer on the job and in many ways beyond the workplace. Leadership is far more than simply occupying a leadership role, it extends to every aspect of life and will benefit each facet in which it is utilized. As the results of this study indicate, multiple leadership skills are required for entry-level engineers to be successful and for industry to prosper. As suggested in multiple examples, leadership skills have a clear correlation to both “objective and subjective success” within engineering (Paul & Falls, 2015). Novice engineers seeking success in entry-level positions should acquire proficiency in at least one leadership style, and long-term growth within such positions will be greatly enhanced if the engineer has a toolbox of leadership styles mastered. As the information from observing and interviewing technical leaders suggests, knowing how to effectively use a multitude of leadership techniques will positively change the trajectory of one’s technical career and quite possibly enhance their life as well.

Acknowledgments

This work was supported in part by the National Science Foundation, S-STEM, under grant number NSF-1644166.

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Biographies

CONNOR EIGELBERGER is a Packaging Specialist and Group Manager with Anheuser-Busch, where he coordinates seven separate state-of-the-art packaging lines, leading employees, planning run-time schedules, and troubleshooting issues. Connor has a Bachelor's Degree in Mechanical Engineering from Southern Illinois University Carbondale and extensive leadership training. Connor assists the Baldwinville Brewery in maintaining the highest quality standards while also adapting to run the highest number of brands of any brewery in the United States. His research in STEM leadership was developed through his many internships, co-op's, current position in the engineering industry. Mr. Eigelberger may be reached at eigelberger@gmail.com

BRUCE DERUNTZ is a Professor in the College of Engineering and also serves as the Director of The Leadership Development Program (LDP) at Southern Illinois University Carbondale, Illinois. DeRuntz and his team have secured partnerships with businesses and the NSF to prepare the next generation of global leaders for the past fifteen years. His research is in leadership development and high-performing six sigma blackbelts. He teaches classes in advanced leadership and project leadership. Dr. DeRuntz may be reached at bruce@siu.edu

HARVEY HENSON is an Associate Professor with joint faculty appointment in Science Education (School of Education) and Geology (School of Earth Systems & Sustainability) and also serves as Interim Director for the STEM Education Research Center at Southern Illinois University in Carbondale, Illinois. Henson mentors undergraduate and graduate students in science education, geology, and STEM leadership. He partners with STEM educators and serves on multiple boards and committees which seek to advance STEM education and research. His research includes STEM leadership, preservice science teaching, teacher professional development, science education assessment, earthquake seismology, and applied geophysics. Dr. Henson may be reached at henson@siu.edu