Identity Crisis: The Disconnect Between Transformational Leadership and Engineering Leadership

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

Engineers are encouraged to build leadership skills throughout their careers. According to professor's Schell & Hughes, "Only through successful collaborations from multi-disciplinary teams will society be able to solve our most complex engineering challenges. In order to be successful, these collaborations will require effective technical leadership, a role that engineers can and should fill" (2017, p.1). What constitutes quality engineering leadership is decided by the engineering community itself through the experiences of individual engineers. In academia and the field of leadership education, transformational leadership has become a popular and well-supported model of leadership. Diaz-Saenz states that since the mid-1980's, transformational leadership has been, "the single most studied and debated idea within the field of leadership" (2011, p. 299). Others have described transformational leadership as the "ascendant" (Odumeru & Ifeanyi, 2013, p. 355) leadership model of the present. However, Schell & Hughes have shown that engineers develop an engineering identity through their education and careers that may conflict with traditional leadership identities (2017). Rottman, Sacks, and Reeve argued,

> Our constant comparative analysis of quantitative data collected…suggests that engineers are largely resistant to dominant leadership paradigms drawn from other disciplines, but that they do, in fact lead in ways that blend key aspects of their identities with professionally recognized forms of influence (2015, p.351).

The transformational model has never been applied specifically to engineering leadership. Therefore, it is unknown whether the model in its traditional form is beneficial or counterproductive for educating engineering leaders. To determine this, the transformational leadership model must be applied to existing data regarding engineer's views on effective leadership, and a goodness-of-fit analysis must be performed.

In this paper, I argue that using the transformational model in engineering leadership education will deter engineers from taking leadership roles. I present data detailing engineer's perception of quality leadership, collected through survey and interview of engineering professionals and students. I explore the transactional leadership model, and apply the model to the above data. I then analyze where the model fails to fit the data, and suggest modifications to create a model better suited for educating engineering leaders.

Part I: Engineers Define the Qualities of Good Engineering Leadership

The Importance of Engineering Leadership

Kumar & Hsiao state, "Every engineering organization, big or small, needs leaders and managers for the success of the organization and projects they execute" (2007, p.18). Engineering leaders help push society forward; they drive innovation and lead teams of knowledgeable engineers to the benefit of society. As society rapidly advances and populations continue to grow, engineers must solve increasingly difficult problems on even larger scales. According to Paul, Sen, & Wyatt, these problems are driving the need for well-rounded engineers capable of leading teams of other engineers (2018, p.1). With such a high demand, practicing engineers are being encouraged to strengthen their leadership skills. As the importance of engineering leadership has become clear, it has also placed pressure on colleges, universities, and accreditation groups to increase the quantity and effectiveness of leadership education specifically developed for engineers (Kumar & Hsiao, 2007) (Paul, Sen, & Wyatt, 2018, p.1) (Rottmann, Sacks, & Reeve, 2015, p. 351-352).

The Qualities of Good Engineering Leadership

Engineering leadership is defined by the qualities and actions of successful engineering leaders. These can be summarized into a working definition of engineering leadership, or effective guidelines for engineers to improve their leadership skills.

In 2018, the American Society for Engineering Education – Canada, proposed a definition of engineering leadership (Paul, Sen, & Wyatt, 2018). Data was collected through a review of the existing literature (Rottmann, Sacks, & Reeve, 2015), as well as a survey of current engineering students and professionals. Figure 1 below summarizes their findings upon analysis.

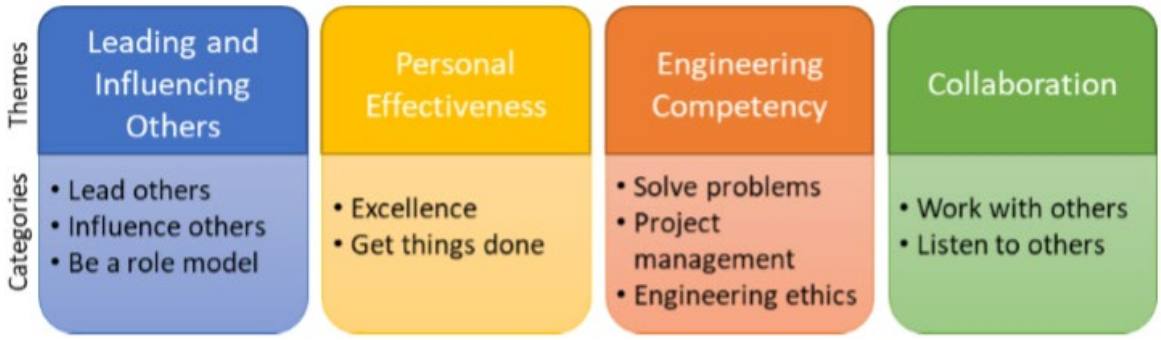

Figure 1: Summary of the themes and categories which emerged from engineering leadership definitions (Paul, Sen, & Wyatt,2018, p. 9)

It was noted that students emphasized leading and influencing others as a key leadership trait, while professionals did likewise for the theme of engineering competency. ASEE proposed the following formal definition following from their research (Paul, Sen, & Wyatt, 2018, p. 10):

> Engineering Leadership is an approach that influences others to effectively collaborate and solve problems. Engineering leadership requires technical expertise, authenticity, personal effectiveness, and the ability to synthesize diverse expertise and skillsets. Through engineering leadership, individuals and groups implement transformative change and innovation to positively influence technologies, organizations, communities, society, and the world at large.

Other researchers have placed greater focus on interviewing current industry professionals. Writing in the American Society of Civil Engineers *Journal of Management in Engineering*, K.T. Odusami surveyed 120 professionals from six different construction engineering fields and representing three different stakeholders in a typical project (2002). Odusami's goal was to determine the skills associated with effective project leadership. Tables 1 and 2 below summarize Odusami's results. Table 1 shows the skills ranked by frequency of response. Table 2 presents the list of skills and their respective definitions given to respondents.

Table 1: Overall ranking of important skills for project leaders (Odusami, 2002, p.5)

	Frequency of response					Mean	
Type of skill	4	3	2	1	0	score	Rank
Decision making	99	21	0	0	0	0.956	1
Communication	95	25	0	0	0	0.948	2
Leadership and motivation	87	32	1	0	0	0.929	3
Problem solving	71	48	1	0	0	0.896	4
Time management	72	43	5	0	0	0.890	5
Organizing	66	51	3	0	0	0.881	6
Planning and goal setting	70	40	10	0	0	0.875	7
Technical knowledge	72	34	13	1	0	0.869	8
Financial management	68	41	11	0	0	0.869	9
Quality management	61	48	10	1	0	0.852	10
Listening	49	64	7	0	0	0.838	11
Delegating	31	67	20	2	0	0.765	12
Negotiating	34	60	23	3	0	0.760	13

Table 2: Definitions of Important Skills (Odusami, 2002, p.4)

Skill	Definition
Communication	Ability to interact effectively with others at all levels within and outside organization
Decision making	Ability to take appropriate action under constraints of limited time, information, and resources
Delegation	Ability to effectively distribute tasks to other members of organization
Financial management	Ability to understand financial statements and financial ratios, and to deal with accounting firms and financial institutions
Leadership and motivation	Ability to make correct decisions for firm and theninfluence others to contribute to attaining firm's goals
Listening	Ability to receive and effectively process information provided by others
Negotiation	Ability to engage in a two-way discussion and achieve interests of firm
Organizing	Ability to align resources in such a way as to be the most beneficial for the firm
Planning and goal setting	Ability to assess and set objectives for firms, then plot a path to achieve those objectives
Problem solving	Ability to analyze adverse conditions or conflict, identify root causes, provide a practical solution, then implement it
Quality management	Ability to manage production of goods or services within a clearly defined set of expectations
Technical knowledge	Understanding of complex elements required to effectively complete tasks associated with a given profession
Time management	Ability to successfully manage multiple tasks within given time constraints

Source: Gushgar et al. (1997).

These responses show that engineering professionals consider "decision making", "communication", and "leadership and motivation" to be the three most important skills for effective project leadership. These skills are strikingly similar to the emergent themes of the ASEE research shown in figure 1. Decision making as defined in Table 2 is similar to technical competency and personal effectiveness. Communication and collaboration are nearly synonymous in definition. Finally, "leadership and motivation" and "leading and influencing others" are similar. Odusami's research reinforces the idea that engineering competency and effective decision making are considered by industry professionals as more important for effective leadership than leadership through influence and motivation.

The Disconnect Between Engineering Identity and Traditional Leadership

Research performed by Schell & Hughes in 2017, and Rottman, Sacks, & Reeve in 2015 has separately shown that engineers develop a unique engineering identity during their education and career. This identity is often at conflict with what engineers consider to be typical leadership traits. Schell & Hughes argue, "recent research has illustrated that engineers frequently exhibit a disdain for leadership and other non-technical aspects of engineering" (2017, p.2). Table 3 below shows the contrast engineering professionals see between their professional identities and "traditional" leadership qualities.

Table 3: Contrast between perceived engineering and leadership identities (Rottman, Sacks, & Reeves, 2015, p. 357)

Table 1. Mismatch between engineers' identities and traditional notions of leadership.

	Engineers' professional identities	Traditional notions of leadership
Key features/Dimensions	Applied scientist	Charismatic visionary
	Service professional	Positional influence at top of hierarchy
	Team work	"Great man"—an agentic individual
	Technical problem solver	Solves people problems
	Task-oriented doer	Delegator
	Process optimizers	Change agent

Engineers see leaders as charismatic, "great" individuals with esoteric qualities. Leaders make heavy use of their positional influence to delegate work to others and solve "people problems". However, engineers identify themselves as action-oriented problem solvers whose work is done in teams, and is primarily technical in nature. These perceived differences cause many engineers to shy away from leadership positions.

Part II: The Transformational Leadership Model's Validity for Engineering Leadership Has Not Been Determined

The literature explored in the previous section presents engineer's perceptions of quality engineering leadership, primarily through survey and interview of engineers and engineering

students. What remains absent, however, is an application of the transformational leadership model to this data. This comparison and resulting analysis must be made before the model's validity as an educational tool for engineers may be determined. First, the transformational model itself must be examined and understood.

Defining the Transformational Leadership Model

Odumeru & Ifeanyi define a transformational leader as, "a person who stimulates and inspires (transforms) followers to achieve extraordinary outcomes" (2013, p.356). Similar definitions exist in other literature, defining transformational leadership as increasing the importance and value to the follower of the leader's/organization's goals. (McCleskey, 2014, p.120). McCleskey argues that, "The transformational leader convinces his followers to transcend their self-interest for the sake of the organization, while elevating "'the followers"' level of need on Maslow's hierarchy from lower-level concerns for safety and security to higher-level needs for achievement and self-actualization" (2014, p.120).

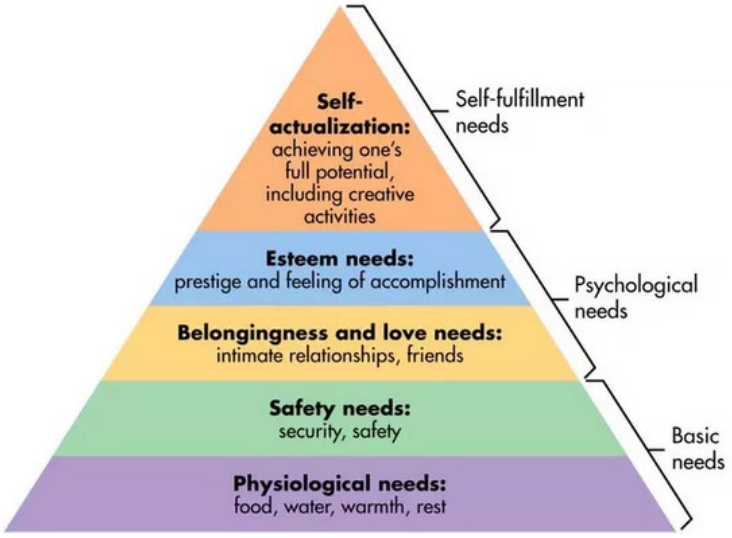

Figure 2: Maslow's Hierarchy of Needs (McLeod, 2018)

The transformational model can be separated into the following components: charisma or idealized influence, inspirational motivation, intellectual stimulation, and personal attention (Odumeru, 2013, p. 356). These components represent either traits the leader possesses, or

actions they consistently perform. Idealized influence is the degree to which followers identify with and admire the leader. People want to emulate and be close to a charismatic leader.

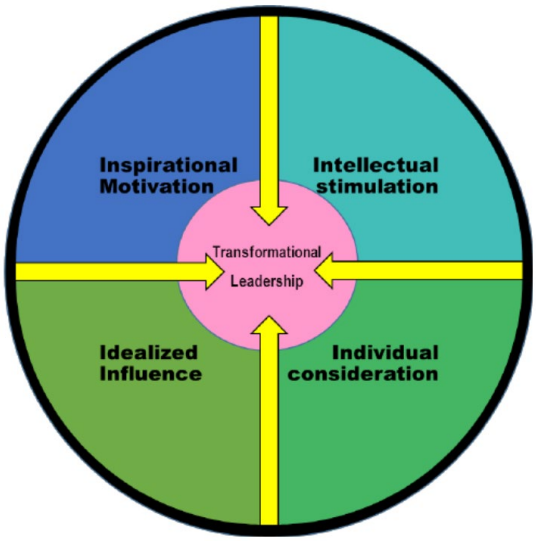

Figure 3: Characteristics of the Transformational Leadership Model (Renjith, G, & George, 2015)

Inspirational motivation is a leader's ability to share a vision of the future that offers meaning to current work and a hopeful outlook on the future. Transformational leaders offer intellectual stimulation by encouraging others to challenge existing frameworks, and work together to find novel solutions to problems. Finally, transformational leaders give personal attention to their followers. They show respect and appreciation, and seek to help others find self-fulfillment (Odumeru & Ifeanyi, 2013, p.356).

According to McCleskey, the transformational leadership model enjoys significant supporting research, but is not without criticism (2014, p. 120). Transformational leadership is extremely ambiguous, both in definition and in application. The above components are difficult to define, separate, and quantify. This makes judgements on the exact effectiveness of the model difficult. Furthermore, the model is challenging to implement due to a lack of focus on linking actionable processes to achievement of the model's component features. Additionally, most

supporting research focuses on the dyadic relationship between leader and individual follower. Less research has been published on the effects of transformational leadership on teams, groups, and organizations as a whole (McCleskey, 2014, p. 120). This weakness is especially significant given the majority of engineering work is done in teams and groups. The transformational model also reinforces the traditional concept of "heroic leadership". The follower or team is seen as dependent upon an exceptional, charismatic leader's influence to achieve success. The influence that followers may have with the leader, and concepts of shared leadership are not explored.

Importance of Testing the Transformational Model against Engineering Leadership Data

The transformational leadership model presented above is a significant part of the existing literature on leadership, and has enjoyed popular appeal for decades. As such, it is frequently applied in leadership education. However, this model has not been specifically applied to engineering leadership, and therefore its validity for teaching engineers has not been assured. By comparing and contrasting the transformational model with the data on engineering leadership presented previously, it becomes clear where the model is not suitable for use in educating engineering leaders.

P.III Use of the Transformational Model in Engineering Leadership Education Will Deter Engineers from Taking Leadership Roles

Summary of the Qualities of Engineering Leadership

While a full exploration was performed earlier in this paper, it is useful to summarize the qualities of engineering leadership before applying the transformational model. This is most clearly presented in figure 1, included here once again for reference.

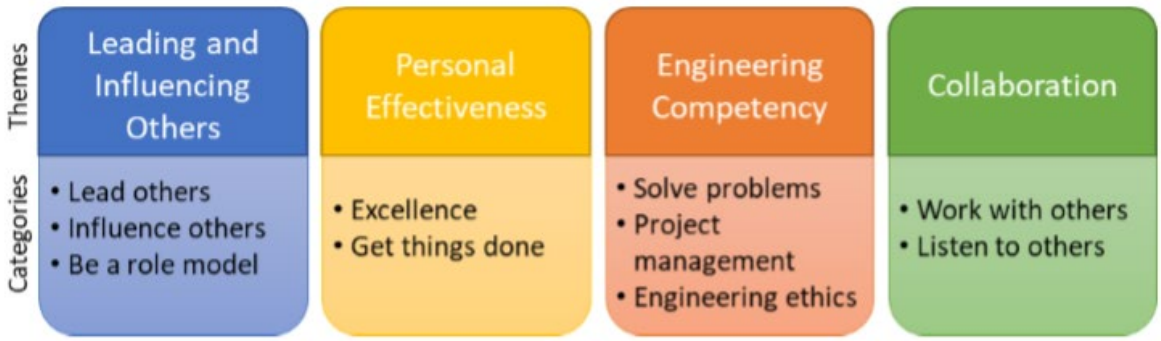

Figure 1: Summary of the themes and categories which emerged from engineering leadership definitions (Paul, Sen, & Wyatt, 2018, p. 9)

These categories are supported throughout the literature. Authors provide alternative terminologies such as "decision making", "communication", and "leadership and motivation" (Odusami, 2002) (Gushgar, Francis, & Saklou, 1997). However, analysis showed that these terminologies are included within the themes of "engineering competency/personal effectiveness", "collaboration", and "leading and influencing others" respectively. The transformational model will be applied to this thematical breakdown of engineering leadership.

Comparing the Transformational Model to Engineering Leadership

The transformational model of leadership clearly captures the theme of leading and influencing others, partially captures the theme of collaboration, and does not address personal effectiveness or competency to any significant degree. This is shown in Table 4.

Table 4: Relationship between engineering leadership themes and supporting components of transformational model

Theme/Category of Engineering Leadership	Supporting Component of Transformational Model
Leading and Influencing Others	Idealized Influence (Charisma) Inspirational Motivation
Personal Effectiveness	None
Engineering Competency	None
Collaboration	Intellectual Stimulation Personal Attention

Two of the four supporting components of transformational leadership can be linked to the engineering leadership theme of leading and influencing others. The definitions of idealized influence and inspirational motivation include similar word choices as the categories listed under leading and influencing others. The concept of a charismatic leader whom followers wish to emulate is strikingly similar to being a role model. However, there is a subtle difference in word choice. A leader whom followers wish to emulate, and a leader who is ethically sound and followers should emulate, are not necessarily the same. While engineering leadership mentions ethics under engineering competency instead of leadership and influencing others, transformational leadership does not mention it at all.

The transformational model does not address the engineering leadership themes of personal effectiveness and engineering competency, which could be summarized as personal competency. While the model conceptually discusses the leader's ability to improve follower productivity and outcomes, it does not mention the leader's own productivity and effectiveness.

While the argument could be made that a leader must be effective and competent for followers to wish to emulate them (idealized influence), this argument misses two key points. First, that the transformational model is focused on follower outcomes not leader actions. Second, that idealized influence focuses solely on the leader's personality. Charisma, or "force of personality", is often used in definitions as substitute for idealized influence. Alternatively, the categorical phrases describing personal effectiveness and engineering competency qualitatively describe direct actions taken by the leader. These themes are not based on the leader's personality, though that may contribute, but rather the quality of his actions.

In the transformational leadership model, intellectual stimulation includes encouraging others to work together when solving problems. It should be noted, however, that there is no explicit mention of the leader themselves working together with others. Similarly, the component of personal attention addresses the need to show appreciation to individual followers, and help them find self-fulfillment. However, it does not explicitly include mention of actually listening to others.

As previously discussed, Rottman, Sacks, & Reeve published a paper in 2015 analyzing the disconnect between traits engineers identified with, and traits they associated with leaders. Further work on the topic was also performed by Schell & Hughes in 2017. Much of this disconnect is caused by engineers seeing leaders as charismatic, "great men" at the top of a positional hierarchy; a role engineers either do not want to fill, or do not believe they can fill. Engineer's description of the leadership identity in Rottman, Sacks, & Reeve's work strongly correlates with the transformational model. This would suggest that engineers do not identify with the transformational model of leadership. It has also been illustrated that the transformational model does not fit all aspects of engineering leadership as defined by engineers

themselves. Specifically, the transformational model is ambiguous; it is not explicit and does not focus on actionable processes that can be initiated by the leader. It does not discuss how the leader themselves should act, or what abilities they should possess beyond strength of personality. Finally, the transformational model in no way mentions the importance of the leader having strong ethical values.

The transformational leadership model enjoys popularity. However, using the transformational model in engineering leadership education without adaptation will result in an even greater disconnect between engineering and leadership identities, and does not effectively prepare students to fulfill the role of an engineering leader. Focus on the transformational model can lead engineers to not identify with leadership traits and therefore not apply for leadership roles. It can also intimidate some engineering students, preventing them from learning more about leadership; as they worry that they don't have the "X-factor" that transformational leadership seems to require. This will limit the growth of engineering leadership as a field. The transformational model must be adapted if it is to be suitable for use in educating engineering leaders. The adapted model should contain more explicit and clear wording. Focus should be placed on the actionable processes a leader can initiate to improve follower outcomes. Perhaps most importantly, focus should be placed on how the leader themselves should act; ethically, effectively, and competently.

Some literature attempts to define engineering leadership as separate from management (Toor & Ofori, 2008) (Toor, 2011). This approach effectively seeks to separate the "leadership, motivation, and communication" qualities from the "technical and personal competency" qualities by definition; leadership and management respectively. The argument could then be made that the transformational leadership model should only be applied to leadership, not

management, thus removing the need for the model to address technical and personal competency. However, in conclusion the authors inevitably determine that both leadership and management are needed as they seek to define them; there is a need for managers who lead and leaders who manage. By admitting that both are necessary and overlap, they reinforce the fact that all of these qualities are necessary for true engineering leadership.

Conclusion

As the demand for engineering leaders grows, so too does the need to prepare engineers to take on these roles. However, engineers develop a unique identity throughout their education and careers. As Schell & Hughes, and Rottman, Sacks, & Reeve discovered, this identity can result in engineers being resistant to typical models of leadership. To determine if this resistance applied to the transformational leadership model, an analysis was performed comparing engineer's conceptualization of quality engineering leadership, the engineering identity summarized by the above authors, and the transformational model of leadership itself. It was discovered that a fundamental disconnect is present between how engineers view themselves and engineering leadership, and how the transformational model conceptualizes leadership. The conclusion of this analysis is that the transformational model in its traditional form, instead of educating future engineering leaders, is likely to deter engineers from seeking leadership roles. Further work should be performed to determine exactly how the transformational model should be adapted for future use in educating engineering leaders.

References

Diaz-Saenz, H. R. (2011). Transformational leadership. In A. Bryman, D. Collinson, K. Grint, B. Jackson & M. Uhl-Bien (Eds.), *The SAGE handbook of leadership* (pp. 299-310). Thousand Oaks, CA: Sage.

Gushgar, S.K., Francis, P.A., & Saklou, J.H. (1997). Skills critical to long-term profitability of engineering firms. *Journal of Management in Engineering, 13(2),* 46-56.

Kumar S. & Hsiao, J.K. (2007). Engineers learn "soft skills the hard way": Planting a seed of leadership in engineering classes. *Leadership and Management in Engineering, 7(1),* 18-23. Doi:10.1061/(ASCE)1532-6748(2007)7:1(18)

McCleskey, J.A. (2014). Situational, transformational, and transactional leadership and leadership development. *Journal of Business Studies Quarterly, 5(4),* 117-130 Retrieved from https://www.semanticscholar.org/paper/Situational-%2C-Transformational-%2C-and-Transactional-McCleskey/f584807652909f1c90c5a647ebcea142d2260d9a

McLeod, S. (2018). *Maslow's Hierarchy of Needs.* Retrieved from https://www.simplypsychology.org/maslow.html

Odumeru, J.A. & Ifeanyi, G.O. (2013). Transformational vs. transactional leadership theories: evidence in literature. *International Review of Management and Business Research, 2(2),* 355-361. Retrieved from http://www.irmbrjournal.com/papers/1371451049.pdf

Odusami, K.T. (2002). Perceptions of construction professionals concerning important skills of effective project leaders. *Journal of Management in Engineering, 18(2),* 61-67. Doi: 10.1061/(ASCE)0742-597X(2002)18:2(61)

Paul, R., Sen, A., & Wyatt, E. (2018). *Proceedings of 2018 ASEE Annual Conference & Exposition*. Salt Lake City, UT.

Renjith, V., G, R., George, A. (2015). Transformational leadership in Nursing. *International Journal of Scientific Research and Management Studies, 2(2),* 112-118. Retrieved from https://www.researchgate.net/publication/277138454_TRANSFORMATIONAL_LEADERSHIP_IN_NURSING

Rottmann, C., Sacks, R., & Reeve, D. (2015). Engineering leadership: Grounding leadership theory in engineers' professional identities. *Leadership, 11(3),* 351-373. Doi: 10.1177/1742715014543581

Schell W.J., & Hughes, B.E. 2017. *Proceedings of the American Society for Engineering Management 2017 International Annual Conference.* Retrieved from https://par.nsf.gov/servlets/purl/10054149

Toor, S.U.R., & Ofori G., (2008). Leadership versus management: How they are different, and why. *Leadership and Management in Engineering, 8(2),* 61-71. Doi: 10.1061/(ASCE)1532-6748(2008)8:2(61)

Toor, S.U.R., (2011). Differentiating leadership from management: An empirical investigation of leaders and mangers. *Leadership and Management in Engineering, 11(4),* 310-320 Doi: 10.1061/(ASCE)LM.1943-5630.0000138