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Management and Leadership Style: Is Style Influenced by Engineering Education?

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MANAGEMENT AND LEADERSHIP STYLE:
IS STYLE INFLUENCED BY ENGINEERING EDUCATION?

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I dedicate this thesis to the souls of my father and grandparents. I would like to dedicate this thesis to the strongest pillar of my life my mother, who supported me at every step in my life. To my younger brother, who made our lives more lively, fun and vital, I wish you all the best for your future and always stand beside me. To my sisters and brothers-in-law who were very supportive throughout my life. To my nephews and nieces who are the fruits of our lives, you have given real meaning to our lives.

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Leadership Development Programs (LDPs) programs are employed by firms globally in different multiple manners that are aimed at accelerating the development and growth of highly capable candidates. Among these candidates, depending on the particular LDP, may be those possess engineering skills typically afforded through engineering education as measured by completion of an engineering degree. Infrastructure reductions might be afforded corporations if multiple LDPs could be supplanted with one program such as an Engineering Leadership Development Program. In practice, however, economic constraints limited the total sample population of this category to 67 (48 with engineering degrees and 15 without). Employing SPSS Sample Power 3, based on the pilot testing for CPMs, 113 subjects per group (with and without engineering degrees - totaling 226) would be required to yield a power of 80%, and of the 350 received completed surveys received, CPMs meeting the desired criteria accounted for only 63 (18%) of the total number of rated organizational leaders. Consequently, while all testing included the CPM group, the scope was expanded to also include managers with and without PMI certifications as well as managers with and without engineering degrees. The first research hypothesis was Ho: There is no affiliation amongst Transformational Leadership (TL) and engineering education. Thus, the author's aim is to determine the role, if any, that engineering education plays in perceived leadership style as exhibited by CPMs and non-CPMs holding

engineering degrees (e.g. EE, ME, IE, etc.) versus the same without engineering degrees.

A secondary goal is to determine, within the management category, which style (transformational or transactional) serves as the dominant style of leadership. With this in mind, the independent variable, CPMs with and without engineering degrees, was operationally defined consistent with this Project.

Introduction

Many corporations employ multiple Leadership Development Programs (LDPs) aimed at accelerating the development and growth of highly capable candidates. Among these candidates, depending on the particular LDP, may be those possess engineering skills typically afforded through engineering education as measured by completion of an engineering degree. Infrastructure reductions might be afforded corporations if multiple LDPs could be supplanted with one program such as an Engineering Leadership Development Program. Thus, the question arises: is there a correlation amongst leadership style (transformational or transactional) and engineering education between candidates with engineering degrees and those without. Further, if such a relationship exists, is it predominantly transformational or transactional? In an attempt to normalize the research in this area, two categories have been selected - CPMs and non-CPM managers with engineering degrees and the same without engineering degrees. The concept of assessing various leadership environments for the presence of transformational or transactional leadership attributes is not entirely new.

Leadership Defined

It has been defined and described at stretch in publications, text books and other formats of literature. One of them is provided by Katz and Kahn (1966) characterizing leadership as "one act of inspiration on a substance of structural significance."

This would imply that one of the principle responsibilities of a leader is to move the organization forward in such a manner consistent with the best interests

of the business. This notion of consistency should not be understated as all too often, instances have been documented of leadership application in a manner inconsistent with the organization's stated relevance (e.g. Enron, Global Crossings, etc.). Bums (1979), said "leadership as leaders tempting factions to doing for particular objectives that characterize the motivations and value of both followers and leaders". This descriptor would imply that there exists a sort of connectedness between and among the leaders and followers. Perhaps this is the intent of the following comments offered by Boyatzis et al. (2005), "great leaders are awake, aware, and attuned to themselves, to others and to the world around them" (p. 3). Leadership is defined by Chemers as "a procedure of public inspiration by which an individual mobilizes and enlists the support of others in the acheivemnt of a mutual objective" (p. 10).

The leader provides direction in the form of inputs to the workers who, in turn, process that direction to develop an output. The initial output is reviewed by employees and modified to fit their interpretation of leader inputs. Follower output is submitted to the leader for assessment. Upon assessment by the leader, the output is either "re-worked" by the followers, or it is accepted by the leader who then provides a new input for processing.

Theoretical Leadership Models

Modeling leadership approaches and patterns has proven quite useful, particularly, in an academic setting where the students have yet to experience first-hand the joys and pains of leadership.

Among the many leadership models is "contingency theory" which,

according to Fiedler & Garcia (1987), "the most widely recognized [contingency theory model]." As the name implies, the model posits that leadership styles and responses are contingent on various situations and, based on these situations, characterizes the leader as either "relationship motivated" or "task motivated." Specific situations may be described as "member - leader relations, position power and task structure." As an example regarding leader- member relations, in an environment where trust and good overall perception of the leader is experienced, those associations are "described as worthy." Task structure denotes "the point to which necessities of a task are spelled out and clear" while position power has to do with "the expanse of power a leader has to punish followers or to reward them" (Northouse, 2013, pp. 124, 125).

As previously mentioned, leadership models aimed at improving leader effectiveness, be it through subordinate motivation, performance management, decision efficiency or otherwise, abound in related literature. And, while it was not the intent of this section to comprehensively address any and all such theoretical approaches, those mentioned should adequately introduce the topic and, possibly, precipitate additional enquiry of the topic which is left to the reader.

Leadership Levers

Thus far, discussion of leadership has considered, for the most part, leadership characterizations, theories and models. Yet, there are other mechanisms at the leader's disposal that may also be of assistance in moving the needle of organizational effectiveness. Three such critical tools are leveraging teams and their associated infrastructure, receiving and delivering feedback, and leadership

coaching.

Leveraging teams

Regarding teams, there is so much to be said about the progress that can be made working in a collaborative group versus flying solo. Strength in numbers is perhaps nowhere more evidenced than with an analysis of nature's wolves. Similar to human teams, wolves achieve even the most critical and fundamental goals (e.g. hunting) in groups or packs. Operating in a sort of hierarchy, wolves are pack animals that communicate by gestures of head, body, and limbs thus maintaining order in the pack. Similar to the responsibility of the leader of a human team, to include removing barriers to effectiveness and quenching the members' hunger for challenge, the father wolf obtains food for the family (Young Students Learning Library, 1995, pp. 2802, 2803). In this way, one construct for viewing wolves in a pack, or a team of people interacting in an interdependent manner, is to consider such in systems context. Doing so is consistent with the systems perspective offered by Kets et al. (2007) who suggest that "a structure is a set of intermingling elements with associations between them" (p. 31).

Feedback

A frequently used tool aimed at honing a leader's effectiveness is the 360° feedback instrument. Although the emphasis of this section, for the purposes of reviewing 360° feedback, has to deal with individual improvement, it may also be used "for merit raises, downsizing, performance appraisals and succession planning" (Capritella, 2002, p. 2). Throughout this paper, reference has been made

to leader of group interactions and its importance in the leadership arena. Have a closer look at a formal feedback instrument, the 360° form, as well as review aspects of its supporting infrastructure.

An instrument that is efficient is as follows: "The 360° feedback is a feedback form that is concluded by the applicant, applicant's superiors, colleagues, subordinates and peers" (Crispo & Sysinger, 2012, p. 2). Hence, reference to the tool as being "360°" feedback adequately articulates the degree to which organizational feedback (participant's strengths and weaknesses) is provided. In fact, in some instances, the word "weaknesses" is often supplanted with "development opportunities" to assure the highest chance for success in the leader's acceptance of such feedback (the latter descriptor may be viewed as less critical). This is a very important aspect associated with the 360° process which is intened to receive balanced feedback from the organizational levels with which the participant most frequently interacts.

Leadership Coaching

The final leadership tool that will be discussed in this section is executive coaching. How often it happens that an underdog team miraculously executes an amazing come from behind victory or heard tale of an impoverished elementary school that succeeded against all odds in meeting testing score requirements? These stories convey the essence of the power behind coaching. Yet, effective coaching is not confined to circumstances offering low probability for success. Today, many executives depend on coaching, either formally or informally, to buttress their success. Indeed, according to the Chartered Institute of Personnel

and Development (2010), "two-thirds of organizations report using coaching..." (p. 140). One might ask how effective coaching at the executive level can actually be given that those at such responsible levels in the organization are, in essence, seasoned and, to some degree, unyielding. There is a metaphorical adage in this area which states that: "you can't teach an old dog new trick."

To the contrary, however, retraining through coaching of seasoned executives is quite doable and beneficial. According to Kets, et al. (2007) "persons whose characteristics of personality have been formed largely (this consists people mostly over 30) can still mark substantial modifications in their manners" (p. 13). While specific coaching strategies vary as a function of client operating environment (e.g family owned business), the focus of this writing assumes the typical corporate environment whereby a leader has no lineage ties within that organization.

Purpose

The intent of this study of quantitative methods is to conclude the association, if one exists, amongst leadership style and engineering education. The independent variable, engineering education, is defined by CPMs and non-CPM managers with engineering degrees and the same without engineering degrees. Thus, engineering degrees are expected to serve as a surrogate for engineering education. Predicated on the above theoretical discussions, the dependent variable, leadership style, is defined in the context of transactional and transformational. The interval based Multifactor Leadership Questionnaire (MLQ) will be employed to assess the presence of the dependent variable among the targeted population.

Although doing so is beyond the scope of the current proposal, results from this paper might become an impetus for extra exploration aimed at addressing the broader question of whether or not a relationship exists between engineering skills and effective leadership.

Problem

Many Fortune 500 companies employ specific programs aimed at developing the core skills and business acumen for future organizational leaders.

Such programs are typically referred to as Leadership Development Programs (LDPs). Often times, these same companies employ multiple LDPs. General Electric, for example, offers LDPs in the areas of Communications, Finance, Information Technology, Manufacturing Operations and Sales and Marketing. Each LDP necessitates dedicated infrastructure for its respective execution which, in turn, requires resource allocation that is often redundant. If multiple LDPs could be supplanted with one LDP, leveraging highly talented entrants, economic benefits would be realized through reduced infrastructure for the support of multiple programs. Intuitively, engineers are potentially an excellent feeder pool for such a replacement program as they are tremendous thinkers and, given the rigor of their curriculum, have demonstrated resolve in the face of complex problems and challenges.
http://www.pmi.org/en/Certification/Project-Management-Professional-PMP.aspx.

Non-CPM managers are operationally defined as those, with and without engineering degrees, from whom direct reports or matrix level reports receive their day-to-day work assignments. The integration of these groups would be

operationally defined simply as the integrated population with and without engineering degrees. Leadership style, the dependent variable, is operationally defined by the transformational and transactional leadership constructs consistent. TL includes influence and motivation while XL focuses on rewards and punishment avoidance.

Literature Review

The notion of transformational and transactional leadership being theory is not as commonly accepted as, for example, the theory regarding relativity. Indeed, (Barling et al., 2010) stated this perspective regarding TL, "usage of the term theory as it is furthermost acquainted to consultants, however it was recognized that ample of the current studies appraised in this chapter might not suit that effort in its stirngent description" (p. 32). Notwithstanding arguments regarding the application of theory in this context, literature addressing the theoretical foundation of leadership abounds.

Effective leadership was not simply about implementing canned tools, models, or applying the traditional carrot and stick rules. Despite the approach employed, any effective attempt at leadership must take into account the psychology of leadership – the cognitive process as previously discussed. Avolio and Bass (2004) described it as "when all echelons of project leaders, students and managers across the globe were requested to define the behaviors and characteristics of leaders who was the most effective with whom they had operated previously" the characterizations were more transformational than transactional. Among the specific descriptors used for these leaders were "intellectually stimulating, inspirational, visionary, challenging, determined to maximize performance and development oriented" (p. 3). These characterizations essentially mirror the five constituent elements of TL. Thus, the presence of these attributes in any one or more of the tested groups might also identify a leadership feeder pool for future effective leaders.

Precedent for assessing the presence of transactional and transformational leadership attributes in the general area of followers and leaders (e.g. project teams) was provided by Hoyt and Ciulla (2004), with the following comments, "transformational

leadership ...studies the association amongst the followers and the leader and emphasizes on matters associated risk-taking, vision, confidence and enthusiasm" (p. 577). Similar sentiments exist regarding the XL style as it, too, assumes a leader - follower environment for its execution.

Aimed at facilitating research toward addressing the above purpose statement, a literature tree was developed and implemented. As indicated in "Figure 1" , the first step in addressing the main problem was to determine appropriate categories, "sub problem number 1," that may afford statistical comparisons between representative groups of candidates possessing engineering education and those without such education. The author searched literature databases for books, journals, etc. in the area of engineering oriented leadership categories. Here, the author sought to identify such categories that were commonly recognized and positioned in a leadership hierarchy. In an effort to further minimize potential noise, incumbent criteria (e.g. project management certification) were established. Thus, CPMs with and without engineering degrees served as one comparison set within the independent variable. A similar search of literature databases (e.g. books, journals, etc.) was conducted in the area of leadership. The aim was to identify references to leadership theory that were commonly understood to be both observable and quantifiable. Thus, transformational and transactional leadership styles (comprising the dependent variable) were selected for assessment when considering the target population - CPMs and non-CPM managers with and without engineering degrees.

The final step in this area, leveraging the literature reviews, was to identify Likert type scale based survey instruments that were commonly regarded as validated per

scholarly and peer reviewed writings. As will be discussed in subsequent sections, the Multi-Leadership Questionnaire (MLQ) was employed for leadership style assessment.

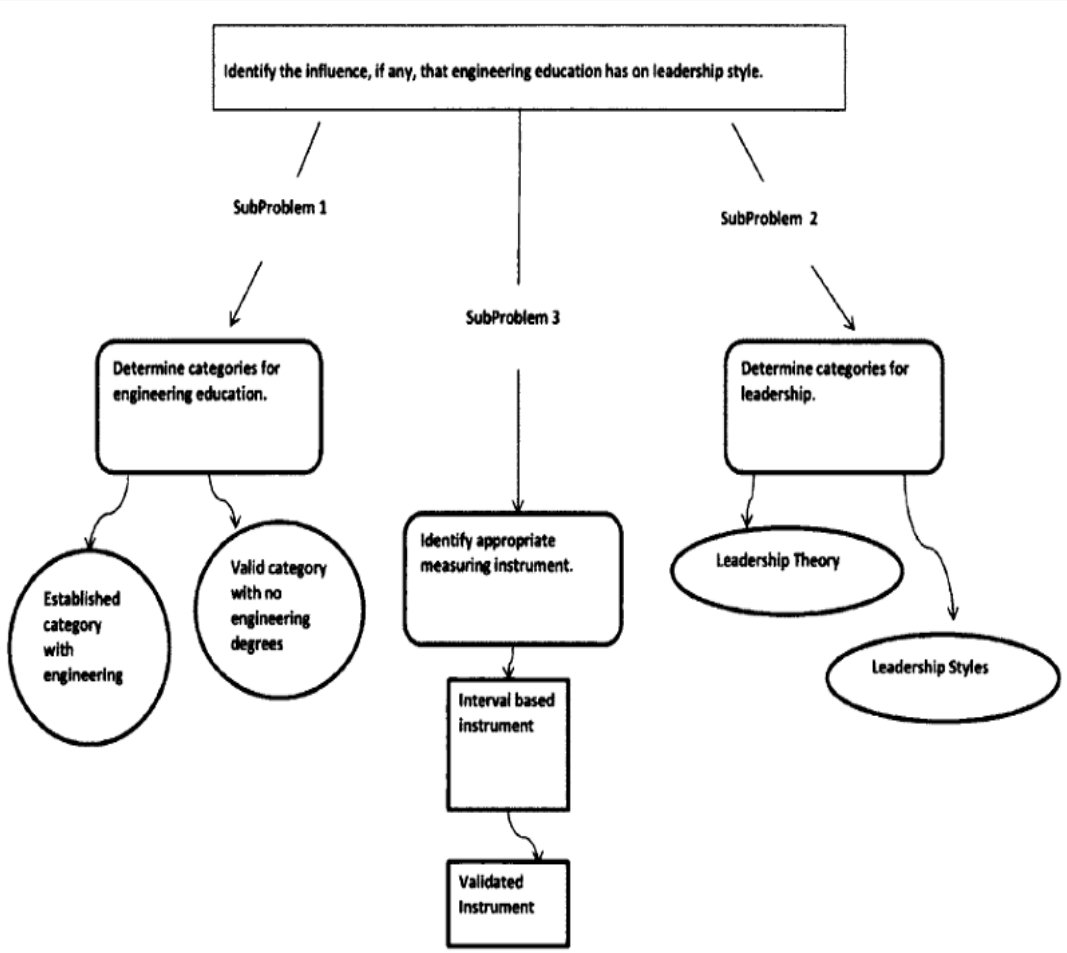

Figure 1. Multi-Leadership Questionnaire.

Literature Review Detail

While literature reviews to date provide much insight regarding the areas of project management and leadership style, such reviews have not identified a study, or studies, assessing the extent that engineering training may, or may not, influence leadership style. This perspective was substantiated by a literature review conducted in support of the current research proposal.

Table 1 reflects the keywords employed, and databases interrogated, in search of literature on the topic.

Table 1.

Database Searches Versus Key Words

Data Base	Keywords
Google Scholar, JSTOR, IEEE, IEEE Xplore, Academic Search Complete	Project Management and Transformational Leadership
Google Scholar, JSTOR, IEEE, IEEE Xplore, Academic Search Complete	CPMS and Transformational Leadership + CPMS and Transactional Leadership
Google Scholar, JSTOR, IEEE, IEEE Xplore, Academic Search Complete	CPMS and Transformational Leadership + CPMS and Transactional Leadership
Google Scholar, JSTOR, IEEE, IEEE Xplore, Academic Search Complete	CPMS and Transformational Leadership
Google Scholar, JSTOR, IEEE, IEEE Xplore, Academic Search Complete	Engineering Project Managers and Transformational Leadership

Resulting from the above search, thirteen articles were retrieved as indicated in Table 2.

Table 2.

Summary of Articles

Article No.	Assessement		Assessment of TL		Assessment of XL		Engineering Degree
	PM TL	PM XL	CPM's	Non CPM's	CPM's	Non CPM's	
1	X	X	GAP	GAP	GAP	GAP	GAP
2	X	GAP	GAP	GAP	GAP	GAP	GAP
3	X	GAP	GAP	GAP	GAP	GAP	GAP
4	X	X	GAP	GAP	GAP	GAP	GAP
5	X	X	GAP	GAP	GAP	GAP	GAP
6	X	GAP	GAP	GAP	GAP	GAP	GAP
7	X	GAP	GAP	GAP	GAP	GAP	GAP
8	X	GAP	GAP	GAP	GAP	GAP	GAP
9	X	X	GAP	GAP	GAP	GAP	GAP
10	X	X	GAP	GAP	GAP	GAP	GAP
11	X	X	GAP	GAP	GAP	GAP	GAP
12	X	GAP	GAP	GAP	GAP	GAP	GAP
13	X	GAP	GAP	GAP	GAP	GAP	GAP

It was clear that while much research had been implemented in the area, little to no categorization of the raters, or those being rated, was identified. Thus, it was not known, for example, whether or not the project managers were certified nor was the level

and or type of education documented. As a point of fact, of the thirteen retrieved articles, only six demonstrated evidence of project manager assessment for TL, four either only assessed one factor, were gender biased, or did not specifically point to the subject being assessed as the project manager. Likewise, while assessments of TL were present in all articles retrieved, ten of the thirteen either referenced other studies, only assessed one factor, assessed portfolio managers, or were gender biased.

Literature Review - Beyond the Gap

Notwithstanding the lack of categorization of the sample group as discussed above, the reviewed literature did offer insights as to the potential for linkages between project management and various leadership styles including transformational and or transactional leadership (Deanne, Hartog & Keegan, 2004; Ryoma & Tapanainen, 1999; Neuhauser, 2007; Muller & Turner, 2010; Prabhakar, 2005; Kissi, Dainty & Tuuli, 2013). Attempting to assess the presence of TL within leader subordinate groups was quite prevalent. Indeed, according to Deane et al. (2004) "transformational leadership was an impression that had grown in importance in previous couple of decades" (p. 610), and while Deane et al. (2004) hypothesized it as "style of transformational leadership was absolutely associated to worker commitment and negatively to worker's perceived stressfulness of the job" (p. 612), Muller and Turner (2010) found that "Concern of people and transformational leadership, was essential on extra challenging assignments" (p. 446). Although the former hypothesized relationship was not supported by study results, taken in concert with findings by Muller and Turner (2010), such might suggest that TL style becomes even more important as project demands increase, particularly

with regard to motivation which was a key component of the TL style and which was also respectively measured by the MLQ instrument (Schriesheim et al., 2009, p. 608).

Notwithstanding Muller and Turner (2010) hypothesizing as"Leadership style of the project manager effects the success of project and that various types of leadership styles can be appropriate for various kidns of assignments" (p. 12), they also cite studies suggesting that motivation falls under the emotional competency category also advancing a slightly different leadership style construct. In this vein, Dulewicz and Higgs (2003), "acknowledged fifteen [proficiencies] which effect performance of leadership". They collect the proficiencies into three types of abilities, which they term managerial (MQ), emotional (EQ) and intellectual (IQ)" (Muller and Turner, 2010, p. 23). While Neuhauser (2007) held a view of leadership style more aligned with transformational and transactional, the role that gender may play in leadership style was also brought to light.

In particular, it was stated that "there was an organization of study that recommends that women and men demonstrates different style of interpersonal communication and leadership" (p. 23). Neuhauser (2007) also cited Rosener (1990) who "establish that women inclines towards transformational leadership in contrast to men" (p. 23). Yet, as also pointed out by Neuhauser (2007), "the conducts branded as the utmost significant (absolutely vital and important) [in project leadership included attributes of] transformational, [and] transactional [leadership]" (p. 25). As previously referenced, one of the key aspects of TL was providing a clear vision. Indeed, according to Lussier and Achua (2009), "leader with transformational skills emphasizes on employees and their inspirations, behaviors and beliefs, and offers them ideas that please their desires and needs" (p. 5).

Christenson and Walker (2004), concurred arguing that "a noteworthy ingredient for success of a project management is intelligent and effective leadership conversed via a motivating idea of what the task was intended to accomplish and how it can make a noteworthy constructive impression" (p. 57). In so much as vision was subsumed by TL style, it could be argued that TL was therefore instrumental in project success. To this end, Kissi et al. (2013) hypothesized that "transformational leadership conducts of portfolio managers definitely impacts the performance of project" (p. 487). Study results offered support for this hypothesis as follows: "transformational leadership [had] a positive and significant association with performance of the project ($p = 0.328$, p b 0.001) and explains 10% of the variance in project performance" (p. 491). Thus, the linkage exists between TL and project success. Andreas et al. (2013) went a step further in defining the linkage between project leadership and project performance hypothesizing that, "behavior of transformational leadership had particularly work in tasks that has clear clarity of objective instead of uncertainty in path-goal [and that such leadership] will be particularly effective in short durations of project" (p. 4). However, despite apparent literature based support offered for the propositions, the authors also stated, "we had not yet empirically confirmed these results... we therefore support the empirical analysis of our suggestions" (p. 7).

To this point, the literature review had, for the most part, focused on the project manager and, as such, assumptions have been made regarding the team. Haung et al. (2011) founded on addressing the relationship between style, leadership, project success and teamwork. They hypothesized that "Leadership and teamwork of the project manager (in lieu of team cohesiveness, collaboration and communication) were interrelated [that]

project success and overall teamwork and overall project success were connected [and that] project kind might act as a mediator amongst project success and overall teamwork" (p. 260). Reflecting on these hypotheses, it would appear logical that the more unified the team the greater the chances were for success. Accordingly, Haung et al. (2011), referring to their study results, found that "all three combined methods (project manger's teamwork, leadership, and overall performance of the project), are connected" (p. 263). Thus, these comments might suggest that while leadership style played a very critical role in project success, it was the team's reception of that style which serves as the impetus for such success.

In the spirit of implementing research that contributes to the body of knowledge, an additional literature review was conducted considering the expanded sample population (managers without PMI certifications). Databases interrogated were Google Scholar and EBSCO Discovery Service. Employing grouped keywords such as "transformational leadership and engineering education" or "leadership style and engineering education" or "transformational leadership and engineers," as well as similar keyword terms, no relevant existing literature was identified on the topic. The author was successful in locating articles that focused on TL and the education sector as well as one article (Sibel, Olga, Alabart, & Medir, 2013) which focused on allowing engineering students of fourth year who were registered in a "Course of project management, the prospect to improve their competencies of team leadership" (p. 66). Another article authored by Collado, Laglera, and Montes (2013) conducted structural equation model testing to assess the "effects of leadership style on engineers" (p. 7). However, this Spain based study did not assess the leadership style of the engineers themselves. Instead, it

assessed the effect of the engineers' superior's leadership style on the engineer's attitudes as subordinates. Consequently, the current research, even considering the expanded sample population, addresses a gap in the literature regarding the associations, if any, amongst engineering education as well as leadership style.

Emotional Intelligence and Leadership

It was no secret that intelligence was a fundamental requisite for executive level leadership. However, it was not simply the technical aspect of intelligence that makes things, it was also the personal or emotional intelligence (El) that enables leaders to make not only critical decisions but also the best critical decisions. Motivating followers to contribute their best in every situation and in all cases was a fundamental tenet of successful leadership. Often, in order to accomplish this precept, a profound connection between leaders and followers was required. According to Boyatzis, et al. (2002), "the demonstrative job of the leader was primal... it was equally the most important and original act of leadership... [thus] the leader performances as the emotional guide of group" (p. 5). This notion that the leader serves as an emotional guide was key given that, according to Boyatzis, et al. (2002), "we depend on relationships with other people for our own demonstrative firmness" (p. 6). It would logically follow then that those leaders who possess the capacity to connect at this level were best positioned for success. The importance of employee emotional satisfaction cannot be understated as it links directly to job performance. In fact, Boyatzis, et al. (2002) suggest "those employees who feel positive will expected to go the furthest to satisfy clients and thus increase the end product i.e. results" (p. 15).

Kets, et al. (2007) said that "emotional intelligence centers primarily on one's ability to manage in a emotional and social environment" (p. 18). Northouse (2013) offers the following comments regarding El, "as the couple of words recommends, demonstrative astuteness had to do with our thinking (cognitive domain), and emotions (affective domain) and the interaction amongst the two" (p. 27). This definition distinguishes between the two words "emotional" and "intelligence" suggesting that effective use or implementation of El be predicated on an understanding of emotions resulting from user intellect.

Having an awareness of, and capacity to manage, one's own feelings as well as being able to empathize and connect with others' feelings positions the leader to implement effective relationship management, our last of the four El domains. More specifically, relationship management was about "authenticity" and how it was used may serve to strengthen a leader's connectedness with not simply employees but also those with whom the leader interacts on a 360° basis. Thus, leaders should continue to build on existing El skills and seek to expand the strengths (e.g. organizational awareness and collaboration) associated with these skills. "Having a greater selection of emotional intelligence powers can brand a leader utmost operative as it simplifies that leader was springy to grip the greater burdens of operating a company" (Boyatzis, et al., 2002, pp. 51, 85).

Thus far, our discussion regarding El had focused on the individual level. However, in order to transform the organization, a leader must transcend self-transformation; and was also responsible for transformation of the team. Key attributes of El, such as self-awareness, were also applicable at the team level

(teams will be discussed in detail in a subsequent section of this paper). It was worth noting, however, that effective use of El at the team level begins with each member of the team acknowledging the feelings and emotions of every other member. Actions in this area '"may similarly mean building customs for instance pay attention to perspective of everyone - comprising that of a sole insurgent – prior to making a decision" (Boyatzis, et al., 2002, p. 179). The art of listening was a requisite skill for leader to organization connectedness and resonance.

Resonant Leadership

A not so subtle relationship exists between resonant leaders and emotionally intelligent leaders. In a sense, resonant leadership was all about connecting or being in tune with those with whom the leader interacts (e.g. subordinates, peers, and other constituents). In other words, "when emotions were driven by leaders confidently they highlight best of everybody this influence was called resonance [and El is] how leaders handle themselves and their relationship" (Boyatzis, et al., 2002, p. 5, 6). In the lexical sense, resonance was defined as "a strengthening of voice in a body having vibrations triggered by influences from a different body vibrating at closely to the same frequency" (Merriam-Webster's Dictionary and Thesaurus, 2007, p. 689). Sure, some help was available to the leader in the form of intrinsic motivation. Yet, according to Ivancevich & Matteson (1993), intrinsic rewards typically align with one or more of the following categories: "completion - the capability to begin and end [something], accomplishment - concludes when someone achieve a difficult task, independence - privilege and right to make judgements, [and] personal growth - expansion of

capabilities" (pp. 208, 209). However, what happens in the instance whereby resulting from job design, as an example, the employee was not allowed to complete an assignment or goal prior to being reallocated to another task, or when decisions were handed down versus allowed, or when job stagnation exists? Under these circumstances, the challenge of motivation, and thus resonance, falls upon the shoulders of the leader.

Transformational Leadership and Credibility

Despite the best business school preparation, only experience in the field can prepare an executive for the vicissitudes of leadership. Transcending these ups and downs of leadership was earned credibility which often serves as the predicate for leadership effectiveness. While the principal goal of this section was to discuss leadership credibility through transformational applications, primarily to allow for reader comprehension, this section briefly addresses the TL style. Nystedt (1997), suggests that "styles of behavior have been explained into concepts for instance transactional, charismatic, visionary and transformational leadership" (p. 49). Focusing on XL and TL styles, according to Cilliers, et al. (2008), the following distinguishing characteristics: "Transformational leadership – idealized influence, indicates that respect of followers, trust and admire, the leader as well as follow his or her conducts, undertake his or her morals, and were dedicated to accomplishing his or her revelation and building expenses in this affection...Transactional leadership - contains a process of social exchange where it was clarified by the leader that what was needed by the followers to do as their task of a deal (completing the task successfully) avoidance of punishment or to receive a reward

(acheiving the supporters desires) that was dependent on the accomplishment of the task (acheiving the needs of leader)..." (p. 255). It might be argued that the characterization of XL was predicated on certain aspects of Maslow's needs hierarchy as will be discussed in a subsequent section of the current research.

Referring once more to TL, which was built on openness and engagement, Lo, Min and Ramayah, (2009) wrote, "transformational leaders [have] a more significant relationship with organizational commitment" (p. 137). Through motivation and workforce engagement, TL builds equity in the form of employee loyalty which serves the entire organization and its constituents. One very simple, yet often elusive, TL practice that facilitates organizational engagement was listening to the employees which enable four dimensions of effectiveness. First, the leader was able to gain an understanding of how employees view the world around them and thus, how they might interpret direction provided to them. Second, the leader was able to begin the process of connectedness (previously discussed), which enables the engagement process. Third, quite simply, the leader gains the respect of employees because they now feel that someone - one quite powerful in the eyes of the organization - cares about what they had to say. Finally, the leader gains insight into what was really happening within the organization and, depending on the employee's organizational hierarchy, critical operational details that might otherwise be overlooked are now made available to the leader. Listening to and engaging employees also sets the ground work for the leader to execute the "five customs of classic leadership: idealize the path, stimulate a combined idea, test the procedure, empower others to perform, and

inspire the efforts" (Kouzes & c Posner, 2007, p. 14).

Returning to TL attributes, if correctly imparted, the organization should also assume the leader's values. The focus here was on shared and synchronized values which "were the fundamentals for creating genuine and productive working associations" and as a result of this approach, "remarkable dynamism was produced when values of organization, group and individual were in synchronized" (Kouzes and Posner, 2007, pp. 60, 61). .

The Role of Psychology in Leadership

To initiate the discussion, first of all recall the definition of psychology which may be summed up as human behavior characterization. In this context, perhaps leadership can be viewed as an attempt to positively influence the followers cognition and emotion such that they, the followers, feel good about themselves and, in turn, are motivated to execute their jobs with quality. This paper had discussed several approaches to leadership; visited theoretical leadership models, and available leadership tools. What remains an open area for discussion was how the cognitive process functions when interpreting various leadership approaches. Why was it essential to recognize the role of the cognitive process in leadership, more importantly why was leadership motivation necessary at all? One response to this question was that "it has been projected that comapnies lost up to $370 billion in productivity each financial year in the United States solely owing to employees not emotionally engaged "(Lawrence, 2011, p. 15). Thus, an understanding of the cognitive process coupled with the appropriate leadership motivation offers the potential for tremendous returns.

Given the complexities of the human brain it was imperative that effective leaders make appropriate connections (recall discussions regarding resonance) with those whom they lead toward change and since very often communication serves as the enabler for such connections it must therefore be executed with the utmost care and scrutiny. This perspective was shared by Kussrow (2001) as he wrote, "meanwhile it was brains of people that leaders attempt to sway...it tracks that it was perilous that the individual being [led] precisely understands what the leader anticipated to converse" (p. 10). Indeed, "it was hard to change behavior, even for persons and even when fresh conducts can mean the dissimilarity amongst existence and bereavement" (Rock & Schwartz, 2007, p. 10). Each and every organization comprises individuals with disparate habits and varying levels of organizational commitment. Thus, it was not at all surprising that any attempt to change an organization's mindset may be extremely difficult. To this point, "transformation of organization that incomes into account the biological brain's nature, and the methods in which it influences persons to fight few kinds of leadership and assent others [may offer the best chance for success]"(Rock & Schwartz, 2007, pp. 10, 11).

With this in mind, as a leader, if something does not progress consistent with plans or expectations, (e.g. sales results did not meet forecast levels), the "drive to defend" may result in the leader overlooking key information that might otherwise provide clues as to why the sales forecast did not come to fruition. Returning to the performance review discussion, in the absence of a "good review," an employee could perceive this as a threat to the right to acquire. This

could logically give rise to the development of barriers to trust building with the leader. Another perspective with regard to human requisites was offered by Maslow's hierarchy of needs. According to Ivancevich & Matteson (1993), Maslow's five stage model includes the following five human needs positioned hierarchically: i) physiological, ii) safety and security, iii) belongingness, social and love, iv) esteem, and v) self actualization. While an extensive review of the five stages was left to the reader, it was worth mentioning that, returning once again to the performance review discussion, the threat to an employee's right to acquire (e.g. a good performance rating) could also represent a threat to physical needs including "food and shelter" (p. 143).

Predicting Leadership Behavior

Although advancement had been made in the area of predicting leadership behavior, based on psychometric modeling, the fundamental concept was not new. According to Lynam and Miller (2001), "as in the beginning, the arena of behavior studies has been anxious with recognizing the simple behaviors that function as the pillars of character" (p. 767). Among some of the most researched behavioral models are the Five Factor Model (FFM) - McCrae and Costa (1990); Three Factor Model (PEN) - Eysenck (1977); Three factor model - Tellegen (1985); Character and Temperament Model - Cloninger et al., (1993), (Lynam & Miller, 2001, p. 767). Lynam and Miller (2001) also suggest that the basis for these models ranges from "lexical hypothesis" associated with the FFM to "factor analysis and mood scales," employed by Tellegan, to "biological/pharmacological," associated with the Cloninger and Eysenck models

(p. 767 -768). There was also the Myers-Briggs Type Indicator (MBTI) – Briggs and Myers, which, according to Carlson (1985), "was a examination intended to instrument...theory kind...thus, similar to the projective methods, the MBTI was narrowly associated by psychodynamic believes, at slightest in its inventive formation" (p. 365). It was appropriate at this point to expand discussions regarding the FFM which was, according to Costa and McCrae (1992), "a categorized exemplary of character mannerisms with five immense customs known as realms on the highest, that was, Conscientiousness, Neuroticism, Agreeableness, Openness, [and] Extraversion" (p.49). According to Levine and Raynor (2006), each of these five domains was further defined as follows: Conscientiousness - refers to striving for competence and achievement, and being self- disciplined, orderly, reliable, and deliberative. Neuroticism - refers to easily experiencing unpleasant and negative emotions, such as fear, anxiousness, pessimism, sadness, and insecurity. Agreeableness - refers to being courteous, good natured, cooperative, tolerant, and compassionate rather than antagonistic. Openness - refers to intelligent, imaginative, curious, flexible and broad minded. Extraversion - refers to enjoying the company of others, and being active, talkative, assertive and seeking stimulation" (p. 73).

Methodology

A quantitative method was employed in the current study. And, as mentioned previously, Likeret based survey instruments were employed to collect data for population of the two category distributions (managers with and without engineering degrees). Survey Monkey, an on line survey company, was enlisted to identify participants belonging to the categories of interest. The survey was "cross sectional with the information composed at one point in time" as espoused by Creswell (2009, p**.** 146). During the initial planning, the author considered various tools associated with the qualitative method (e.g. interviews) for collecting category data. And, while interviews would certainly allow researcher to insert and possibly add context to data collected, such an approach can be quite protracted and cost and time prohibitive. For example, assuming an n = 100 per category, such would require as many one-on-one interviews. This also assumes, of course, that the author was able to secure time with each of the interviewees across varying corporate and possibly geographic environments. There was also the potential issue of noise inherent with in person interviews. For example, were the author to conduct such interviews, interpretations of responses would be tied to the author's views of the world which may not necessarily be aligned with the views of those being interviewed? This perspective is shared somewhat by Noonan (2013) in the following comments regarding disadvantages of interviews, "the views of researcher can impact the responses of participants thorugh communicating disapproval or surprise" (p. 29). Thus, the author elected to implement a purely quantitative methods approach in conducting the current research.

Research Paradigm

Figure 2 models the selected research paradigm for the current study to include the worldview or ontological position as well as the epistemological stance, the method employed and the mode of reasoning selected. Creswell (2009) talked about the need for positivists to identify and assess causes that influence outcomes which aligns with the current research plan relative to engineering education and leadership style. This, of course, can only occur empirically through others' observation of leadership style as was the case employing the MLQ. Although some may argue the objectivity of results predicated on individual observation and suggest that such more closely aligns with a qualitative methodology, that the current research quantifies the survey results begins to shift the plan to the quantitative method. Many scholarly writings support this perspective including Leedy and Ormond (2013) who stated that, "a quantifiable scholar naturally attempts to extent variables in few arithmetical means [including] tests, questionnaires [and] rating scales" (p. 95). Creswell (2009) regards this approach as residing in the quantitative space as well stating, "A survey design offers a numeric or quantitative portrayal of attitudes, opinions or trends of a populace by reviewing a section of that populace" (p. 145). Likewise, Hathaway (1995) also sanctioned the use of surveys in quantitative research by stating, "A quantitative approach [includes] surveys as well as arithmetical examination of replies [versus] qualitative method (e.g., transcript examination of meetings)" (p. 536).

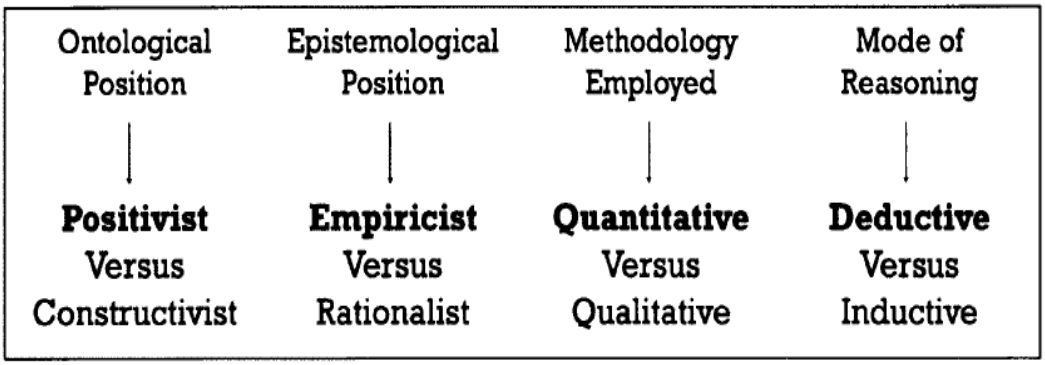

Figure 2. Model.

Consistent with the above referenced positivist world view, four basic rules, or cannons, were also selected for the current research. First, there must be internal validity such that the author was able to draw accurate conclusions regarding any of the relationships presented in the data. Second, the study must also had good external validity which, in turn, would allow the results to be generalizable to the broader context. Implementation of this second cannon was supported by Leedy and Ormond (2009) who stated, "Scholars underwrite extra knowledge of humanity about the globe when they perform a study that had repercussions that spread far beyond the condition being premeditated" (p. 103). Third, particularly as it was related to the measuring instrument, in this case a survey questionnaire was discussed, the research has to provide reliable results. And finally, the research must provide objectivity. Thus, as mentioned above, the positivist position was taken with the current research resulting in the development of data consistent with mind independent review and neutrality. Enabling the objectivity platform on which the positivist approach was founded, was the objectivity of findings predicated on implementation of a measuring instrument with proven validity and reliability as will be discussed in the next section.

Measuring Instrument

Indeed, as previously discussed, there were many instruments (e.g. FFM) that may be used to measure leadership style. Critical to the instrument chosen, however, was its reliability and validity. Leedy and Ormond (2013), offered support for this perspective stating, "Irrespective of the kind of gage a measurement tool includes, it should have both reliability and validity for its determination" (p. 89). Likewise, "although individuals may have different views in terms of what constitutes psychometric adequacy, most people can agree that a measurement was only useful to the extent that it provides meaningful information about individuals" (Briesch, Chafouleas & Swaminathan, 2014, p. 14).

Creswell (2009) added to the discourse stating, "to use an existing instrument [the author should] describe the established validity and reliability of the instrument [which includes] reporting efforts by authors to establish validity" (p. 149). Figure 3, reflects the interconnectedness of the relationships between and among the instrument of choice and the critical components of validity, reliability and objectivity.

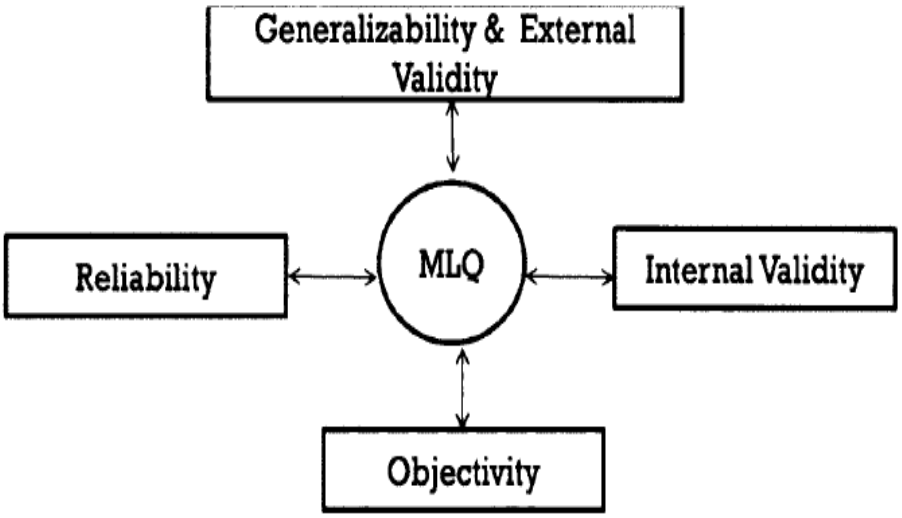

Figure 3. Instrument Reliability and Validity.

Prior to initiating discussions regarding instrument validity and reliability, it is appropriate to first visit the MLQ in the framework of Full Range Leadership Theory (FRLT). Pioneering authors of leadership theory such as Bass and Avolio determined that more than simply providing rewards for subordinate behavior by leaders was needed characterized by XL. They also identified the need to comprehend how followers are influenced by leaders to set aside self interests for the benefit of their company through optimal levels of performance. Early expansions in leadership theory included five TL factors, three XL factors, and one non transactional Laissez faire leadership component (Antonakis et al, p. 264). The contemporary FRLT model maintains the five (5) TL factors as discussed previously: idealized behaviors, intellectual stimulation, inspirational motivation, idealized influence and individualized consideration. However, the XL factors total to two (2) and were defined as management-by exception active (MBEA) and contingent reward (CR): Active (MBEA) versus one (1). The last style of leadership, Passive Avoidant, was likewise consists of two (2) attributes (Laissez-Faire (LF) and (Management-by-exception: Passive (MBEP)). The MLQ questionnaire was designed to assess each of the three leadership styles through select questions that are subsequently combined via the MLQ5X form for determination of applicable descriptive statistics.

Measuring Instrument Validity

Leedy and Ormond (2013) characterized exterior rationality as "the level to which the research study's conclusions smear to circumstances a far the research itself" (p. 103). According to Avolio and Bass (2004), "in various researches, transformational leaders were originate to create extra dedication in their followers" (p. 36). Thus, what was being measured by the MLQ can be traced to a valid form of real world effective leadership.

Likewise, testing conducted by Bogler (2001) determined “that satisfaction of teachers' surges as they observe leadership style of their principals' as less transactional and more transformational” (p. 677). Fuller et al (1996), reported in a meta-analysis greater follower compliance if their leaders were more transformational than transactional (Avolio & Bass, 2004, p. 36). The list of scholarly writings substantiating the external validity of the MLQ was far reaching. Thus, discussions in this section will shift to build rationality.

“The level to which an apparatus measures a person that cannot be openly perceived however supposed to occur built on arrays in behavior of people [was termed paradigm validity]” (Leedy & Ormond, 2013, p.90). Creswell (2009) addressed the topic of construct validity by asking, “do items measure hypothetical constructs or concepts” (p. 149)? According to Barge and Schlueter (1991), “the MLQ retains better paradigm validity...as depicts in the earlier research, transactional versus transformational leadership was happens to be largly connected with a variation of results” (p. 551).

Measurement Instrument Reliability

Reliability described by Leedy and Ormond (2013) as “the uniformity with which a measuring tool produces a particular, reliable outcome when the organization being measured had not transformed” (p. 91). Bass and Avolio (1991), concluded that although “the alpha reliability factors for the self rating arrangement were regularly lesser than those for the rater arrangements, with reliabilities stretching between .60 to .92 [however] reliability of the twoforms existed” (p. 550). (It should be noted that the current research utilizes the rater form for data collection.) Bass and Avolio (2004) concluded that “reliabilities for each leadership factor and for total items scale between .74 to .94...all of

the scales' reliabilities were usually great, surpassing normal cut-offs for inner steadiness suggested in the literature" (p. 49). Barge and Schlueter (1991), also "report[ed] the MLQ Rater Form validated better inner reliability with all dynamics beyond an alpha of .82, with the concession of management by exception (79) and laissez-faire leadership" (p. 549). Also in this area, Bennett (2009) cited research conducted by Lowe, Kroech and Sivasubramaniam (1996) which assessed five factors of the MLQ which were intellectual stimulation, individualized consideration, charisma, management by exception and contingent reward. The resulting "mean Cronbach scale obtained for the five scales tested were 0.86, 0.88, 0.92, 0.65 and 8.82 respectively" (p. 6). Bennett (2009) also cited work by Dumdum, Lower and Avolio (2002) which assessed "twelve scales" of the MLQ concluding that "inner reliability was better as the mean Cronbach... for eleven out of twelve scales was beyond 0.7 and the final one was 0.69" (p. 7).

There was another reliability measure termed Test Re-Test Reliability, and according to Bass and Avolio (1990), "test-retest reliabilities were delivered by a research consuming the evaluations by 33 leaders and 193 followers measured 6 months apart...the rater form test-retest reliabilities between.52 to .82 and.44 to .74 for the self-evaluation form" (p. 550).

Method and Procedure

Employing a quantitative approach, the proposed research seeks to assess leadership styles (transformational and transactional) as a function of engineering education. To minimize noise associated with this proposal, the author had elected to measure leadership styles among several populations: CPMs, non-CPM managers, the integrated population with engineering degrees, and the same

without engineering degrees. Thus, the critical research questions are as follows.

- Does the integrated population with engineering degrees exhibit a leadership style that statistically differs from the leadership style of the integrated population without engineering degrees?
- Does a predominant style of leadership (transformational or transactional), emerge when comparing the two populations (managers with and without engineering degrees) and, if so, what is it?

The Ho hypothesis associated with this study is: There is no statistically important dissimilarity amongst manager's transformational styles of leadership (CPMs, non – CPM managers or the integrated group of manager) with engineering degrees versus the same without engineering degrees. The Ha hypothesis is: No predominant style of leadership is evident among CPMs, non-CPM managers or the integrated population with or without engineering degrees. In an effort to address hypotheses Ho and Ha, sample population descriptive statistics were formulated and tested employing parametric statistical approaches. In particular, the independent sample's t-test was used for the comparison of population means for perceived leadership style scores, analysis of variance (ANOVA) was engaged to examine multiple comparisons of perceived mean leadership style scores, and the one sample t-test was used to test perceived mean leadership style scores versus a gold standard.

The research environment was the domestic manufacturing environment facilitated by the internet. Leveraging Survey Monkey, an on-line survey resource, the MLQ questionnaire, was issued to raters who reported directly or on a

matrix basis to managers as described above. The survey process, required the submission of participant profile information to the survey hosting company Survey Monkey. The hosting company then selected the participants based on the profile data provided. Based on discussions with the hosting company, it was believed that the greatest opportunity for yielding the desired sample population was to solicit participant responses from the manufacturing industry. Participants were directed to the Survey Monkey site and given the option to participate in the survey or exit the survey.

Likert Scale

A Likert scale usually known as a psychometric measure, in which questionnaires are used. It is commonly used as an method to measure replies in research and survey development, such that the word (or more precisely the Likert-type scale) is generally used interchangeably with rating measures, although the two are not tantamount.

Result, Analysis and Interpretations

The original aim of the current research was to specifically test the previously discussed hypotheses with respect to CPMs alone. Thus, the sample population was to only include CPMs with engineering degrees and those without engineering degrees. In practice, however, economic constraints limited the total sample population of this category to 67 (48 with engineering degrees and 15 without). Employing SPSS Sample Power 3, based on the pilot testing for CPMs, 113 subjects per group (with and without engineering degrees - totaling 226) would be required to yield a power of 80%, and of the 350 received completed surveys received, CPMs meeting the desired criteria accounted for only 63 (18%) of the total number of rated organizational leaders. Consequently, while all testing included the CPM group, the scope was expanded to also include managers with and without PMI certifications as well as managers with and without engineering degrees. However, all managers were responsible for providing the day-to-day work activities for one or more reports (direct or matrix). Population, inclusive of CPMs, was termed the "integrated population." Based on this population pilot testing, 116 subjects per group (with and without engineering degrees - totaling 232) would yield a power of 90%. Expanding the scope of the current research to include the integrated population not only increased the statistical power of the testing due to increased cases available, it also remained true to the fundamental research goal to determine the relationship, if any, between engineering education and leadership style by assessing leader styles of those with engineering degrees and those without.

Population and Demographics

Those employed in the domestic manufacturing sector comprised the sample group. Based on information supplied by Survey Monkey, roughly 500 prospective participants visited the site for potential survey completion. Of those, only 350 actually completed the survey (this should not suggest a 70% conversion rate as it was not known to the researcher how many individuals were actually asked to complete the survey and elected not follow the link to the survey). Figure 4 reflects the number of total cases (completed surveys) received as well as the group allocation for those cases. As previously indicated, of the 350 cases, close to 20% were not usable due to the "not sure" response provided by the raters under the questions regarding engineering education. Consequently, only 283 cases were potentially usable for testing the research hypotheses.

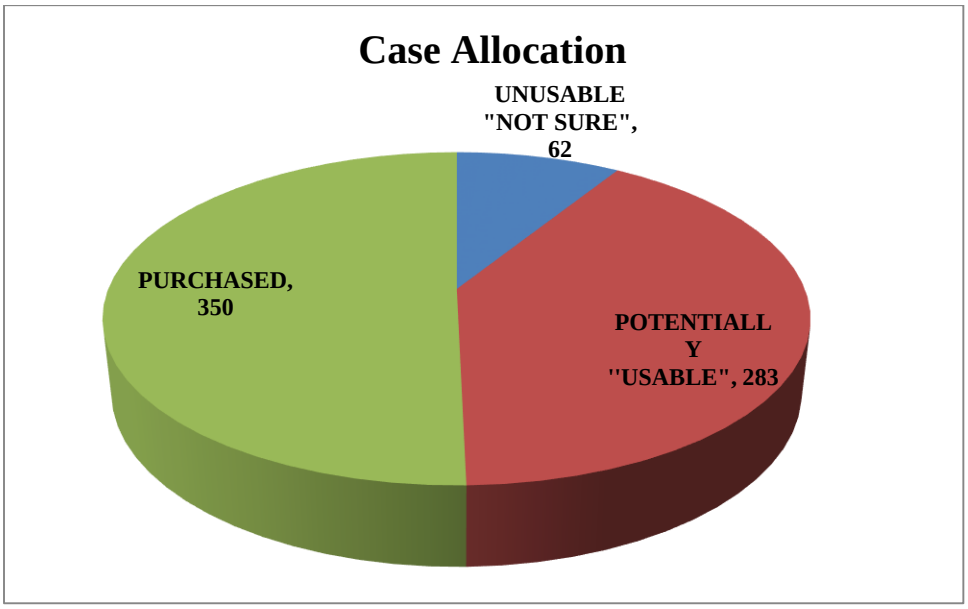

Figure 4. Database.

Results of the researcher question regarding engineering education were shown in Figure 5. Accordingly, the terms "No Engineers" and "Engineers" refers to whether or

not the individual being rated possessed an engineering degree. In the CPM population, 48 individuals being rated possessed engineering degrees while 15 did not. MGRS (managers without PMI certifications) and integrated managers (the combined groups of CPMs and MGRS) were 64 and 154 and 112 and 169 respectively.

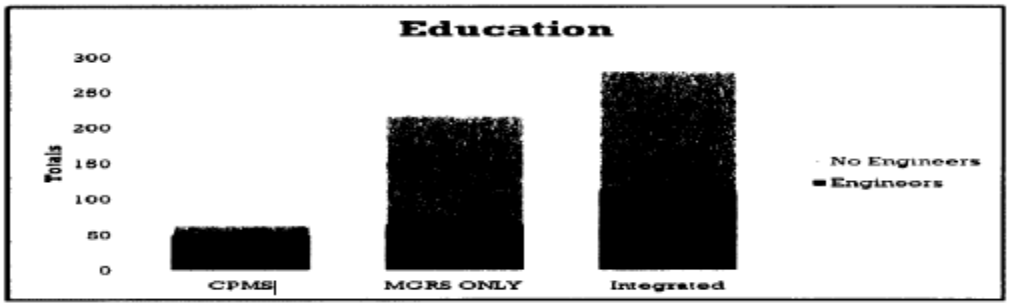

Figure 5. Education Data.

Because the largest sample population was in the integrated population, demographic data will be reviewed in that context. The first bit of demographic data had to do with gender as shown in Figure 6. Among the integrated population, there were 34 females with engineering degrees and 76 without. The same for males was 76 and 91 respectively.

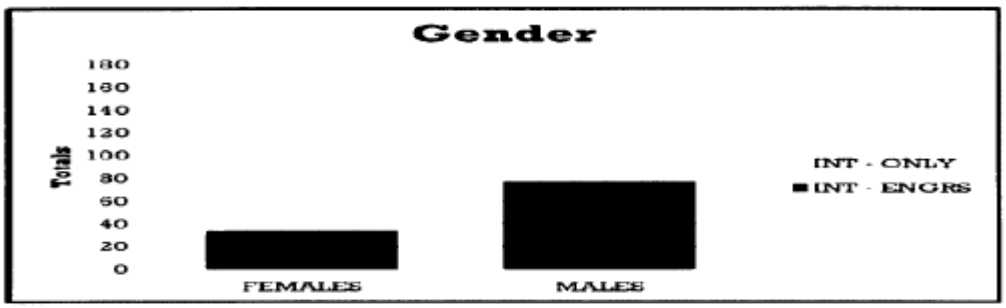

Figure 6. Gender.

Figure 7 reflects the experience level of the individuals being rated. Among the integrated population with engineering degrees, there were 14 with 0 - 4 years of

experience, 37 with 4 to 10 years of experience and 60 with 10+ years ofexperience. The same data for those without engineering degrees was 61, 33 and 74 respectively.

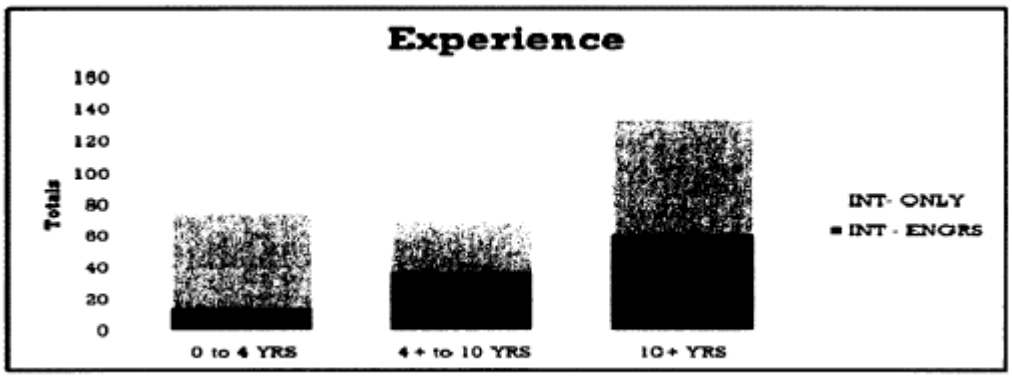

Figure 7. Experience Level for Those Rated.

It reflects the number of persons who the individual has day to day work assignment responsibility. Accordingly, in the group with engineering degrees, there were 35 with 0 - 4 organizational reports, 56 with 4+ to 10 organizational reports and 20 with more than 10 organizational reports. The findings for the group without engineering degrees was 90, 46 and 30 respectively.

Data Analysis

The SPSS statistical software package was used to facilitate data analysis. The first research hypothesis, Ho: There is no association amongst Transformational Leadership (TL) and engineering education, was restated to accommodate the appropriate statistical testing. Restated, we have: Ho: pTLW = pTLWO (the population means for TL styles of CPMs with and without engineering degrees are the same), and Ha: pTLW ^ pTLWO (the population means for TL styles of CPMs with and without engineering degrees are different). Accordingly, this first test focused on the CPM groups with and without engineering degrees. Given that the groups were independent, the “independent

samples t-test" was implemented. One of the assumptions that should be tested before applying the t-test was an assessment of the data in search of outliers.

Following the initial box plot run two outliers (lines 42 and 23 - not shown) were identified. In looking at the data, it appeared that a couple of the respondents sort of flat lined the survey entering a "0" (not at all observed) for at least twenty-two of forty-five MLQ questions for CPM's with engineering degrees for line 42. Likewise, for outlier 23 a comparable arrangement was witnessed.

About the use of t-test and the consequences of outliers or failed tests for normality, Elliott and Woodward (2007), cite "rules of thumb" offered by Moore and McCabe (2006), among which was: "if the taster populace was big (at least 40), then the one-taster t-test can be carefully deployed without honor to outliers or skewness" (p. 49). Although the current study also leverages the two sample t-test and ANOVA, Elliot & Woodward refers the reader back to these guidelines for both of these tests as well. From the t-test the significance value was .026. Consequently, the assumption of homogeneity of variances was not met. Thus, the "Equal variances not assumed" row was used for decision making. Because the t-test at t (18) degrees of freedom returned "Sig"or p = .164, which was greater than .05, existance of a statistically essential difference amongst the two perceived TL style mean scores for CPMs with and without engineering degrees cannot be established. Consequently, possibly driven by the low power of the test which was less than 80%, the null hypothesis was not rejected.

Although the first research hypothesis was limited to TL, given the availability of information offered by the MLQ regarding the full range of leadership, the same tests were implemented for Transactional and Passive Avoidant (PA) leadership styles. Again,

restating the hypothesis to accommodate this test, we have: Ho: pLdrstylei = pLdrstylej and, conversely, Ha: pLdrstylei ^ pLdrstylej. In the lexical sense, the general restated hypothesis was that there is no difference in leader style with "i" and "j " serving as a surrogate for the respective styles with and without engineering degrees.

Summarizing the analysis, due to unequal variances for XL, the "Equal Variances not Assumed" column was once again used for statistical decision making and, despite degreed CPMs having a perceived mean score of 0.48 higher, because t (18) degrees of freedom returned a "Sig" or p = .083, it cannot be established that a statistically essential transformation exists amongst the two XL style means for CPMs with and without engineering degrees. Thus the null cannot be rejected. Similarly for PA, although the degreed CPM's perceived mean PA leadership style was 0.41 higher than the PA Leadership style for Non-degreed CPM's, because at t (60) degrees of freedom "Sig" = 0.180, it cannot be concluded that a statistically essential difference exists amongst the two PA style means and, once again, the null hypothesis cannot be rejected. In an effort to simplify the presentation of statistical testing, referring to the managers group and the TL style, it was evident that the normality assumption was not met for either distribution but the equality of variance assumption was met. It was also evident that the mean difference between the TL style of the two groups was 0.47 with a confidence interval of (0.18 to 0.76) and that the sample sizes were N1 = 64 and N2 = 154 for managers with engineering degrees and the same without respectively. Finally, it was evident that "t" at 216 degrees of freedom was 3.24 and with a two tailed "p" value of 0.001, the means were statistically different.

No statistically essential dissimilarities were found in the CPM groups with or without engineering degrees for TL. However, in both the manager and integrated population, TL and XL were statistically different and higher for those with engineering degrees versus those without. Likewise, no statistically essential dissimilarities were established in the CPM groups with or without engineering degrees for XL, yet in both the manager and integrated population, TL and XL were statistically different and higher for those with engineering degrees versus those without. No differences were detected in any of the groups for PA. Returning once again to TL theory, recall that Intellectual Stimulation (IS) was one of its five constituent elements. And, according to Avolio and Bass (2004) leaders demonstrating this attribute stimulate innovation and imagination by reframing problems, questioning assumptions and impending old conditions in new traditions. They also implore new solutions to problems and include followers in the problem solving process (p. 102). Considering the academic lesson's learned by engineers, especially in the area of problem solving, the current research also considered whether or not statistically significant differences existed in the perceived demonstration of the IS attribute when comparing those with engineering degrees to those without. Restating the hypothesis to accommodate this test we have, Ho: pIS = pIS (the population means for IS in groups with and without engineering degrees are the same) and conversely Ha: pIS ^ pIS (the population means for IS in groups with and without engineering degrees are different).

Summary Statistics for IS

From this it was evident, as might be expected due to the low sample size, the null hypothesis stating that therewais no dissimilarity amongst the mean perceived IS styles

for CPMs with and without engineering degrees cannot be rejected. However, for the group of managers and the integrated population, the null hypothesis can be rejected suggesting that those with engineering degrees may be perceived to demonstrate more of the IS style as evidenced by the two tail Sig values. As mentioned previously, given the rigor of training in the academic setting this finding was also somewhat intuitive.

At this point we will shift to discuss the approach taken to test the remaining research hypothesis: Ho: There is no predominant style of leadership among actors with and without engineering degrees. Unlike the first hypothesis, here we were not looking to determine the extent to which the leadership styles differ when comparing the two groups (with and without engineering degrees). Instead, the aim was to identify whether or not a predominant style emerges within each group. In order to attempt this, three parametric statistical approaches were taken. First, each of the five constituent items for each of the TL leadership styles previously discussed were compared to each other to determine if a difference existed in the mean perceptions for each group. Second, each of the perceived means for each overall leadership style (TL, XL and PA) were compared with each other for differences in mean perceptions of the respective styles. Lastly, each of the Leadership style scores for (TL, XL and PA) were compared to the MLQ "Norm" tables, to be discussed later, and the extent that the scored style was, or was not, different from a given norm percentile was determined. These three pronged approach were appropriate because, unlike the first hypothesis, the focus here was on the complete variety of leadership to include XL and PA.

Regarding the five constituent test, restated we have Ho: pTLl = pTL2 = pTL3 = pTL4 = pTL5 (the population means for all TL constituents with and without engineering

degrees are the same) and conversely Ha: pTLconsi ^ pTLconsj for some "i ^ j" (the population means for at least two TL constituents with and without engineering degrees are different). ANOVA was employed to assess the first portion of this hypothesis regarding TL. And to allow for the maximum power, all TL constituent tests were conducted using the integrated data. As was the case with the t-test, the first step in the ANOVA analysis included review of a box plot to identify any outliers for the integrated sample population with engineering degrees. Elliot and Woodward had a similar view relative to ANOVA as with the t-test to which the author defers. More specifically, Elliot and Woodward (2007) cited Glass, Peckham & Sanders and stated that,"studies have shown the one-way ANOVA to be robust against some departures from assumptions...if the taster populac was big (at least 40) then the one taster t-test [or ANOVA] can be used without honor to outliers or skewness." Additionally, it was stated that "generally, non-normality of the data was not a concern unless you have small sample sizes or your data were highly non-normal... if you had equal or near equal sample sizes, in each group, the equal variance assumption becomes less important" (p. 167). As mentioned previously, the author refers to these comments and proceeds with statistical testing employing ANOVA.

Having run the same battery of tests for each of the leadership styles and for each of the subject groups with and without engineering degrees, Tables 3, 4 and 5 summarize the resulting findings for those as well as for the CPM groups with and without engineering degrees. There was a statistically significant difference between TL and PA and XL and PA in the CPM Group with engineering degrees, but statistically significant differences were not detected between TL & XL in both groups. Note that in the CPM

group without engineering degrees, the same pattern exists with a statistically significant difference occurring between TL and PA as well as XL and PA but no difference was detected between TL and XL.

Table 3.

Post Hoc CPM Means Comparison

CPMS With & Without Engineering Degrees		
Leaders Style	With	Without
TL	2.96	2.70
XL	2.83	2.48
PA	1.81	1.47

The same pattern whereby in both groups, with and without engineering degrees, statistically significant differences occurred between TL and PA as well as XL and PA, but no difference was detected between TL and XL.

Table 4.

Post Hoc Manager Means Comparison

Managers With & Without Engineering Degrees		
Leaders Style	With	Without
TL	2.54	2.07
XL	2.43	2.03
PA	1.60	1.60

The same pattern once more whereby in both groups, with and without engineering degrees, statistically significant differences occurred between TL and PA as well as XL and PA, but no difference was detected between TL and XL.

Table 5.

Post Hoc Integrated Means Comparison

Integrated With & Without Engineering Degrees		
Leaders Style	With	Without
TL	2.72	2.13
XL	2.60	2.07
PA	1.64	1.59

To summarize this second test of the Ho hypothesis regarding a predominant leadership style, based on the foregoing analysis, the restated Ho: must be rejected due to statistically significant differences in PA versus TL & XL among those with or without engineering degrees. However, because TL & XL were not statistically significantly different, the overarching hypothesis regarding evidence of a predominant leadership style cannot be rejected.

For the third test, referring once again to the predominant leadership style hypothesis, using the MLQ "Norm tables" the aim in this final test is to determine whether or not any perceived leadership style (TL, TX or PA) was at a higher percentile level than any one of the remaining styles. This would be determined by comparing each of the population mean values to the "Gold standard" value located in the "Norm Tables" To explain how these tables were to be interpreted, the author refers to the specific MLQ

score assessment recommendations offered by Mind Garden, the survey supplier. The first step was to group the like constituent items on the MLQ 5X which simply sums their respective ratings and then divides them by the total number of items to get an average style constituent value. With this information at hand, Mind Garden suggests that the individual then should be labeled more transformational or more transactional versus simply stating that the individual being rated either transformational or transactional. The averages for each style constituent, and for the styles themselves, were then compared to the "Norm Tables." Referring to Table 6 as a point of clarification, recall that TL contains five constituent elements, while XL and PA contain only two items each respectively. And, as previously mentioned, the Items listed were to be summed and then distributed by the complete digit of items to arrive at the constituent average. Accordingly, for each of the Leadership styles (TL, XL and PA) there were five (5), two (2) and two (2) constituent elements respectively.

Table 6 was the norm table reflecting percentiles for subordinates ratings of higher levels with N= just over 12,000 cases. To ensure understanding, if a leader had a perceived IM (Inspirational Motivation) average rating of 3.00, he or she was operating in the 50th percentile. Likewise, if each of the five constituent elements of TL were averaged together, the overall perceived leader score can be determined on a percentile level. For example, if the 50th percentile scores for TL were all averaged, the mean TL score would then be 2.90. This 2.90 could be referred to as the "Gold Standard" for the 50^{th} percentile TL rating based on the norming table.

Table 6.

Subordinates Rating Higher Levels Norm Table

	II(A)	II(B)	IM	IS	IC	CR	MBEA	MBEP	LF
N	2,118	12,118	12,118	12,118	12,118	2,118	12,118	12,118	12,118
%tile	MLQ Score								
5	1.25	1.25	1.50	1.50	1.00	1.28	0.25	0.00	0.00
10	1.75	1.75	2.00	1.75	1.50	1.75	0.50	0.00	0.00
20	2.25	2.21	2.25	2.25	2.00	2.25	0.75	0.25	0.00
30	2.50	2.50	2.75	2.50	2.50	2.50	1.11	0.50	0.25
40	2.75	2.54	3.00	2.75	2.75	2.75	1.37	0.75	0.25
50	3.00	2.75	3.00	2.75	3.00	3.00	1.62	1.00	0.50
60	3.25	3.00	3.25	3.00	3.17	3.13	1.87	1.00	0.75
70	3.50	3.25	3.50	3.25	3.25	3.25	2.25	1.25	0.93
80	3.75	3.46	3.75	3.50	3.50	3.50	2.50	1.70	1.25
90	4.00	3.75	4.00	3.75	3.75	3.75	3.00	2.00	1.75
95	4.00	3.75	4.00	4.00	4.00	4.00	3.25	2.50	2.00

Table 7 reflects the survey reported mean scores for each of the 3 leadership styles from the perspective of subordinates as well as the respective percentiles for each of the row scores.

Table 7.

Survey Reported Mean Scores

%tile	TL Mean	XL Mean	Pass Mean
5	1.30	0.77	0.00
10	1.75	1.13	0.00
20	2.19	1.50	0.13
30	2.55	1.81	0.38
40	2.76	2.06	0.50
50	2.90	2.31	0.75
60	3.13	2.50	0.88
70	3.35	2.75	1.09
80	3.59	3.00	1.48
90	3.85	3.38	1.88
95	3.95	3.63	2.25

Table 8 indicates the average scores from the received survey for the perceived leadership styles of CPMs with and without engineering degrees. Based on the reported averages, the closest matching average leadership scores in the Mind Garden supplied "Norm Tables" (that were numerically less than the received scores) was then identified for each of the style scores. As an example, the average perceived TL score for the CPM's with an engineering degree was 2.96 and the closest matching "Norm Table" mean score was found in the 50th percentile to be 2.90. However, although the average PA score for this same group was only 1.70, the closest corresponding "Norm Table"

percentile, that was also less than the received survey PA score, was 1.48 which was located at the 80th percentile.

Table 8.

CPM Percentile Levels

	CPMs W&W/O			
	Subjects	TL	XL	PA
	CPMW	2.96	2.83	1.70
%tile	50	2.90		
%tile	70		2.75	
%tile	80			1.48
	CPMW/O	2.70	2.48	1.47
%tile	30	2.55		
%tile	50		2.31	
%tile	80			1.48

The process, then, was to statistically compare the survey reported average leadership style score to the closest not to exceed "Norm Table" match at an alpha of .05. If the survey reported score was not statistically different from the "Norm Table" mean score, then the reported operating percentile level may also be assumed. However, if the survey reported score was statistically different and numerically greater than the norm score, the operating percentile may be higher than the "Norm Table" percentile. The one sample t-test was employed to implement the necessary comparisons. The first test was for the CPM groups and TL. For simplicity of presentation, the box plots will not be

shown. As indicated in Table 9, based on the "Wilk Sig" test, given that the p value = 0.001 which was less than 0.05, the reported TL data for CPMs with engineering degree were not normally distributed.

Table 9.

CPM Normality Test

	Kolmogorov-Smirnov[2]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistics	df	Sig
Ldr Style	130	48	0.042	899	48	0.001

As reflected in Table 10, the mean TL score (2.96 ± 0.82) was numerically 50th higher than the population 50 percentile TL score of 2.90 as demonstrated previously.

Table 10.

TL Mean Score

	N	Mean	Std. Deviation	Std. Error Mean
Ldr Style	48	2.9625	0.82019	0.11838

However, referring to Table 11, the TL score was not statistically significantly different from the population 50th percentile score, t (47) = .528, and p = .600. Because the reported score was not statistically different from the percentile score, there was no statistical basis for rejecting the theory that the perceived demonstration of TL was not equal to the Norm table 50th percentile level.

Table 11.

One Sample "t" Test Results

	Test Value = 2.90					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Ldr Style	0.528	47	0.600	0.0625	0.1757	0.3007

The results discussed in Tables 9, 10 and11, as well as the results for the remaining tests for the two CPM Groups (with and without engineering degrees) were shown in Table 12. In all cases, application of the one sample t-test did not identify statistically significant differences between the "Norm Table" percentile and the perceived operating level of the CPMS with or without engineering degrees. Consequently, in both groups, the highest operating percentile scores were related to the PA leadership style.

Table 12.

CPM Percentile Results

	CPMs W&W/O			
	Subjects	TL	XL	PA
	CPMW	2.96	2.83	1.70
%tile	50	2.90		
%tile	70		2.75	
%tile	80			1.48
	CPMW/O	2.70	2.48	1.47
%tile	30	2.55		
%tile	50		2.31	
%tile	80			1.48

Referring to Table 13, while no statistically significant differences were revealed for managers with engineering degrees versus the "Norm Table" in the TL, XL and PA styles, statistically significant differences were identified for managers without engineering degrees for TL and XL but not for PA. In both cases, the differences point to the managers operating above the selected norm percentile.

Table 13.

Manager Percentile Results

	Managers W&W/O			
	Subjects	TL	XL	PA
	Mang. W	2.54	2.43	1.60
%tile	30	2.55		
%tile	50		2.31	
%tile	80			1.48
	Mang. W/O	2.07	2.03	1.60
%tile	10	1.75		
%tile	30		1.81	
%tile	80			1.48

Referring to Table 14, although no statistically significant differences were revealed for the integrated population, compared to the norm, with engineering degrees in the XL and PA styles, a statistically significant difference was identified for this group in the TL style. Likewise, in the integrated population without engineering degrees, both the PA and XL leadership styles were not statistically significantly different from the norm table while the TL style was statistically different from the norm table in this group. In both cases, TL differences point to the integrated population operating abpve the selected norm percentile.

Table 14.

Integrated Percentile Results

	Integrated W&W/O			
	Subjects	TL	XL	PA
	Intgr W	2.72	2.60	1.64
%tile	30	2.55		
%tile	60		2.50	
%tile	80			1.48
	Intgr W/O	2.13	2.07	1.60
%tile	10	1.75		
%tile	40		2.06	
%tile	80			1.48

Summarizing the above findings regarding CPMs, the one sample t-test did not identify statistically significant differences between the "Norm Table" and reported perceived mean leadership style scores (with and without engineering degrees). Regarding managers, the one sample t-test identified differences only in this group without engineering degrees and for the TL and XL styles. Regarding the integrated population, the one sample t-test revealed differences in this group regarding TL (with engineering degrees) and TL (without) engineering degrees. The differences suggested higher percentile operating levels versus the norm.

When compared the integrated population (including CPM's and non-CPM managers) to the 50th percentile norm score. A key observation here, as was identified in

the second test above, was that the integrated population with engineering degrees appears to be operating at an overall higher percentile level than those without engineering degrees. There was also a slight, yet obvious, downward trend in both integrated population with and without engineering degrees from TL to XL and then more decelerated to PA. Although the trend might suggest both groups (with and without engineering degrees) operate at a higher level of TL when compared to the other leadership styles, there was still insufficient evidence to reject the hypothesis that there was no predominant leadership style among those with or without engineering degrees. This, of course, was due to the lack of statistical significance between TL & XL. Although there were statistically significant differences identified for the mean PA leadership style when compared to TL or XL, it was just not practical to conclude that a predominant style exists as, inherently, the PA scores were also very different from TL and XL in the "Norm Tables." In both comparisons, the mean PA scores were significantly and numerically lower than either TL or XL.

Summarizing all testing for the second hypothesis, for the first test the ANOVA test did not identify statistically essential dissimilarities at the 95% assurance level amongst the five TL constituents (IA, IB, IM, IS & IC). For the second test the ANOVA test identified statistically essential dissimilarities at a 95% assurance level amongst TL and PA as well as XL and PA. However, TL and XL were not statistically different. For the third and final test the one tester t-test confirmed that for all groups, with and without engineering degrees, at the 95% confidence level, varying percentile levels of "in-group"demonstration of full range leadership styles (TL, XL & PA) were perceived to be present.

Conclusion

The first research hypothesis was Ho: There is no association amongst Transformational Leadership (TL) and engineering education. Based on the evidence presented, this hypothesis should be rejected when considering the manager and integrated sample populations with engineering degrees versus those without. This, of course, suggests that those with engineering degrees were more transformational. However, perhaps due to the reduced power of the test, analysis of the CPM groups did not identify statistically significant differences at an alpha of 0.05. Another statistically significant difference, occurring in the manager and integrated populations with engineering degrees was a higher perceived level of XL style versus the same for those without engineering degrees. This difference, on the surface, may appear to undermine the significance of the TL findings for the same group. This should not be the case however when considering a couple of key mitigating factors. First, it is incumbent upon leaders to make clear the expectations (e.g. goals and objectives) for subordinates which may also be viewed in the context of providing what to do. How and why subordinates achieve the goals and objectives may be linked to, among other things, motivation and inspiration provided by the leader. According to Avolio and Bass (2004) some of the qualities associated with XL include, "provides support in altercation for exertions, converses who is liable for what, makes clear [the] rewards for efforts, focuses attention on mistakes and attention [is] directed to failure" (p. 102). The same for TL include, "inspire, instill pride, sense of purpose, displays confidence, talks optimistically, articulates a vision [and] questions assumptions" (p. 101). From these comments, it

should be clear that effective leaders must provide both what is to be done and, concurrently, offer vision and strategies regarding how such may be accomplished.

Supporting this point, Avolio and Bass (2004) stated that, "the transactional process, [contingent reward] in which the leader simplifies what the relationships requisite to do for an incentive, was however observed ...as an significant part of ...effective leadership" (p. 21). Second, contingent reward was one of only two XL constituents thereby accounting for 50% of the total perceived style rating. The other constituent for XL is management by exception active (MBEA). Bennet (2009) cited works of multiple authors who argued that contingent reward was, in itself, related to TL (p. 6). Thus, it might be concluded that if the reported perceived contingent reward (CR) constituent of XL was, in essence, driving the overall XL mean score, and XL was determined to be statistically different and higher for those in the integrated population versus the same without, such may be consistent with arguments posed above by Avolio, Bass and Bennet. Namely, that CR, in combination with TL, may be required for effective leadership. Table 15 reflects the mean scores for CR and MBEA.

Table 15.

Perceived Mean Scores for CR and MBEA

Group Statistics

	Ldr Style	N	Mean	Std. Deviation	Std. Error Mean
Score	INTXLCR	112	2.8058	0.8461	0.07995
	INTXLMBEA	112	2.3884	0.93472	0.08832

To test this theory, an liberated taster's t-test was implemented seeking to identify mean differences for both XL constituents (CR and MBEA shown in Table 15 above). Referring to Table 16, it can be seen that the normality assumption was not met for either group. The p values of .001 and 0.015 for CR and MBEA respectively, were less than .05.

Table 16.

CR and MBEA Means Test

		Kolmogorov-Smirnov[2]			Shapiro-Wilk		
	Ldr Style	Statistic	df	Sig.	Statistics	Df	Sig
	INTXCLR	0.091	112	0.023	0.952	112	0.001
Score	INTXLMBEA	0.081	112	0.069	0.971	112	0.015

The "sig" value was 0.280 and this was > p = .05, the variances were equal. Also note the value in the "Sig (2-tailed) column in the Equa Variances Assumed row. Because this value, p = .001 was less than .05, it can therefore be concluded that CR and MBEA did have statistically significantly different mean XL constituent style scores with the CR mean being numerically greater. This difference in CR and MBEA scores may potentially support previously referenced arguments suggesting that the CR component of XL is linked to TL and consequently, effective leadership.

The second research hypothesis was Ho: There is no predominant style of leadership among actors with and without engineering degrees. Efforts to assess this hypothesis required a three pronged statistical approach including ANOVA and the one sample t-test. Based on the evidence presented from the first test, and at an alpha level of

.05, no statistically significant constituent differences were detected for TL for the integrated population. Likewise, as determined by the second test, TL and XL were not statistically different when comparing the reported mean leadership styles for all three sample populations (CPMs, managers and integrated). Finally, although a visible trend existed in the integrated population (for those with and without engineering degrees) from the TL style downward to the PA style, there was no statistically significant difference at an alpha level of .05 for the TL and XL perceived mean scores. Due to the lack of statistical significance here, and considering the above practicality discussion regarding Pk2A and its respective inherently low mean scores relative to the remaining style mean values, this hypothesis should not be rejected.

The reader may recall the author's deference to comments and citations offered by Elliot and Woodward (2007) regarding the severity of assumptions (e.g. normality, outliers, etc.). Namely, that the parametric tests employed were robust enough to accommodate some departures from these assumptions while still providing valid statistical results. In an effort offer further support for this position, two (2) nonparametric tests were run - the Mann-Whitney U and the Kruskal-Wallis. The "Mann-Whitney U (compare[s] two independent groups) [and served as a] nonparametric substitute to a two sample t-test" (Elliot & Woodward, 2007, p. 193). Likewise, the "Kruskal-Wallis (compare[s] two or more independent groups) [and served as a] nonparametric alternative to a one-way analysis of variance" (Elliot & Woodward, 2007, p. 193).

There are limitations with regard to the generalizability of current research which was to determine the relationship, if one existed, between engineering education and

leadership style with emphasis on TL. And, while some statistically significant differences were detected, particularly in the larger populations, such should not be interpreted to suggest generalizability to all those with engineering degrees. Indeed, literature abounds regarding the lack of leadership skills, perhaps due to the lack of desire for such positions, inherent with engineering graduates as leaders. What can be said of the generalizability of the results was that predicated on the sampled integrated population, inclusive of those with and without engineering degrees who held leadership positions, raters perceived the group with engineering degrees to be more transformational, and transactional, than those without.

The design of the MLQ5X was also conducive in providing some insight into the overall leadership effectiveness resulting from the perceived mean style scores. However, although such data was also collected with the current research, addressing this area was not within the research scope.

Limitations and Areas for Future Research

Research also identified opportunities for future research. Returning to some of the demographic information reviewed earlier, although any comprehensive analysis was well beyond the scope of the current research, ANOVA and the independent samples t-test were employed, on the integrated Population (with and without engineering degrees), to determine the extent to which experience, gender and the number of organizational reports (direct and/or matrix) may have influenced perceived leadership style of the individual being rated. As was obvious from the outcomes in Table 17, females were different from males (female mean 2.06 versus male mean 1.57). Otherwise, no statistically significant differences were identified between the various demographic and

organizational structure factors for either of the integrated population groups (with or without engineering degrees).

Table 17.

Areas for Future Research

Integrated with engineering degrees	The TL Value was Not statistically different between experience levels, F(2.109) = 2.53, p = 0.084.
	The TL Value was Not statistically different between gender levels, T(109) = -0.543, and p = 0.588.
	The TL Value was Not statistically different between direct report levels, F(2.109) = 2.2268, p = 0.113.
Integrated without engineering degrees	The TL Value was Not statistically different between experience levels, F(2.166) = 3.401, p = 0.036.
	The TL Value was Not statistically different between gender levels, T(137) = 3.119, and p = 0.002.
	The TL Value was Not statistically different between direct report levels, F(2.172) = 2.526, p = 0.083.

Constructed on the above preliminary outcomes, the resulting imminent research questions may be posed:

1. Is the perception of leadership style of those with engineering degrees influenced by leader gender or experience?

2. Is the perception of leadership style of those with engineering degrees influenced by the number of reports?

3. Does the possession of an engineering degree/experience by the "rater" influence the perception of leadership style?

4. Does the possession of an engineering degree by the "rater" and/or "rater" gender influence the perception of leadership style?

As mentioned in the Research Limitations Section, another future research opportunity is to determine the perceived leadership effectiveness based on data collected while also considering the questions posed above. With answers to the expanded questions, as well as leadership effectiveness, the generalizability of the current study may be further substantiated.

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