Work-In-Progress: Understanding "Engineering Leadership" within Engineering Consulting Firms

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Abstract:
This paper examines how engineering leadership is understood and recognized within the specific context of engineering consulting. Engineering consulting has consistently grown over the last couple of decades in both the United States and globally. Additionally, engineering consulting is a type of Professional Service Firm (PSF), which is recognised to have organizationally distinct characteristics differing from traditional, hierarchical bureaucratic firms. These unique characteristics have implications for leadership. In this paper, we examine engineering leadership within engineering consulting through a qualitative case study on one mid-size North American engineering consulting firm. Preliminary findings from a subset of our interviews with engineering consultants across various career stages are presented. This work aligns with ASEE LEAD division's strategic initiative "Explore" as it contributes to understanding how engineering leadership is understood in professional practice. This work is also particularly relevant to knowledge-intensive, high-autonomy work environments.

Introduction:

In recent decades, leadership skills are increasingly recognized as an important aspect of the engineering profession. Accreditation boards across North America have included leadership capabilities, such as effective collaboration and teamwork skills and communication skills in their accreditation criteria [1], [2]. As a result, there has been increased focus and research around engineering leadership (EL) by engineering educators, particularly around identifying associated skills and effective pedagogical practices for teaching leadership [3], [4], [5].

While there has been prior work on engineering leadership situated in the workplace [6], [7], [8], [9], [10], research in this area tend to examine the engineering profession via a breadth of roles, disciplines and industries. As a result, there has been less exploration on how workplace context may influence how engineering leadership is understood or practiced.

This work-in-progress paper examines how engineering leadership is understood and recognized within the specific context of engineering consulting by studying one mid-size, Canadian engineering services firm. More specifically, the research question we seek to address is *who is identified as a leader inside engineering consulting firms and why*; for example, what skills, qualities or other attributes are recognized within the firm? By examining engineering leadership *in situ*, we acknowledge the prospect that "engineering leadership" may be impacted by the context in which it is practiced. This work will support engineering educators in further understanding engineering leadership, particularly for Capstone, design, and other problem-based, project-based courses where students are meant to be situated in replicated professional practice environments.

Context: Engineering Consulting:

Engineering consulting is a unique and important professional setting to study engineering leadership. First, the engineering consulting industry is a sizable employer for engineering graduates, having seen consistent growth in employment and market capitalization over the last couple of decades [11]. The increased demand for engineering services is further exemplified by the introduction of technical services offerings within other existing professional services firms (PSFs) in recent years. Finally, engineering consulting is an industry where leadership and non-technical skills are not only valued, but an inherent and integral aspect of the work because engineering consultants interact frequently with clients, consistently collaborate to design custom solutions, and regularly change teams, supervisors and/or clients due to the project-based nature of the work, all aspects that require adaptability by employees[12], [13], [14].

Literature Review:

Engineering Leadership

In engineering education research, attention has been given to leadership skills or competencies for engineering graduates, and pedagogical practices to developing proficiency or self-efficacy in these areas [15], [16], [17], [18]. Commonly cited skills include communication, teamwork, interpersonal skills, and other non-technical attributes [3], [4], [7], [19]. However, emphasis in extant literature has been on *what* these leadership qualities are, rather than *how* leadership skills are applied.

Studying engineering leadership situated in professional practice, in part, seeks to address the application or enactment of engineering leadership. Previous works have studied engineering professionals situated in the workplace, where the workplace was represented by a diverse set of roles and industries. For example, Rottmann *et al.* (2015) spoke to senior leaders at engineering intensive organizations, spanning software, structural consulting, and mining to form the Engineering Leadership Orientations [9]. While these orientations describe the ways engineers lead, their behaviours and how they influenced the team and organization around them, *the influence of the organizational type on leadership is not considered*. Fromel *et al*. (2009) studied different leadership styles experienced in the workplace, and spoke to participants who held a variety of roles including project engineers to upper level management, and from seven different disciplines, including civil, computer, automotive, etc. [6].

These types of studies allow us to develop an understanding between engineering leadership and the broad profession. However, the workplace in these studies is treated more as a site for the research, rather than a potential influence on the practice of engineering leadership. When the workplace context is backgrounded and wide-ranging, findings that emerge about leadership retain a level of abstraction. While these findings may be generalized across a wide range of contexts, the discussion provides less information on how these often-cited competencies (e.g. communication, teamwork) may be uniquely expressed and realized in a specific context. Our work attempts to address this gap.

Professional Services Firms

To investigate leadership and the contextual influence of the organization, we looked to the literature in Professional Services Firms (PSF). Engineering consulting is a type of professional service firm (PSF) [20]. The distinct characteristics of these organizations (flat-hierarchy and high-autonomy environments [20], [21]), and how these firms differ from traditional, hierarchical bureaucratic firms has been well documented. The unique characteristics of PSFs have implications for leadership [22] and by extension, engineering leadership, as we previously contended [23]. However, there exist limited empirical studies on leadership within PSF, and the body of literature on PSFs has primarily been built from investigations of accounting, law, and management consulting firms. Thus, engineering services firms remain an understudied context in both engineering leadership and PSF research.

While we can infer from the existing research on PSF about engineering consulting, the heterogeneity of PSFs has also been well documented and these variations have impact on the ways professionals work and lead (Malhotra 2009, von Nordenflycht 2015), For example, in engineering, teamwork is fundamental to projects, where each project draws upon various specialties, requiring engineers to collaborate more widely across the firm and negotiate iteratively in the design process. The size of the teams can also be much larger than counterparts in law or accounting. Exploration of engineering consulting firms builds on our understanding of engineering leadership as well as extends our knowledge of how leadership is enacted within PSFs.

Conceptual Framework:

To guide our exploration, we employ Empson and Langley's framework on leadership within PSFs [22] as our conceptual lens. This framework describes leadership as mechanisms of influence applied in an environment where authority and power are sometimes contested and ambiguous. They established this framework by reviewing practitioner-oriented texts about leadership within PSFs, and leadership theories from applicable contexts, such as studies focused on knowledge-intensive organizations and theories that saw leadership as a process, rather than positional. The *focus of influence* defined by Empson and Langley occurs on three levels: individual and teams, organizational, and strategic levels; mechanisms for influence come from the following *resources*: professional expertise, political interaction and personal embodiment [22]. Leadership in PSF can be summarized by all the ways influence manifests across each of these two dimensions.

Table 1: Manifestations of Leadership in Professional Services Firms (Adapted from Empson and Langley's framework) [22]

	Resources of influence		
Focus of influence	**Professional Expertise**	**Political Interaction**	**Personal Embodiment**
Individual / Group	Coaching	Nurturing	Role-modeling
Organizational	Balancing	Enabling	Meaning-making
Strategic	Championing	Consensus-Building	Visioning

The emphasis in engineering has similarly remarked that leadership is not positional, but rather a process. This characterization of leadership is shared within body of literature on PSFs, as the governance within these firms tend to negotiated and shared.

Research Approach:

Methodology:

We employ a case study approach as our methodology for studying how engineering leadership is understood within one engineering services firm. A case study is an inquiry of a phenomenon by collecting detailed information through various methods about a case over a defined period of time [24], [25], [26]. Case study methodologies are employed when the research questions seek to explain a phenomenon where the contextual conditions are pertinent to the understanding of the real-world case [25], [26], [27]. For our work, the phenomenon under investigation is how engineering leadership is understood within the context of engineering services firms. This methodology is often used when the boundaries between the phenomenon of interest and the context may not be fully evident [26], making it an apt approach for our interrogation of what engineering leadership means within engineering consulting.

Our case is formed around a private, employee-owned, mid-size (~1000 employees) Canadian engineering services firm. These firm services multiple engineering disciplines, with a large part of their focus on civil and infrastructure projects.

Data Collection:

Our qualitative case study is made up of data collected through semi-structured interviews with employees of the Firm. The authors worked with the project sponsor at the Firm to determine a pool of suitable people (i.e., the sampling frame) to participate in interviews for this study. To protect the anonymity of participants, the interview participant pool included approximately three times as many employees as compared to the number of anticipated interview participants. The criteria used to determine eligibility for the interview pool were participants that had direct involvement in delivering the services to a client extern to the organization, including services such as engineering design, reporting, analysis, project engineering, project management and field services.

To understand the perception of engineers across varying career stages and professional responsibility, we stratified our sampling pool into 3 groups.

1. The most senior group were individuals holding titles such as VP or Senior VP. These individuals led and managed the business units or service offerings within a firm. Their accountabilities included executing business strategies, profit and loss management and sponsoring large projects.
2. The second group of individuals held titles such as Director or Manager. These were individuals with direct reports and indirectly supervising or individuals within their teams or projects. Similar to group 1, these individuals held financial and technical responsibilities, but were more intimately involved with staff development and project execution.

3. The last group of individuals spanned between team leaders to individual contributors, who held titles such as project engineer or discipline engineer. Team leaders may have some positional responsibilities including mentoring junior staff, being a technical resource on projects or allocation of resources for projects. Individual contributors were individuals without direct reports but may be mentored or mentor others informally. Some of the individual contributors had yet to achieve professional licensure.

Our selection criteria above were provided to the Human Resource (HR) Lead at the Firm to build our participant pool. As part of the criteria for developing the sampling frame, we requested that women and racialized individuals were sufficiently included in the participant pool (~1/3 where feasible). We also asked for representation of staff across all business units of the firm but limited to those who worked in North American offices. This ensured that the author and the participant could communicate in English for the interview. The HR lead chose engineering consultants that fit the various selection criteria presented here to build the participant pool. In selecting who to interview from the participant pool, our intent was to maximize the diversity of perspectives by selecting individuals working in different locations, different businesses, and different roles. We also attempted to have representation of women and racialized individuals across each career stage grouping, to the extent possible. This became more challenging at the senior level as there were fewer women and racialized individualized represented in the pool. Not all invited to participate responded to our requests for interviews, which also partially determined the participants we were able to connect with.

The interviews took place between February and December 2023, were conducted online via Zoom and MS Teams, and typically lasted approximately an hour. Specifically, the interviews probed how participants define, enact, and recognize leadership within their lived experience at work and the various ways they believe their leadership development has been supported or hindered.

Data Analysis:
Interviews were transcribed by software and verified by the authors. Transcripts underwent thematic analysis using the constant comparison method, borrowing from grounded theory [28]. We primarily employed open and axial coding to form the findings of this paper.

Findings:

Our work explores how engineering leadership is recognized within the organizational context of engineering consulting through examining the lived experienced of consulting engineers within one firm. We report on our preliminary analysis of interviews with 7 individuals who work at the Firm. Our participants include 3 females, 4 males, and 2 racialized individuals. Participants spanned between the three career stage groupings we discussed previously, with 3 interview subjects in senior leadership and 2 individuals in each of the other two career stage groupings.

Baseline competencies:
Our findings suggest that the pre-requisite to leadership is proficiency at one's role within the firm. All participants talked about leaders having a baseline of competency that allowed them to fulfill their responsibilities. For individuals inside engineering consulting firms, their

responsibilities mapped to three categories: technical, relational (or people-oriented) and operational. Technical responsibilities spanned across all career stages. Operational and relational responsibilities increased as an engineer became more experienced, and, for some, held positional leadership roles, such as Team Lead or Department Manager. Leaders, as described by participants, tended to be exceptionally strong in one of the three areas, but there was no emphasis or preference for one type of leadership strength over other types. In fact, participants emphasized the need for diversity in type of strengths in positional leadership roles, as it benefited the team and broader organization.

Relational strengths:

One category that was salient in our interviews was around relational skills that participants commonly referred to as "people skills", "social skills", "interpersonal skills", and "the people side of things". When asked to untangle what participants meant by this, a few themes emerged. Conflict resolution was often associated with leaders in functional leadership roles. Leadership meant being able to mediate interpersonal conflict between team members, or more frequently, with unhappy clients. Leaders took to resolving such conflicts by diffusing tension through listening actively to opposing viewpoints and suggesting a path forward, or by shifting the mood in the room through simple acts like making a joke. Participants described effective leaders as individuals who were able to attentively listen with empathy to the concerns of the employee, such as dissatisfaction with salaries or career advancement. Leadership behaviour included taking time to explain the firm's policies (which was often not in their control), and strategized actionable things the employee could do, such as bringing data on salaries for the industry so it could be negotiated with the Firm.

The leaders who left the most significant impact on participants were often ones who demonstrated care for the employee, and that care extending to the whole person rather than just the worker. These were leaders who had built relationships with individuals. One participant described: *"I know who their significant others are. I've met them. I know if they've got kids. I know about how old those kids are. I kind of know some of the things they enjoy doing."* Caring leaders were sometimes not direct supervisors or in the reporting line for participants but nevertheless checked-in frequently and provided feedback to how they were doing or how the team was performing. These leaders were generally well-liked, and had the capacity to build camaraderie on teams, where that care was expanded to the culture of the team.

Finally, relational strengths of recognized leaders were individuals who built relationships with others within the Firm. Their relationships and broad network provided them provided resources that they could tap into for projects, as well as for mentorship. These relationships also facilitated better teamwork on large projects. This aspect of leadership was recognized across all career stages. Early career professionals recognized as leaders by more senior staff were noted as taking the initiative to build relationships across teams and even geographic offices.

Operational leadership:

The participants made it clear that part of engineering leadership is founded on good management skills. Participants emphasized the need for leaders to be organized in their delegation of tasks on projects, and in their administrative duties as part of the organization. They held themselves and their teams accountable for completing project deliverables, meeting

client needs, and managing financial controls of their project portfolio. There was a dependability quality attributed to these leaders, which led to trust and confidence from both more senior and subordinate members of the team. Operational accountabilities were described as a necessary requirement to exemplary engineering leadership.

Technical excellence:

While "people skills" were more often associated with positional leadership, all participants emphasized the importance of having technical competence in this industry. From early career to experienced professionals within the Firm, technical competence was the bedrock of leadership. These individuals were identified in some cases informally, and other cases more formally by a role or title, as the subject matter expert to consult, including identified by individuals outside of their direct team or office. Leadership was further demonstrated by the mentorship these individuals provided. Even for early career engineers, leadership was exemplified by helping and teaching others on the team who may lack experience with a certain tools or project tasks. The expectation to teach and mentor was implicit within the organization, and particularly prominent after a consultant became professionally licensed. In fact, early to mid-career individuals who exemplified this capacity for technical coaching were seen as emerging leaders by superiors.

Lastly, one aspect regarding the culture of engineering leadership within engineering consulting firms emerged from our interviews. Senior leaders emphasized the importance and need for technical leadership within these firms. The ability to recognizes technical leadership was important to senior leaders to relieve the pressure of limited people-leadership positions, and the need by the employee base to see "career progression" in the form of changing job titles. For this reason, titles signifying technical leadership were created to identify and recognize these individuals. Despite these efforts, when participants were asked to speak about exemplary leaders or leadership within the firm, the predominant sentiment often defaulted to individuals holding people-leadership or functional management roles.

Highlighting communication:

Effective communication was emphasized by all participants. This is not surprising as communication is one of the most cited skills in extant literature on engineering leadership [4]. Communication in this organizational context was enacted in several ways by recognized leaders within the Firm. As previously mentioned, the ability to allow people to feel understood and empathized with during conflict resolution was attributed to "effective communication". In terms of related relational capabilities of leaders, communication allowed professionals to impart meaning and purpose of the work to the team and motivated workers towards a common vision. Communication was also described as what it took to build trust and confidence between individuals on a team.

Participants also spoke about communication within project or task-based contexts. Individuals spoke about leaders having the ability to effectively communicate technical information to client, which meant providing the "right amount" of technical information. Additionally, effective technical communication often was described as starting with the ability to listen and meet the client at their level of understanding. Effective communication in these cases led to answering clients' questions directly, without providing excess information, rushing to explain a bigger point, or delivering a pedantic-like lecture.

Other aspects of communication that related to leadership was around the project execution and overlapped with good project management practices. Strong leaders were clear in their scope management, helping the client understand what was within or outside of their mandate. Their communication was also clear in supporting the team in executing project deliverables, including meaningful follow-up that articulated clearly what needed to be done.

Leaders exemplifying effective communication was associated with thoughtful and calm communication style. Some participants reflected on less effective staff who were "aggressive [and] run very hot". Other reflected that women especially needed to be calm and were implicitly expected by others to diffuse tension and maintain positive morale.

Application of influence

Our conceptual framework looked at leadership in terms of the ways that influence was applied. In our interviews, some participants explicitly spoke about the need to influence or being influenced by individuals without positional authority. Key themes that were noted in our conceptual framework include role modelling. Individuals looked to leaders to learn how to be a professional, from the "mundane" things like how to dress or answer calls, or other more complex items such as how to listen and engage with clients.

Recognized leaders were often champions for members of their team. This was done by providing support for stretch assignments, such as leading a meeting, or managing a section of the project, especially before they had necessarily built that trust with clients and peers. In these cases, a leader may explicitly communicate their support of the individual taking on the increased responsibility. Leaders created opportunities for others, while striking the balance between autonomy and support. Effective leaders were shown to let their staff solve project or technical problems based on their line of thinking but were there to provide guidance when needed. During these opportunities, the psychological safety to make mistakes and fail was emphasized by participants.

Future Work & Limitations of the study

Future work will include perspectives from other participants of the study whose interview data were not included as part of this paper. Relational skills discussed by engineering consultants include commonly cited skills in the engineering leadership literature, including communication, activity listening and ability to build relationships [3], [4], [7]. We anticipate our full findings will support better understanding of how these relational skills allowed participants to apply influence within their organization, especially in circumstances where they lacked positional authority. Future work will also explore the differentiated experience that may exist for women and racialized individuals.

Case studies are an in-depth analysis around the phenomenon of interest; as such, we cannot assume these results are generalizable across engineering consulting firms more broadly. Without additional studies on other engineering consulting organizations, we cannot comment on the impact of firm-specific structures that can influence the definition and recognition of leadership.

As well, our study also only investigated the experiences of employees working within North America, though the Firm has offices internationally.

Implications:

This work is relevant to ASEE LEAD division's strategic initiative "Explore" because it contributes to understanding how engineering leadership is understood in professional practice, particularly inside engineering consulting and other knowledge-intensive, high-autonomy environments. A better understanding of engineering leadership in the workplace setting supports engineering educators' efforts in equipping graduates with the relevant leadership and professional skills.