"We Did It!" Proud Moments as a Catalyst for Engineers' Situated Leadership Learning

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Abstract

Engineers' day-to-day responsibilities include supervision, influence, management, and leadership, yet much of this work occurs on the periphery of their professional attention. Our study aims to make the largely implicit process of engineering leadership (EL) development explicit, and thus teachable, by pairing memorable career events with leadership learning processes. More specifically, we use Lave and Wenger's situated learning theory to investigate how career-embedded ***proud moments*** *contribute to engineers' leadership development. Our team identified four types of proud moments along with corresponding leadership lessons in the career history narratives of 29 senior engineers. This four-part proud moment typology—honing professional dexterity, mobilizing teams, realizing values, and driving excellence—illustrates four distinct ways that engineers can and do institutionalize leadership in their respective workplaces. This finding suggests that proud moments are not only personally affirming stories, but also institutionally realized leadership catalysts. By making four types of EL development catalysts explicit, we provide engineering educators with authentic, industry-embedded narratives to support their programing. This project is significant to the ASEE LEAD division because it provides us with a way of scaffolding leadership development opportunities for all our students, even those who may resist the notion of engineering as a leadership profession.*

Keywords: career paths, engineering leadership, situated workplace learning, leadership narratives

Introduction

The majority of engineers working in industry encounter supervisory or managerial responsibilities within four years of graduation [1-4], yet research suggests that many of them resist the notion of engineering as a leadership profession [5-7]. This reluctance among many engineers to accept leadership as an inherent aspect of their professional identities has consequences for engineering leadership (EL) educators because it relegates leadership learning to the periphery of engineers' attention. Compounding this professional identification challenge, the peripheral status of EL development in most undergraduate engineering programs reifies a powerful socio-technical dualism privileging technical over relational dimensions of engineers' work [8, 9]. Our study on engineers' situated leadership development implicitly challenges this dualistic thinking by examining how engineers learn to lead, motivate, guide, and mentor others while busy meeting a more task-oriented set of organizational objectives [10]. In particular, the line of analysis we investigate in this paper asks: How do career-embedded proud moments contribute to senior engineers' leadership development?

Leadership development researchers vary in terms of their entering paradigms and theoretical perspectives, but most frame their work as a challenge to two basic assumptions: 1) leaders are born and 2) leadership is dependent on one's position or title. If leaders are born, there is no reason to study leadership development. Instead, we may simply identify the characteristics of exceptional leaders and promote people with these attributes into managerial roles. If leadership is tied to a person's position, there is no need to integrate leadership development opportunities into K-12 or post-secondary education. Instead, employers may provide the sub-set of engineers identified as high potential leaders with role specific training. While these two assumptions have limited empirical backing, they nevertheless persist in engineers' professional practice leaving meritocratic assumptions about leadership and inequitable promotion patterns intact.

In 2011, the *Journal of Leadership Studies* published a special issue dedicated to conceptual consensus in the otherwise disparate field of leadership learning. According to Allen and Roberts [11], leadership learning research builds on five foundational assumptions: 1) leadership is a process of solving adaptive challenges, 2) it can be developed, 3) it requires holistic individual development, 4) it is relational, and 5) it happens in context. They go on to suggest that the umbrella term, leadership learning, is made up of three discrete elements: leadership training, leadership education, and leadership development. Leadership training involves activities designed to improve the performance of individuals in specific managerial roles; leadership education aims to improve individuals' leadership competencies beyond their current roles; and leadership development involves a "continuous, systemic process designed to expand the capacities and awareness of individuals, groups, and organizations in an effort to meet shared goals and objectives"[11] (p.67). When we use the umbrella term "situated EL development" in this article, we are referring to the ongoing, often tacit, learning process that occurs as a product of engineers' professional practice, not a role-specific training opportunity or formal educational intervention. It is our contention that situated, career-embedded learning is an important, though often neglected aspect of engineering education.

Our paper extends Allen and Roberts' conception of leadership development and supplements the growing body of classroom based EL research by studying leadership development in the context of engineers' professional practice. While a growing number of engineering education researchers have begun to focus on professional practice [12-20], very few examine how engineers learn to lead at work. The implicit message is that leadership *learning* happens at school and leadership *practice* happens at work. Far fewer examine leadership *learning through practice*. While this would be an important line of inquiry for leadership development researchers situated in any occupation, it is especially important given the deeply rooted history of apprenticeship and practical arts [21-26] in the engineering profession.

Our study of senior engineers' career-embedded leadership learning takes up this challenge, making three key contributions to the EL literature. First, by examining the experiences of practicing engineers as they engage in a variety of leadership, management, and supervisory practices, we are disrupting the notion of engineers as pure technologists. Second, by reporting on senior engineers' leadership learning trajectories, we examine what they have learned, not what industry leaders would like us to teach, providing some respite from the enduring expectation that we play catch up to global economic forces. Finally, by analyzing the experiences of engineers who learn to lead while busy doing other things, we make a tacit workplace learning process explicit, providing engineering educators with authentic, workplace-embedded leadership development catalysts to support their programing. These three contributions to the field of EL research are direct products of our adopted theoretical perspective—Lave and Wenger's [27] situated learning theory.

Briefly, Lave and Wenger draw on ethnographic studies of four occupations and one social group to characterize learning as an inherent dimension of social practice. They define learning as a process of legitimate peripheral participation in a community of practice. The first concept, "legitimate peripheral participation" (p.35-37) describes the active process by which newcomers learn to become full members of a mature field through participation in shared work, while the second, "community of practice" (p.98-100) depicts the social field itself—a mature, yet dynamic group of individuals working on a shared project, set of problems, or common concern. In contrast to most learning theories which are rooted in cognitive psychology, Lave and Wenger's conception of learning is rooted in social anthropology. At the risk of over-simplifying two multifaceted disciplines, cognitive psychologists are primarily concerned with mental processes, while social anthropologists are primarily concerned with enculturation.

We have adopted *situated* learning theory rooted in social anthropology as our theoretical perspective, rather than a *situative* learning perspective rooted in cognitive psychology because we believe engineers learn to lead through deeply contextualized practice, whether they are aware of this learning or not. We are making this distinction because the *situative* learning perspective is more prevalent in engineering education research [28-30]. This makes sense given the field's focus on formal teaching and learning practices in undergraduate engineering education contexts. The epistemological distinction between learning as the acquisition of decontextualized, transferable knowledge and learning as a product of community immersion may explain why Lave and Wenger's situated learning theory has received little attention in engineering education research. For Lave and Wenger, learning is the product of communal human activity which occurs even when individuals are unable to express cognitive shifts catalyzed by their experiences. Applying this idea to EL, we believe engineers may learn to lead even if they struggle to list their newly developed professional skills or explain their enhanced cognitive processes to researchers. While their leadership learning may involve meta-cognitive awareness, it may also occur through a more tacit process embedded in everyday practice. As Wenger states [31]:

> *Learning is something we can assume – whether we see it or not, whether we like the way it goes or not, whether what we are learning is to repeat the past or to shake it off…learning is an integral part of our everyday lives. It is part of our participation in our communities and organizations. The problem is not that we do not know this, but rather that we do not have very systematic ways of talking about this familiar experience. (p.214)*

Our project provided senior engineers with a systematic way of talking about "this familiar experience," by prompting them to describe two memorable events (a proud moment and a struggle) and reflect on how each of these experiences shaped their leadership development. Bennis and Thomas [32] have coined a phrase to characterize this type of powerful catalyst for leadership development—"leadership crucibles" (p.39). After analyzing interviews with 40 business leaders, they learned that regardless of age or stage, all participants had lived through "intense, often traumatic, experiences that transformed them and became the source of their distinctive leadership abilities" (p.39). By focusing on "proud moments," our paper highlights a relatively affirming subset of leadership development challenges that senior engineers have managed to overcome. This conceptualization of proud moments as affirming leadership crucibles not only enables us to examine one of the many ways engineers develop as leaders, but also helps us investigate organizational impact over time. Our follow up question prompted senior engineers to consider the longer-term impact of their proud moments on themselves, their colleagues and their organizations, providing us with important insights about how affirming leadership experiences are codified in the origin stories, culture, values, policies, and practices of an organization.

Methodology—Career history research

Our interest in engineers' career paths combined with our desire to respect their "billable hours," drove us to use a truncated version of life history research [33, 34] called "career history research" [33, 35, 36]. Briefly, life history research builds on deeply contextualized chronological narratives about individuals' lives, enabling researchers to study human development over time without the expense and inevitable attrition rates associated with longitudinal designs. Career history research does the same, paying specific attention to an individual's period of employment. We chose this methodology to answer our research question because we believed the primary means of data generation—semi-structured chronological interviews touching on engineers' career transitions—would enable participants to construct occupationally embedded narratives about leadership development without having to characterize their experiences as leadership learning events. Stated differently, we believed that senior engineers with some level of supervisory or managerial responsibility would find it easier to recall and articulate their decisions to become engineers, their first jobs, the many career transitions along the way, proud moments, and struggles, than to answer the direct question, "how did you learn to lead?" To further aid recall, we invited research participants to bring an updated resume to the interview.

Between March and December 2018, we conducted 29 career history interviews with senior engineering leaders working in eight different industries: chemical processing, manufacturing, higher education, public service, mining, financial services, consulting, and software. We began with a convenience sample of industry partners, then branched out to identify disciplinary gaps. At each organization, we identified a key informant, a senior engineer with an extensive, interdepartmental network. We invited these individuals to participate in the study and encouraged them to identify a demographically and experientially diverse group of three to five engineering colleagues who had graduated from an undergraduate engineering program no later than 1992. At the time of the interviews, all participants had a minimum of 25 years' workplace experience, 93% were licensed Professional Engineers, and all but one worked in Canada. Despite a deliberate attempt to demographically diversify our sample, the final group was 72% male and 79% White. Slightly more than a third of participants shared stories about growing up in working class families. The proportion of women in our sample (28%) may seem small, but it is substantially greater than the 13% of licensed engineers in Canada who identify as female. We lack a reliable repository of race-based data in Canada, but the proportion of racially minoritized (RM) engineers in our sample (21%), is greater than the 13% of racially minoritized engineers in our nearest neighbour, the United States[1] [37]. The mean age of engineers in our sample (58) is higher than the mean age of professional engineers in Canada (43). Thus, our sample is considerably older, more female, and slightly less white than the population of licenced engineers in Canada, but considerably whiter and more male than the Canadian population. Please see Table 1 for the demographic breakdown of our sample.

[1] We were unable to locate comparable population level statistics for Canadian engineers by race.

Table 1: Sample Demographics

Industry	Leadership Role	Undergrad	Licensed	Age	Gender	Race
Chemical Processing	C-Suite/ Executive	Domestic	Yes	60	M	White
	Managing Director	Domestic	Yes	50	M	White
	Technical Specialist	Domestic	Yes	61	M	White
	Managing Director	Domestic	Yes	50	F	White
Manufacturing	Managing Director	Domestic	Yes	57	M	White
	C-Suite/ Executive	Domestic	Yes	57	M	White
	Entrepreneur/CEO	Domestic	Yes	72	M	White
	Entrepreneur	International	Yes	70	M	Racially minoritized
Higher Education	Entrepreneur	Domestic	Yes	72	M	White
	C-Suite/ Executive	Domestic	Yes	82	M	White
	Entrepreneur	International	Yes	66	M	White
	Technical Specialist	International	Yes	71	M	White
Consulting/ Mining	C-Suite/ Executive	Domestic	Yes	55	M	White
	Managing Director	Domestic	Yes	50	F	White
	Technical Specialist	Domestic	Yes	81	M	White
	Managing Director	Domestic	Yes	48	F	White
	Entrepreneur	Domestic	Yes	52	M	Racially minoritized
	Technical Specialist	International	Yes	48	F	White
Public Sector, Infrastructure	Managing Director	Domestic	Yes	53	F	White
	Managing Director	Domestic	Yes	48	M	White
	Managing Director	Domestic	Yes	49	F	White
	Managing Director	Domestic	Yes	53	M	White
Finance	C-Suite/ Executive	Domestic	No	65	M	White
	Managing Director	Domestic	No	54	F	White
	Managing Director	Domestic	Yes	44	F	Racially minoritized
	Managing Director	Domestic	Yes	54	M	White
Software	Entrepreneur/CEO	Domestic	Yes	50	M	Racially minoritized
	Technical Specialist	International	Yes	47	M	Racially minoritized
	Technical Specialist	International	Yes	55	M	Racially minoritized

Our primary means of data generation involved semi-structured career history interviews beginning with the following question: "Briefly walk us through the major milestones of your career, beginning with your decision to become an engineer." Follow up prompts helped participants generate reflective narratives about their professional journeys, touching on career transitions, proud moments, and struggles. As participants described these career-embedded experiences, we invited them to reflect on what each one taught them about leadership. We refer to these interviews as "data generation"[38] rather than "data collection" because they involve knowledge construction rather than foraging for facts. Participants' career path narratives are rich with interpretation, values, priorities, and salient memories. Most of the interviews lasted two hours with each of the 29 transcripts ranging from 60 to 150 pages. We recorded interviews with participants' permission, then transcribed them verbatim—removing identifying features prior to analysis. For this paper, we analyze participant responses to a single question, "looking back over your career, tell us about an accomplishment you feel most proud of." Follow up questions prompted them to discuss lessons learned, how they integrated these lessons into their work, institutional supports, and the impact of each experience on themselves and others.

Our interdisciplinary team of researchers analyzed participants' proud moment narratives using a combination of inductive [39] and thematic [40] coding. We began our collective analytic process by training on a shared transcript. We did not do this to "triangulate" findings, as triangulation presumes a single true interpretation. Rather, we used this collaborative coding process to help members of our team who were novice qualitative researchers engage in "researcher reflexivity" [41, 42], examining our individual analytic tendencies and subjectivities in relation to the larger group. Each team member became a career path specialist, inductively analyzing [39] five to eight transcripts for each successive analytic phase. We generated summaries for each interviewee as well as a composite summary for the five to eight engineers in our respective career path sub-groups. The team leader convened monthly meetings to facilitate intensive cross-case analysis sessions during which we collectively identified salient themes within and across groups. Our final typology of proud moments was a collective analytic effort involving the coding, sorting, classification, and re-classification of all 29 proud moments into experientially analogous groups. Since proud moments cannot be fully expressed through reductive typologies, we supplement our typology with experiential narratives. Few of these narratives involve direct quotes. Rather, we use composite descriptions merging the voices, stories, and contexts of senior engineers whose proud moments aligned. An additional reason for using composite narratives in place of illustrative quotations is to mask the identities of participants and their employers.

Findings: Proud moments as leadership learning catalysts

The 29 senior engineers we interviewed shared four different types of experiences that elicited pride: honing professional dexterity (n=9), mobilizing teams (n=9), realizing values (n=6), and driving global excellence (n=5). The first group reflected on an experience of exceeding their perceived technical or business capabilities on a project. The second group spoke about mobilizing their teams to achieve success despite incredible odds, with nearly half using the analogy of "turning around" a sinking ship. A slightly smaller group of participants spoke with pride about their abilities to integrate personally meaningful values into organizational policies and practices. Finally, the fourth group felt proud of achieving national or global recognition as industry leaders. Participants shared many important accomplishments with us over the course of their interviews, but for this paper, we draw on their responses to our explicit interview prompt about a proud moment or career highlight. We expand on each type of proud moment below through an illustrative quotation and a composite narrative.

1) **I did it: Exceeding perceived capacity through professional dexterity (n= 9)**

So, by (X year), we were halfway done. And then, there was news that our sales team managed to sell the system to the whole country of Y. So, Holy %$#&!,It's not possible. We're only halfway there and none of us spoke Y as another language, but me and two other people put a lot of overtime and we managed to create a special version just for Y. This was long before the general North American release. So, on a personal engineering level, I would say I feel really proud of that.

Nine senior engineers, mostly on a technical specialist career path, described experiences of professional dexterity. Their career highs involved solving a thorny technical or managerial problem from start to finish. The key distinguishing feature of proud moment narratives in this group was the successful application of technical skills or business acumen to solve a complex problem at a pivotal point in the life cycle of a project. For example, the quotation above comes from a technical specialist at a mid-sized software development firm who worked over-time, under extreme pressure alongside a few colleagues to adapt a new product line to a European context prior to its general, North American release.

This example emphasizes technical excellence, but several of the individuals in this group shared experiences of business acumen. Irrespective of domain, they attributed their success to a combination of professional dexterity and intense personal effort. In terms of demographics, participants in this group roughly reflected the gender and racial balance of the sample but included the greatest proportion of internationally educated engineers. The nine senior engineers in this group were all presented with a grand challenge style problem, had managers or senior colleagues who trusted them to lead the project from start to finish, and were recognized by clients for their skillful resolution of the problem. Their work typically resulted in positive impact for the client, as well as future mentees. At a personal level, the senior engineers in this group achieved a sense of professional satisfaction and gained confidence in their abilities to solve problems from start to finish. When it came to leadership development, most participants with a professional dexterity narrative learned that even the best technical or business solutions cannot proceed without buy-in at multiple levels.

2) We turned it around: Mobilizing team efforts (n=9)

> *For me this was a really great success because I got the team moving. It became a signature project for the team and really cemented a lot of what we had been talking about with (org priority). We had the right people at the right time and the right things happening.*

Another nine senior engineers—mostly managing directors who led interdisciplinary teams—were proud of leading others through incredible odds, driving organizational change in prosocial ways, and exceeding the expectations of senior executives. Members of this group were all white and included a greater percentage of women than was present in the sample. The individual cited above worked for a large international consulting company and recalls mobilizing her team, effectively negotiating with diverse client groups across international borders to turn an inherited project with multiple inherited problems into a viable venture. In contrast to proud moments experienced by the professional dexterity group, the mobilizing teams group tended to speak in terms of "we" and operationalize their learning as a team sport. They were proud of their personal, additive contribution to their respective projects, but were more inclined to highlight their experiences getting teams moving, than their own technical problem-solving prowess. In fact, many of the engineers in this group experienced leadership development as a process of coming to terms with the fact that they were no longer the primary technical specialists on their teams. In contrast to the core technical challenges faced by the first group, the senior engineers in this group were presented with a high-stakes trial-by-fire type problem. While it was not always the case in their day-to-day work, when it came to these career-enhancing proud moments, all nine were supported by having the trust and necessary resources from senior management to address uphill battles as well as the freedom to build their own teams, choose their own leadership strategy, and bend organizational rules. They were often recognized by senior executives for addressing high-risk problems on projects that had gone off the rails. Their leadership not only resulted in project delivery, but also in greater team cohesion. Over time, nearly all spoke about having fostered a more collaborative organizational culture. In an earlier line of analysis on this project, we referred to these managing directors in two different ways. We called those working for non-technical employees "invisible engineers" and those working for engineering-intensive firms "boundary spanners" [10, 43]. Both invisible engineers and boundary spanners built enduring, cross-departmental networks, formalizing knowledge gained through their varied experiences across divisions, but the former group faced the added challenge of having to regularly claim and re-claim their engineering identities. At a personal level, the team mobilization work of these participants helped them re-invigorate their careers. Their professional experience, confidence and humility enabled them to see beyond the scope of an individual project in support of organizational capacity building and cultural change. For these engineers, personal and organizational development were always works in progress.

3) Put my stamp on it: Institutionalizing personal values (n=6)

When I started here, there wasn't even a process safety engineer…they had programs and procedures and commitments and policies …things were being done on an inconsistent basis, but I mounted a consolidated, coordinated effort… I think the success was to build a comprehensive process safety management program so that we don't lapse, that we always do it, we always do it the right way and that we build standards to drive continued progress.

Six senior engineers, mostly on entrepreneurial and intrapreneurial career paths, were most proud of integrating their personal values into organizational practice. If the motto of the first and second groups were respectively, "I did it!" and "we turned it around!" the motto of the third was "put my stamp on it!" For example, the individual cited above who worked at a chemical processing and manufacturing company described weaving his personal commitment to safety into a comprehensive safety management program that became standard operating procedure for the organization. When it came to demographic patterns, the participants with value-driven proud moments included more racially minoritized men than the full sample. Senior engineers in this group were proud of their ability to leave a personally meaningful imprint on their respective organizations. Like the other two groups, these engineers also faced a challenge, but this challenge was more internally driven than the other two groups. They were motivated to achieve organizational alignment around a personally meaningful value. They often derived support from those who had hired them with a mandate to integrate these values into organizational policies, practices, and products, but experienced hostility from a small number of vocal resisters who preferred pre-existing organizational norms and practices. These value driven engineers were often characterized by their colleagues as the moral compass of their respective organizations. Their steadfast commitments to workplace safety, social justice, sustainability, health and safety, and collegiality had a ripple effect on colleagues, clients, users, and local communities. At a personal level, senior engineers in this group gained professional satisfaction from being able to bring their whole selves to work and commit their labour to a personally meaningful goal. When it came to leadership lessons, they learned to stand up for what they believed in, listen to those who disagreed with them, and retain procedural flexibility when it came to facilitating change. In several cases, they described themselves as "lone wolves" who nevertheless had a positive impact on others.

4) We're the Best: Driving global excellence (n=5)

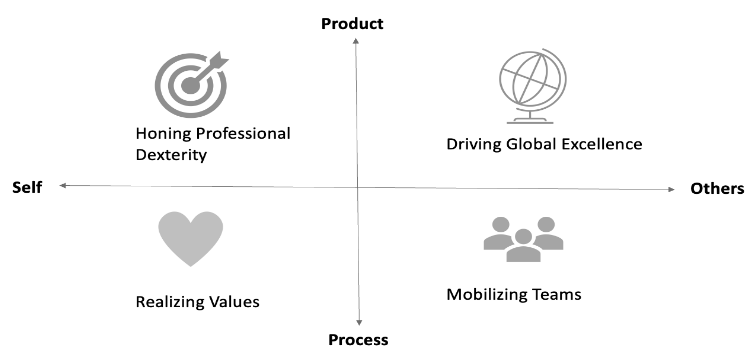
I think my major achievement was getting [organization] on a trajectory to global excellence.

The final five senior engineers we interviewed, all white men in C-Suite or equivalent senior executive roles, shared career highs that involved achieving national or international recognition for their respective organizations. Implicit in their stories was a “we’re the best!” message. For example, the senior academic administrator cited above described his experience catapulting the status of his university from national to global leader. The other four individuals with similar types of proud moments were senior executives in industry who had spent their careers in a single organization. As such, they enjoyed greater institutional status, privilege, and positional authority than most of their counterparts in our sample. Executive status notwithstanding, their proud moment narratives included the same four themes present in others: a challenging problem, institutional support, external recognition for a job well done, and positive impact at an individual and organizational level. The problem set out for them, often by their respective boards of directors, involved paving the way for organizational expansion. In terms of supports, they had access to significant organizational resources, information and powerful networks tied to their titles and positions. Their achievements were recognized by national and global competitors who viewed them as industry leaders. When successful, their high-risk, resource-intensive ventures led to enhanced organizational growth and status, with a net positive effect of job creation and resource expansion for the company. Senior engineers in this group learned to sniff the wind for opportunities, envision where they wanted to go, outline how to get there, and locate sponsors to fund the way. At a personal level, their achievements brought them professional satisfaction and enhanced their confidence as leaders.

Summary of findings

The senior engineers we interviewed for this career history project learned to lead while busy solving technical problems, mobilizing their teams to turn around failing projects, introducing value-driven change into their organizations, and helping their organizations attain new international heights. In other words, they learned to lead while busy doing other things. As a result, they were not always able to independently articulate or even claim their leadership development journeys without our reflective prompts. They honed professional competence and gained confidence from these memorable “proud moment” experiences, with all 29 finding ways to institutionalize their learning into organizational policies, practices, or strategies—albeit with different levels of organizational support. While there were similarities across the four groups, there are also differences worth highlighting. Please see Figure 1 for a proud moment typology clarifying these differences along two continua, one highlighting their primary leadership achievement (y-axis) and the other highlighting the primary recipient of their work (x-axis).

Figure 1: Proud Moment Typology



The vertical axis on Figure 1 represents participants' leadership accomplishments as primarily product (top) or process (bottom) driven. While all participants led in both process and product-driven ways, members of the "honing professional dexterity" and "driving global excellence" groups were most proud of their work addressing well-defined projects in ways that enabled product or goal-driven leadership, while members of the "realizing values" and "mobilizing teams" groups tended to be faced with more ambiguous or poorly specified problems requiring them to lead in a process-driven way. All the senior engineers we interviewed were goal-driven, but members of the latter two groups were regularly assigned work that required them to improve a situation rather than complete a project. These external assignments limited their abilities to successfully deliver a final product. Many of these engineers were penalized for the type of work they had been assigned through slower career advancement trajectories—a structural reality that impacted a greater proportion of women and racially minoritized engineers than white men in our sample.

The horizontal axis on Figure 1 represents the primary beneficiary of the experience, with personal impact on the left, and collective impact on the right. In terms of primary beneficiaries, senior engineers whose proud moments involved "honing professional dexterity" and "realizing values" foregrounded the impact of these experiences on themselves. In contrast, the senior engineers who were most proud of "mobilizing teams" and "driving global excellence" were more inclined to describe the impact their leadership had on others—their direct reports in the case of the mobilizing teams group, and the organization as a whole in the case of the driving excellence group.

The four categories privileged by our typology are not mutually exclusive. Engineering leaders must pay attention to product and process, self and others. We are not suggesting that participants' proud moments have fixed them to a specific destiny. Rather, we believe that every experience contains traces of structural details. These proud moment narratives are no different. All 29 contain details that help us make implicit structural advantages and disadvantages explicit. Please see Table 2 for a disaggregation of our proud moment typology by motto, description, leadership role, gender, and race.

Table 2: Proud moment typology by leadership position and demographics

Proud moment	n	Motto	Description	Leadership Role	Gender (72% M)	Race (79% W)
Professional Dexterity	9	"I did it!"	Exceeding one's perceived technical capacity	Technical Specialist	78% M	78% white
Mobilizing Teams	9	"We turned it around!"	Mobilizing teams to achieve success despite the odds	Managing Director (Boundary Spanner)	44% M	100% white
Realizing Values	6	"Put my stamp on it!"	Integrating values into organizational policies and practices	Entrepreneur/ Intrapreneur	83% M	67% white
Driving Global Excellence	5	"We're the best!"	Achieving global or national recognition as industry leader	Senior Executive	100% M	100% white

Perhaps not surprisingly, engineers who were most proud of their technical contributions to a project tended to be in technical specialist roles, while those who were most proud of mobilizing teams were in integrative managing director roles spanning multiple departments, divisions, and responsibilities. Those who were most proud of realizing their values at the organizational level were either entrepreneurs whose businesses reflected their underlying beliefs or intrapreneurs striving to influence organizational change from within. Finally, the engineers who proudly told us about global recognition garnered by their organizations tended to be in C-Suite or other senior executive roles. In other words, senior engineers' proud moments tended to reflect their organizational locations and leadership positions. In terms of demographic trends, women were over-represented in the "mobilizing teams" group and racially minoritized engineers were over-represented in the "realizing values" group. The senior executives in the driving global excellence group were all white men. Returning to our two-by-two typology, this suggests that engineers in boundary spanning roles with a relatively high proportion of women experienced more collective and process-driven leadership catalysts than the full sample, while the small group of racially minoritized engineers, all but one of whom were men, tended to share process-driven proud moments that centred themselves as lone wolves or autonomous agents. The one racially minoritized woman in the group was most proud of her leadership development in finance, made possible by her difficult decision to exit a toxic, decade-long engineering-intensive workplace experience. The 29 narratives include particular experiences faced by particular individuals, all of whom are more complex than their gender, race, or leadership role can predict. Still, as engineering educators supporting the development of the next generation, we cannot ethically ignore the structural inequities evident in their stories.

Our early methodological decisions prevent us from generalizing our findings to the full population of senior engineers in Canada, but we can share patterns of privilege within our sample. Three such patterns are noteworthy: the group whose members strove to drive global impact had the greatest positional authority and were all white men; the group whose proud moments involved mobilizing and empowering others included an over-representation of women; and the two groups whose proud moments involved limited structural interdependence, were more racially minoritized and internationally trained than the full sample. The first two trends reflect gendered patterns of privilege while the first and third reflect the normative power of white privilege and domestic graduate advantage in engineering organizations and Canadian society.

Discussion

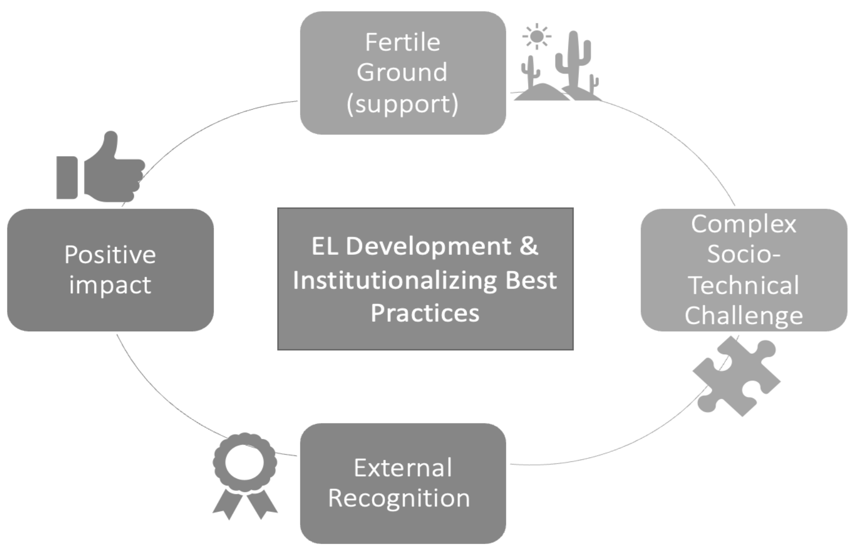
What did senior engineers learn from these proud moments in the context of their careers? First, they gained socio-technical competencies that enhanced their professional development as engineering leaders; second, their awareness of this competence enhanced their professional confidence; and third, they learned how to pay their leadership development forward—passing the positive impact of these proud moments on to their colleagues, teams, organizations and in some cases society. We briefly discuss these three consolidated findings then distill participants' leadership development paths into a process-based framework that may be used to guide future research and practice in engineering leadership education.

First, the senior engineers we interviewed gained socio-technical competencies that enhanced their professional development as engineering leaders, even as some continued to resist a leadership identity. These competencies included problem-solving ingenuity, communicating across technical and managerial audiences, system thinking, mobilizing technical teams, balancing contextual awareness with piercing analytic insight, and drawing on deep industry knowledge to expand market share. Interestingly, in contrast to more generic leadership skills like communication, critical thinking, risk-taking, and persuasion, the four competencies developed by engineers through career-embedded proud moments, can all be characterized as socio-technical skills that exist at the nexus of engineering and leadership. To drive this point home, participants derived great professional satisfaction from occupationally situated leadership development opportunities that were integral to their professional responsibilities as engineers. In these moments, the senior engineers we interviewed were not obligated to give up their engineering identities to accept themselves as leaders. Rather, they were positioned to draw on their technical training and professional experience, transcending dualistic thinking in the process. To use a term coined by Law [44] and empirically examined by Faulkner [45], senior engineers' proud moments provided them with the necessary experience to foster a "heterogeneous" engineering leadership identity.

Second, participants noted that the increased competence they gained through these proud moment experiences enhanced their professional confidence. One of the most prevalent characteristics we observed in the senior engineers we interviewed was their agentic worldview. This was even characteristic of managing directors who had been assigned to salvage failing projects. By the time of the interview, most were at or past the midpoint of their careers. Nearly all of them expressed confidence that they could address any problem, even ones they had never encountered. This was particularly noteworthy to the social scientists on our team who have been socialized to think of problems as points of departure, not as acute dilemmas requiring a solution. Upon further discussion with the engineers on our team, we came to view proud moments as a type of situated learning catalyst that was especially well suited to engineers. Not unlike the traumatic events faced by many of the leaders interviewed by Bennis and Thomas in their examination of "leadership crucibles"[32], the proud moments described by the senior engineers we interviewed functioned as transformational leadership learning catalysts. These situations certainly had challenging and at times harrowing moments, but the narrators put a positive spin on them viewing them as career highs. The nature and intensity of these EL catalysts varied by career path. For instance, the boundary spanners who repeatedly faced trials-by-fire were afforded very different types of leadership development opportunities than senior executives, who were sent on prospecting trips to expand their firm's market share in their respective industries. Senior engineers on both paths developed leadership skills leading to enhanced professional confidence, but the nature of their proud moments led some to believe they could solve any problem, and others to believe that success may be limited to fire fighting. It is important to mention that while all participants learned something about leadership, they were differentially rewarded for these achievements through uneven career advancement opportunities reflecting broader patterns of privilege in Canadian society.

Finally, the senior engineers we interviewed reported multiple positive consequences of proud moments on themselves and on others. At the level of self, they spoke about competence leading to confidence, reinforced commitment to their goals, career satisfaction, broadened horizons at the system level, and a combination of material and emotional rewards. These personal impacts left imprints at the team, organizational, and societal levels, fostering institutionalization. Thus, in addition to developing professionally relevant skills that served them well as engineering leaders, participants' proud moments became the backbone of their professional practice, living on through the institutionalization of their actions. To take one of the more pronounced examples of institutionalization, a participant who was committed to building university-industry partnerships noted that his proud moment experience gave him a leadership methodology he is still using today. This methodology not only supported his professional development as an engineering leader, but also had a positive impact on several generations of students, academics, and industry partners. While few participants were able to articulate their impact as engineering leaders in such an explicit way, all 29 distilled leadership lessons from proud moments enabling them to pay benefits forward to others in their respective "communities of practice"[27]. This finding suggests that researchers interested in examining dominant narratives about EL development in professional practice would do well to analyze the structural traces in senior engineers' proud moment narratives. Please see Figure 2 for a distillation of our findings about EL development through the realization of proud moments.

Figure 2: Leadership Development in Engineers' Professional Practice



In all 29 cases, participants experienced institutional support as *fertile ground* for leadership development. The absence of this support was actually one of the key differentiators between participants' proud moments and their career lows [46]. Several interviewees attempted to replicate a previously successful leadership strategy in a new context, only to be disappointed that their efforts failed to achieve similar ends. When we invited them to reflect on the main difference between the two experiences, most described the lack of resources, or limited decision-making authority granted to them and their teams in the latter case. In some cases, this reflective insight helped them feel less disappointed in themselves for failing to solve poorly resourced problems. Moving on to the second phase of the cycle illustrated in Figure 2, all 29 participants were presented with a *complex socio-technical challenge*. They were not always able to solve these wicked problems, especially in the case of "trials by fire," but they managed to address the problems in ways that exceeded organizational expectations. This suggests that leadership development is not only about individual competence or fertile ground, but also about *external recognition* or authentic appreciation for a job well done. Senior engineers could usually tell when things were going well, but each of their proud moments involved further affirmation from board members, the executive team, mentors, industry peers, direct reports, family, and friends. Moving to the final phase of Figure 2, each of the 29 proud moment narratives included details about a second external validator, *positive impact*, suggesting that senior engineers feel most proud of their work when it is broadly impactful their teams, organizations, and society.

Of the four phases illustrated in Figure 2, the idea of *fertile ground* may be the least conceptually clear to engineering educators, and thus requires further explanation. Despite their agentic worldviews, most of the senior engineers we interviewed required structural supports for their proud moments to take root at the institutional level. While their accomplishments may have felt deeply personal, their strategies were only successful when participants were trusted by others to take the lead, afforded the professional autonomy to contribute to the resolution of a challenging problem, and provided with the material resources necessary to enable their work. These three elements—trust, autonomy, and material resources—provided the senior engineers in our sample with the *fertile ground* necessary to convert their efforts and problem-solving expertise into leadership development opportunities for themselves and others. We suspect that this fertile ground also facilitated the institutionalization of EL practices in their respective organizations.

Implications for engineering leadership education

The primary way in which our findings advance EL education is by supplementing the existing knowledge base on leadership development in university contexts with an account of *situated leadership development in practice*. As we indicated in our introduction, the emerging field of EL development is rooted primarily in case studies of university-based leadership programs. Workplaces, when they are mentioned, tend to be invoked as a destination for engineering graduates, a place where graduates independently practice “lifelong learning.” A growing number of researchers have turned their attention to engineers’ professional practice [13, 19, 29, 47-50], but very few examine how engineers learn to lead over the course of their careers. There are at least two reasons for this gap. First, leadership development tends to occur on the periphery of engineers’ professional attention and as such can be difficult to access through traditional empirical means. And second, while engineers inevitably learn things through professional practice, workplaces are not typically set up to foster learning. They are set up to achieve organizationally prioritized goals such as economic growth, client satisfaction, and socio-technical impact. As a result of this key institutional difference between university classrooms and engineering workplaces, it is difficult to ascertain what exactly engineers are learning when busy doing other things. The absence of explicit learning objectives, formal curriculum, or intentionally designed leadership development activities can make it difficult for EL researchers to convincingly document workplace learning processes. Our analysis of leadership development as an inherent aspect of engineers’ professional practice fills this gap by tracing the unintended positive consequences of memorable accomplishments—something we have called “proud moments.” Our analysis of senior engineers’ proud moments makes three key contributions to EL research and education: 1) a professionally relevant leadership learning catalyst, 2) four low-risk, empirically available alternatives to “sink or swim” stretch assignments, and 3) a set of deeply contextualized “best EL practices.”

First, by framing proud moments as a career-embedded leadership learning opportunity, we have identified an affirmative alternative to Bennis and Thomas’ (2002) “leadership crucibles.” Stated differently, we are asserting that it is not only possible for engineers to learn to lead through adversity, but also to hone their leadership competencies through success. To the extent that engineers can tap enhanced levels of self and contextual awareness through periodic reflection on career-embedded proud moments, they will be well positioned to enhance their own leadership development and scaffold similar opportunities for others. Based on this contribution, we encourage employers, managers, and human resource professionals to consider how opportunities for developmentally appropriate participation on meaningful projects may lay the foundation for effective, relevant, and humane onboarding, mid-career leadership development, and organizational strategy in their respective workplace contexts. Related to this point, four key features distinguishing senior engineers' proud moments from more mundane workplace experiences include fertile ground through institutional support, complex socio-technical problems, external recognition for a job well done, and positive impact. This empirically derived process provides employers with a straightforward, organizationally relevant strategy for enhancing the professional engagement and satisfaction of junior engineers who are busy meeting organizational objectives. While not all tasks are necessarily complex or personally meaningful, all projects have at least some challenging features. By involving junior engineers in the full life cycle of a project with its technical problem solving, administrative coordination, client relations, and socio-political considerations, employers provide young professionals with the fertile ground of challenging problems, professional autonomy, and structural support alongside the comparatively arid ground of repetitive or impossible work, tight regulations, and resource insufficiency.

Second, by identifying four types of career-embedded proud moments drawn from senior engineers' workplace experiences, we have provided EL educators and employers with a low-risk alternative to "sink or swim" assignments. That is, instead of exposing first year engineering students and novice engineers to extreme trials by fire, we can provide them with opportunities to hone professional dexterity, mobilize team efforts, integrate their values into institutional practices, and share strategies for driving excellence. Additionally, beyond engaging students and young professionals in the specific types of proud moments experienced by the 29 senior engineers we interviewed, we can encourage them to draw on their own proud moments, priming them for a life of reflective, experiential learning. Students who engage in this kind of reflection on a regular basis are primed to learn from their ongoing professional practice in the absence of formal assessment. Engineering educators who engage students in these activities will come to normalize proud moments and leadership development as an inherent aspect of everyday life.

Finally, by treating proud moments as an idiographic feature of every life lived rather than a norm-referenced exceptionality, we provide an empirical antidote to the interventionist notion of "best EL practices"—a decontextualized, nomothetic prescription for how things ought to work in universities and workplaces. Every engineer and engineering student has experienced a practice that has felt "the best so far." It is our responsibility as EL educators to characterize these experiences as valuable professional development opportunities worthy of appreciation and reflection. Personal highs and lows are not one-time events in the lives of superstars. They occur regularly throughout the lives of engineering students and graduates. Like other types of situated learning experiences, proud moments present engineering students and young professionals with a series of opportunities to develop as human beings and as leaders. It is vital that we cultivate these career-embedded leadership learning opportunities by fostering reflective practice, identifying the necessary supports to achieve organizational goals, and building these supports into our workplaces and classrooms equitably. This final point about equity is important. By providing all students and professionals with multiple opportunities to solve complex problems and draw on socio-technical competencies alongside a diverse network of mentors, we will be in a better position to equitably distribute leadership development opportunities in the profession.

Institutional Ethics Approval: All procedures performed in this study involving human participants were in accordance with the ethical standards of the University of Toronto Research Ethics Board per RIS Human Protocol Number 27770: "The engineering leadership project: Best practice in leadership education."

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