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Human-Centered Leadership in an AI-Driven World: Practitioner Reflections on Engineering Leadership Education

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Human-Centered Leadership in an AI-Driven World: Practitioner Reflections on Engineering Leadership Education

Introduction

The advent of accessible generative artificial intelligence (AI) with the release of ChatGPT in 2022 has resulted in a transformative wave of new AI driven products and applications [1]. AI is also changing how science is being conducted, as new and more powerful tools increase analytical capability, prediction and simulation capabilities [2],[3]. AI is also having a significant impact on education by introducing automation and enabling new pedagogical approaches [4]. Similarly, AI is impacting the workplace as new tools are introduced, both at the organizational level and by AI-enthusiast employees [5]. At the same time, warnings are being issued about the considerable societal threats of AI technology – from issues with data privacy, bias, reliability, the concentration of power in a few companies, and the water and energy requirements of the data centres required for increased computation [6],[7].

As engineers, we may be the creators of AI technology, the developers of AI enabled tools and products, as well as users of AI to do our work. Like any other profession, our workplaces and work processes are being transformed. Thus, as engineering educators, we must ask ourselves how the practice of engineering is changing, and whether we need to alter our approach to teaching engineering leadership in light of the AI revolution.

This paper arose from a 2-day ASEE LEAD Offsite meeting held at Northeastern University from October 15-16, 2025 which included a full day of speakers and panels focussed on AI and the implications for Engineering Leadership (EL). Participants were asked the following research question: **Does the instruction of EL need to change in light of the AI revolution? And if so, how?** The submitted reflections were inductively coded by a subset of the authors and then deductively coded against a definition of engineering leadership.

This paper provides context and motivation for the reflection questions, outlines the findings from the reflections, discusses the implications for engineering leadership education, and offers recommendations for preparing our educators, students, future workforce and prospective leaders to navigate a world in which AI is an inevitable member of the cadre.

Literature Review

Our paper draws on two fields of literature to answer our research question: engineering leadership (EL) and the impact of AI on engineering practice. We start with a short review of the current state of EL education in North America, provide some basic descriptions of AI technology as a primer for the reader, and then examine recent literature on the impact of AI in the workplace and engineering education. Our paper contributes to both the EL and AI in engineering literature by examining the intersection of AI and EL, taking a closer look at the changing nature of engineering work and asking whether and how EL must adapt to reflect this change.

Engineering Leadership

Engineering Leadership (EL) has developed as a sub-field of engineering education over the past 25 years. A diversity of engineering leadership programs have been developed, from one-off course or cohort offerings, to more institutionalized curricular integration, to specific degree programs at the undergraduate or graduate level [8]. The publication of the New Directions in Student Leadership (NDSL) special edition on EL in 2022 summarized the evolution of the field and the current types of programs being offered in universities across North America [9].

Engineering leadership programs combine technical skills with teamwork and self-awareness to expand the characterization of engineering to include the human and social elements of technology [10]. Programs develop student's leadership identity and competency in key leadership skills, explore various leadership styles, and position leadership as a collective responsibility. Donald & Jamieson [8] synthesized the various approaches to engineering leadership from across various programs into a framework with four key areas of engineering leadership skills: technical knowledge, including mastery, innovation and design; socio-contextual skills including vision, impact, risk and systems thinking; professional skills including ethics, teamwork and collaboration; and metacognitive skills, including learning and effectual behaviour (Figure 1).

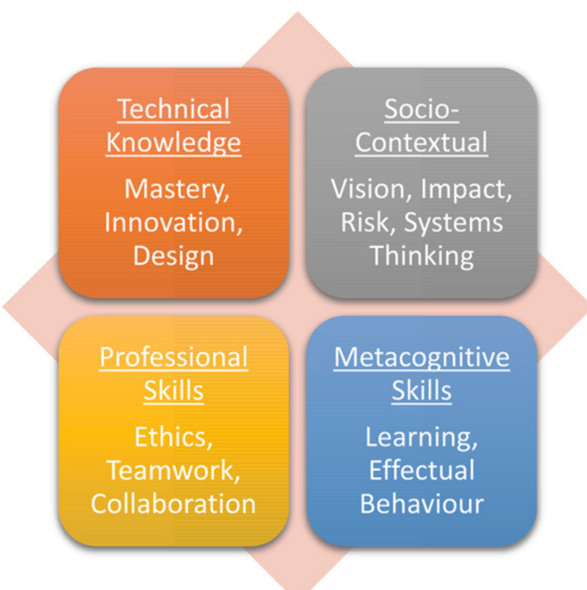

Figure 1. Engineering leadership definition synthesis and alignment with engineering education themes. From [8].

Similarly, Kendall et al. [11] proposed a definition of EL that encompasses the various skills, behaviours and capabilities required by an engineering leader:

> *"Engineering Leaders (a) employ the full range of engineering skills and knowledge in the design of socio-technical innovations, while (b) seeking to understand, embrace, and address the current and future impact of their work in context by (c) actively fostering engaged and productive relationships with diverse stakeholders, including themselves and their team, the users of their technologies, and those impacted by their engineering work."*

Engineering leadership programs are informed by the needs of engineers in the workplace, and thus there is a strong emphasis on team-based experiences, discussion, and individual reflection to build the required socio-context, professional and metacognitive skills [8]. Programs tend to be highly experiential, with students exploring case studies or conducting team projects that are drawn from engineering practice. Given the focus on developing skills for professional practice, EL educators must understand how the engineering workplace is changing with the introduction of AI tools and the implications for EL instruction.

Artificial Intelligence

Artificial Intelligence (AI) is a broad term which can be simply defined as "the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings" [12]. Machine Learning is a subset of AI in which algorithms look for patterns in data sets to make predictions, and as these algorithms have become more sophisticated, deep learning technologies have increased the sophistication of these predictions; generative AI (GenAI), which exploded onto the scene in 2022 with the launch of ChatGPT, is a further innovation which uses large language models (LLMs) to create new content based on existing, massive data sets [13]. Agentic AI goes even further, acting autonomously to make decisions and executing tasks towards specific goals using both historical data and business rules for real time data processing [14].

With the advent of ChatGPT, there has been increasing focus on the substantial ethical and environmental issues with AI technology. Issues such as encoded bias [15], the unattributed and uncompensated use of other's intellectual and creative output [6], the lack of reliability from generative tools that are prone to hallucination [16], and the high energy and water consumption required to operate data centres [7] are a few of the challenges that are causing significant concern.

Impact of AI on Engineering Practice

Engineers have long used data analysis and model building in their work. Recent advances in AI increase hold the promise to increase the power of those tools for applications like predictive maintenance and design optimization as well as accelerating new technology development [17]. A report by Engineers Australia found that 56% of engineers surveyed in 2024 were already using machine learning in the workplace [18]. GenAI was seen as an essential transformer of the engineering profession, with 43% of respondents using GenAI; this number was even higher with students with 74% using. Individual adoption of GenAI was occurring faster than institutionalized workplace adoption, as AI enthusiasts introduced new innovations from the ground-up.

Some engineering disciplines are adopting AI faster than others. Erdil [19] conducted a literature review on the use of GenAI in industrial engineering applications and found use cases in supply chain and operations, education and research, manufacturing, and quality. Kim & Swarup [20] surveyed construction industry professionals to understand their learning needs with AI, finding significant gaps in knowledge and understanding of AI which limits the ability of professionals to deploy the tools.

As more AI tools are adopted in the workplace, engineers will spend less time on high-exposure skills such as document drafting and programming, and shift to medium-exposure skills that combined human judgement with digital tools, and low-exposure skills based on human connection and care, such as leadership [21]. Furthermore, it is argued that by reducing the amount of time leaders and managers need to spend gathering, processing and analyzing data, AI tools will free up managers' and leaders' time to spend more time on building human connection [22]. But how does the adoption of AI interact with the practice of leadership?

In their review of literature, Vivek & Krupskyi [23] found that integrating AI and Emotional Intelligence (EI) in leadership enhanced decision-making and strategic planning, talent management, and communication and conflict resolution, with AI providing data-driven analysis to support decisions and EI the nuanced understanding of human dynamics that is required for successful leadership action. However, they also noted the danger of leaders overly relying on AI, as well as ethical concerns with data privacy and algorithmic bias. They advocated that leadership development programs should focus on training in both EI and AI. Similarly, in a survey of 385 Turkish engineers, Abositta et al. [24] investigated the direct impact of AI on engineering management decision making and examined how transformational leaders leveraged AI technologies to enhance strategic decision making. They found that transformational leaders fostered more inclusive, collaborative and adaptive decision-making environments, highlighting the importance of combining human judgement and leadership skills with AI.

Impact of AI on Engineering Education

There is an emerging body of literature on the impact of AI on engineering education, including how it is being used to enhance pedagogy [25], [26], [27], and how students are using it and the impact on learning outcomes [28], [29]. The 2025 ASEE Conference had 34 papers and posters with "Artificial Intelligence" in the title, mostly focussed on the use of AI in the classroom. Several papers examined student perceptions and use of AI [29], [30], [31] while others considered faculty attitudes and literacy for AI integration into engineering education [30], [32]. Appiah-Kubi et al [33] investigated engineering management students' perceptions of AI application in engineering teams, finding concerns about job displacement, data privacy and transparency, reflecting a lack of familiarity and proficiency with AI tools.

A few papers have been written about the introduction of AI into engineering leadership courses. Addison [34] developed a dedicated course for the NC State Masters of Engineering Management program to provide engineering managers with AI fluency. The goal of the course is to remove the technical barriers associated with AI so that individuals can unlock organizational value. Students develop an understanding the history, methodologies and ethical and economic considerations of AI as well receiving instruction on data sourcing, product planning and resource estimation. Aucoin et al. [35] introduced interventions exploring the impact of GenAI on student careers and ethical decisions into an undergraduate Engineering Leadership class at Texas A&M, using servant leadership as a compass to the application of GenAI.

Given the focus of engineering leadership education on preparing our students for the workplace, and the role of the ASEE LEAD division in supporting engineering leadership research and pedagogy, there is a gap in the literature on the implications of AI on engineering leadership education which this paper begins to address.

Methodology

This work analyzed participant reflections on the ASEE Lead Division Off-site meeting held at Northeastern University on October 15 and 16, 2025. The agenda for the meeting encompassed panel discussions and presentations from both academia and industry on the impact of AI and the role of systems thinking in engineering leadership. The presentations were complemented by back-briefing sessions and interactive presentations on the value proposition of an engineering leadership education and a strategic planning session for the division. The full meeting agenda is included in the Appendix. Approximately 60 participants joined the sessions over the course of the two days, both in person and on-line.

After the conference, all attendees were invited via email to share their reflections on the workshop based on a simple prompt: ***Does the instruction of EL need to change in light of the AI revolution? And if so, how?*** Potential participants were also provided a draft abstract for the paper and invited to indicate the degree to which they wanted to participate in the synthesis of the paper. Thirteen reflections were submitted. Six individuals volunteered to participate in the coding process, and the remaining seven to provide editorial review. The respondents were all from academia, with a mix of graduate students, instructors, and professors who have an interest and varying levels of experience in engineering leadership. Reflections ranged from a few sentences to several paragraphs long.

Each reflection passage was de-identified and circulated to the six individuals who had volunteered to participate in the coding process. The coders were all academics who have been working in engineering leadership for more than 7 years; the coders were all white, with three women and three men. Four of the six were trained as engineers, each with significant industrial experience, and the remaining two were trained in social science and education.

Every reflection was systematically analyzed by at least four coders following an inductive coding process [36]. Each coder used the method they were most familiar with; some identified categories and counted the number of instances while others generated directional themes in response to the research questions. Some focused on the skills and competencies EL educators would need to teach our students to prepare them for professional practice in an AI-infused world, while others stood back and took a systems approach to answering the question. The diversity in our experiences and our approaches helped us to collectively notice patterns that we as individuals may have missed. Coders selected their most salient themes and shared with the coding team. The team then came together to cluster the codes and define key themes over the course of two on-line meetings using Mural [37]. The lead author then coded deductively using the constant comparison method [38], connecting the key themes to Kendall et al.'s 3-part definition of engineering leadership [11]. The lead author drafted the paper, inviting comments from the other coders during drafting, then sent the draft to all thirteen individuals who had submitted reflections for editorial review.

Findings

Participants were asked to reflect on the questions: **Does the instruction of EL need to change in light of the AI revolution? And if so, how?** The overwhelming response to the first question was yes, that the current EL curriculum will need to evolve. There was broad agreement that the core emphasis on human-centred skill development in EL education should remain unchanged, and in fact may be even more important, but also that pedagogy needed to be modified in light of the AI context. Additionally, several topics were identified that need more emphasis in EL programs: critical thinking, ethical decision making, and change management. Each of these topics will be explored in this section, along with potential pedagogical opportunities that might help to achieve them.

Engineering leadership programs have historically focussed on the development of human-centred skills to support engineering practice, and it was strongly felt that this emphasis should continue. Core EL competencies such as individual self-knowledge, emotional intelligence, leadership identity, communication and teamwork will be even more important as engineers struggle to exercise agency and navigate complex work environments. Virtually all panelists and speakers spoke about the importance of building vision and getting alignment among people, and this was reflected in the responses.

> At the same time, the heart of leadership still rests on skills AI cannot supply for us: teamwork, communication, collaboration, integrity, and equity. These are developed through practice—facilitating discussions, giving and receiving feedback, navigating conflict, and making trade-offs that affect people, not just metrics. An engineer who can

> articulate assumptions, invite diverse perspectives, and generate their own outcomes will outperform someone who merely produces faster analyses with a chatbot. (Respondent 2)

> The engineer of the future needs to tie their disciplinary expertise to an understanding of complex systems composed of both humans and AI tools. Leadership will increasingly mean the ability to coordinate across this human–AI interface with the goal of communicating effectively, making ethical judgments, and aligning intelligent agents toward shared goals. In this sense, the future of engineering leadership education lies not in replacing traditional skills but in expanding them: teaching engineers how to think, act, and lead alongside artificial intelligence while maintaining human-centered values and control. (Respondent 8)

Several respondents advocated an embrace of AI technology to support the instruction of EL in the new workplace reality, for example by using AI as an instruction aid, or creating assignments with AI as a teammate.

> One approach I am personally leveraging to expand my skills is integrating AI into my workflows and using it to improve how I design and deliver courses and leadership development programs. AI has proven helpful in generating assessment rubrics, streamlined grading of written assignments (largely through reduction in minor writing errors by students, allowing me to focus on content, not writing quality, in my engineering courses), prototyping assignments, and helping me uncover where students may be circumventing rather than enhancing their own learning through the use of AI. (Respondent 12)

> [We should] design team-based experiences in which there is an AI team member. Allowing students to explore the ways in which they can trust & rely on this contributor. Allowing students to explore what is effective or not in conveying aspects of the broader context to refine & improve the AI's outputs / recommendations. And, in a safe environment (though perhaps dark), allowing students to explore just how much they can abuse & exploit this team member - how much of the work can they foist upon it, how much can they manipulate it into providing the answer they want… and after doing so, Reflect. How much did they learn? Are they more capable as an engineer or leader? Are they more employable somehow? What do they retain about the project goals or how the problem was solved? Do they feel fulfilled or successful? (Respondent 7).

As EL educators, we cannot lose sight of the critical, human-centred skills that are too often left out of the technical curriculum. Creating experiential opportunities that reflect the AI-enabled workplace will allow our students to practice these key skills in a context that is relevant to the changing workplace.

While the core topics of EL education should not change, there was a call for an increased emphasis on critical thinking given the interplay of AI with engineering design. The importance of verification and validation when using AI tools was brought up repeatedly by speakers and mentioned by many respondents.

> The key for engineering leaders is not to outsource judgment to AI but to understand how and when to use it. This entails developing the ability to formulate insightful questions for AI tools, verifying the reliability of sources, rigorously testing outputs against fundamental principles, and recognizing the threshold of uncertainty that necessitates a human's slowdown, data collection, or consultation with domain experts. Used this way, AI becomes a force multiplier for curiosity and problem solving rather than a dependency. (Respondent 2)

Critical thinking is strongly related to professional judgement and accountability. AI does not change the requirement for engineers to protect the public and exercise their expert judgement, but AI may make exercising that judgement more difficult.

> Today's readily available AI tools can vastly accelerate many types of work pertinent to the engineer, such as: various forms of research and literature review, summarizing lengthy regulations, hunting for esoteric design solutions like specialty components or materials, routine reporting, etc. However, engineers' underlying responsibilities do not change: engineers are still going to be the ones looked to when a bridge deck collapses. The issue is that, in accelerating the various tasks that generative AI can accelerate, it actually makes it harder for engineers to spot various issues that can jeopardize product efficacy and safety. AI hallucinations can cause these systems to err in reporting material properties or component performance. Engineers, more than ever, are going to need solution judgement, critical thinking, and an awareness of what essential analyses must be checked by an expert. (Respondent 5)

To exercise critical thinking and professional judgement, engineers will require a certain degree of AI literacy. As engineering leaders, this means not only being able to select the appropriate AI tools, but also to understand and communicate the limitations of those tools and to exercise their technical expertise to verify and validate AI generated results:

> For literacy, engineering leaders should be exposed to different cutting-edge AI tools. Many of these tools may not be immediately useful, but it is essential to be aware of their existence so that they can be quickly integrated into the workflow when needed… For awareness, it is crucial to inform engineering leaders about the limitations of various AI tools, ranging from small ML models to complex digital twins and generative large language models. AI models can only generate reliable results based on the data they have been trained on…For caution, engineering leaders need to retain the skills to utilize their domain knowledge, as well as other sources (such as reputable and reliable online resources or publications), to cross-check any AI-generated results and improve the AI tools being used if possible. (Respondent 4)

The challenge of keeping the “human in the loop” in design will also impact team dynamics. Traditional EL discussions on topics like teamwork, collaboration, trust, and psychological safety need to evolve to include these shifting power dynamics and include explicit links to professional responsibility.

> But with the AI revolution, how individuals are contributing to teams & the very nature of teams themselves is changing drastically. On one end, the contributions from individual team members to the overall team's goal may be a combination of their own original work supplemented or informed by AI. On the other, work teams may now, or in the near future, include an AI team member as an equal partner / contributor to the team. While this may result in efficiency gains, it requires team members to think critically, exercise judgement, & explore the internal / external factors of the broad context. (Respondent 7)

> Discussion about trust is going to need to evolve – trusting your colleagues, trusting your technology, and trusting the model. I think there are some very interesting potential pitfalls as engineers work for bots and work with bots to give over too much trust to the “generated answer” – leadership discussions on critical judgement will be an important topic that brings ethics discussions from the social realm to the day-to-day decision-making of engineers. The need to critically evaluate what an individual – or a model – knows and may not know is an essential skill. Judgement and decision-making need to be explicitly taught – and how individuals become [Subject Matter Experts] over time but establishing the depth and limits of their knowledge. (Respondent 1)

Engineering leaders will need to integrate their technical knowledge, their understanding of AI with their human centred skills in order to adequately fulfil their professional responsibility to deliver effective and safe designs. This presents a challenge for engineering leadership educators to create experiences that develop these skills together.

A second topic that was seen as requiring more attention was the importance of ethical decision making. This theme encompassed both opportunities for AI to enhance education, and the need for specific education on the ethical challenges of AI. There is an opportunity for GenAI to enhance engineers’ understanding of the context of their work.

> However, at the story level of leadership - the level where action is taken, experience is gained, and learning is generated - AI can play a role. At the story level is where mental heuristics exist. In this space, mountains of data arrive constantly, and teams receive, sort, and evaluate this data quickly in order to take action. The stories within each team member and leader are the foundation of the mental heuristics implemented. Large language model (LLM) AI algorithms can help teams and leaders fluidly explore stories beyond their lived experience and beyond their “data intake” capabilities. AI helps augment ideation, risk assessment, analysis method selection, alternative design, and consequence implementation beyond the collective knowledge of a team. (Respondent 6)

However, engineering leaders must be educated to go beyond understanding how to use AI to gather information, to also understand the emergent properties of these systems to avoid negative consequences when they are making decisions.

> Professor Heidari's work with AI agents, functioning as semi-autonomous units within a broader system, underscored the importance of understanding both individual algorithms and the emergent behavior of entire AI-driven systems. Future engineers will not only need to understand how these agents function but also how they interact with one another, and how those interactions produce systemic outcomes that leaders must anticipate and guide. (Respondent 8)

It is also important that engineers understand the ethical challenges of AI technology, not only technological issues like bias, data reliability and hallucinations but also more foundational issues like environmental costs, corporatization of knowledge, and privacy. One respondent strongly challenged the implicit assumption that AI is inevitable and urged engineering leaders to resist GenAI :

> If we resist genAI and require proper development, reasonable controls, and a critical view of the technology we will all be better off. The forced acceptance of genAI bothers me on so many levels--the impact on our perception of truth, the impact on cognition and learning at school and work, the ethics of scraping others' work without attribution (which also deprives website owners of clicks that generate traffic and revenue for them!), the false display of LLMs as "intelligent," the claims that checking bad answers (even bad math!) saves more time than generating correct answers, the massive energy and water demands required to run data centers, the financial shell games being played by major corporations (e.g., the OpenAI-Nvidia deal) and the apparent desire to create a world where wealthy and powerful people run the show, drones do the work, and intelligent and creative people (like engineers) are ignored and devalued … Do I think there are useful places for machine learning? Yes. Do I think LLMs and other genAI tools are ready for prime time? Absolutely not. Engineering leaders need to find the courage to resist the wholesale adoption of a fundamentally unethical and underdeveloped technology. (Respondent 11)

The ethical aspects of AI is a core component of AI literacy. Teaching students how to gather information in ways that ensure equitable outcomes and respect privacy and discussing the social and environmental costs of AI should be an important part of an engineering leader's education..

A third theme was the need for engineering leaders to understand the human aspects of change management. There is a perceived increase in the pace of change, both from the emergence of new AI technologies and from management pressure to adopt AI for greater productivity and efficiency. Speakers highlighted that engineers are being asked to step into leadership and communicate to senior management earlier in their career, including clarifying what AI technology can and cannot do. Therefore, engineering leadership educators need to support the socio-emotional needs of their students by supporting the development of self-regulation to manage cognitive overload and develop resilience.

> Engineering leaders who are capable of managing their stress responses intentionally are more able to *respond* strategically, rather than *react* reflexively. Employing a constantly reactionary approach can lead to increased anxiety, burnout, and a decline in creativity and innovation. Over time, functioning in this way may make it difficult to maintain long-term strategic vision and a sense of purpose individually or organizationally. (Respondent 13)

As well as self-regulation, engineering leaders need to exercise empathy to help their teams manage the pace of change and navigate ambiguity. This may include being sensitive to the threat of job loss for some employees.

> Leaders should be prepared to guide their teams/constituents through any concerns -even anxiety- they may have about the effects and implications of AI on their functioning as a cohesive unit, on projects, and in programs. (Respondent 9)

Incorporating more opportunity for students to practice self-regulation and empathy builds on the the current emphases of so many EL programs on self-awareness and leadership identity. The core EL skills of vision setting, collaboration and communication will be necessary to help keep teams aligned and working towards the stated mission.

> There is, however, an increased need to help engineering leaders to navigate complexity and elucidate context. Team communication skills continue to be core to engineering leadership, perhaps even more so in a world which is moving even faster (as per Tao's talk) but is also more fragmented by AI technology as "teammates" and hybrid work. (Respondent 1)

Helping engineers to manage complexity and rapid change in the Age of AI, both for themselves and their teams, will set them up for leadership success and will have added benefit of supporting the other two identified themes of critical thinking and ethical decision making. Exercises to develop self-regulation and empathy can complement the current core skills of EL programs.

Our findings suggest that there is a need to expand the instruction of EL to include three further topic areas: critical thinking, ethical decision making, and change management in a way that goes beyond what has been the traditional focus of EL development programs. This does not suggest that we should abandon the core of EL; indeed, the consensus is that the human-centred skills of our programs are increasingly important as we prepare engineers for an AI enabled workplace.

Discussion

The advent of AI is at times overwhelming as technologies rapidly progress. Most EL educators are not experts in AI, and our students are often well ahead of us as instructors. The fact that leadership skills have been identified as having “low-exposure” to AI [39] could lead us to double down on our current approach to EL instruction and leave consideration of AI to others.. However, doing so runs the risk of making EL instruction less contextualized to rapidly changing the engineering workplace.

In answering if and how EL instruction needs to change in the Age of AI, we must first ask if the definition of EL leadership needs to change. It is helpful to consider the key themes from the gathered responses against Kendall et al.’s definition of engineering leadership *[11]*:

> *Engineering Leaders (a) employ the full range of engineering skills and knowledge in the design of socio-technical innovations, while (b) seeking to understand, embrace, and address the current and future impact of their work in context by (c) actively fostering engaged and productive relationships with diverse stakeholders, including themselves and their team, the users of their technologies, and those impacted by their engineering work.”*

There is nothing from our findings to suggest that this definition of engineering leadership needs to change. Fundamentally, the work that engineers do and their professional responsibilities are the same, though AI may be changing ways in which they practice. In fact, it could be argued that the definition of EL *requires* that EL education practice change to reflect the new reality for engineering leaders. Employing the full range of engineering skills and knowledge requires an understanding of the tools of engineering practice and their appropriate use; AI is now adding to that set of tools. Understanding, embracing and addressing the future impact of their work in context requires understanding the ethical implications of AI, and the ways that it impacts decision making. Fostering engaged and productive relationships may be enabled by AI but is also challenged by AI. We will now discuss how the themes identified in our findings impact each aspect of the definition.

Engineering design (part a of the definition) with AI tools will require a high degree of critical thinking as engineers exercise their professional judgement. Engineers cannot hand over their responsibility to AI; ultimately, they are accountable for the performance of their work. This requires the appropriate selection of AI tools, as well as adequate verification and validation of AI outputs through the exercise of their domain knowledge. AI also has the potential to change team dynamics in ways that require careful consideration of how trust in work outputs is established in team collaboration.

Ethical decision making must be informed by understanding of context to ensure that engineers understand the potential impacts of their work (part b of the definition). GenAI may present opportunities to help students gather perspectives and distill information into digestible formats, expanding the breadth information that it is possible to gather. However, engineers must also understand the limitations of these tools, and we must continue to push engineers towards meaningful engagement with stakeholders. We must also educate engineers on the ethical issues associated with AI so that they are attuned to the risk of bias, hallucination and can evaluate the cost-benefits of energy and water use, the risks to privacy, and the responsible use of data that respects the contribution of others.

Change management is enabled by fostering engaged and productive relationships with stakeholders (part c of the definiton). In the face of rapid change, increased complexity and uncertainty, engineering leaders must learn to self-regulate, to lead their teams with empathy, and to clearly communicate to ensure alignment. Change management builds on skills that are already core to current EL programs and further supports the ability of engineering leaders to fulfil part b of the EL definition, as engagement with stakeholders provides the contextual information required to deliver ethical impact.

Our findings suggest implications for the way that EL is taught that span across these three aspects of engineering leadership. To achieve an increased focus on critical thinking, ethical decision making, and change management, there is a need for specific instruction on AI literacy, for an evolution in the way we talk about team dynamics and trust, and the need to move beyond self-awareness to self-authorship.

Ruiz et al. defines AI literacy as “the knowledge and skills that enable humans to critically understand, evaluate, and use AI systems and tools to safely and ethically participate in an increasingly digital world” [40]. AI literacy is key to all three main themes. AI literacy enables critical thinking; knowledge about how a given AI technology works is key to ensuring that the tool being used is appropriate for the task, and that adequate validation and verification are being conducted. AI literacy enables ethical decision making by ensuring that individuals understand the ethical challenges of AI and can mitigate them or challenge unethical use. And AI literacy is needed to be able to communicate with stakeholders in ways that are transparent about the cost versus the benefits of technology as well as the limitations to ensure alignment, transparency and ensure ethical use. As EL educators, we must find ways to explore these concepts with our students to develop AI literacy, which will require us to develop AI literacy ourselves.

The impact of AI on team dynamics is a new and important challenge for EL educators. Teamwork is a core part of many programs, but there are new aspects being introduced with the incorporation of AI. Discussions of individual and team accountability drive an expanded discussion of trust and power dynamics. Does the need to verify and validate increase with the incorporation of AI? Are we less able to trust our teammates when they may have used AI? How will the team decide what is appropriate use? How do we establish psychological safety when one of our teammates is a bot? Developing team scenarios and experiences that play with these concepts will be important to support critical thinking, ethical decision making and change management.

The concept of self-authorship, defined as “the capacity to internally construct one’s own beliefs, identity and social relations rather than relying on external authorities” [41], was a point of discussion during the work shop and is reflected in many of our findings. If we think of AI as a type of external authority, the ability to think critically, to challenge unethical practice, and to lead yourself and your stakeholders through rapid change and ambiguity will require engineers to have a strong sense of their values, identity and beliefs. In our current EL programs, we use reflection to help students to build self-awareness and self-knowledge, but we should also think of ways to develop a more agentic concept of self-authorship.

Implications

As AI changes the way that engineers perform their work, the EL community must adapt to address those changes. As an EL educators, we have always worked at the socio-technical interface, trying to combine the human-centred leadership domain with the specific context of engineering work. In a similar way, we need to look for ways to bring AI and EL together. Such integration is consistent with the recommendations from the literature to integrate AI and leadership education [23], [24].

The EL community might consider a number of different approaches to support instructors in this integration (Figure 2). Ignoring AI completely ("We can't teach all of that") or focussing only on certain aspects like using AI for project management or AI and social ethics ("we should teach some of that") risks reducing the relevance of EL education. To adequately integrate EL with AI literacy, we can look to formal sources such as seminars and webinars, draw from and contribute to broader literature and research, engage with industry to understand the changes in the workplace, share novel pedagogy with our EL community, learn from our students who are ahead of us in the adoption of AI, and draw on informal training such as MOOCs.

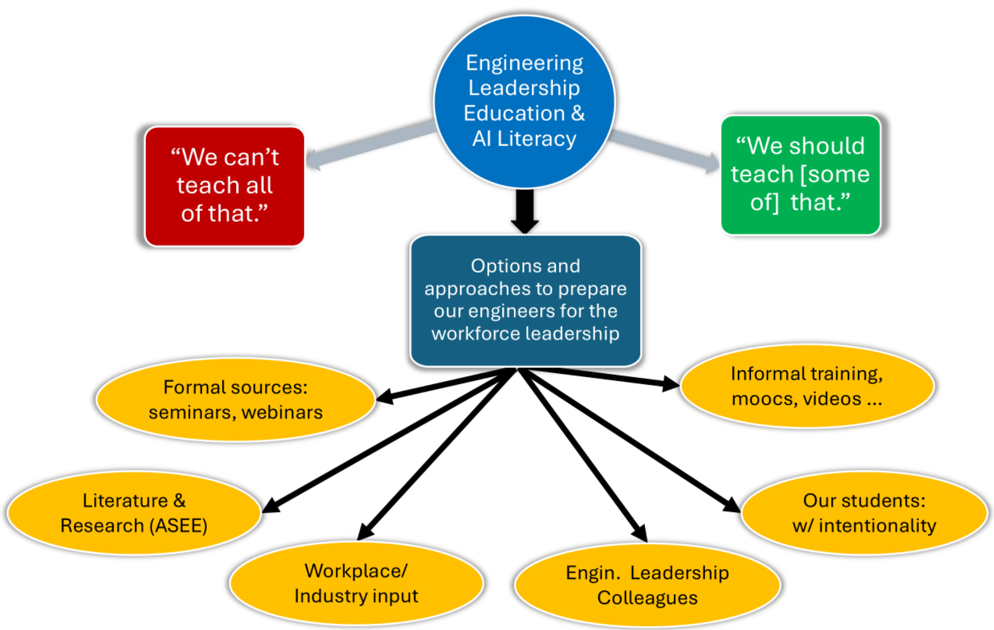

Figure 2: Approaches to integrating AI Literacy into Engineering Leadership education.

Conclusions

The goal of engineering leadership education is to prepare engineers to make positive impact in the world, equipping students with the tools they need to be able to thrive in their chosen careers. With the advent of AI, it is imperative that we ensure that students do not cede responsibility and control to AI agents but enable them to harness these new tools for good.

While the work of engineering remains the same, the definition of engineering leadership may not need to change. However, we must not treat AI as something separate from the EL curriculum. We need to develop AI literacy – our own and our students. We need to experiment with pedagogy to help students explore the impact of AI on team dynamics, with nuanced discussion on trust. And we need to help engineering leaders to develop self-authorship, the ability to navigate challenges based on a strong sense of their own values and beliefs. Doing so will develop engineering leaders who to think critically, make ethical decisions, and manage change in a complex and fast-moving world.

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Appendix: ASEE LEAD Division Off-Site Meeting Agenda

The workshop was arranged and hosted by Col. Mike Manning, Director of Strategic Planning, ASEE LEAD Division and the Gordon Institute of Engineering Leadership at Northeastern University.

October 15, 2025

9:00am - 9:30am	Check-in: Colonel Mike Manning
9:30am - 9:35am	Welcome: Kenneth Lamb, Chair, ASEE LEAD Division
9:35am - 9:45am	Conference Overview: Colonel Mike Manning, Director of Strategic Planning, ASEE LEAD Division
9:45am - 10:45am	Session I: Panel Discussion with Doctors Auroop Ganguly, Sam Scarpino & Abishek Murthy: "AI Mysticism and Demystification for Interdisciplinary Engineering Leaders - Challenges/Opportunities of AI for Engineering Leadership"
11:00am - 12:00pm	Session II: "Engineering Leadership in the Age of AI" with Dr. David Nino
1:30pm - 2:30pm	Session III: "Engineering w/Society in the Loop: Modeling Sociotechnical Futures with AI Agents": A Presentation by Dr. Babak Heydari
2:45pm - 3:15pm	Session IV: "Navigating the Future of Generative and Dexterous Technology": A Conversation with Dr. Tao Yu, Director of Dexterous AI Group, Analog Devices
3:15pm - 4:45pm	Session V: Breakouts: Small group ideation and back-briefs
4:45pm - 5:00pm	Day 1 Wrap-up: Colonel Mike Manning

October 16, 2025

9:00am - 9:30am	Session I: "Systems Thinking Integration into Engineering Leadership": A Conversation with Dr. Don Jenkins, Chief Operating Officer, FRV Services Australia
9:30am - 10:30am	Session II: Panel Discussion with Doctors Emily Moore, Dave Ellis & Kavitha Chandra: "Systems Thinking as a 21 Century Engineering Leadership Tool"
11:00am - 12:00pm	Session III: "Exploring the Value Proposition of an Engineering Leadership Education": A Presentation by Professor Monica Pheifer
1:30pm - 2:30pm	Session IV: "Historical Foundations and Future Directions of Strategic Planning in LEAD": Presentation by Doctors Meg Handley & Meagan Kendall

2:45pm - 3:15pm	Session V: "Leading Practical Systems": A Conversation with Adam Khaw, Head of Autonomy, Senior Director, Danfoss Power Solutions
3:15pm - 4:45pm	Session VI: Breakouts: Small group ideation and back-briefs
4:45pm - 5:00pm	Conference Wrap-up: Colonel Mike Manning