Students' Perception of Artificial Intelligence Applications in Workload Distribution, Performance Monitoring, And Improving Collaboration in Engineering Teams.

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Introduction

The impact of Artificial intelligence (AI) continues to be felt both in academia and industry, yet its full potential is yet to be exploited for the common good. While AI technologies are increasingly being implemented, questions linger over their long-term impact on education and the workforce. Recent research efforts have focused on promoting the ethical and responsible use of AI. As a result, explainable AI, which focuses on helping users understand how AI systems make decisions, has received a lot of interest [1].

Even though some skepticism about AI decisions still lingers, it is already transforming workplaces by enhancing efficiency, automating repetitive tasks, and enabling data-driven decision-making. AI technologies such as natural language processing help to streamline business operations and enhance customer interactions. In industries such as manufacturing and logistics, engineering managers may utilize AI for predictive maintenance and performance monitoring. Despite these advancements, concerns about data privacy, transparency, and job displacement persist, potentially impeding AI adoption for broader deployment. This paper explores engineering students' perceptions of AI in workload distribution, performance monitoring, and collaboration.

The rapidly evolving engineering work environment and work design for modern engineering offer enormous opportunities for AI integration. Areas of contemporary engineering that benefit from AI applications include management and optimization of repetitive tasks, which include task assignments. To this effect, AI applications have been used for several years in production and manufacturing settings. However, their expansion to other engineering and academic facets has not always been fast-tracked. As with any new technology, consumers take time to fully embrace the full capabilities [2]. The experience with AI applications in engineering team assignments has not been different. The generic Gartner Hype Cycle (GHC) explains the perceived value of innovation and the likelihood of adoption. Pusic and Ellaway [2] present the distinct stages in the GHC innovation adoption curve. For most technologies, after the initial technology trigger, the perceived value typically peaks at the inflated expectations and drops before gradually growing again.

As the complexity and the need to speed up engineering tasks continue to grow, one cannot discount the benefits of AI integration. The presence of complex challenges and the need to efficiently execute engineering tasks, by optimizing multifaceted team assignments becomes apparent and inevitable. Traditional team assignment methods, which rely on experience, knowledge, static criteria, and human intuition, may not always be attuned to the sometimes-dynamic nature of modern engineering tasks. To this effect, AI offers an alternative to this challenge. With real-time data, insights about complex engineering tasks, and employee qualities, AI tools may be able to streamline team assignments and workflow to enhance engineering project overall outcomes.

The benefits of AI's role in optimizing engineering team assignments extend beyond automating team assignments. As experienced engineers move on to different roles and new managers and supervisors are hired, it requires effort and time to learn and know the strengths and capabilities of teams, and sometimes the complexities of the engineering tasks and team size make traditional assignments suboptimal. Leveraging AI, machine learning algorithms, and advanced data analytics can match personality traits, experience, and individual skills to optimize team assignments and maximize synergistic performance.

Utilizing AI in engineering decision-making concerning team assignments enables organizations to mitigate the challenges inherent in traditional engineering team assignments. For example, subjective biases, lack of real-time adaptability, and inconsistent assessment criteria found in traditional team assignments and assessments may be minimized with the use of AI in engineering team assessment and assessment.

Engineering teams can also utilize past projects to train AI tools to learn to optimize team assignments for future projects. With the incorporation of future trends and new information about complex projects, the deployment of AI tools and effective utilization may potentially help corporations align teams to the ever-changing demand for effective engineering teams. Thus, a nuanced approach to team assignment and performance assessment is needed to enhance the likelihood of success of complex projects that require interdisciplinary teams of engineers.

Brief Literature Review

AI and its potential impact as a transformative force across academia and industry have been highly trumpeted in recent years. While the use of AI in academia has sometimes been met with disdain, Floridi et al. [3] explain the importance of striking a balance between the potential underuse and overuse of AI tools. The authors emphasize that AI could create risks or additional opportunities to enhance human potential. However, it has generally and tacitly been accepted that the use of AI implies a good and ethical application of AI technology [3]. The underutilization of AI could create opportunity costs. Similarly, overuse or misuse of AI in academia and industry could lead to fear, loss of trust, and misplaced concerns for potentially wrong reasons, which may lead to unnecessary governmental oversight and regulations [3]. Thus, the purported transformative power of AI may not be realized, or the fulfillment of its potential may be delayed for academia and some industries [3].

Fostering organizational change and enhancing productivity in the 21st century and beyond requires human-AI integration. It is therefore not surprising that this field continues to attract attention in academia and the industry. Torre et al. [4] utilized Goal Programming to model the human-AI integration problem in a collaborative workspace. They explore an intuitive approach to optimize team formation in a collaborative workspace where human and AI collaboration is required for the successful execution of tasks [4]. The goal programming model balances AI capabilities and human skills with the organizational objectives to enhance the synergistic output of the agents to drive organizational change. The model utilizes diverse and complementary skills to align tasks in ways that optimize the outputs in a collaborative and dynamic environment for entrepreneurial success [4].

The stochastic nature of entrepreneurship and the competitive work environment require human-AI teams to function effectively by complementing each other. Nambisan [5] highlights the transformative role of AI and digital technologies in transforming entrepreneurial processes. The advent of AI and its transformative potential is creating new opportunities and redefining business ecosystems [5]. This observation aligns with previous studies that analyzed the challenges entrepreneurs have to overcome in positioning their entities for a competitive advantage as they develop helpful resources [6]. Such tasks require significant investment and sometimes diverse and complementary skills. Thus, entrepreneurial team formation has remained a critical business need. While new team members may require extra support to integrate, AI tools could be deployed to speed up such integration processes.

Forbes et al. [7] studied ways new team members integrate into entrepreneurial teams and concluded that successful integration is a critical factor in determining project success. Klotz et al. [8] provided a comprehensive roadmap for understanding entrepreneurial team effectiveness. Effective team dynamics are not only relevant in entrepreneurship but also in industrial and academic settings. Various team assignment techniques have been explored and well-researched. Chapman et al. [9] revealed that team selection methods impact the team dynamics and have a significant influence on project outcomes. Team dynamics influence attitudes within project teams and serve as a strong indicator of academic performance [10]. AI-human integration offers the opportunity to minimize the negative impact of team dynamics.

AI systems and tools can be tailored to complement human abilities by not only executing repetitive tasks but also sharing tasks and providing decision-support insights. For AI to function effectively as a collaborator in shared workspaces, it must demonstrate key team attributes and contextual awareness [11]. If the appropriate AI tool is deployed effectively in a collaborative workspace, it can reduce the cognitive workload of the team, freeing up team members' time to focus on other equally important tasks [12]. However, the ability of AI to function effectively in a team environment relies on team members' ability to effectively utilize it.

Other factors, such as reliability, transparency, and the ability to understand and explain AI results, are equally critical. Their efficacy could also be impacted by team members' ability to adapt to the new environment [13]. To maximize the benefits of AI in collaborative workspaces, additional research is required to assess the ethical considerations and human perception of AI. As with any good technology, the ability of the human agent to feel comfortable utilizing it impacts the limit of its use. Hence, the need to understand students' (who are the future workforce) perception of AI applications in workload distribution and performance monitoring. This may help to improve collaboration in engineering teams.

Methodology and Data Collection

A survey (in the appendix) was designed to collect feedback from undergraduate and graduate engineering students during the fall 2024 and spring 2025 semesters. To ensure the validity of the survey questions, a peer with experience in designing surveys reviewed and provided feedback, which helped to refine the survey questions. The questions were then attached to the Institutional Review Board (IRB) application for approval to conduct this exploratory study.

After the IRB approval, the survey was sent to 92 students (as a Google form) in five different classes. Since this study was exploratory, a non-probabilistic (convenient) sample of two graduate and three undergraduate classes taught by the authors and their graduate advisees was surveyed.

The survey included basic demographic questions about academic level and the number of years in the engineering field. They were also asked whether they had worked in a team environment. After these initial background questions, they responded to eight Likert scale questions, which are discussed in the next section. The questions revolved around AI and its applications in engineering teams. In addition, there were some short essay questions. The survey questions can be found in the appendix. This paper only presents the results of the survey questions that received substantive responses.

Results and Discussions

Out of the 92 students who were sent the voluntary survey, 42 responses were received. Among the responders, 88.1% were undergraduate engineering students, and the remaining were in master's degree engineering programs. The majority (53.7%) of the students had one to three years of experience working in the engineering field. Approximately 31.7% had less than one year of experience, and 12.2% had four to six years of experience. The remaining students had seven or more years of experience working in the engineering field. All the graduate students had at least one year of experience. Not surprisingly, 95.2% indicated that they have worked in a team-based engineering environment. All of the respondents indicated some level of familiarity with AI.

Approximately 40% agreed or strongly agreed that AI can effectively balance workload distribution in engineering teams. The remaining were neutral (38.1%), disagree (16.7%), or strongly disagree (4.8%). The high number of respondents who neither agreed nor disagreed supports the axiom that additional work is required to demonstrate AI's efficacy, build trust, and address the challenges identified in the literature [3]. It also follows the GHC innovation adoption model [2]. To this effect, explainable AI (XAI) is becoming more popular.

A similar result was observed when the respondents were asked to indicate the extent to which they agree that AI systems can fairly allocate tasks without introducing bias (Figure 1). Workload distribution was a major focus of this study; hence, Figure 1 explains the students' perception of AI's ability to distribute workload unbiasedly. Approximately 43% agreed or strongly agreed, while the rest strongly disagreed (4.8%), disagreed (19%), or neutral (31%). This observation also supports the general concerns identified in the literature about ethical concerns that AI has yet to fully address [2, 3]. It is, therefore, not surprising that an equal number of students either agreed or disagreed when asked about the usefulness of AI in real-time performance tracking of engineering teams. Similar to the previous question, 36.6% neither agreed nor disagreed.

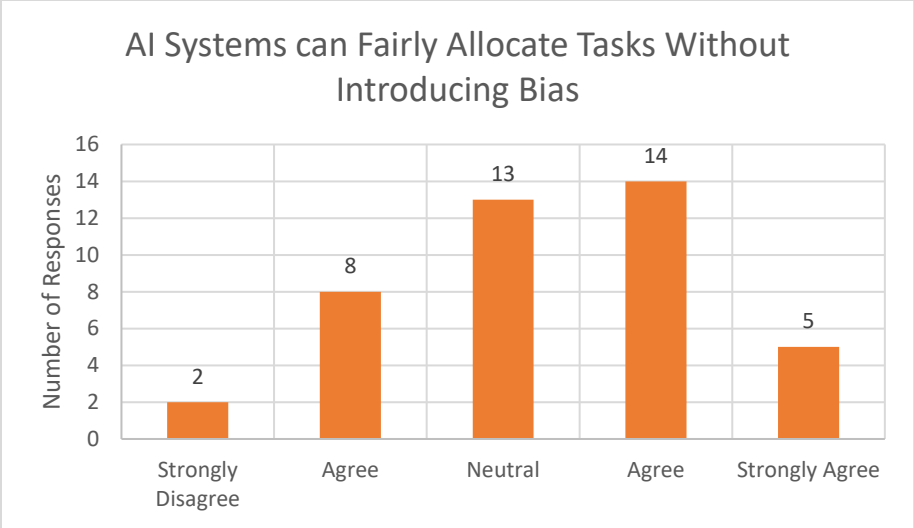

Figure 1: Distribution of Participants in Bias-Free Task Allocation Using AI Systems

When the participants were asked about the use of AI in monitoring individual performance, the majority (51.2%) of them disagreed (24.4%) or strongly disagreed (26.8%). Only 19.5% agreed or strongly agreed to the use of AI in monitoring individual performance. Compared to the previous question, 11 out of the 17 participants who felt comfortable using AI in monitoring team performance did not agree with its use in individual performance monitoring. While the reason for this observation was not explored in this research, future studies will focus on understanding the reasons why they felt uncomfortable with AI in monitoring individual performance. Kovari [1] explains that emphasis on transparency and interpretability of AI systems helps in trust building.

Almost half (47.6%) of the respondents agreed that AI can improve collaboration among team members by facilitating communication and information-sharing. Similarly, 41.5% indicated that they agree or strongly agree that engineering teams are ready to adopt AI technologies in their workflows. Moreover, 35.8% indicated that they would recommend the use of AI for engineering team management, while 38.1 would not recommend AI for engineering team management. The qualitative questions also yielded a lot of interesting responses. For the sake of brevity, only the main themes from the qualitative questions are discussed in this paper.

In response to challenges participants foresee in using AI for collaborative workload distribution, concerns were expressed about biases in training the AI, and its ability to differentiate fact from theory. Other comments also spoke about the inability of AI tools to accurately understand team dynamics and human abilities. Generally, participants expressed a positive outlook on the utilization of AI as a complementary tool for idea generation. One comment, which captures the general theme of the other qualitative responses, noted that AI "*is a useful tool to simplify complex tasks accurately or perform simple tasks efficiently*." However, in the field of engineering team management "*I think that although AI can be a useful tool in a lot of ways, I would be hesitant to use it for managing an engineering team. I think there's a lot of nuance that goes into that sort of management that would be difficult for an AI to achieve, at least where the technology currently stands*."

Conclusion

Artificial intelligence (AI) has gained prominence in recent years. It continues to attract attention to its purported transformative power for academia and industry. While many have embraced it and continue to explore ways to utilize it to enhance productivity, concerns exist about the misuse and the risk that AI poses to humans and work design. Lack of trust and ethical issues are among the many concerns about AI applications. In this paper, we explored students' perceptions of the use of AI in workload distribution, team assignment, and performance monitoring for improving collaboration in engineering teams. It was observed that a lot of work needs to be done to build trust in a human-AI collaborative workspace. Within the last three years, a lot of progress in AI has been made, but additional work is required to fully exploit the transformative potential of AI. The lack of trust in AI deployment calls for explainable AI. Albeit many see the potential benefit of AI in a collaborative workspace, a significant number of the respondents express their lack of readiness to accept AI integration for performance monitoring and workload assignment. Thus, since many engineering students are eventually going to graduate and become engineering managers who may utilize AI tools, engineering educators and researchers must continue to explore ways to enhance students' familiarity and proficiency with AI systems.

Limitations

This exploratory study utilized a limited sample in a randomized survey. Therefore, additional work is needed before the findings can be generalized.

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Appendix – Survey Questions

- What is your current academic level of study?
- How many years of experience do you have in the engineering field?
- Have you worked in a team-based engineering environment or project before?
- What challenges do you foresee in using AI for workload distribution?
- What concerns (if any) do you have about using AI for performance monitoring?
- What role do you think AI should play in resolving conflicts or improving interpersonal relationships in teams?
- Have you used or observed any AI tools that promote collaboration? If yes, please specify.
- What are your primary expectations or concerns about integrating AI into engineering team dynamics?

<u>Likert scale questions</u>

- How familiar are you with Artificial Intelligence (AI)? (1 = not familiar at all, 5 = Very familiar)
- How familiar are you with Artificial Intelligence (AI)? (1 = not familiar at all, 5 = Very familiar)
- To what extent do you agree that AI can effectively balance workload distribution in engineering teams?
- To what extent do you agree that AI systems can fairly allocate tasks without introducing bias?
- How useful do you think AI is for real-time performance tracking of engineering teams?

- Do you feel comfortable with AI being used to monitor individual performance?
- To what level do you agree that AI can improve collaboration among team members by facilitating communication and information sharing?
- To what extent do you agree that engineering teams are ready to adopt AI technologies in their workflows?
- On a scale of 1–5, how likely are you to recommend the use of AI for engineering team management?