

# *WIP: Exploring Mathematical Proficiency in AI-Driven Engineering Environments: A Survey-Based Study of Current Workforce Needs*

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**Abstract**—This research WIP paper describes the current workforce needs of math skills. In today's rapidly evolving technological landscape, understanding the mathematical requirements of the engineering workforce is essential for educational institutions and industry stakeholders alike. This study outlines a comprehensive survey-based study aimed at identifying the current and future mathematical needs of engineers in the workforce, while considering the impact of artificial intelligence (AI) on these requirements. The study will involve administering a survey to practicing engineers to gauge their utilization of mathematics in their respective fields. Questions will delve into areas such as the types of mathematical concepts commonly employed, the most complex problems encountered, and any gaps in mathematical education that have been observed. Furthermore, the survey will seek insights into potential training needs to enhance mathematical skills among professionals. One of the primary objectives of this research is to provide valuable insights into the current state and future perspectives of the workforce's mathematical requirements. By analyzing survey responses, the study aims to offer recommendations to educational institutions to align their curricula with the evolving needs of industry. This proactive approach will ensure that future generations of engineers are equipped with the necessary mathematical competencies to thrive in their careers.

A key aspect of this study is the differentiation between engineering and engineering technology disciplines, recognizing that mathematical requirements may vary across different sectors. By delineating these distinctions, the research will provide targeted recommendations tailored to the specific needs of each field for two year and four years institutions. Collaboration with national and international organizations, including IEEE, ASEE, STEM Pioneers and other platforms, will ensure a broad and diverse participation pool for the survey. This strategic partnership will facilitate access to a wide audience of professionals, thereby enhancing the validity and reliability of the study outcomes.

In conclusion, this survey-based study represents a concerted effort to comprehensively understand and address the mathematical needs of the current workforce, particularly within AI-driven

engineering environments. By bridging the gap between academia and industry, the research aims to foster a symbiotic relationship wherein educational institutions adapt their offerings to meet the demands of the evolving job market, heavily influenced by the pervasive integration of AI technologies. With meticulous data analysis and strategic collaboration, the study anticipates yielding actionable insights that will not only shape the future of mathematical education but also contribute significantly to professional development in engineering and engineering technology fields amidst the omnipresent influence of AI.

**Keywords**—Workplace Mathematics, Workforce needs, Mathematical requirements, Artificial intelligence and STEM education, Career development, Engineering Curriculum

## I. INTRODUCTION

In today's dynamic technological landscape, adept mathematical skills among professionals have become more crucial than ever [1],[2]. Across diverse fields such as engineering, computer science, finance, and healthcare, mathematics serves as the bedrock of problem-solving and innovation. It provides the means for quantification, progress of discoveries, and propels advancements forward, fostering continuous improvements across various sectors.

In the realm of engineering, mathematical prowess is indispensable. Engineers rely extensively on mathematical concepts to design, analyze, and optimize complex systems [2]. Whether it is structural engineers calculating load distributions or electrical engineers modeling circuit behavior, mathematics is the universal language that enables engineers to articulate their ideas and solve intricate problems effectively. While different disciplines within engineering may emphasize varying levels of mathematical complexity, they unanimously agree on the foundational mathematical skills required.

The advent of data science and machine learning has further underscored the significance of mathematics [3]. Algorithms,

the backbone of these technologies, heavily rely on mathematical principles for training and inference, highlighting the indispensability of mathematical proficiency in today's workforce.

However, the specific mathematical competencies demanded vary significantly across different sectors of the workforce [4]. Software engineers may prioritize discrete mathematics and algorithmic analysis, while mechanical engineers may focus more on applied calculus and numerical methods. Recognizing these sector-specific needs is crucial for educational institutions tasked with preparing students for the workforce.

It is widely recognized that engineers undergo a progression in their careers, starting from field engineering roles and advancing into managerial positions where they oversee operations and strategic decision-making [5],[6]. Therefore, this study aims to capture the current utilization of mathematics by engineers across various roles, whether they are in field engineering or managerial positions.

A survey-based approach provides a pragmatic means of understanding the current mathematical needs and expected future trajectory of professionals across various industries. By directly soliciting insights from practicing engineers, valuable data can be gathered regarding the frequency and importance of different mathematical skills in the workplace. Analyzing survey responses can illuminate potential gaps in mathematical education, informing curriculum development initiatives aimed at addressing these deficiencies.

Moreover, the rise of artificial intelligence (AI) has catalyzed a paradigm shift in the workforce, redefining the role of mathematics in problem-solving [7]. AI-powered tools and algorithms augment human capabilities, automating repetitive tasks and enabling engineers to tackle more complex challenges. Thus, there is a growing emphasis on understanding the intersection of AI and mathematical proficiency, with AI serving as both a tool for analysis and a subject of study in its own right.

This survey-based research endeavors to delve into the workforce's mathematical skill requirements within specific sectors. By assessing sector-specific needs and the influence of AI, this study aims to provide actionable insights for educational institutions and industry stakeholders. Through collaborative efforts and meticulous data analysis, this research seeks to bridge the gap between academia and industry, ensuring that future professionals possess the requisite mathematical competencies to excel in their careers, enhance performance, and make a meaningful impact on the economy.

## II. PURPOSE OF THE SURVEY

In this study, we present a comprehensive survey aimed at professional engineers across diverse domains. Through anonymous participation, engineers are invited to contribute their invaluable insights into the mathematical competencies required in today's engineering landscape. By understanding the real-world application of mathematical concepts and the demand for AI-integrated engineering solutions, this survey endeavors to inform educational curricula and professional development strategies. We anticipate that the findings will not only foster greater engagement from professional engineers but

also enhance the alignment between industry needs and educational initiatives, ultimately advancing the proficiency of future engineering professionals. The survey will feature a section titled "Purpose of Survey," which will succinctly articulate the objectives of the study. This segment will serve as a guide for participants, outlining the significance of their contributions and emphasizing the survey's aim to gather crucial insights from professional engineers across various disciplines. Below is the Purpose of the Survey, which will be shared with participants: "Dear Participants, We extend a special invitation to ENGINEERS, irrespective of their role level, to partake in a vital anonymous survey tailored for experienced professionals in the engineering domain. This survey aims to gather insights into the math courses studied during BS degrees, the mathematical skills presently utilized in the workplace, and the specific mathematical requirements based on your experience within your current engineering discipline. Additionally, we inquire about any AI-integrated engineering with mathematical applications in the workplace. Your participation will play a pivotal role in bridging the gap between industry demands and educational practices, ensuring that future engineers and STEM educators are well-prepared to excel in AI-driven environments.

## III. SURVEY QUESTIONS

The survey guarantees complete confidentiality, ensuring that all information gathered remains secure. Below are some guidelines of the information to be collected:

- The specific title of the participant's B.S. degree and the institution where it was earned.
- Whether the participant holds a technical degree beyond the B.S. level, such as an M.S. or Ph.D.
- The participant's current or most recent engineering job title and the duration of their experience as an engineer.
- The size of the participant's current or most recent company in terms of the number of employees.
- The participant's country and state of residence.
- Whether the participant is a registered Professional Engineer (PE) and, if so, in how many states.
- The participant's age group.

The survey will also inquire about the mathematical subjects included in the participant's B.S. (Algebra, Trigonometry, Integral Calculus, Differential Calculus, Vector/Multi-variable Calculus, Ordinary Differential Equations, Partial Differential Equations, Boolean Algebra, Numerical Analysis, Statistics, Combinatorics, Discrete Mathematics, Linear Algebra) degree curriculum. Participants will be asked to indicate the frequency with which they use various mathematical skills in their engineering work, as well as their opinion of the importance of each skill. Additionally, participants will be asked to specify the area where they primarily perform engineering work and whether they have used AI with mathematical applications in the workplace.

Moreover, the survey seeks to objectively evaluate the practical application of software skills in participants' workplaces, emphasizing the critical competencies necessary

for contemporary engineering tasks. Additionally, participants will be prompted to assess their proficiency in communication, problem-solving, and technical knowledge in the context of their professional roles.

#### IV. SURVEY DISTRIBUTION CHANNELS

To maximize outreach, our survey will be strategically disseminated through reputable channels. This includes distribution via email lists administered by esteemed professional organizations such as the Institute of Electrical and Electronics Engineers (IEEE) and the American Society for Engineering Education (ASEE). Furthermore, with appropriate permissions, platforms like LinkedIn will be leveraged to broaden the survey's exposure to a diverse audience within the engineering community. Additionally, surveys can be hosted and distributed through platforms like SurveyMonkey. We are committed to ensuring a robust participation rate and comprehensive representation across various industry sectors. To achieve this, we will actively pursue a significant number of participants, ensuring a statistically significant sample size. Additionally, efforts will be made to include participants from a wide array of industry backgrounds, thus enriching the survey's insights and findings.

#### V. SURVEY RESULTS AND DISSEMINATION

Upon completion, the survey data will undergo thorough analysis, with the findings then shared with industry stakeholders to offer valuable insights. Moreover, academic institutions will benefit from the gathered data, aiding in curriculum development and educational enhancements. Additionally, the survey outcomes will be disseminated through scholarly papers and presentations at professional meetings, contributing to broader knowledge dissemination within the engineering community.

#### VI. ETHICAL CONSIDERATIONS AND DATA STORAGE

In addition to maintaining pseudonymity, we are committed to addressing ethical issues surrounding data storage and protection. All survey data will be securely stored on

encrypted servers, accessible only to authorized personnel. We will implement strict data management protocols to ensure the confidentiality and integrity of the collected information. Participants' responses will remain anonymous, and any identifying information will be removed to protect their privacy. We will comply with all relevant data protection regulations and ethical guidelines to safeguard participants' rights and data [8].

#### ACKNOWLEDGMENT

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