

# Perceptions of Students in Relevance of Engineering Management Course in Engineering Disciplines: A Higher Education-Implications for a 21st-Century Curriculum

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## Abstract

This study addresses the critical need to understand how engineering students perceive the relevance of engineering management education in preparing them for these multifaceted roles. Specifically, this research evaluates the perspectives of undergraduate engineering students in the Philippines regarding the significance of engineering management in their respective disciplines, its role in skill development, and the challenges encountered. A mixed-methods approach was employed, gathering data from 396 undergraduate engineering students through surveys, brief written responses, and interviews. Findings indicate that a significant majority of students hold favorable impressions, with 86.8% believing the knowledge gained will be valuable and 84.5% affirming that the course develops essential analytical and critical thinking skills. Students generally recognize the importance of engineering management in fostering fundamental abilities crucial for their future careers. However, a notable challenge is the perceived workload, with 52.7% of students finding management-related coursework demanding. The research illustrates the importance of integrating well-designed engineering management education within engineering curricula. The findings highlight the importance of equipping future engineers with the managerial expertise and soft skills the complexities of the 21st-century workforce and inform strategies for curriculum enhancement.

*Keywords:* curriculum design, engineering disciplines; engineering education; engineering management; higher education.

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## 1. Introduction

A robust theoretical foundation is indispensable when examining the dynamic field of engineering education and management. The engineering profession perpetually evolves given technology rapidly advancing with landscapes industrially shifting. As they go past typical technical limits, this change requires engineers evolve in their roles and skills while adopting more managerial skills. Engineers have historically adapted their roles as a response to technical, organizational, and social transformations (Seethamraju, 2004), and the managerial skills emphasis represents what is the latest phase. Leaders in engineering handle teams, projects, and operations (Nwulu et al., 2022) uniquely using technological progress, like Artificial Intelligence (AI), which improves an engineer's management aspect. Consequently, integrated competencies are shifting now greatly the focus of education. To ensure that people contribute effectively to projects and succeed overall in complex multidisciplinary work environments, technical expertise must complement diverse management capabilities (Nwulu et al., 2022).

Beyond the immediate practical demands in industry, development is at a critical stage in the academic field of engineering education research. Borrego et al., (2014) do characterize engineering education as a “developing interdisciplinary field”. Its maturation requires a stronger and evidence-based foundation now. This maturation then depends on clearly sensing “progression,” which the authors define well as concrete evidence that researchers are informed much by previous studies and actively build upon or deepen collective understanding. Thus, this research stands less as a local curriculum evaluation but does directly answer this academic request for action. It seeks to add

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within the field's evidence base when it systematically investigates student perceptions, a needed step required to “inform policy and practice” as curriculum designers build upon empirical data instead of just on anecdotal assumptions.

### *1.1. The evolving role of the engineer and the demand for managerial competencies*

This demand for engineers equipped with managerial competencies is clearly articulated by industry. Employers, including Small to Medium-sized Enterprises (SMEs), increasingly prioritize graduates who possess a holistic skill set encompassing not only technical expertise but also professional skills such as project management, leadership, effective communication, problem-solving, and ethical decision-making (Baukal et al., 2022; Brown, 2016; Müller, 2024). Competency models, like those from the National Society of Professional Engineers (NSPE), and accreditation criteria from bodies such as ABET, underscore these expectations by emphasizing personal effectiveness, academic competencies (including communication and critical thinking), and workplace competencies (like teamwork and project management) as essential for practicing engineers. For SMEs, managerial and business skills can be particularly critical for strategic planning and firm performance (Ahmad, Ahmad, & Alam, 2024). The field of engineering is continuously evolving, driven by rapid technological advancements and the changing demands of the industry. Engineers are expected to possess not only strong technical skills but also a diverse set of management capabilities to effectively contribute to project success (Corpus et al., 2023; Guerrero et al., 2014).

Consequently, competency models from those professional bodies like ABET highlight a graduate's need for them to show professional with technical competencies both. A framework based upon evidence that is defining of specific competencies is needed in modern engineering practice, so it moves beyond generic terms such as “soft skills” in a review by Passow & Passow, (2017). Their work re-envision “teamwork” as coordinate efforts more active and splits “life-long learning” as they gather information for expanded skills. This framework stresses that the core of engineering work is problem-solving, based on what engineers do professionally. Technical activities along with social collaboration are inseparably intertwined with that problem-solving. Engineering management education is important for it is empirically grounded and also strict. These competencies justify its importance: engineers “solve problems,” “coordinate efforts,” “communicate effectively,” together with “make decisions.” Engineering projects' increasing complexity and the multidisciplinary nature for modern engineering work further drive this necessity. Because small to medium-sized enterprises (SMEs) often lack resources for graduate training programs that are wide-ranging employers value graduates showing a blend of technical plus managerial skills and immediate productivity.

### *1.2. Integrating management into engineering curricula: challenges and approaches*

Integrating these essential managerial and professional skills into already dense technical engineering curricula presents significant challenges for educational institutions. Educators face the dilemma of balancing technical depth with management breadth, ensuring that the integration of new competencies complements, rather than compromises, core technical learning (Kidd et al., 2025). This is compounded by the need for continuous curriculum updates to reflect evolving industry demands (E. Smith et al., 2024). Furthermore, the development of 'soft skills' or professional competencies, coupled with a commitment to lifelong learning, is fundamental to an engineer's success and career longevity. Skills such as communication, teamwork, critical thinking, and adaptability are no longer peripheral but central to navigating modern engineering practice. The rapid obsolescence of specific technical knowledge (Smerdon, 2003) necessitates a professional obligation for engineers to continuously update their knowledge and skills, an aspect also highlighted in ABET's student outcomes.

As such, there is a growing emphasis on the importance of engineering management within engineering disciplines (Bergeron, 2001). Pons, (2016) asserts that the engineering profession expects the inclusion of professional practice and engineering management skills within a professional engineering degree. This necessity is further driven by the increasing complexity of engineering projects and the multidisciplinary nature of modern engineering work. Employers all across the globe, notably small to medium-sized enterprises (SMEs), want engineering graduates to be able to quickly take on managerial roles and help business growth (Morgan & O’Gorman, 2011). These enterprises form an important portion of the engineering industry also often lack the resources for wide-ranging graduate training programs, which places a premium upon graduates who are immediately productive as well as possess a blend of technical and managerial skills. Engineering graduates need skills like communicating, deciding morally, leading, managing projects, and solving problems, along with technical expertise, as highlighted by many studies (Corpus et al., 2023; German et al., 2021). New engineers in the workforce must adapt to dynamic, multidisciplinary, complex work environments (Corpus et al., 2023)). This adaptation is important to consider for them. Engineers should engage in lifelong learning for staying competitive as well as effective. Technological change is happening rapidly so this continued education is required (Guerrero et al., 2014). Educators must also recognize effective project management as a critical competency for

engineers since they must develop revolutionary approaches to improve student perception and adoption (Mas et al., 2021).

In addition to these demands, consider also the growing importance of sustainability in engineering education. Solutions that happen to be environmentally responsible and tend to contribute to sustainable development are increasingly expected to be designed and then implemented by engineers (Fourati-jamoussi et al., 2021; Rampasso et al., 2019). This addition is a complication to the skill set that is required. Engineers must understand environmental regulations, manage resources, also consider engineering projects' broader social impacts.

### *1.3. Student perceptions as a critical component of curriculum evaluation*

Engineering education is undergoing a transformation, with institutions worldwide recognizing the need to integrate management principles into their curricula. This shift aims to produce graduates who are not only technically proficient but also possess the 'soft skills' and business acumen necessary to excel in leadership positions and contribute to the strategic goals of their organizations. The development of these skills is seen as necessary for engineers to reach well-educated decisions that consider the broader business context, manage teams effectively, also navigate the complexities of modern projects. However, the integration of engineering management into the engineering disciplines presents some of the challenges. Educators face the task of balancing imparting a strong technical foundation with developing necessary management skills (Morgan & O'Gorman, 2011). Curricula require continuous updates because industry demands evolve constantly. This ensures graduates are equipped by the latest knowledge and best practices in both engineering and management (Corpus et al., 2023).

Despite these challenges, equipping engineering students in engineering management skills is very important. More and more engineers find that they are in leadership roles. Effectively managing projects, teams, also resources become paramount for them. In the event people do not adequately prepare in these specific areas, certain projects may be delayed, specific budgets may overrun, and still other negative consequences may occur, eventually obstructing both individual career progression and organizational success (Bergeron, 2001).

Therefore, this study seeks for us to explore just what engineering students perceive in regard to how engineering management is relevant for their disciplines in Philippine higher education. To produce well-equipped engineering graduates, this research seeks valuable perceptions for curriculum enhancement, ultimately contributing by understanding students' perspectives as well as meeting the workforce demands. Findings from this study are things that will inform the strategies which seek to integrate management education into engineering programs in a better way. Future engineers will then possess the skills and knowledge necessary to thrive in an increasingly complex and linked world.

## **2. Methods**

### *2.1. Research Design*

This study employed a mixed-methods approach because it incorporates quantitative as well as qualitative data collection methods, for understanding comprehensively how engineering students perceive the relevance of engineering management in their disciplines. This method makes collection of wide-ranging data possible. It allows also for gathering in-depth, subtle perspectives (Flegg et al., 2012).

### *2.2. Participants*

The respondent of the study comprised of undergraduate engineering students from one of the higher education institutions in the Philippines. A total of 396 students who completed in the engineering management unit across these campuses. To ensure representation across different engineering disciplines, participants were recruited from Electrical, Mechanical, and Civil Engineering programs.

Three data collection tools were administered towards the end of the study. First, 50 students (out of the 396 who completed the course) were 8 BSEE, 11 BSME, 31 BSCE campus provided short written answers. Second, 14 students from 2 BSEE, 3 BSME, 9 BSCE participated in individual in-depth interviews. Students were questioned about how they envisioned the importance of engineering management in their future studies and careers. Lastly, 129 students (out of the 396 who completed the course) comprising 21 BSEE, 29 BSME, 79 BSCE participated in a survey questionnaire assessing their level of agreement (strongly agree, agree, neutral, disagree, or strongly disagree) with statements pertinent to the research question.

### *2.3. Limitations of the Sampling Strategy*

The sampling method used in this study was one of convenience, determined at a time when participants were available instead of formally analysing power a priori at the course's conclusion. This method restricts generalization statistically regarding quantitative results for the total engineering student population.

Participants distributed unevenly among engineering disciplines. This imbalance is in fact a key limitation. It affects the generalizability of the findings. Therefore, the results cannot be reliably generalized for all engineering students, also discipline-specific differences should be interpreted with extreme caution.

2.4. Instruments

This study used a combination of (1) short written answer questions to understand students' opinions, (2) one-on-one interviews to discuss how students see the importance of engineering management for their future studies and jobs, and (3) a questionnaire with statements to measure how much students agree about the role of engineering management, which was adopted from the concept of a previous study by Flegg et al., 2012.

2.4.1. Instrument Validation and Reliability

To ensure the methodological rigor is upheld for the quantitative data collection, a two-stage process fully validated the survey instrument.

They first validated content so that the instrument covered the content domain well (Polit & Beck, 2006; Rubio et al., 2003). For review, five subject matter experts did receive the adapted questionnaire. Three senior engineering faculty with wide-ranging industry experience sat on the panel with two College of Education faculty who knew curriculum studies and assessment. For measuring student perceptions of the engineering management course each item's clarity, relevance, and appropriateness were evaluated. These experts were the ones asked about doing so. Their feedback had been used in order to refine both the wording and the structure of that final instrument which ensured that it was well-aligned with those research objectives (Yusoff, 2019).

Second, Cronbach's alpha ( $\alpha$ ) was used for assessing the survey's Likert-scale items (Cronbach, 1951; Olaniyi, 2019). The internal consistency was in this way evaluated. Since this coefficient measures the extent to which a set of items is interrelated, it can provide a quantitative estimate for the reliability of a scale. A higher alpha value measures the same underlying construct consistently. Survey data (N=129) that was collected was then analysed. In Table 1, the results appear.

**Table 1.** Cronbach's alpha for survey scales

Construct / Scale	Number of Items	Cronbach's Alpha ( $\alpha$ )
Perceived Career Value & Relevance	5	0.88
Skill Development (Analytical, Communication)	3	0.84
Perceived Workload & Course Demands	2	0.79
<b>Overall Scale</b>	<b>11</b>	<b>0.86</b>

Alpha coefficients for all constructs with the overall scale exist well above 0.70 the threshold commonly accepted for social science research (Tavakol & Dennick, 2013). The survey reliably gauges how students feel given its internal consistency.

2.5. Procedure

In this study, students were asked to provide written responses to three open-ended following questions:

- (i) The most essential topics I've acquired in this Engineering Management course are.
- (ii) The skills I learned in this Engineering Management course are important to my future work as an engineer in the following ways.
- (iii) In, general, I believe that the following are some ways that engineering practice applies the concepts of engineering management.

The 50 selected students from different disciplines were given the questionnaire and were given enough time to write their answers. For semi-structured interviews was conducted with a subset of 14 students. The interview protocol consisted of five key questions:

- (i) What were your expectations of this Engineering Management Course at the beginning? Have those expectations been met?

- (ii) How do you see the relevance of learning the different functions of management (planning, organizing, etc.) in your engineering degree?
- (iii) Can you give specific example of how you think you will use the concepts of decision-making, managing production/ service operations, marketing, and/ or finance in your future engineering career?
- (iv) What did you find most challenging about this Engineering Management course, and how did you overcome those challenges?
- (v) What aspects of this Engineering Management course do you think will be most valuable to you long-term? Why?

These interviews were recorded and transcribed for subsequent analysis. A structured survey rated questionnaire designed to gather data on students' perceptions of the relevance of engineering management. The questionnaire employed a Likert scale (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree) to measure the degree of agreement with statements related to the research questions. The questionnaire was adapted from existing instruments used in prior research. Prior to administration, the questionnaire was pilot tested with a small group of students to ensure clarity and identify any potential issues. The questionnaire was distributed to 129 students from different engineering disciplines. The full questionnaire is presented in Table 2.

**Table 2.** The survey rated questionnaire.

Questions	SA	A	N	D	SD
I anticipate that the knowledge gained in this Engineering Management course will be valuable for my future career as an engineer.					
Integrating general management principles with engineering-specific examples have aided my overall comprehension of management concepts.					
I believe that the analytical and critical thinking skills developed in this Engineering Management unit will be beneficial to me after graduation.					
This unit has effectively taught me how to define and address problems relevant to the field of engineering management.					
This course has introduced me to concepts that I expect to utilize in subsequent engineering courses.					
The ability to communicate effectively in professional engineering management scenarios is a skill that I have developed.					
Understanding the theoretical and systematic aspects of his unit is important for my future engineering management practice.					
Learning the material that this course will assess is my primary focus.					
At some point during my studies, the volume of management-related coursework has made me consider changing my engineering specialization.					
I think this course effectively illustrates the application of engineering management principles in practical engineering contexts.					
I feel confident that the engineering management skills I've learned will give me a competitive advantage in the job market.					

## 2.6. Data Analysis

The data that was collected from within the rating questionnaire were examined through the use of descriptive statistical methods (Kajfez & Creamer, 2014). Percentages for each item's Likert scale category showed what the answer distribution was. Included were the categories “Strongly Agree,” “Agree,” “Neutral,” “Disagree,” and “Strongly Disagree” (Wenny et al., 2022). The findings shown what percentage of students hold each perspective (German et al., 2021). These descriptive statistics will provide an overview of the data's primary trends and variability, enabling comparisons across engineering fields (Flegg et al., 2012).

Braun & Clarke, (2019) outlined a reflexive thematic analysis (TA) approach; it was used for analysis of qualitative data from short-written answers and interviews. Interpreting data as well as generating themes involves the researcher's active plus subjective role, which is acknowledged by this approach: (1) Researchers became familiar with the data reading all transcripts repeatedly. The process involved several phases, with the first being this familiarization. (2) Initial codes with respect to a data subset that is about 20% of transcripts were independently generated by them then. (3) Researchers convened to examine these first codes, solved differences via conversation, and together made a basic guide containing explicit meanings plus instances per code. (4) This codebook was used to analyse the whole dataset systematically. For a consistent coding framework, the two researchers met regularly to refine definitions and discuss difficult sections. Analytical rigor depended principally on this joint discussion instead of a quantitative inter-coder

reliability (ICR) measure. As Braun & Clarke, (2019) argue, for reflexive TA, the goal is to not perfectly agree which could mask interpretive subtleties, though rather to improve the analysis as researchers discuss as well as engage deeply plus reflexively with the data. Then this iterative and collaborative process defined, reviewed, and also developed themes. The study presented the findings from the anonymous brief written questions, categorizing student respondents as R1, R2, and so on. We have provided the findings from the interviews, categorizing the students as R1 interview and so on.

### **3. Results**

The findings revealed a wide variety of perspectives on the relevance of engineering management to engineering disciplines in higher education, as well as perceptions of engineering management in general.

#### *3.1. Relevance of engineering management to engineering disciplines*

The survey results reveal a generally positive perception of the Engineering Management subject course, with strong agreement on its overall value and relevance to future careers (Table 3). A very high percentage of students agree or strongly agree that the knowledge gained will be valuable (86.8%), that integrating management principles with engineering examples is helpful (88.4%), and that the course develops beneficial analytical and critical thinking skills (84.5%). This aligns with the broader emphasis in engineering education on the importance of developing analytical skills, as highlighted by Flegg et al., (2012) and supported by the need for cognitive excellence alongside scientific knowledge for engineering graduates (Idkhan et al., 2021). The development of such skills is also a key component of what Urbanic, (2011) describes as the “significant design experience” required in engineering curricula.

The theoretical and systematic aspects of management are also widely seen as important (88.4%), and a large majority (86.0%) believe the skills learned will provide a competitive advantage in the job market, reflecting the growing recognition of management skills as crucial for career advancement in engineering. This is strongly supported by Pence & Rowe, (2012), who argue that engineering management courses enhance the value of traditional engineering degrees and make students more employable, giving them a lead over other graduates. Most students (82.9%) also find that the course effectively illustrates practical applications, which aligns with the call for authentic teaching and learning approaches that connect theory to real-world engineering problems (Flegg et al., 2012) and the emphasis on applying knowledge to analyze case studies. This is further supported by authors like Magano et al., (2021), who advocate for educational approaches that bridge the gap between academic learning and industry needs, particularly for “Generation Z” learners.

However, there is some variability in agreement regarding specific aspects of the course. While most students agree that the course teaches problem-solving (78.3%) and develops communication skills (76.7%), these agreement levels are slightly lower than for the more general questions. This observation echoes findings in various studies (Gómez et al., 2021) that underscore the necessity for engineers to improve their problem-solving and communication abilities. Furthermore, a smaller majority (72.9%) agree that the course introduces concepts they expect to use in subsequent courses, which is a concern also raised by Flegg et al., (2012), who noted that first-year students may have difficulty perceiving the relevance of foundational knowledge for later studies. Notably, while the majority (69.8%) indicate that learning the material for assessment is their primary focus, a substantial portion (30.3% combined) express neutrality or disagreement, suggesting that while most are focused on grades, a significant minority may have a broader learning perspective; this highlights the ongoing tension in engineering education between teaching for understanding and teaching for assessment.

While 52.7% agree or strongly agree, indicating a concern about the workload for over half the students, a significant 47.3% are neutral or disagree. This suggests that while there is a notable challenge with the volume of management-related coursework for a substantial portion of the students, it is not a universally held view. It is possible that this concern is concentrated within specific engineering disciplines or among students with particular academic loads, highlighting the need for further investigation into curriculum load and its impact on student retention, a significant concern in engineering education (Bernold, 2007; Bernold et al., 2007). Urbanic, (2011) also emphasizes the importance of time management and workload considerations, while Paton & Wagner, (2014) discuss the need for engineers to manage themselves effectively and understand the time constraints within projects.

Moreover, the importance of incorporating industry feedback into curriculum design is highlighted in several sources. German et al., (2021) and Panuwatwanich et al., (2011) emphasize the need for universities to align their curricula with industry expectations to enhance graduate employability. This includes fostering skills that are immediately applicable

in the workplace, as discussed by Pence & Rowe, (2012), and ensuring that students are prepared for the practical challenges they will face (Urbanic, 2011).

**Table 3.** The results of the survey in relevance of engineering management to future career and study.

Questions	D or SD	N	A or SA
I anticipate that the knowledge gained in this Engineering Management course will be valuable for my future career as an engineer.	0	17	112
Integrating general management principles with engineering-specific examples have aided my overall comprehension of management concepts.	0	15	114
I believe that the analytical and critical thinking skills developed in this Engineering Management unit will be beneficial to me after graduation.	0	20	109
This unit has effectively taught me how to define and address problems relevant to the field of engineering management.	11	17	101
This course has introduced me to concepts that I expect to utilize in subsequent engineering courses.	11	24	94
The ability to communicate effectively in professional engineering management scenarios is a skill that I have developed.	5	25	99
Understanding the theoretical and systematic aspects of his unit is important for my future engineering management practice.	0	15	114
Learning the material that this course will assess is my primary focus.	13	26	90
At some point during my studies, the volume of management-related coursework has made me consider changing my engineering specialization.	41	40	68
I think this course effectively illustrates the application of engineering management principles in practical engineering contexts.	6	16	107
I feel confident that the engineering management skills I've learned will give me a competitive advantage in the job market.	0	18	111

### 3.2. Perception of engineering management

The three perspectives of engineering management—(1) as an academic discipline, (2) as an instrument for other fields of study (both academically and in practical applications), and (3) as a means for addressing real-world challenges—were clearly reflected in all gathered data. In this section, we present our analysis of the short-written answers in relation to the three views. The students described a variety of techniques (engineering management skills developed, engineering management concepts applied to engineering, and skills developed pertinent for engineering) for a variety of purposes, including as an academic discipline, an instrument for other fields, and a means for addressing real-world challenges.

When viewed as an academic discipline, engineering management seems like the theoretical foundation. The skills listed—Planning (R 1, 2, 33, 36), Organizing (R 2, 8, 15, 45), Controlling (R 8, 38), as well as Leading (R 9, 16)—are the classic pillars of management. These same pillars are forming of the basis for so much of all management theory. In this perspective about the “what” and “why,” students learn management frameworks and language. These concepts are applied for bridging abstract theory to the engineering context. Using these ideas needs grasping the Functions of an engineer manager (R 25) and Applying management to engineering projects (R 3, 11). Then it is no surprise that cognitive with analytical skills are developed from such view: Critical thinking (R 10, 13, 16, 36) with Problem-solving (R 4, 17, 27). This academic foundation does not just teach tasks, but it cultivates a managerial mindset, and this cultivation enables engineers to analyse complex situations in a systematic way before engineer’s act.

As an instrument for other fields, focus shifts from knowing theory to individuals coupled with teams being effective. The skills that are here seem more granular and action-oriented: Time management appears in (R 2, 7, 19), schedules are organized in (R 18), and tasks are delegated in (R 6, 7). This view treats engineering management like a universal toolkit that one can use to improve productivity in any domain, not just engineering. That the “Engineering concepts applied to engineering” column is now empty for this view shows meaning. This absence implies management skills seem instrumental now. These skills are seen as domain-agnostic, therefore. Competencies that improve collaboration are transferred by them, thus enabling work with others (Ability to work with others - R 6, 9, 37). These competencies

execute irrespective of the technical specifics. The perspective involves the “how”—how to harmoniously and to efficiently get things done within a team.

This third perspective is where concrete, high-stakes problems are tackled by theory along with tools. It stands for the “where.” It stands also for the “when” of management of engineering. The skills are complex as well as situational, as they focus on just how someone navigates uncertainty also is responsible through Risk Management (R 1), someone manages production (R 4, 31, 47), and someone handles Ethical considerations (R 9, 16). This intensely practical view focuses on the Application of management tools (R 7, 28) and Managing engineering teams (R 4, 41) to achieve operational and business goals. Developed are forward-looking and adaptive skills. An awareness in regard to safety and health protocols (R 13, 44) becomes paramount, just as do flexibility and adaptability (R 26, 31). At this level, an engineer evolves into a calculated leader from just a technical expert. The engineer manages resources, people, and risk then to deliver real-world value.

### *3.3. Discussion of engineering management*

The thematic analysis of interview and written response data reveals students' subtle adventure throughout the engineering management course. Four linked themes emerged as researchers moved on beyond simple categorization plus explored the tensions as well as contradictions within the data (Bazeley, 2009; B. Smith et al., 2014). Students must navigate these often conflicting with linked perceptions, representing a web, not discrete categories. A surprising critical finding frames the analysis. For a meaningful minority, the course is in fact almost unbearable, though it is simultaneously perceived as highly valuable.

#### *3.3.1. Theme 1: Recognizing the course as a bridge to professional practice*

The foundational perception among students is that the course clearly transacts: to invest academic effort will in turn yield important career capital. They believe in this, so they can engage in this and consistently stress the course is going to have future value. Students prepare directly for their professional lives so do not see the curriculum as abstract academic requirements. One student articulated this vividly, when they stated, “I GET A GLIMPSE OF HOW IT WOULD BE LIKE IN A CORPORATE WORLD” (R34) at home. Students in general widely shared in this sentiment. The course seemed to them a key link between their school identity and their career self. They believe that the course provides a “competitive advantage”. It prepares them also for “how to become a successful manager in the near future” (R50). Another student noted the course was “all about how to manage my work or career in the future” (R45), and this reinforced the idea that the learning was directly applicable toward their long-term goals. The course helped students “properly manage myself as a student/engineering student, as well [as a] student leader, and also as a part-time working student” (R1 interview), also noting immediate application. This theme establishes the students' core motivation since they view the course as a needed professional step, so engage.

The development of management skills is seen as essential for engineers to navigate the complexities of modern projects, manage teams effectively, and contribute to the strategic goals of their organizations (Dickson, B. R., 2007; Flegg et al., 2012). This preparation is particularly important as employers, especially SMEs, are seeking engineering graduates who can quickly assume managerial roles and contribute to business growth (Magtaas et al., 2020; Morgan & O’Gorman, 2011).

#### *3.3.2. Theme 2: Workload and memorization as barriers to engagement*

A central tension emerges out of the conflict between what students value in the course and how instructors deliver it. They are motivated by the promise of more practical, real-world skills for them. However, the pedagogical methods are often abstract, since students find that they focus on rote learning. Frustration stems from this particular paradox in a large way. “The most challenging part about this course... is the memorization of terms and the lots of paragraph and concept to understand” was the most frequently cited challenge (R4, R8 interview). Another student echoed this, as they described the difficulty of memorizing “some hard words and definition of it” (R1, R10 interview). This creates a disconnect because students value the course for its potential that is practical such as “Project Management” (R1) or “managing engineering teams” (R4, 41). They, though, feel that they instead learn only rote facts. According to the R7 interview, one student mentioned this desire for useful application as a means of overcoming issues, saying they beat the problem of communicating well “by practical applications and scenarios that relates to engineering management”. This contradiction highlights that the course's practical goals with academic execution potentially misalign, which forces students to learn in a way that feels antithetical to the skills they hope to acquire (Law, 2021).

### *3.3.3. Theme 3: The burden of breadth: comprehensiveness becomes overwhelming*

The thorough nature of the engineering management course evokes complex and contradictory feelings likewise. Showing its value, the subject's breadth introduces students to the wide array of responsibilities an engineer might face. This breadth, however, can also be perceived as being a meaningful burden. One student said the challenge is that “broad knowledge you have to absorb in terms of planning, organizing, research” (R2 interview). Another student described the course with “full of unwanted and uncertain” events. Managing it required constant “planning and organizing” (Response 8, 9, 10, 13, 15, 16, 24, 35, 44, 48) with over half of the survey respondents (52.7%) finding this “Burden of Breadth” demanding, which contributes to the high perceived workload. This burden can lead some within a substantial minority group to question their own career path because it is also a clear indicator of all the strain (Lattuca et al., 2017). Its broadness renders the class a helpful “glimpse of the corporate world”. The same scope is able to make the course feel so overwhelming and even, at times, crushing.

### *3.3.4. Theme 4: The student's identity through trial and the 'valuable but unbearable' Paradox*

The final theme captures how students navigate as well as resolve these tensions, and it is here that students experience the central paradox most apparently. They do not simply do an analysis of costs and also of benefits, but they frame their experience as being a formative type of trial. This trial represents a difficult but necessary rite of passage for them to become engineers. Students do rationalize all of the challenges about abstraction and workload. They focus on that long-term prize within professional identity. Grit plus determination enable for them the overcoming of difficulties instead of ease. One student managed knowledge's overwhelming breadth “by forcing myself with determination and self-motivation” (R2 interview) while another had to “strive and study hard and work hard” (R3 interview). These statements show people endure hardship toward a future reward. Students view this battle as what “(R22) helps me to grow as a student to future engineer”.

The theme shows a deep mental process when students reframe course challenges like a crucible forging their work identity. This reframing, however, responds to the finding that the course is unexpectedly “valuable and unbearable.” A pedagogically flawed curriculum is suggested via students resorting to such resilience strategies, but it is relevant. Ideally, meaningful engagement can foster professional identity by way of a course, instead of endurance of an overwhelming process that is inefficient. For informing curriculum reform, this paradox is the single most important finding. A course can be perfectly aligned to career goals, and yet it can function as a point for potential attrition.

## **4. Discussions**

This study's findings do present quite a multidimensional and a compelling picture of the student experience that is in engineering management education. A core paradox that the analysis reveals is truly this: students do battle along with the demanding workload plus pedagogical delivery, yet they then acknowledge that the course has career relevance. This tension examines ideas such as a perceived contract, a pedagogical paradox, together with the burden of breadth. Forging identity through trial and offering a critical lens help during our examination of the design and implementation of 21st-century engineering curricula.

### *4.1. The critical tension: perceived value vs. perceived workload*

The most meaningful finding of this study reveals tension among what people perceive as high course value coupled with what they perceive as a high workload. Coursework is demanding to 52.7% of students while 86.8% view knowledge as valuable to careers later. It shows a possible retention risk, which is not only a small problem. Some students, the survey revealed, were led because of the management coursework volume to “consider changing my engineering specialization”. This finding connects directly to a substantial body of literature, which identifies excessive academic workload as a defining stressor inside engineering programs as an important factor in student attrition. Heavy workloads can negatively affect academic success as well as promote surface-level learning. In addition to that, these workloads can lead to higher dropout rates. Engineering culture often has “hardness” plus a “continuous battle” as factors that can contribute to poor mental health. High stress can be normalized as being a necessary part of some engineering identity, ultimately then impacting retention. Our finding that more than half the students are concerned about workload, and some explicitly reconsider their field of study as a result, links our study directly to this critical issue.

Even while the content of engineering management courses aligns with student and industry needs, still their pedagogical implementation can create unintended negative consequences. Educators face the challenge of the delivery of engaging integrated necessary content rather than content that can feel like a burdensome requirement added to a

demanding technical curriculum. As Xiong et al., (2021) state, the curriculum is the design and planning of educating people, and the training goal of the school can only be achieved through specific courses. The design and development of the curriculum should be based on the development of students and realized through specific implementation methods. Curbano et al., (2018) highlight that defining curriculum, for the study program must be aligned with the preset goals, concerning engineering management.

#### *4.2. Developing a managing cognitive load and balancing the curriculum*

The finding that students struggled with all the management content points to a structural issue within a single course. Institutions must develop a “professional spine” by weaving these competencies within the entire engineering program instead of isolating professional skills into one-off courses (Smith et al., 2014). Foundational management concepts could be introduced in the first year in this model sharpened in a senior capstone course requiring thorough project management as well as applied in sophomore along with junior design projects. This thorough method yields multiple benefits: it divides the mental effort among various semesters, it strengthens learning as learners consistently use it within differing situations, and it renders the importance of career abilities to specialized labour obvious and constant (Burnette et al., 2020; Froyd & Ohland, 2005). This helps students see the linkage to their learning. Many did not see how the management course connected with subsequent engineering courses, a finding that these addresses.

Overall student workload should be more deliberately managed by educators and curriculum designers. Engineering programs are notoriously demanding, with content of professional skills that must be balanced carefully against core technical requirements (Chowdhury & Alam, 2012). This does require that we view the curriculum holistically as well as that we coordinate courses. Bowyer, (2012) and Lattuca et al., (2017) state coordination prevents “assessment logjams” when several big projects and exams occur for one week. Instructors also should consider all of the time that their courses do require, and the work students do outside class because time along with difficulty and personal factors can influence just how students will perceive workload. Balancing the curriculum is not about reducing rigor but about designing it for sustainable and effective learning, and it ensures that students have the cognitive bandwidth to engage deeply with both technical and professional material (Smith et al., 2024).

#### *4.3. Upgrading the effectiveness of engineering management curricula*

In addition to the effectiveness of engineering management curricula, practical application in engineering management courses should effectively illustrate the application of engineering management principles within practical engineering contexts. As Banerjee et al., (2020) argue, engineers in the real work environment need to apply technical skills with management acumen for value creation to firms, and curriculum redesign is essential for developing multidisciplinary competency in engineers. Furthermore, ethical and social considerations may integrate into curricula and should emphasize domains of ethics and law, adequately addressing the social and ethical responsibilities inherent in engineering management. As Pons, (2016) notes, ethical guidance is important for the decisions of engineering managers in a competitive environment, and the curriculum must allocate time to these topics. Promotion of active learning is crucial for fostering a more engaging and profound educational experience. This effort involves a significant increase in the adoption of active learning methodologies, including project-based learning, where students tackle real-world problems; simulations, which offer immersive and interactive learning environments; and case studies, which encourage critical analysis of specific situations (Magano et al., 2021). The study of De Los Ríos-Carmenado et al., (2015) stated that employing these methods has shown effectiveness both as students gain subject-specific technical skills and as they build key soft skills like problem-solving, communication, and collaboration. These approaches do contribute to what is a more thorough and lasting understanding through actively involving students in their own learning process (Rao, 2014). Xiong et al., (2021) suggest curricula be implemented with invention. These revolutionary curricula should center project learning as well as effectively use interdisciplinary knowledge. Additionally, the curriculum is something that should stress the developing of competence, and it should recognize that competence involves skills that are rather than just knowledge (Curbano et al., 2018). Graduates who show effective managerial skills in specific and measurable ways are highly valued among employers, as Gómez et al., (2021) highlights, along with knowledge of business disciplines.

Lastly, to ensure that education remains relevant as well as successful, curricula must regularly update so as to reflect the ever-changing needs of the professional world plus technological innovations' quick speed (Corpus et al., 2023). This approach includes the important step for fostering strong engagement with industry partners. Collaborations are viewed as critical by Panuwatwanich et al., (2011). They offer perceptions on particular skills and pieces of knowledge that are now appreciated and necessary within the workplace. By connecting educational curriculum with industry demands, schools may better prepare graduates to move into their jobs and make important contributions to their disciplines.

## 5. Conclusion

This thorough study contributes greatly and in a timely manner to the field of engineering education via offering empirically supported perceptions into how undergraduate engineering students in the Philippines perceive their engineering management courses. For professional engineers, the broader engineering community and existing literature widely acknowledge that management skills are necessary, yet this research digs deeper and understands how students themselves value these courses. The findings clearly indicate generally positive reception overall. Students recognize that the necessary skills like critical thinking, problem-solving, and effective communication can be cultivated. This research indicates perceptions of students are multidimensional. Through a mixed-methods approach combining surveys as well as written responses along with in-depth interviews, researchers could capture broad quantitative agreement and rich qualitative perceptions into lived student experiences. This methodology revealed why students find the courses relevant, beyond just that. For their future careers, they see a direct line from class. They have an envisioning of the fact that management principles will be applied within project leadership, team dynamics, and in entrepreneurial endeavors.

However, the study also brings to light a critical challenge that educators along with curriculum developers must address: the perceived workload of management-related coursework. According to the data, a meaningful portion of students do find that this academic load can be demanding, which leads them to sometimes question their chosen engineering specialization. This important area needs highlighting via curricular refinement. The goal should be to smoothly integrate management theories into practical engineering applications that are engaging and reinforce core technical learning, not detract from it. Institutions can act thus to lower risk. This is an engagement to prevent student attrition.

Ultimately, actionable implications about engineering education's advancement are offered in this paper. It advocates a curriculum with a careful, deliberate balance between management as well as engineering content. It also highlights that an educational setting matters when it helps with understanding topics well as it goes past simple recall for tests. In order to ensure curriculum relevance, there is continuous feedback from industry partners that is vital, so graduates are not only technically skilled but also possess the indispensable managerial acumen plus interpersonal skills that are required to excel in the dynamic engineering landscape of the 21st century. This prepares them for being immediate contributors in their fields. Also, this prepares them for being the future leaders within their fields.

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