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The TQM J

Comprehending The Role of Soft Skills in Current Work Scenarios Among Engineering Domain

Journal:	*The TQM Journal*
Manuscript ID	TQM-05-2024-0184.R2
Manuscript Type:	Research Paper
Keywords:	Communications, Consumer Behaviour, Human resources management, Industrial design, Students, Social responsibility

Abstract

Purpose: To investigate the transformative impact of soft skills on the career pathways of experts and students in the engineering domain

Design/methodology/approach: The study adopts a comprehensive approach, combining a review of existing literature with primary data to analyse quantitative and qualitative empirical investigations. Data from 40 participants, who are engineering students and professionals, is analysed using descriptive statistics and advanced software tools like ATLAS.ti and Jamovi.

Findings: The findings underscore the indispensable nature of soft skills in elevating employability, emphasising the urgent need for mandatory soft skills education for engineering students and professionals. The research identifies the top five soft skills engineers need: communication, teamwork, time management, leadership, and problem-solving.

Originality: The study recognises the current job market demands and asserts that engineers must combine technical expertise with soft skills to succeed in the technology-driven yet people-centric engineering profession.

Practical implications: The research contributes to understanding soft skills' pivotal role in engineering professions, providing valuable insights for professionals and organisations aiming to enhance performance and competitiveness in the industry. The study advocates for a holistic approach that recognises the symbiotic relationship between technical proficiency and soft skills in shaping the success of engineering graduates in the 21st-century workforce.

Keywords: Soft Skills; engineering experts; Human Resource Management; Employability; engineering students

Article Type: Research paper

1. Introduction

A nation's economic prosperity and productive capacity depend on its intellectual and professional abilities (Doherty & Stephens, 2023). To sustain in today's highly competitive scenario, many institutions cannot produce a competitive human workforce that can withstand the different work scenarios and situations (Poláková et al., 2023). It is imperative to encompass different sets of skills, including soft skills, to remain a flag bearer. Soft skills must comprise communication, collaboration, motivation, problem-solving, enthusiasm, and trust in professional environments (Ellis et al., 2014; Rasul et al.,2013). These soft skills and competencies are recognised as essential for success in business ventures and professional endeavours (Doherty & Stephens, 2023). Soft skills enable individuals to adapt and exhibit positive behaviours, effectively navigating challenges in their work and daily lives. These soft skills encompass various interpersonal and social attributes and capabilities applicable across diverse economic sectors and industries.

The term 'engineering' encompasses various disciplines and requires diverse abilities. Innovators, designers, developers, scientists, and critical thinkers are all characteristics of engineers (Nalliveettil & Gadallah,2024). The objective is to enhance individuals' standard of living, proficiency, and security worldwide (Dubey et al., 2021). Engineers must possess scientific or technical expertise and the capacity to utilise materials and resources wisely for humanity's betterment. Employees must engage in discussions, develop plans, communicate, and collaborate with their colleagues and the community embers. It has been found that the employability rate for engineering graduates is significantly lower than the pass-out ratio (Asiedu et al.,2023). The academic must produce graduates that bridge the need for jobs based on technical capabilities and articulation at different levels (pandey & Dhand, 2024). The need for adequate soft skills is a primary factor contributing to the unemployment of engineering graduates and the growth of employed ones. (Dubey & Gunasekaran, 2015) According to research by the Protocol School of Washington, DC, Harvard University, the Carnegie Foundation, and the Stanford Research Institute, technical expertise and knowledge explain roughly 15% of why someone obtains a job, holds onto it, and progresses. The remaining 85% of a person's employment success is determined by their "people and soft skills."

After extensive research efforts and initiatives, educational institutions have introduced separate courses for soft skills. However, a need for more soft skills among the younger generations still exists, resulting in job vacancies and the industry needing help finding employees who meet their requirements (Itani & Srour, 2016). To address this issue, continuous efforts in soft skills training within engineering education are needed, as there is considerable room for improvement, especially among students. (Daun et al.,2023). For this, the present study will answer the following

research question: "How do you identify, evaluate, and recognise soft skills' impact on employability in the engineering domain?".

The manuscript comprises five sections, commencing with the introduction. Section 2 provides a literature review that identifies the research problem. Section 3 demonstrates the research methodology. Section 4 encapsulates implementation, results, and discussion, demonstrating how the goals were attained. Section 5 illustrates the conclusion, addressing limitations and future scope perspectives.

2. Literature Review

This literature review embarks on a comprehensive exploration of the pivotal role soft skills play in the employability of engineers, shedding light on their significance, the evolving demands of the industry, and the strategies employed to foster their development. The literature review section is divided into four parts. Section 2.1 provides background on soft skills. Section 2.2 describes the requirements of soft skills in the engineering domain. Section 2.3 discusses the second variable, which is employability enhancement. Finally, section 2.4 identifies the research gaps.

2.1 Soft Skills

Soft skills have a background and a historical evolution, which will be investigated in this longitudinal study. The pressing need of the time was to improve social and interpersonal skills, which are as necessary in today's competitive environment (Dean, 2019). The array of soft skills is extensive and often varies in meaning, showing country-specific nuances. For instance, (Herrmann,2013) identified 14 different soft skills, emphasising the importance of building social networks and knowing the right people. (McArdle et al., 2007) highlighted that engineers value soft employability skills such as motivation, enthusiasm, and self-esteem, which are linked to career identity, self-confidence, and empowerment. Recent research (Schulz,2008) emphasises that education beyond academic knowledge, including soft skills, is crucial for professional success. Graduates argue that personal employability is tied to individual agency, and taking the initiative, being proactive, and avoiding a passive approach are critical factors in enhancing employability.

2.2 Need for soft skills in the engineering domain

Today, soft skills are essential in the field of engineering, enabling engineers to thrive in the face of intense global competition, advanced technology, and constantly evolving work environments (French et al., 2005). These skills contribute to personal and professional growth by emphasising each individual's distinct capabilities in the workplace. Research has shown that engineering education needs reform to align with industry expectations better. Interviews and surveys with

students, professors, graduate engineers, and employers reveal a gap between academic training and the employability skills required for entry-level engineers (Domal & Trevelyan, 2009). Moreover, studies examining the skills demanded by accrediting institutions in countries like the US and Japan highlight the importance of non-technical skills such as communication, teamwork, lifelong learning, professionalism, and decision-making in engineering (Zaharim et al., 2010).

2.3 Enhancement of Employability

Employability, as discussed by (Shekhawat,2020) and further developed by (Fugate et al., 2020), emphasises the importance of balancing technical and soft skills for engineering students and professionals. Employability is a dynamic attribute that requires individuals to adapt to the evolving demands of the workplace. It comprises three main dimensions: career identity, personal adaptability, and social and human capital. The analysis highlights the crucial role of soft skills in enhancing organisational performance in operations and supply chain management (OSCM). According to (Fantozzi et al., 2024), a study utilising the O*NET database revealed significant correlations between individual characteristics and task requirements in OSCM roles. Despite recognising the need for continuous learning and adaptability, (Pandey & Dhand,2024) highlights challenges such as the lack of time for reflection, which is critical for enhancing employability but is seen as a barrier to learning. Furthermore, while there are opportunities for structured learning within organisations, the development of employability often focuses on immediate job requirements and future demands, underscoring the importance of individual responsibility in employability development.

2.3.1 Employability of soft skills

Engineers generally view interpersonal skills, socio-communicative abilities, and leadership qualities as crucial foundations for a successful career and personal employability in today's professional landscape (Markes, 2006). This perspective also emphasises the importance of building and maintaining social networks, often called social and cultural capital, or simply "knowing the right people" (DeFillippi & Arthur, 1994). Engineers further highlight other soft employability skills, such as motivation, enthusiasm, and self-esteem, which are associated with career identity, self-confidence, and empowerment (McArdle et al., 2007). An individual's inherent characteristics and talents intertwine with these soft employability skills. Graduates argue that individuals should be bold in tackling new challenges and issues, as personal employability closely aligns with personal agency. Critical aspects of employability include engagement within the organisation, generosity, sincerity, honesty, information sharing with colleagues, the ability to meet job requirements, conscientiousness, trustworthiness, and reliability in a professional role.

2.4 Awareness of skills and the significance of soft skills is crucial

Individuals and organisations must understand their skills to succeed in today's ever-changing job market. This understanding helps develop the necessary competencies for career growth and personal development. According to recent studies, knowing one's skill set allows for more focused learning and professional growth, thereby improving employability and job satisfaction (Capella et al., 2002). The fast pace of technological advancements requires individuals to stay informed about emerging skills and trends. Being aware of one's skills encourages a mindset of continual learning and development. Recognising strengths and weaknesses also aids in effective task allocation and performance management, ultimately enhancing employability (Itani & Srour, 2016). Moreover, the modern workplace emphasises soft skills such as communication, teamwork, and problem-solving, which complement technical abilities and enable effective collaboration and leadership (George et al., 2024). As workplaces become more dynamic and interconnected, these soft skills significantly contribute to organisational success and personal career advancement while also promoting continuous learning and improving overall performance.

2.5 Research gaps

In today's generation, particularly among mechanical and automobile engineers, the unemployment rate is rising daily, with engineering graduates and postgraduates dominating the job market. A more comprehensive understanding of the most crucial soft skills for success in engineering is necessary. The National Skills Development Association highlights numerous research papers identifying a prevalent gap: the imperative to prioritise incorporating and cultivating soft skills within engineering domains to enhance employability. This gap between academic preparation and industry expectations for developing soft skills among engineering graduates is a significant issue. The journey of soft skills in engineering education is a fascinating tale that spans decades. It commenced in 1960 when the U.S. Army introduced "soft skills," recognising their significance in leadership, motivation, and military success. By 1972, the concept had gained sufficient momentum to warrant formal training and conferences, with Dr. Whitmore presenting influential reports on soft skills across various educational institutions. The 1990s marked a pivotal moment when the engineering sector began to acknowledge the vital role of soft skills in effective practice. This realisation prompted initial efforts to incorporate these skills into engineering curricula. The 2000s witnessed a more structured integration, notably with the introduction of ABET's EC2000 accreditation criteria in the United States. These criteria underscored essential soft skills for engineers in an increasingly globalised profession, although their implementation and assessment remained challenging. As we entered the 2017s, soft skills

were recognised as an indispensable complement to technical abilities. Programs such as the Grand Challenges Scholars Program and Arizona State University's KEEN initiative began emphasising developing these skills through practical, real-world projects. By the 2020s, the focus shifted towards integration and assessment, with digital platforms being employed to evaluate soft skills and foster student reflection. Despite this progress, a significant research gap persists. Towards the mid-2020s, there is a clear need for more systematic approaches to incorporating and developing soft skills in engineering education. More robust and responsive approaches must be developed and implemented to align with the engineering profession's and education's evolving needs. In the paper "Empirical Investigation of Data Analytics Capability and Organizational Flexibility as Complements to Supply Chain Resilience" (2020), the authors identify that data analytics capabilities enhance supply chain resilience and competitive advantage when complemented by organisational flexibility. However, this study lacks a focus on data analytics capabilities as part of soft skills, instead advising managers to invest in data analytics and improve information processing capacities. The paper "Employability and Skill Set of Newly Graduated Engineers" (2010) identifies the skills expected of new graduate engineers, but it focuses on online bank engineering. On the other hand, our study addresses the skills of mechanical, electrical, and computer science engineering students and working professionals, specifically those in technical departments. Our paper uniquely focuses on the essentiality of soft skills for today's and future technical professionals. We offer solutions to current and forthcoming challenges, emphasising the significance of soft skills for employability and reducing unemployment. To address this problem, the study aims to provide valuable insights and recommendations to educational institutions, policymakers, and industry stakeholders on improving the assessment, integration, and alignment of soft skills in engineering curricula. To achieve this aim, the study will conduct a literature review and a survey among engineering employers and educators to identify and rank the top five soft skills essential for engineers to succeed in their careers, enhance their employability, and compare the results across different regions and sectors. Moreover, this research makes a significant contribution by elucidating soft skills' pivotal role in engineering vocations, furnishing valuable insights for professionals and organisations striving to enhance performance and competitiveness within the industry.

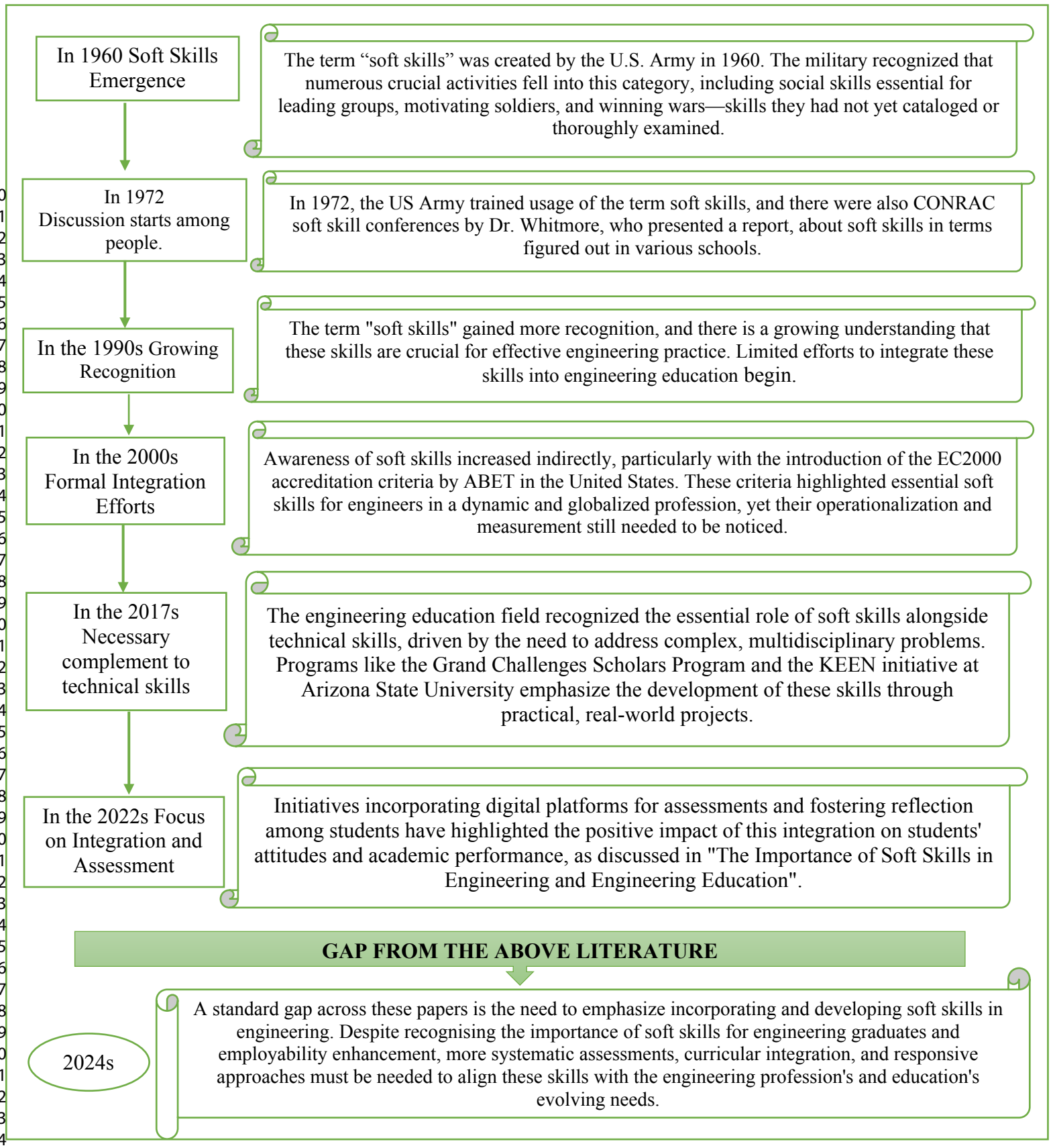

Figure.1: Research gap identification method

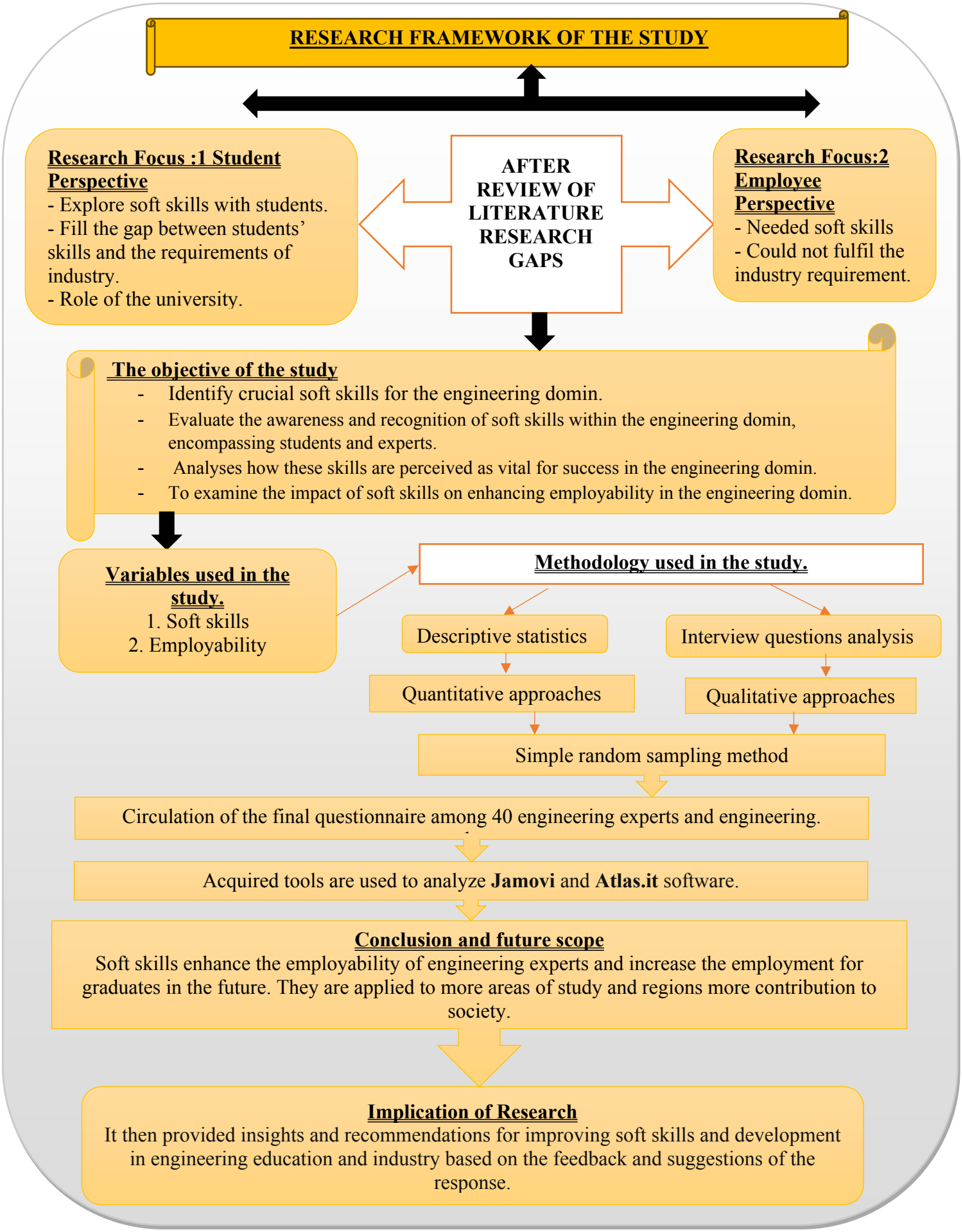

Figure.2: Research Framework of Study

3. Research Methodology

The research methodology applied to the present study involved a comprehensive review of various scholarly articles to understand the viewpoints of students and professionals in the engineering field. It was observed from these studies that there seems to be a disconnect between educational institutions and the industry regarding their requirements. This gap is one of the primary focuses of this study (Dean & East, 2019). The aim is to identify, evaluate, and recognize the impact of soft skills on employability within the engineering sector. The concept of learning and career development theories underpins this study. Concept learning theory emphasizes the importance of understanding and categorizing information, enabling individuals to apply knowledge to various contexts (Bruner, 1961). Career development theory, particularly the Social Cognitive Career Theory (SCCT), posits that career choices are influenced by self-efficacy, outcome expectations, and personal goals (Lent et al.,1994). These theories highlight the significance of both technical and soft skills in shaping career trajectories and employability. The literature review identified employability and soft skills as the critical research variables. The study adopted both quantitative and qualitative research methodologies. The quantitative approach involved data analysis using descriptive statistics, which provided a numerical overview of the data. On the other hand, the qualitative approach focused on analysing interview responses to gain deeper insights. The study employed a simple random sampling method, selecting participants randomly to ensure an unbiased sample. The study involved 40 participants. The selection process began with reaching out to 60 individuals, out of which 50 met the initial criteria: that the professionals should have more than three years of experience in their work and awareness of soft skills in their work environment, whether positive or negative. Student participants were chosen from those in their third or final year of graduation who have undergone summer training in the companies and sense the importance of soft skills in their respective career progression. However, our questionnaire first questioned the awareness of soft skills, resulting in 40 responses to achieve the study's objectives. The researcher believes this sample provides a broad perspective on the topic, though they do not explicitly state whether it is representative of the wider engineering population. After data collection, we conducted the analysis using Jamovi and ATLAS.ti software. These tools facilitated a comprehensive examination of quantitative data and qualitative insights, allowing for a thorough understanding of the impact of soft skills on employability. The results, derived from robust statistical and thematic analyses, provided valuable insights into the critical role of soft skills in enhancing employability in the engineering sector. The feedback and suggestions gathered during the research process offer useful insights and tips for enhancing soft skills and fostering growth in engineering education and industry.

4. Results and Discussion

4.1 Quantitative data

Quantitative data was acquired through surveys and a review of pertinent literature. The findings, combined with the literature analysis, reveal that a substantial portion of the survey participants have identified a deficiency in interpersonal skills among individuals. This highlights the importance of incorporating soft skills into engineering education, from undergraduate studies to professional development. The 40 respondents acknowledged the lack of soft skills among engineers and even agreed to incorporate them into their professional development. The research paper aimed to evaluate the role of soft skills in improving employability and identify the top five essential soft skills in the engineering domain. The data presented in Table 1 and Table 2 provide insights into people's perspectives on various aspects of soft skills, including their awareness, efforts to improve them, and opinions on their significance in academic and professional contexts. Table 1 shows the mean and standard deviation of the statements generated from the questionnaires that engineering experts and students file. These questionnaires were developed based on a literature review, creating five criteria statements that serve as the testing criteria for evaluating our research objective.

Table :1 Soft skills comparison among engineering experts and students

Questions	Code	N	Mean	S.E.	S.D.
Awareness	Engineering Expert	18	1.11	0.0762	0.323
	Engineering students	22	1.09	0.0627	0.294
Crucial skills	Engineering Expert	18	1.11	0.0762	0.323
	Engineering students	22	1.23	0.0914	0.429
Training in Engineering Studies	Engineering Expert	18	1.33	0.1143	0.485
	Engineering students	22	1.18	0.0824	0.395
Success and Challenge	Engineering Expert	18	1.17	0.0904	0.383
	Engineering students	22	1.18	0.0842	0.395
Soft Skills Emphasis in Engineering Curricula	Engineering Expert	18	1.22	0.1008	0.428
	Engineering students	22	1.23	0.914	0.429

(N means the number of students and experts)

Table 2: Descriptive statistics of soft skills

Question	N	Mean	S.E.	Mode	SD
Awareness	10	8.70	2.15	3.00	6.78
Crucial skills	10	14.50	1.58	8.00	4.99
Training in Engineering Studies	10	8.70	2.15	3.00	6.78
Enhance employability	10	15.10	1.22	10.00	3.84

(N means the number of soft skills)

Table 2, with a sample size of N=10, identifies ten soft skills derived from the literature review. It specifies which soft skills are most preferred by engineers, as detailed in the accompanying bar graph and description below. To analyze the significance of the survey responses further, one-sample t-tests were conducted for both the engineering expert and engineering student groups. The results of these analyses are presented in Tables 3 and 4.

Table 3: Perception of engineering expert regarding soft skills

Questions	T- value	DF	P- value
Awareness	14.6	17.0	< .001
Crucial skills	14.6	17.0	< .001
Training in Engineering Studies	11.7	17.0	< .001
Success and Challenge	12.9	17.0	< .001
Soft Skills Emphasis in Engineering Curricula	12.1	17.0	< .001

Note. H_a $\mu \neq 0$, DF = N

Table 4: Perception of engineering students regarding soft skills

Questions	T- value	DF	P- value
Awareness	17.4	21.0	< .001
Crucial skills	13.4	21.0	< .001
Training in Engineering Studies	14.0	21.0	< .001
Success and Challenge	14.0	21.0	< .001
Soft Skills Emphasis in Engineering Curricula	13.4	21.0	< .001

Note. H_a $\mu \neq 0$, DF = N

This table provides statistical evidence of the importance of survey responses in various aspects of soft skills awareness and importance. The t-values represent the test statistic for each question, while the degree of freedom (DF) indicates the reduced sample size. p-values that were all <.001 indicated that responses were statistically significant for both groups for all questions. Interestingly, while both groups show high t-values across all categories, students consistently score higher than experts. This could suggest that the younger generation of engineers emphasises soft skills more than their more experienced counterparts, potentially reflecting a shift in the engineering field's priorities.

4.1.1 Awareness of soft skills

In today's dynamic landscape, engineers must seamlessly collaborate with diverse teams, articulate complex concepts to technical and non-technical stakeholders, and adapt to evolving challenges. Table 1 displays the mean scores for two groups: Engineering Experts, with an average score of 1.11, and Engineering Students, with an average score of 1.09. The proximity of both groups averages 1, suggesting that both groups demonstrate a comparable awareness of soft skills. As depicted in Fig 1, the data reveals that only 13% of individuals need more awareness regarding soft skills. These slight variations in scores indicate that most participants from both categories clearly understand the concept of "soft skills." These two distinct sources of information make it apparent that soft skills are gaining recognition in engineering. (Poláková et al , 2023) They suggest that experts and engineering students acknowledge the significance of incorporating soft skills into their skill sets.

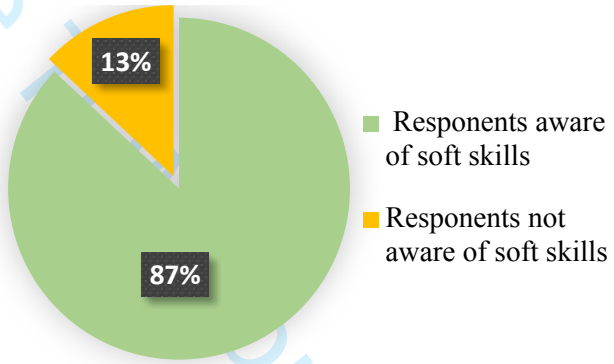

Figure 2: Awareness of soft skills

Table 3 and Table 4 both support the high awareness of soft skills among engineering experts as well as students. For engineering experts (Table 3), awareness has a t-value of 14.6 ($p < .001$), which is a significantly high level of awareness. The same case happens for engineering students (Table 4) where the t-value for awareness is even higher at 17.4 ($p < .001$). These findings reinforce our earlier conclusion that about 87% of the respondents know the significance of soft skills in their lives. The finding also suggests that modern generations of engineers may be more aware as shown by the larger t-value for students. This awareness is a positive reflection of the concerted efforts made by educational institutions and the industry to promote and provide training in these crucial skills as though the literature review by (Fantozzi et al., 2024) highlights that soft skills are categorized into communication, teamwork, problem-solving, time management, and adaptability, which are indispensable across various professional domains. The ProKnow-C methodology employed provides a comprehensive taxonomy of these skills, underlining their impact on employability and professional growth. The study emphasises the need for a structured approach to developing and accessing these skills to bridge the gap between academic preparation and

industry requirements. Soft skills training equips engineers to interact effectively with consumers and helps them maintain harmonious interpersonal relationships within the workplace, as highlighted by (Ellis et al., 2014).

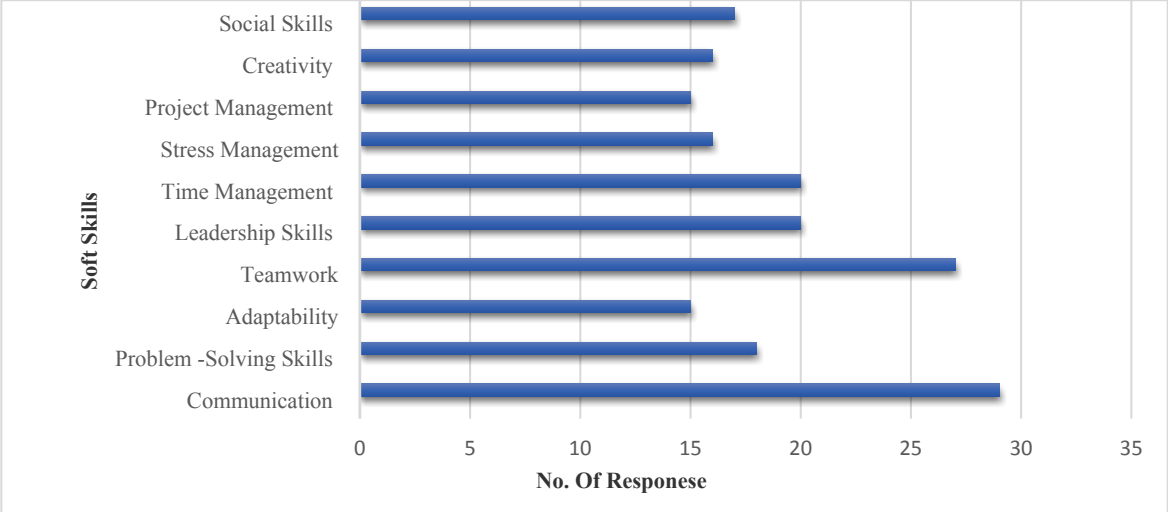

Figure 3. The most prevalent soft skills

The data in Table 2 shows that awareness of soft skills has a mean of 8.70 with a standard deviation of 6.78. This relatively high mean, coupled with a mode of 3.00, suggests that while there is general awareness of soft skills among respondents, there is also considerable variation in the level of awareness. The bar graphs derived from this data identify specific soft skills, showing which are considered more important and which are less so. The analysis of Figure 3 shows that conversations between engineering students and experts have highlighted the soft skills that are considered most beneficial for both in the engineering domain. The ability to communicate effectively is the most valuable soft skill for engineering professionals, with 29 responses. As the engineering field continues to evolve, collaboration is becoming increasingly important. Teamwork, which garnered 27 responses, is the second most important skill. Engineers must work together cohesively to tackle complex projects. Leadership and time management skills are tied for third place, with 20 responses each. These skills are essential for guiding teams and managing resources and tasks efficiently. Additionally, problem-solving skills (18 responses), stress management (16 responses), project management (15 responses), creativity (16 responses), and social skills (17 responses) are all essential and are all recognised as valuable assets contributing significantly to an engineer's success. This analysis underscores the consensus among engineering students and experts regarding the diverse yet interconnected soft skills essential for excelling in engineering.

4.1.2 Soft skills essential for success in the engineering domain

There is a consensus among individuals that soft skills should be integrated into the engineering field, both within the educational framework and at the professional level. As soft skills are essential to their success in the engineering area the mean score for Engineering Experts (1.11) corresponds to their awareness score, indicating that they consider specific essential skills significant for success in the engineering industry. Conversely, Engineering Students exhibit a slightly higher mean score (1.23), implying that they perceive these skills as even more crucial, as presented in Table 1. This variance in perception may stem from the students' understanding of soft skills' vital role in their future careers, as depicted in Fig 4. Notably, the statistical analysis further supports the importance of soft skills for success in engineering. Table 3 shows that engineering experts rate "Crucial skills" with a t-value of 14.6 ($p < .001$), identical to their awareness score. For engineering students (Table 4), the t-value for "Crucial skills" is 13.4 ($p < .001$). While slightly lower than their awareness score, it still indicates strong agreement on the essential nature of these skills. These findings corroborate our earlier observation that 82% of respondents believe soft skills benefit engineering success. In comparison, 18% assert that technical skills alone are sufficient. This study unveiled that their performance improved following soft skills training.

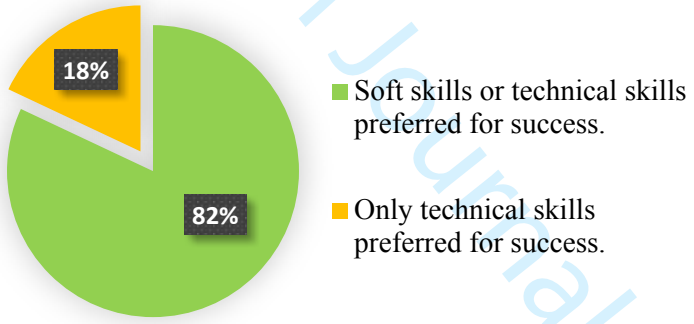

Figure 4: Crucial skills for success in engineering

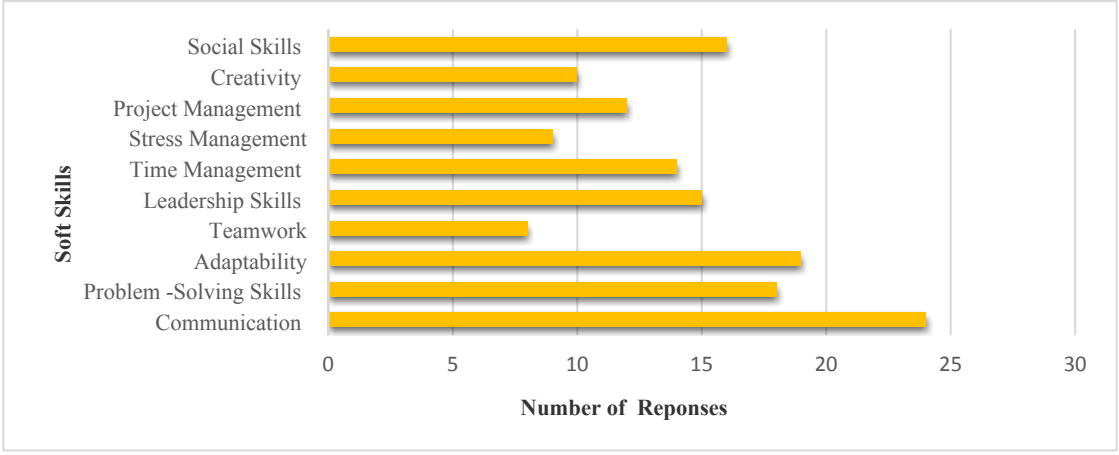

Figure 5: Crucial soft skills

Based on (Majid et al.,2019) research, engineering professionals can enhance their performance and achieve the highest level of career success by developing crucial skills. The study by (Fantozzi et al., 2024) focused on verbal and non-verbal communication skills and problem-solving skills specifically for operation and supply chain management, which are important but primarily at the middle management level. In contrast, our research identifies soft skills as essential at every stage of life, both professionally and personally. Our data collection and analysis of ten crucial soft skills necessary for success in the engineering industry, as shown in "Table 2 indicates that crucial skills have the second-highest mean (14.50) among the categories, with a relatively low standard deviation (4.99). This suggests a strong consensus among respondents about the importance of certain soft skills for success in engineering. The bar graphs show essential soft skills , as illustrated in Figure 5. Communication is the most crucial soft skill, with 24 responses emphasizing its vital significance in engineering for effective technical collaboration, exchanging information, and managing projects. Problem-solving skills (18 responses) and adaptability (19 responses) are the most prevalent skills, reflecting the engineering community's emphasis on analytical and creative thinking abilities to solve complex technological challenges and the need for adaptability in the ever-changing engineering area. Leadership skills (15 responses) and time management (14 responses) are also highly valued soft skills in the engineering domain, as they are essential for successfully guiding projects, managing resources, and achieving success in engineering endeavours. Other notable soft skills include social skills (16 responses), project management (12 responses), stress management (9 responses), creativity (10 responses), and teamwork (8 responses). These skills are considered essential for various aspects of engineering work, such as collaboration, managing stress, creative problem-solving, and effective project execution. These abilities are considered essential for both engineering students and professionals. According to (Hissey, 2000) soft skills must requirement of the 21st future through educational and other professional enhancement. This investigation highlights the agreement over the crucial significance of a comprehensive range of soft skills in effectively navigating and achieving success in the ever-evolving and challenging engineering career (Sin & Neave, 2016), and even according to (Ramirez-Mendoza et al., 2018; Coşkun et al., 2019). The university is a relevant and essential agent to ensure knowledge and competency development in this fourth industrial revolution, which has been called Industry 4.0.

4.1.3 Soft skills development training in engineering studies.

This study explored the significance of soft skills in enhancing employability within the engineering domain, focusing on the perceptions of engineering experts and students. The descriptive statistics analysis indicates that, on average, both engineering students and experts

recognize the importance of training in engineering studies for improving employability prospects. Engineering experts, with a mean value response of 1.33, express a slightly stronger belief in the significance of training in engineering studies for employability compared to engineering students, who have a mean value response of 1.18, as shown in Table 2. This suggests that individuals with more experience in the engineering field place a slightly higher emphasis on formal education and training to enhance employability.

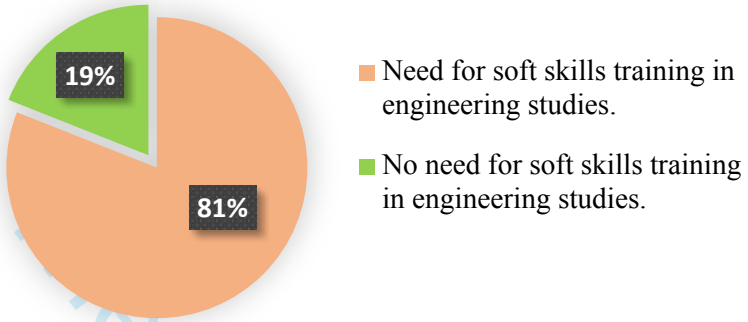

Figure 6: Soft skills training in engineering studies

Figure 6 depicts the proportion of engineering students and experts who have undergone training in engineering studies. The descriptive statistics for awareness and training in engineering studies are almost similar based on Table 2, signifying that there is a relationship between understanding soft skills and the presence of training in engineering studies, which implies that it may be possible to increase awareness or vice versa. Soft skill training in engineering courses as captured by the data. For professionals of Engineering (Table 3), the t-value for "Training in Engineering Studies" is higher at 11.7 ($p < .001$) whereas for students of Engineering (Table 4) it is even higher at 14.0 ($p < .001$). This agrees with our previous statement that about four-fifths of respondents received some form of soft skills training for engineers. Indeed, among young people, this represents an increased trend towards such training over time as evidenced by a bigger T value from the student group than from expert respondents. In contrast, 19% of respondents view it as optional, believing their technical expertise suffices. (McCarthy, 2013) As illustrated in Figure 7, Communication is the most frequently cited soft skill for training among engineering students and experts, garnering 24 responses. It indicates that communication skills are perceived as the most essential and highly valued soft skill for engineering professionals to receive training in. The ability to effectively communicate ideas, collaborate, and present work is crucial in engineering. The second highest number of responses is for Teamwork, with 17, highlighting the importance of teamwork and collaboration skills in engineering projects and work environments. Other soft skills like Leadership Skills (9 responses), Time Management (8 responses), Problem-Solving Skills (7 responses), Creativity (7 responses), and Project Management (6 responses) received lower

numbers of responses, suggesting that while valuable, they are not considered as critical as communication and teamwork skills for engineering students and experts to receive training in. Skills like Adaptability (3 responses), Stress Management (3 responses), and Social Skills (3 responses) received the lowest number of responses, indicating that they are least perceived as highly essential or prioritized for training in the engineering domain compared to other soft skills.

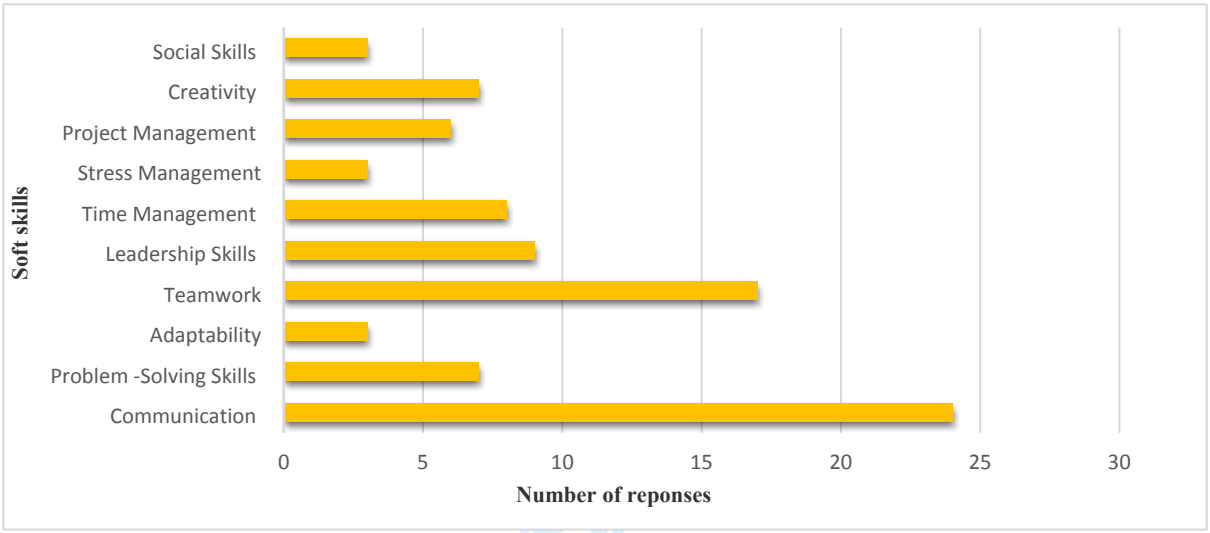

Figure 7: Types of soft skills training in engineering studies

These skills are not considered essential or relevant for engineering students and experts or depend more on personal traits or preferences. Therefore, Table 3 shows the mean value of training soft skills in engineering studies is 8.70, which illustrates the diversity and importance of soft skills for engineering students and experts in the engineering domain.

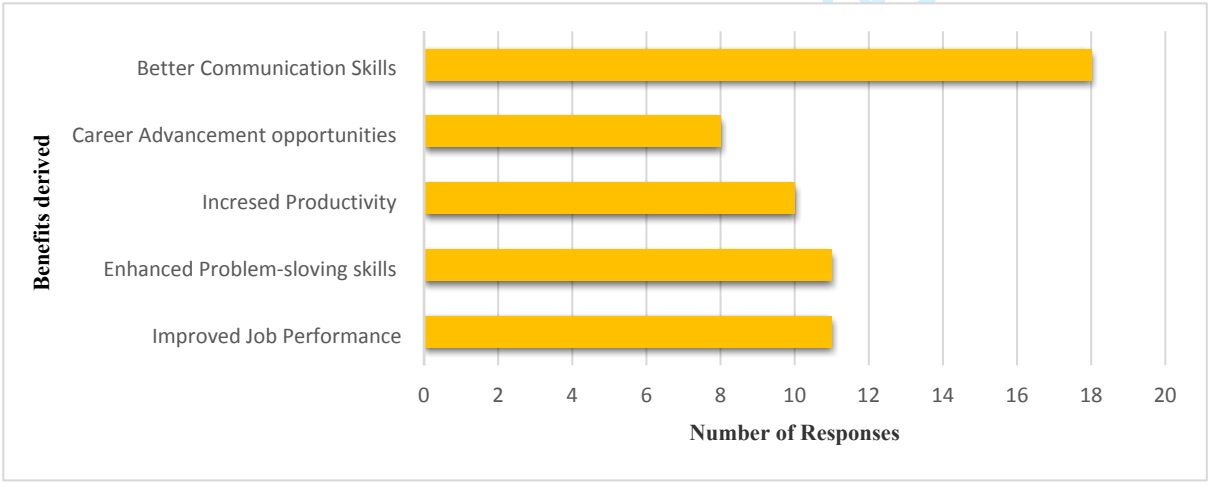

Figure 8: Benefits derived from training and programs.

Figure 8 illustrates the various benefits derived from soft skills training and programs reported by respondents in the engineering domain. As indicated by 18 responses, the most significant benefit

is Better Communication Skills. However, it highlights the crucial role of practical communication skills for professional growth and personal development in engineering. Enhanced Problem-Solving Skills and Improved Job Performance are the most reported benefits, each with 11 responses. These results demonstrate the concrete impact of soft skills training on participants' ability to overcome challenges effectively and perform their jobs more proficiently. Furthermore, 10 respondents reported Increased Productivity as a benefit, suggesting that the training helped enhance the work quality and efficiency of the participants. Lastly, with 8 responses, Career Advancement Opportunities reflects the belief that acquiring soft skills can lead to new and better career prospects for engineering professionals. These diverse benefits, from improved communication and problem-solving abilities to increased productivity and career advancement opportunities, collectively showcase the tangible and multifaceted advantages engineering students and experts can experience from participating in soft skills training programs. The results emphasise the significant role of soft skills in complementing technical expertise, enabling personal growth, enhancing job performance, and facilitating career progression in the engineering domain. However, there is also a significant minority of the respondents who have not received training in engineering studies, which may imply that they encounter some obstacles or difficulties in accessing or completing such training. Therefore, the above chart and figure show that training in engineering studies is a common and valuable experience for engineering students and experts.

4.1.4 Soft skills impact on success and challenge resolution across various levels

Soft skills are the interpersonal and personal attributes that enable us to communicate, collaborate, and cope with various situations in life. They include communication, teamwork, problem-solving, creativity, Adaptability, and emotional intelligence. Soft skills have played a significant role in achieving success or overcoming challenges in various experiences, such as academics, internships, jobs, and projects.

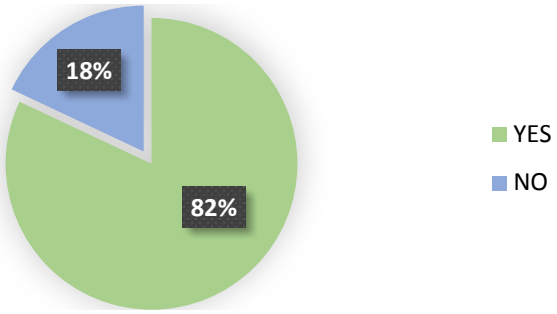

Figure 9: Achieving success or overcoming challenges at various levels.

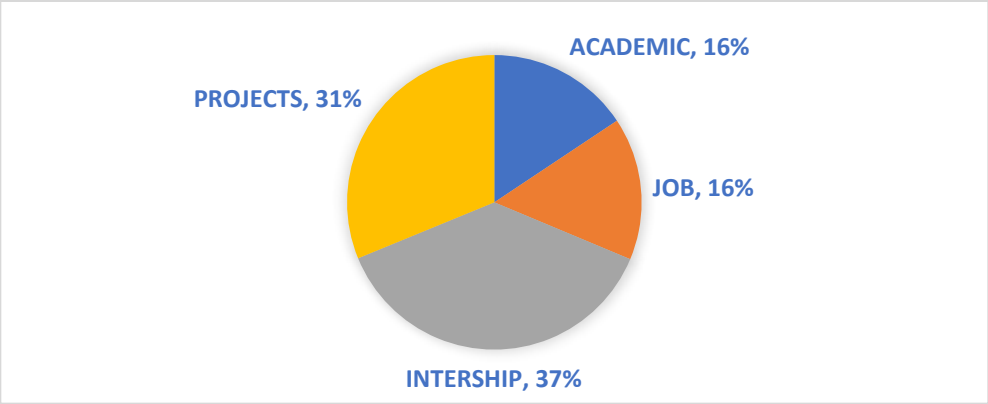

Figure 10: Success and challenge resolution across various levels

Figure 9 shows the proportion of engineering students and experts who have attained success or overcome difficulties in different levels of their studies or work. Figure 9 shows that 82% of the respondents said yes, while 18 % of respondents said no. This implies that most engineering students and experts have experienced some success or challenge resolution in their academic, internship, job, or project activities. In Table 3, engineering experts show a high t-value of 12.9 ($p < .001$) for "Success and Challenge", indicating a strong belief in the role of soft skills in career success. Similarly, in Table 4, engineering students demonstrate an even higher t-value of 14.0 ($p < .001$) for the same category. These results statistically support our earlier qualitative findings on the importance of soft skills for enhancing employability in the engineering domain. This indicates that they have used their soft skills, such as communication, problem-solving, teamwork, Adaptability, creativity, and leadership, to achieve their objectives and overcome challenges. This highlights that they have faced some barriers or obstacles that hindered them from using their soft skills effectively or that they needed more soft skills for success and challenge resolution. In Table 1, Engineering Experts and Engineering Students have comparable mean scores (1.17 and 1.18, respectively) concerning the role of soft skills in achieving success and overcoming challenges. These scores imply that both groups acknowledge the importance of soft skills in their academic and professional-level pursuits. Therefore, table 1 illustrates the importance and impact of soft skills for engineering students and experts at various levels of their studies or work. It also points out the need for more support and development for those who have yet to succeed or overcome difficulties. By interview survey, as shown in Figure 10. presents the distribution of experiences across different levels, including academic endeavors, employment, internships, and projects. It reveals that a significant proportion, academic for 16 %, is dedicated to academic activities, suggesting that individuals invest considerable time in formal education. Simultaneously, an equal allocation of 16% is directed towards job-related experiences, emphasizing the importance of gaining practical skills and exposure to real-world work environments. Internships occupy the largest share at 37%, indicating the substantial focus on hands-on learning and professional

exposure during education. This high percentage suggests a widespread recognition of the value of internships in bridging the gap between academic knowledge and practical application. Furthermore, allocating 31% to projects underscores the significance of undertaking practical, project-based work, which is often an integral part of academic and professional development. Overall, the table implies a balanced engagement in diverse experiences, emphasizing individuals' multifaceted approach to enhancing their skills and readiness for the workforce, combining academic learning, job experiences, internships, and project-based activities. The employability of engineering students, this chart suggests that they should focus on developing their soft skills through engaging in projects and academic activities that challenge their technical and interpersonal abilities, as the essential soft skills for the employability of engineers can be grouped into six main groups: Problem-Solving and social skills Communication, Team Work, Ethical Perspective, leadership skills, and Time management. E.E. #36 These skills help engineering students perform better in their technical domain and communicate and collaborate effectively with others. According to a Harvard Business School article, leadership is "mobilizing others so they can execute a set of individual and collective tasks," which requires solid and soft skills such as communication, listening, negotiation, positive attitude, teamwork, leadership skills, and Time management. Therefore, this chart highlights the importance of soft skills for engineering students and experts. They should seek opportunities to develop and apply these skills through projects and academic activities that stimulate their creativity, collaboration, and problem-solving abilities.

4.1.5 Soft skills leverage to enhance your employability in the engineering domain after graduation.

Soft skills are the non-technical skills that are needed in a specific work environment that allow someone to communicate knowledge or services to customers and co-workers, work effectively as a member of a group, learn or achieve the technical skills required to complete a task, gain the trust of managers and leaders, and understand and adjust to the established norms of the professional setting (Kumar & Hsiao,2007). States that engineering graduates should be prepared to work from the first day and be flexible in a changing world. They need technical skills and the skills to work well with others from different backgrounds (Sin & Neave, 2016). "The engineering students their jobs need soft skills to do projects with a team, communicate with clients, develop products, etc. So, this requires developing soft skills to work more efficiently and grow their carefree. #17"They should provide students with the opportunity to develop professionalism and efficiency, which will help them to integrate smoothly into the professional world." E.E. #9. both groups show strong support for emphasizing soft skills in engineering curricula. Engineering experts (Table 3) have a t-value of 12.1 ($p < .001$) for "Soft Skills Emphasis in Engineering

Curricula", while engineering students (Table 4) show a slightly higher t-value of 13.4 ($p < .001$) for the same category. This statistical evidence reinforces the need for prioritizing soft skills development in engineering education to enhance employability.

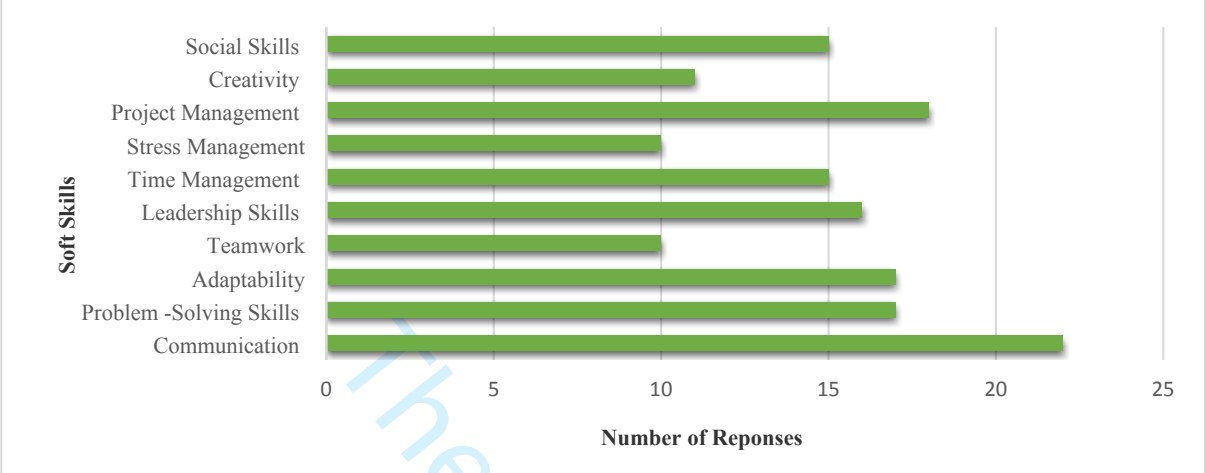

Figure 11: Soft skills leverage to enhance employability.

Figure 11 shows the percentage of engineering students and experts who have leveraged their soft skills to enhance their employability. The 'Enhance employability' category in Table 2 shows the highest mean (15.10) and the lowest standard deviation (3.84) among all categories. This indicates a strong and consistent belief among respondents that soft skills significantly enhance employability in the engineering domain. According to Figure 11, communication is the most leveraged soft skill, with 22 respondents. This indicates that communication is vital for engineering students and experts, as it helps them express their ideas, collaborate with others, and present their work effectively. Problem-solving and Adaptability are the second most leveraged soft skills, with 17 respondents each (Mathew & Donald, 2022). They suggest that engineering students and experts must be able to solve complex problems and work well with others in their field. Leadership and project management are the third most leveraged soft skills, with 15 and 18 respondents, respectively (Brian et al., 2013). This implies that engineering students and experts must be able to lead and manage projects successfully. Time management 16, stress management 10, Teamwork 10, creativity 11, and social skills are the least leveraged soft skills, with 15 respondents each. This may indicate that these skills are less necessary or relevant for engineering students and experts or are more challenging to develop or apply (Almeida, F., & Morais, J.,2023). Therefore, the chart illustrates the importance and impact of soft skills for engineering students and experts in enhancing their employability. It also highlights the need for more development and application of these skills. As noted by (Hirudayaraj et al., 2021), effective communication, problem-solving abilities, ethical conduct, and a commitment to lifelong learning hold greater significance in the field of engineering when compared to proficiency in mathematics, science,

and engineering knowledge. Engineering educators must recognize this shift and adjust their teaching methods to align with the demands of the industry. From an educator's perspective, a valuable example of embedding commercial awareness in the curriculum can be found courtesy of the University of Ulster (Morgan, 2009). Their model is shown in Figure 12.

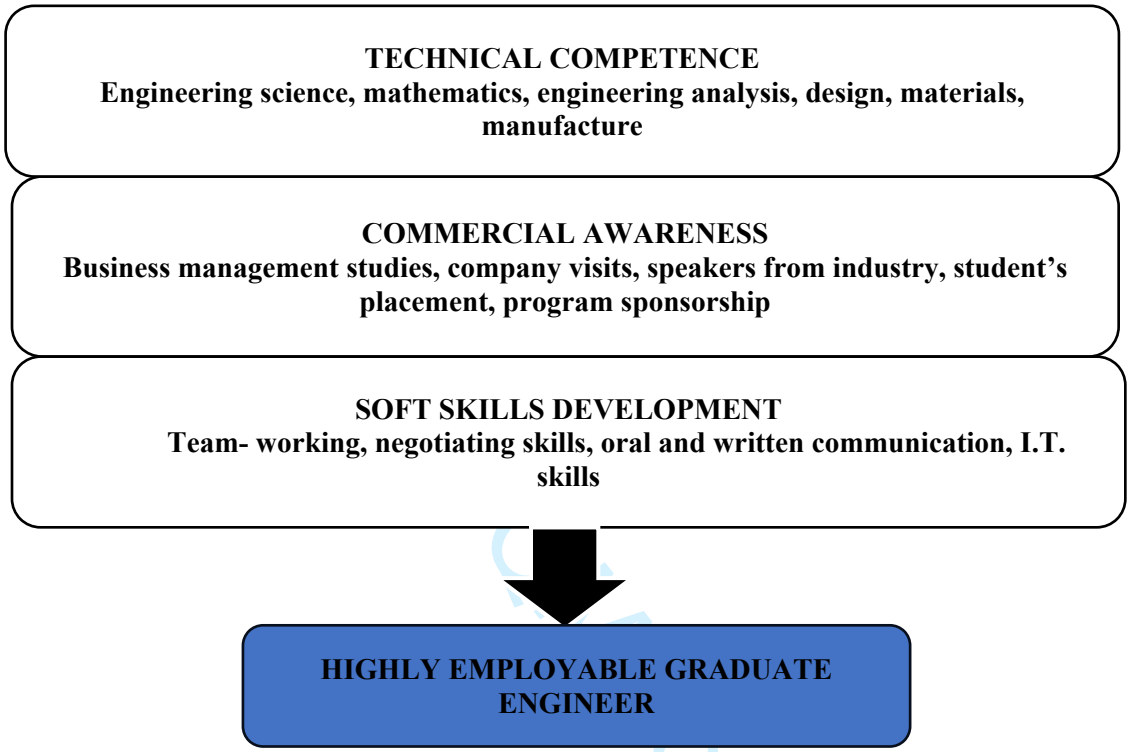

Figure 12: Developing employability skills of engineers (Morgan, 2009)

University challenges cultivate vital, transferable skills by immersing students in practical problem-solving situations (Fantozzi et al., 2024). This enhances critical thinking, creativity, and teamwork abilities. The active learning approach leads to improved comprehension and knowledge retention. It deepens theoretical understanding through hands-on application while developing essential soft skills like communication and adaptability. These experiences prepare engineers to address complex issues, devise innovative solutions, and contribute meaningfully to technological and societal progress. The resulting soft skills boost productivity and nurture an innovative environment.

4.1.6 Preferred soft skills among professionals and students

The preceding discussion explored various aspects of soft skills essential in engineering. We have examined multiple sub-themes highlighting the importance and necessity of soft skills for engineering students and professionals. To conclude, we have presented a selection of soft skills based on expert opinions from their work experiences and student perspectives influenced by their

disciplines and years of study. Table 5 shows the preferred selection pattern of these top five soft skills, which is more elaborated through the figure below.

Soft skills	Soft skills preferred Based on Experience of expert				Soft skills preferred based on engineering disciplines and year				
	0-5 years	5-15 years	15 + years	Total	Data Science	Computer science	Information technology	Electrical engineering	Total
Communication	4	5	3	12	3	5	3	3	14
Teamwork	4	3	1	8	3	3	2	5	13
Leadership skills	2	4	9	15	4	3	2	2	12
Problem-solving skills	2	5	6	12	2	3	1	4	10
Time management	1	3	5	9	4	5	2	1	12
Adaptability	2	2	1	5	0	2	4	1	7
Social skills	1	1	2	4	1	1	1	1	4
Stress Management	1	1	1	2	3	1	1	0	5
Project Management	0	1	2	3	2	3	0	1	6
Creativity	1	0	1	2	2	1	0	0	3

Table 5: Soft skills preferred by Experts and Students

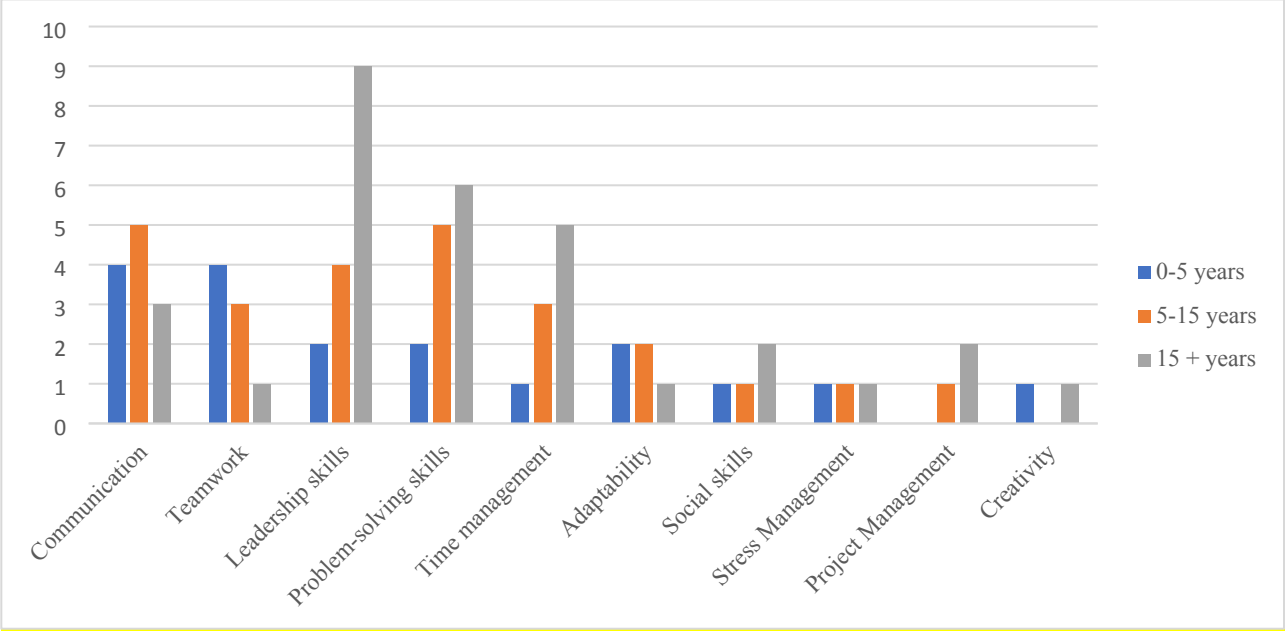

Figure 13: Graphical Representation of the expert's preferred soft skills

As shown in Figure 14 is interpreted as depicting the soft skills preferred by engineering students across various disciplines. All disciplines consistently value communication skills highly, with data science and computer science placing particular emphasis on them. Teamwork is strongly preferred in Electrical Engineering and Computer Science, highlighting its importance in collaborative technical environments. All disciplines value leadership skills moderately, with data science showing a slightly higher preference. Problem-solving skills are highly regarded, especially in Electrical Engineering and Data Science, underscoring their critical role in technical

problem-solving. Time management is notably important in data science and computer science, reflecting their project-based nature. Adaptability is particularly valuable in information technology, likely due to its rapidly evolving nature.

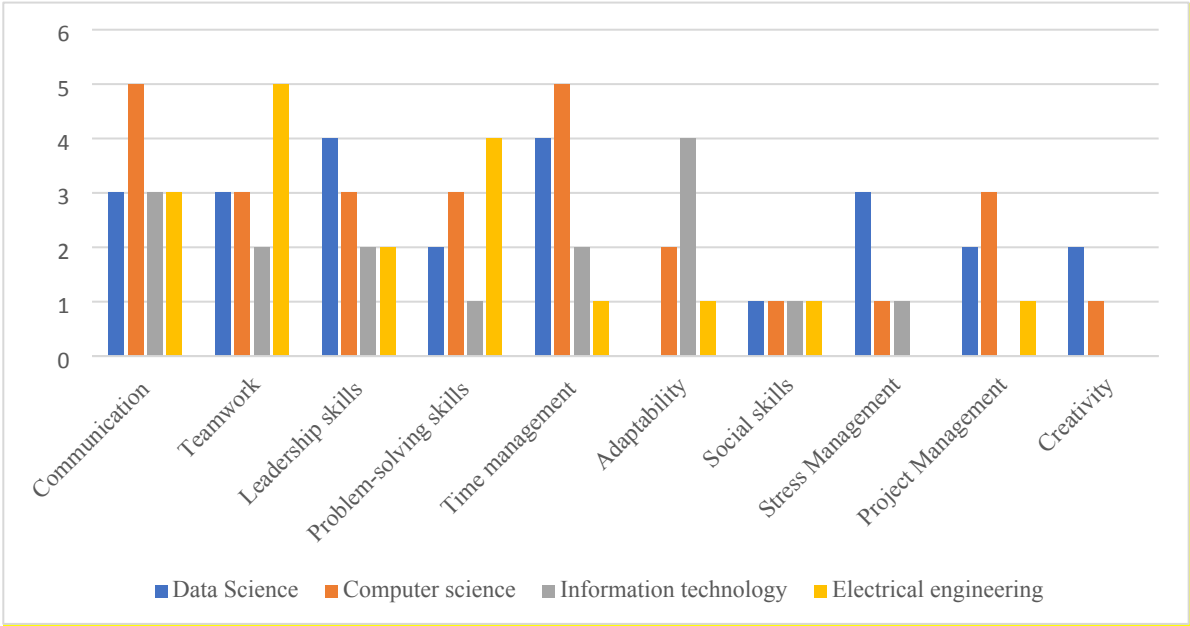

Figure 14: Graphical Representation of the student's preferred soft skills

Various disciplines show varying levels of importance for social skills, stress management, project management, and creativity, with Data Science and Computer Science placing more emphasis on project management.

Analysing of Table 5, Figure 13 and Figure 14 together reveals critical insights into the soft skills landscape in the engineering world. The data consistently highlights the paramount importance of the top five soft skills: communication, teamwork, leadership, problem-solving, and time management. These skills form the cornerstone of professional success in engineering, transcending experience levels and specific disciplines. Communication is universally critical and valued highly by experienced professionals and students across all engineering fields. Teamwork, while slightly more emphasised by students and early-career professionals, remains essential throughout one's career. Leadership skills show a clear trend of increasing importance with experience, suggesting a need to cultivate these skills early for long-term career growth. Problem-solving maintains its status as a fundamental skill, highly valued regardless of experience or specific discipline. Time management's importance grows with career progression, reflecting the increasing complexities of senior roles. The data underscores that these five soft skills are indispensable in engineering. They complement technical expertise, enabling engineers to effectively collaborate, lead projects, solve complex problems, and manage their work efficiently. While other skills like adaptability, social skills, and creativity play important roles, the consistently high ranking of communication, teamwork, leadership, problem-solving, and time

management across both figures emphasises their critical nature in engineering education and professional development. In conclusion, professionals must cultivate and continually develop these five core soft skills alongside their technical capabilities to succeed in engineering. Engineering curricula and professional training programs should prioritise these skills to prepare students and professionals for the multifaceted challenges of the modern engineering landscape.

4.2 Qualitative data

This section reviews the qualitative data from engineering students and experts using questionnaires and interviews. To maintain confidentiality, the 40 engineering students and experts who completed the questionnaires with their viewpoints coded E.E. #1 to E.E. #18 {EE= Engineering Expert}, E.S. #1 to E.S. #22 (ES= Engineering students}

4.2.1 Contribution of soft skills to employability in the engineering domain

In today's world, the significance of possessing a desirable personality surpasses that of possessing information. More ability to effectively portray oneself in social settings may help one's prospects of attaining success and employment. Soft or employability skills are often recognised as generic or transferable talents, as (Blom, A. and Saeki, H., 2011) Educating engineers with a robust and thorough skill set that meets current demands is crucial for both individual employability and national development.

Major economic sectors, including IT, infrastructure, power, and water, heavily depend on engineering expertise and technologies, according to the findings derived from the Atlas. it analysis, the answers from the interview survey, and the literature study substantially enhance employability within engineering (Rashidi Abbas et al., 2013). Although possessing technical skills is crucial for carrying out the technical components of a job, it is also necessary for candidates to have soft skills such as effective communication, efficient time management, strong social skills, adept problem-solving abilities, and creative thinking. These soft skills contribute to an individual's overall efficiency and worth within the workplace (Vyas & Chauhan, 2013).

Integrating technical and soft skills augments an engineer's prospects of securing employment and achieving success in their professional trajectory (Lavy & Yadin,2013). Finally, creativity assumes a vital role in engineering as it facilitates the cultivation of innovation, the generation of novel concepts, and the exploration of alternative approaches to problem-solving. Hence, robust soft skills are vital for engineers to excel in their professional endeavours and make meaningful project contributions. In the engineering industry, robust soft skills with technical expertise have been shown to substantially impact one's employment opportunities and overall employability. The data in Figure 15 illustrates the opinions about their responses regarding employability. Employers often assign high importance to applicants with exceptional communication skills, recognising their significance in achieving success in engineering positions.

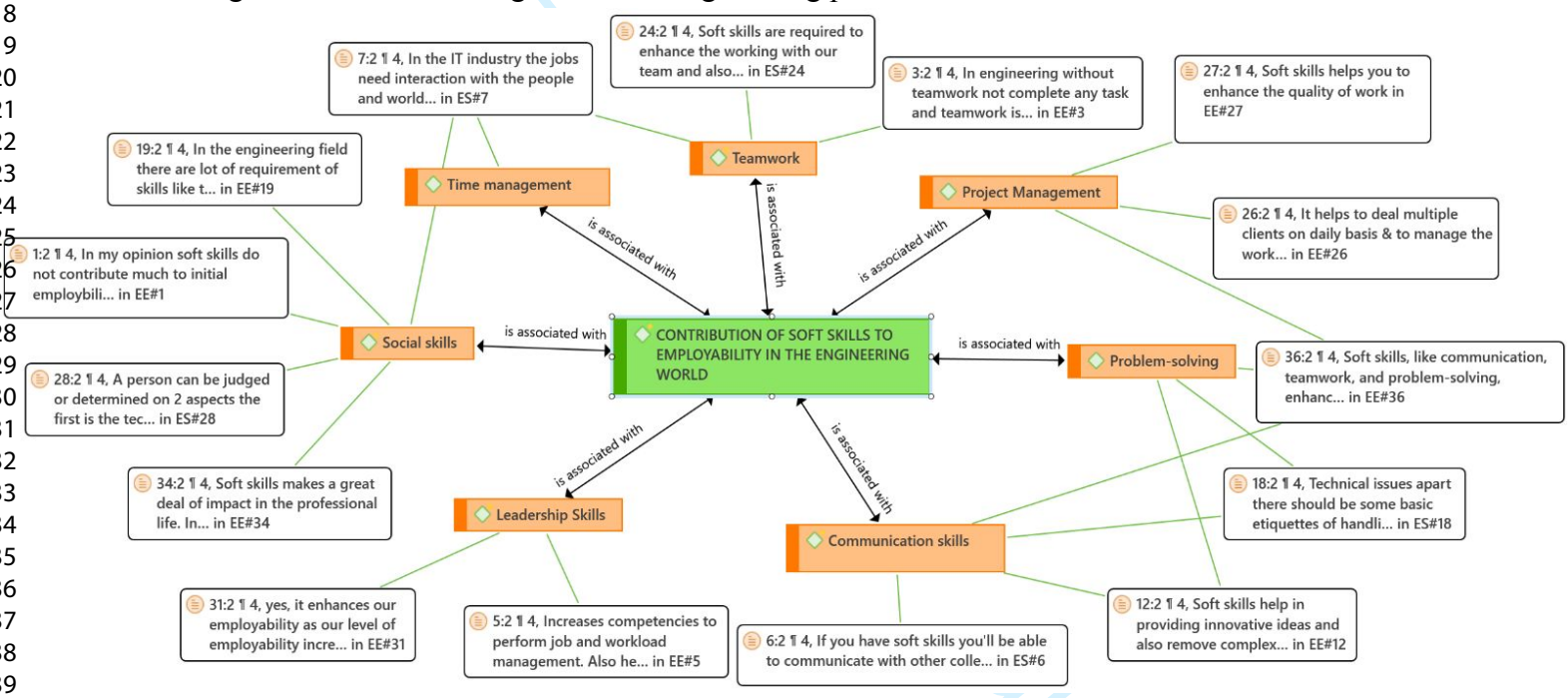

Figure 15: Contribution of soft skills to employability in the engineering

It may significantly contribute to facilitating efficient communication, seamless cooperation, and proficient leadership capabilities, all highly esteemed attributes within the engineering domain.

E.E. #21 Hence, the cultivation and exhibition of proficient soft skills may significantly enhance an individual's prospects for employment and their capacity to choose a preferred professional trajectory within the field of engineering. Engineers often encounter unanticipated difficulties and must use inventive approaches to fulfill project specifications. E.E. #22 robust soft skills might significantly augment an engineer's employability and achievement. E.E. #25. Employers place significant value on these abilities due to their ability to enhance engineers' effectiveness in various work settings, their capacity to adapt to dynamic circumstances, and their potential to make constructive contributions to the overall achievements of projects or organizations (Hurrell, 2016). Hence, cultivating and demonstrating robust soft skills may significantly enhance an engineer's marketability and professional opportunities in engineering—E.S. #33. The possession of

leadership qualities is very advantageous in the context of guiding teams and projects, exhibiting proactivity, and assuming accountability. Moreover, cultivating a creative mentality serves as a catalyst for innovation and the generation of novel approaches to problem-solving (Valcour, 2021). Effective stress management is crucial for individuals to effectively cope with the demands of their occupation and sustain high levels of productivity. E.E. #6 Effective communication plays a pivotal role in the transmission of ideas, the dissemination of information, and collaborative efforts toward achieving a shared objective. Cultivating robust interpersonal skills may also augment one's capacity to effectively articulate and advocate for their viewpoints, concepts, and discoveries with clarity and persuasiveness. E.E. #39 In conclusion, the possession of robust soft skills not only augments an engineer's marketability but adds to their general efficiency and triumph in engineering.

4.2.2 Should engineering curricula prioritise soft skills and their impact on enhancing employability

Engineering is more than just self-improvement. (Pedrazzini, 2012) contends that an engineering curriculum should also encompass the knowledge of professional and ethical engineering, which is more than just self-improvement. Slaughter (Slaughter. J, 2013) concurs that global challenges such as renewable energy, global warming, and infrastructure development cannot be addressed by mathematics and science alone. Their interaction with society is mutual, and if they are to survive and succeed in their personal and professional growth, they require soft skills. Engineering education institutions need to acknowledge this requirement and accordingly provide soft skills training in their curricula for their employability in the future. ((Kaur & Batra, 2018; Munir, 2021). In Table 1, the analysis of survey data shows that the mean value differences between the two groups (1.22 for Engineering Experts and 1.23 for Engineering Students) regarding the role of soft skills in enhancing employability are similar. This indicates that experts and students share a common belief in the value of soft skills for improving their job prospects and advancing their careers. This consensus can be attributed to the highly competitive job market and limited opportunities (Norback et al., 2009; Zaharim et al.,2010), which make achieving this goal challenging. This argument is supported by the analysis of a survey conducted among Engineering Students (E.S.) and Engineering experts (E.E.) in India. The survey asked them about their views on the importance of soft skills for engineers and the need for more soft skill training in the engineering curriculum; most participants agreed that soft skills are essential for engineers as they help experts enhance their employability and prepare students for their future. They also decided that engineering courses should teach more soft skills to help build a bond with colleagues and clients, which helps achieve goals and enhance work output.

- Soft skills prepare engineers for the industry's demands and enhance their overall effectiveness and employability (E.E. #3, E.E. #5).
- Soft skills attract a wide range of people from diverse backgrounds to engineering studies in India. However, many of them lack soft skills, which creates issues for them later in their careers. Therefore, engineering courses should inculcate soft skills in their academic plans (E.S. #37).
- Engineering jobs need soft skills to do projects with teams, communicate with clients, develop products, etc. Therefore, developing soft skills can help engineers work more efficiently and grow their careers (E.E. #17).
- There should be mandatory training or courses or subjects for students or trainees to improve their time management skills, which can help them in employment (E.E. #12).

Figure 16: Engineering curricula prioritise soft skills and their impact on enhancing employability.

- Soft skills training enhance effective communication, collaboration, problem-solving, and career advancement. Engineers must develop these skills to improve their employability and thrive in the industry (E.E. #15).

The engineering curriculum should focus more on soft skill development to address this gap analysis of the interview survey by using Atlas.it, as shown in Chart 7. This is essential because it prepares engineers for a well-rounded professional journey. Soft skills like communication,

teamwork, career development, Adaptability, problem-solving, professional development, stress management, and time management are crucial in real-world engineering. (Kirn & Benson, 2018; Shekhawat, 2020) They enable engineers to collaborate effectively, manage projects efficiently, and adapt to evolving technologies and diverse teams. This holistic education enhances employability and fosters engineers who can innovate, communicate their ideas, and lead in a complex, interconnected world. Engineering curricula often focus more on hard skills, such as mathematics, physics, programming, and design, than soft skills, such as communication, teamwork, creativity, adaptability, leadership, interpersonal skills, time management, stress management, and so on (Nathan & Rajamanoharane,2016; Clarke & Patrickson, 2008). This may create a gap between academic preparation and the industry expectations of engineering graduates. This research can help engineering graduates perform better in their technical domain and communicate and collaborate effectively with others, as they are essential for the professional success and career advancement of engineering students and professionals.

4.3. Implications

Engineering institutions need to Acknowledge the value of soft skills, incorporate soft skills into the engineering curriculum, Shift the assessments and teaching-learning process towards higher-order skills, and communicate more with employers to comprehend the specific skill requirements in that area and sector. The Present study provides different implications that are beneficial for the future as follows:

- **Incorporate soft skills training in engineering curriculum**: Engineering educational institutions and universities should consider including soft skills training as an integral part of their curriculum. It will better prepare them for the demands of the 21st-century job market.
- **Industry collaboration**: Engineering schools should establish stronger collaborations with companies to tailor their programs to meet evolving industry expectations continuously. This partnership will be crucial in equipping graduates with a balanced mix of technical and soft skills, preparing them for future trends such as the integration of AI in various sectors.
- **Recruitment and hiring practices**: Employers should revise their recruitment and hiring practices to prioritise candidates with a balance of technical and soft skills. This shift can reduce the need for extensive training and contribute to a more efficient and productive workforce.

4.3.1 Managerial Implications

Incorporating soft skills training into engineering education and organizational development can significantly enhance workforce performance. Organizations can cultivate more adaptable, efficient, and collaborative employees by fostering skills such as communication, teamwork, leadership, and time management. For example, engineers equipped with these skills can better manage teams, coordinate complex projects, and resolve conflicts, leading to smoother project execution and enhanced productivity. Moreover, investing in soft skills development contributes to better leadership by preparing professionals to take on management roles, where they can inspire, motivate, and align teams toward organizational goals. This also facilitates smoother succession planning and leadership transitions, ensuring continuity in project leadership. Additionally, soft skills improve client relations, as engineers with strong interpersonal and communication abilities are better positioned to understand client needs, explain technical solutions, and foster long-term business partnerships. The ripple effect of these skills includes reduced training costs, as new hires with a balance of technical and soft skills require less supplementary training, speeding up their transition into productive roles. For instance, companies hiring engineers who already possess key interpersonal skills may save on training expenses and reduce onboarding time. In summary, by prioritizing soft skills development, managers can expect a more effective and harmonious work environment, enhanced team performance, and a stronger alignment between technical execution and client satisfaction. These improvements elevate organizational productivity and enhance employee engagement and career development pathways.

4.3.2 Social Implications

The social implications of this study extend far beyond individual professional growth, influencing broader societal structures.Increased employability is a key social benefit, particularly as graduates with strong soft skills can secure better job opportunities, contributing to a lower unemployment rate and strengthening economic stability. For instance, in the healthcare engineering sector, professionals who excel in communication and teamwork are more likely to find employment and advance in their careers, improving overall economic resilience. Moreover, work-life balance improves in workplaces where empathy and effective communication are prioritized, reducing stress and improving mental well-being. For example, engineers in high-pressure environments, like tech startups, who foster emotional intelligence and teamwork create supportive cultures, which boost productivity and employee satisfaction. Additionally, enhanced social mobility is facilitated when individuals from disadvantaged backgrounds acquire soft skills, enabling them to overcome socio-economic barriers. Engineers from such backgrounds who hone their networking and communication skills find it easier to navigate corporate environments and advance their careers, leading to greater equity in the workforce. Ethical considerations also play a role, as soft

skills foster a sense of responsibility toward society and the environment. In fields such as environmental engineering, professionals with strong ethical awareness and communication skills make sustainable decisions that benefit both human health and the environment. Consequently, soft skills contribute to individual success and the development of ethical, inclusive, and socially responsible work environments that support holistic societal growth.

5. Conclusion, limitations, and future Scope

Soft skills are non-technical capabilities crucial in a particular professional to improve operational performance. These skills allow individuals to effectively convey information to clients and peers, work collaboratively, and develop trust in leaders and management. Although an engineer's knowledge is fundaentally based on technical expertise, the capacity to communicate effectively, work together, solve problems, manage time and stress, and exhibit leadership and creativity have become critical drivers for innovation, project accomplishment, and comprehensive career development. Approximately 87% of the respondents show awareness of soft skills, a positive reflection of the concerted efforts by educational institutions and the industry to promote and provide training in these crucial abilities. The one-sample t-tests conducted for both the Engineering Expert and Engineering Student groups further substantiated the significance of these soft skills, showing statistically significant results across all categories, which enhance the results of the present study, which states that the top five soft skills that imperative for engineering professionals are communication, teamwork, time management, leadership, and problem-solving. These skills are vital for facilitating effective collaboration, conveying technical information, guiding teams, and efficiently tackling complex challenges. The data in figure 4. further reveals that most engineering students and experts (82%) believe that soft skills are crucial for success in the engineering career. The qualitative insights gathered through interviews are expounded in Figure 15. reinforce the consensus among engineering stakeholders that soft skills should be integrated into the educational framework and professional development for engineers. Respondents highlighted the ability of soft skills to foster innovation, entrepreneurship, adaptability, and overall effectiveness in the workplace. They emphasised that a holistic educational approach, combining technical expertise with complementary soft skills, is essential to prepare engineers for the dynamic and collaborative nature of the modern engineering landscape. Despite the widespread recognition of soft skills, the study also identified areas for improvement. Figure 6 shows that 19% of respondents reported a need for formal training in soft skills during their engineering studies. Figure 16 indicates a need for a more comprehensive integration of these competencies into the engineering curriculum to enhance employability skills. In conclusion, this study underscores the imperative for engineering education and the profession

to prioritise the development of soft skills alongside technical expertise. By fostering a well-rounded skill set, engineering graduates can enhance their employability, navigate the complexities of the modern workplace, and contribute meaningfully to advancing technology and innovation. So, our findings of the paper perfectly fit the cross-disciplinary application because soft skills are an inseparable dimension of any job profile/role/ designation, which is pervasive. Undoubtedly, previous research states that technical skills are important in the STEM field. However, in this paper, the author made an attempt to develop meaningful insights regarding the significance of soft skills in employability enhancement, growth and promotions and improving employability and organisational growth. However, the above discussion shows at every level, soft skill training is required; figures 13 and 14 show the top five soft skills which are crucial for success in the engineering world. As the engineering field continues to evolve, the necessity for a harmonious integration of hard and soft skills will only become more pronounced, paving the way for a new generation of engineers poised for success in an increasingly dynamic and interconnected world. Engineering graduates today need to be equipped with skills beyond just technical expertise. Employers seek graduates who can address contemporary engineering challenges without exacerbating them and adapt to a highly technology-driven profession emphasising interpersonal interactions. Engineering institutions should recognise the importance of soft skills in their graduates' professional performance and success. This study was conducted within the context of the Indian nation, so the final content can be generalized to all nations. The survey focused on factors from the literature, possibly missing other influences on students' views of soft skills. Future research could use varied data collection methods for deeper insights, explore factors like work experience, gender, and culture affecting perceptions of soft skills, and include participants from different locations for a global perspective.

Acknowledgements

The research for this paper was undertaken as part of my PhD at Lovely Professional University, Punjab, and benefited from supervisory input from Dr. Shivani Dhand. I also thank Dr. Mahender Singh Kaswan for giving valuable feedback on this paper. I am also grateful for the generous comments and constructive feedback I received on previous versions of this paper, which have undoubtedly improved its arguments. All remaining mistakes and omissions are my responsibility.

Disclosure statement

The authors declare no conflict of interest.

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Annexure 1
Data information
List of students and expert

S.No	Name of the Expert	Domain	Work specialisation	Work Experience
1.	Expert 1	Engineering	Mechanical	10 years
2.	Expert 2	Engineering	Computer science	5 years
3.	Expert 3	Engineering	Electronics Engineering	20 years
4.	Expert 4	Engineering	Computer science	8 years
5.	Expert 5	Engineering	Computer science	5 years
6.	Expert 6	Engineering	Computer science	3 years
7.	Expert 7	Engineering	Computer science	6 years
8.	Expert 8	Engineering	Electronics Engineering	15 years
9.	Expert 9	Engineering	Mechanical Engineering	30 years
10.	Expert 10	Engineering	B.tech CS	10 years
11.	Expert 11	Engineering	Mechanical	12 years
12.	Expert 12	Engineering	Apex & Java Specialist	9 years
13.	Expert 13	Engineering	RS-CIT	16 years
14.	Expert 14	Engineering	Mechanical	8 years
15.	Expert 15	Engineering	Mechanical	5 years
16.	Expert 16	Engineering	Mechanical	8 years
17.	Expert 17	Engineering	Computer science	35 years
18.	Expert 18	Engineering	Computer science	13 years

S. No	Name Students	Domain	Specialisation domain	3 and 4 years	University Name
1.	Students 1	Engineering	Computer science	3 year	Amity University
2.	Students 2	Engineering	Information technology	4 year	Lovely Professional University
3.	Students 3	Engineering	Computer science	3 year	Narayana engineering college
4.	Students 4	Engineering	Cyber security	3 year	Bennett University
5.	Students 5	Engineering	CSE - Full Stack Development	4year	Bennett University
6.	Students 6	Engineering	Computer Science Engineering	3 year	Bennett University
7.	Students 7	Engineering	Information technology	3 year	Bennett University
8.	Students 8	Engineering	Computer science engineering	4year	Veer Bahadur Singh Paranuchal University
9.	Students 9	Engineering	Information technology	3 year	Bennett University
10.	Students 10	Engineering	Electrical Engineering	3 year	Veer Bahadur Singh Paranuchal University
11.	Students 11	Engineering	Computer Science	3 year	Veer Bahadur Singh Paranuchal University
12.	Students 12	Engineering	Electrical engineering	3 year	Veer Bahadur Singh Paranuchal University
13.	Students 13	Engineering	Electrical engineering	4 year	NIT Kurukshetra
14.	Students 14	Engineering	Computer science	3 year	Bennett University
15.	Students 15	Engineering	Computer Science	3 year	GMR institute of technology
16.	Students 16	Engineering	CSE	4 year	Bennett University
17.	Students 17	Engineering	Data Science	4 year	Bennett University
18.	Students 18	Engineering	Data Science	4 year	Bennett University
19.	Students 19	Engineering	Data Science	4 year	Bennett University
20.	Students 20	Engineering	Computer Science	3 year	Amity University
21.	Students 21	Engineering	Information technology	3 year	Lovely Professional University
22.	Students 22	Engineering	Computer Science	4 year	Narayana engineering college