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Research Article

Designing A Future Workforce Skills Framework: A Gap Analysis Of Future Workforce Skills Between Academicians And Manufacturing Industry Players

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ABSTRACT

This study underscores the critical need to prepare the youth for the challenges of Industry 4.0, requiring a paradigm shift in skills due to rapid technological advancements. Notably, in Malaysia, employers' express concerns about a skills mismatch, contributing to elevated unemployment rates. Centered on the manufacturing sector, the research employs a gap analysis to discern and address the skills disparities between academic institutions and industry stakeholders, encompassing both essential soft and hard skills crucial for the future workforce. The resulting framework aims to precisely outline the skills required for the evolving job landscape, crucial for sustaining Malaysia's economic dependence on manufacturing. The findings underscore substantial gaps in both soft and hard skills between academicians and industry, emphasizing the urgency for targeted skill development initiatives. The study's insights offer valuable guidance for industries, educational institutions, policymakers, and the Malaysian youth, enabling them to rectify deficiencies and cultivate a workforce that is well-prepared for the future, aligning with Malaysia's economic aspirations of becoming a robust, high-income nation.

Index Terms— Future workforce, skills, manufacturing, academician

I. INTRODUCTION

Acquiring skills is crucial for prospective members of the workforce aiming to secure employment in the evolving job market. The significance of skills is underscored by their pivotal role in the decision-making process of recruiters [1]. Consequently, Higher Education Institutions (HEI) bear the responsibility of cultivating graduates equipped with the requisite skills, serving as the primary source for the future workforce [2]. Employers hold high expectations regarding the skill set of graduates upon their departure from HEI, a challenge compounded by the impact of Industry 4.0 and its technological advancements [1]. The changing landscape, influenced by automation and robotics, suggests that future jobs will differ significantly from their predecessors [3]. The rapid technological progress in Industry 4.0 prompts the future workforce to acquire new skills [4]. Therefore, to effectively navigate the challenges posed by Industry 4.0, graduates in Malaysia must be exposed to skills aligned with technological advancements. Furthermore, Industry 4.0 presents a global challenge for the working environment, necessitating readiness to confront the transformative waves in the industry.

Despite the pressing need for graduates to align with essential future workforce skills, the persisting issue of skill mismatch remains unresolved. This mismatch arises from imbalances in supply and demand across various fields of study, discrepancies between soft and hard skills, and disparities between theories and practical training received

by graduates [5]. Furthermore, it is characterized as a widening gap between the soft and hard skills expected by industries and those provided by Higher Education Institutions (HEI) [6]. Failure to address this issue could lead to a rise in unemployment rates among graduates. Notably, the unemployment rate in Malaysia attributed to public HEI stands at 13.3%, impacting 13,906 graduates [7]. The skills mismatch issue is also

emphasized by public HEI in Malaysia. One contributing factor is the lack of clarity among graduates from public HEI regarding industry requirements [3]. Comparatively, graduates from public HEI exhibit deficiencies in both soft and hard skills compared to their counterparts from private HEI. Consequently, graduates from public HEI face greater challenges in securing job placements, as industries show a preference for recruiting from private HEI.

Moreover, the lack of skills or skill deficiencies, as highlighted by [3] & [8], further complicates the situation. [9] study, commissioned by the National Economic Action Council (NEAC), identified a shortage of skills as one of the five factors contributing to the challenges faced by graduates entering the job market. The advent of Industry 4.0 demands that all employees across industries utilize digital tools and technologies [9], necessitating the acquisition of new skills tailored to the demands of jobs in Industry 4.0. The dynamic changes in the working environment underscore the imperative for the future workforce to possess updated skills and qualifications [10]. Consequently, higher learning institutions must incorporate the skills required for current graduates to assimilate, preparing them as a competent workforce for Industry 4.0.

Given the identified issues and the comprehensive review, this prompts the present study to investigate both soft and hard skills from the perspectives of both academicians and industry players. Additionally, the study seeks to delve into the skills gap existing between these two crucial stakeholders, with the goal of aligning with the industry players' demands and the supply from Higher Education Institutions (HEI). A key objective of the present study is to formulate a comprehensive future workforce skills framework, filling the current gap where no such holistic framework exists, outlining the requisite soft and hard skills for future work scenarios.

The outcomes of this study are expected to yield significant empirical and practical implications. From an empirical standpoint, the findings contribute to the existing body of knowledge, bringing novelty through the research methodology employed and the gap analysis conducted. This, in turn, enhances our understanding of skill gaps between academicians and industry players. On a practical level, a thorough comprehension of skills essential for the future allows all stakeholders, including students, academicians, and industry players, to strategically plan and meet the required skill sets. Moreover, it supports the formulation and implementation of government policies across various stakeholder domains.

II. LITERATURE REVIEW

A. Industry 4.0

Due to its affiliation with cutting-edge technology and its incorporation into everyday life and work patterns, the Fourth Industrial Revolution, or Industry 4.0, has attracted interest worldwide, including in Malaysia [9] & [11]. [12] describes Industry 4.0 as a paradigm shift driven by technical improvements targeted at enhancing individual talents and altering industries through the confluence of digital and internet technologies with traditional ones. Industry 4.0, which has its roots in Germany's high-tech policies, is a collection of technical innovations meant to boost productivity and make it easier for different industries to collaborate [13]. Building on the achievements of the three previous industrial revolutions, it signals a shift in business practices toward digitization and the use of cyber-physical systems. Nine major technologies are essential to Industry 4.0: cybersecurity, cloud computing, big data analytics, IoT, additive manufacturing, augmented reality, robots, simulation, and both horizontal and vertical system integration [13]. Production techniques and business models are being revolutionized by these technologies because they allow for improved communication, data exchange, and automation across industrial processes [4] which leads to a great impact on many industries especially with regard to continuous automation, digitization, and the requirement for a highly skilled labour force [14] particularly in manufacturing and education. As a result, stakeholders will need to work together to address the changing needs of the workforce and make sure that educational curricula are in line with industry demands [3]. As a result, Industry 4.0 emphasizes the significance of proactive skill development and educational adaptation to get people ready for the rapidly evolving job and technological landscapes [15].

B. Perceptions of Academicians on Soft Skills and Hard Skills

In Malaysia, the perceptions of academicians on soft skills and hard skills are scarcely sought after especially in the context of Industry 4.0 era expectation. In addition, existing studies have primarily focused on students and graduate perceptions, leaving a gap in understanding academic perspectives on necessary skills [16]. [17] investigated graduate employability; upon interviewing ten academicians in public HEI, it is found that the relevant skills required by Industry 4.0 to improve students' readiness were communication, critical thinking, creative thinking and collaboration skills. On the other hand, [18] surveyed 61 academicians from public HEI in Malaysia and found that academicians' readiness to implement Industry 4.0 was still at a moderate level. Therefore, academicians need to be ready to implement technologies in Industry 4.0 to be delivered to students in the HEI, ensuring that relevant soft skills and hard skills expected by the industries are fulfilled. Furthermore, given the wave of Industry 4.0 and its impacts on graduates' skills, the skills required in Industry 4.0 need to be further explored and gaps between what is more needed in a certain industry should be investigated.

Efforts to bridge this gap include studies like [19], which emphasized the importance of hard skills, particularly digital skills, in preparing students for the industrial environment. Similarly, [20] underscored

the need to enhance cognitive and creative-thinking skills through curriculum approaches aligned with industry demands and the challenges of Industry 4.0. To meet industry needs of possessing good soft skills and hard skills, collaboration between academia and industry is crucial, as highlighted by [21]. The development of key competencies, validated through collaboration with industry experts, can ensure graduates possess relevant skills for the workforce. However, challenges persist, such as discrepancies in industrial training durations between public and private HEIs [22]. While public HEIs prioritize graduate readiness for Industry 4.0 skills like communication and critical thinking (Majid, 2019), readiness among academicians to implement these technologies remains moderate [18]. As Industry 4.0 continues to reshape skill demands, research like that of [23] emphasizes the importance of skills like critical thinking, problem-solving, creativity, and cognitive flexibility, alongside people-oriented skills, to thrive in this era.

C. Perceptions of Manufacturing Industry Players on Soft Skills and Hard Skills

Manufacturing is one of the vital industries in Malaysia that contributes to the national Gross Domestic Product (GDP) and provides employment for society. The manufacturing sector involves the use of various technologies in order to produce output. Past studies have extensively explored the perceptions of manufacturing industry players regarding both soft and hard skills. Soft skills, encompassing interpersonal, communication, and problem-solving abilities, are considered vital by industry professionals for effective teamwork, leadership, and adaptability in dynamic work environments. However, technological advancement has affected the manufacturing sector mainly in terms of skills demanded. Furthermore, studies focusing on skills demanded in the future from the manufacturing industry perspective regarding Industry 4.0 remain scarce. A study by [19] underscored the importance of hard skills, particularly digital proficiency, as essential skill sets for engineering students entering the manufacturing sector. Additionally, [20] highlighted the significance of cognitive and creative-thinking skills in meeting the demands of the manufacturing industry, emphasizing the need for curricula to foster these competencies among students. Moreover, the collaboration between academia and industry, as advocated by [21] underscores the importance of aligning educational programs with the skill requirements of the manufacturing sector. On the other hand, the literature also delves into the perceptions of manufacturing industry players regarding hard skills, including technical competencies and digital literacy. Studies such as that of [23] emphasize the maintenance of skills like critical thinking, problem-solving, and cognitive skill.

D. The Skills Gap between Academicians and Manufacturing Industry Players

Academicians and those involved in the industrial business have different expectations about the abilities needed, which highlights a fundamental difference in how the workforce is regarded to be prepared. While academics frequently place a higher priority on theoretical knowledge and technical proficiency in their courses, professionals in the manufacturing sector place a higher value on soft skills and practical, hands-on experience. Because of this mismatch, graduates may not have the industry-specific knowledge and practical skills that companies require when they enter the workforce. Furthermore, the divide between academia and industry is further exacerbated by divergent perspectives on how the manufacturing landscape is changing, particularly regarding developing technologies and industry trends. Thus, to close this gap and better prepare graduates for the opportunities and difficulties of today's industrial landscape, academicians and industry stakeholders must work together to guarantee that educational programs are in line with the changing needs of the manufacturing sector.

Malaysia faces a significant skills gap between the advanced technical abilities required for its manufacturing aspirations outlined in the New Industrial Masterplan 2023 and the current capabilities of its workforce. Historically, the country's education system has not prioritized the development of homegrown talent for complex manufacturing, with challenges including a focus on resource extraction over manufacturing, societal preferences for white-collar degrees, and an underdeveloped technical vocational education system. To address these issues and prepare a workforce better suited for the manufacturing sector, recommendations include enhancing Technical and Vocational Education and Training (TVET) programs, promoting apprenticeships and work experience, revisiting university curricula to emphasize practical applications, fostering collaboration between industry and academia, implementing comprehensive career guidance, and increasing investments in technical skills development. These efforts, combined with initiatives from companies like Tenaga Nasional Berhad (TNB) to offer industry-focused internships, mentorship programs, and specialized scholarships, are crucial for bridging the skills gap and positioning Malaysia for success in high-value manufacturing under the New Industrial Masterplan 2030.

[24] pointed out that the skills gap issue arises when Higher Education Institutions (HEIs), acting as the supply side, produce a future workforce that fails to meet the demands of industries. CEDEFOP (2010) further highlights the skills gap as a situation where certain skills do not align with job requirements. For example, [25] discovered a disparity between HEIs' and industries' expectations regarding soft skills.

[25] conducted a qualitative investigation to explore the anticipated skills of fresh graduates by industry experts and academicians. They identified five essential soft skills – problem-solving, critical thinking, communication, lifelong learning, teamwork, and independence – crucial for securing future employment. However, there were differences in expectations; while academicians emphasized lifelong learning, industry experts prioritized analytical skills. Numerous studies have highlighted the skills gap between graduates and

industry demands. [26] found that while the majority of 300 surveyed graduates possessed relevant skills such as ICT, teamwork, time management, and leadership, the job market required enhancements in communication, problem-solving, and analytical abilities. Similarly, [27] reported a soft skills gap between Community College graduates in the electrical field and industry employers. Surveys involving 103 industry players and 162 graduates revealed significant deficiencies in communication, information management, self-management, ethics, professionalism, leadership, and teamwork skills, prompting industry recommendations for their integration into the teaching and learning process.

III. METHODOLOGY

The research aimed to pinpoint skills as perceived by stakeholders from the perspective of academicians and manufacturing industry players, while also delineating the skill gap between these two groups. This study employed purposive sampling to select respondents, targeting top management and academicians from public Higher Education Institutions (HEI), alongside managers, engineers, and industry representatives from the Electrical and Electronic (E&E) sector. These individuals were chosen based on their expertise and familiarity with workforce skills in manufacturing. The GPower technique was utilized to determine the necessary sample size for the quantitative phase. [28] noted the utility of GPower in sample size determination, which is not contingent on population size. The software considers the number of independent variables and moderator variables set by the researcher. In this study, the t-test was selected as the statistical test to assess differences in means between two independent groups. Input parameters included a two-tailed test, effect size of 0.5, and a significance level (α) of 0.05. [29] Memon et al. (2018) advocate for a medium effect size of 0.5, a significance level (α) of 5%, and a power of 0.8. Following the G*Power analysis, a minimum sample size of 128 was determined, comprising 64 respondents from both academicians in public HEIs and the E&E industry.

The research objectives were achieved through the administration of an online survey, involving 64 academicians from public higher education institutions and 64 respondents from the manufacturing industry players in Malaysia. The survey consisted of three sections: Section A addressed soft skills, Section B focused on hard skills, and Section C gathered demographic information from respondents. A descriptive questionnaire was designed to assess the importance of soft and hard skills for graduates, as well as to identify skills gaps as perceived by academicians and industry players. The questionnaire included 28 soft skills, categorized into cognitive, interpersonal, and personal skills, and 10 hard skills, categorized into digital and technical skills. Respondents evaluated items using a 10-point Likert scale. The collected data underwent descriptive analysis and an independent t-test to determine the importance of soft skills and to identify skill gaps between the two stakeholder groups.

In the qualitative phase, the researcher selected 12 participants comprising top management and academicians from public higher education institutions (HEIs), as well as experts from the electrical and electronic (E&E) industry, including managers, engineers, and industry representatives. While there are established guidelines for determining sample size in qualitative research [28], a total of 12 respondents was considered adequate based on recommendations by [30].

IV. RESULTS AND DISCUSSIONS

A. Academicians and Manufacturing Industry Demographic Profiles (Survey)

This section delves into the demographic profiles of academicians, encompassing factors such as gender, age, race, discipline, grade, work experience, and involvement in undergraduate academic program development. The distribution of male and female respondents was nearly equal. Most respondents (46.9%) fell within the age range of 31 to 40 years, with only three respondents (4.7%) aged between 25 and 30. Almost all respondents identified as Malay. Regarding academic discipline, the highest proportion of respondents hailed from the Social Sciences (54.7%), followed by those in the Science and Technology disciplines (37.5%). Majority of respondents held grade DS51/DS52 positions (59.4%). Additionally, nearly three-quarters of respondents reported experience in developing academic programs at the undergraduate level. The findings underscore the significant role of academicians in shaping the future workforce, especially considering concerns raised by [31] regarding the quality of education in Malaysia. Consequently, there is a pressing need for academicians to enhance teaching and learning methodologies within Higher Education Institutions to nurture high-caliber graduates.

Other than that, the demographic profiles of industry players encompassed gender, age, race, departmental affiliation, work experience, and the scale of their electrical and electronic companies. Similarly to the demographic distribution among academicians, most respondents were male (64.1%) and Malay (84.4%). A significant portion of respondents fell within the 25 to 30 age brackets. Half of the respondents worked in technical departments, which are crucial components of Technical and Vocational Education and Training (TVET), emphasizing hands-on skills. Most respondents reported having less than five years of work experience. Additionally, 75.0% of respondents were employed by large electrical and electronic companies with 201 or more employees. These findings underscore the diverse skill sets required across various departments within the electrical and electronic industry. As highlighted by [32], aligning the skills of the workforce with business needs is imperative for the manufacturing industry. Therefore, the electrical and

electronic sector, being a vital component of manufacturing, must prioritize workforce training to enhance skill development.

B. Academicians and Manufacturing Industry Demographic Profiles (Survey)

The demographic profiles provide details regarding gender, years of service, and positions within their respective organizations. The selected participants were experts representing various service backgrounds. Among the six academicians, Academician 2 stood out as the longest serving, with 39 years of service, followed by Academician 6, while the remaining had five years of service each. Conversely, Industry Player 6 held the highest tenure among participants from the Electrical and Electronic (E&E) industry, trailed by Industry Players 2, 4, and 5, each with eight years of service.

C. Perceptions of Academicians on Soft Skills and Hard Skills

Table 1 shows the soft skills encompass three primary categories: cognitive skills, interpersonal skills, and personal skills. Among cognitive skills, decision-making skills emerged as the most crucial among the five subskills examined. Regarding interpersonal skills, communication skills ranked highest in importance among academicians ($\mu = 9.23$, $\sigma = 0.938$), followed by teamwork ($\mu = 9.08$, $\sigma = 1.028$) and coordination skills ($\mu = 8.91$, $\sigma = 1.003$). In the personal skills category, nine subskills were identified. Time management ($\mu = 9.20$, $\sigma = 0.995$) was highlighted as the most critical, followed by ethics and moral professionalism ($\mu = 9.13$, $\sigma = 1.062$), and stress management ($\mu = 8.94$, $\sigma = 1.139$).

The findings indicate that decision-making skills were deemed paramount for the future workforce within the cognitive skills category. In the realm of interpersonal skills, communication skills emerged as particularly pertinent, while time management was highlighted as the most crucial within the personal skills category. The importance of decision-making skills for graduates in navigating Industry 4.0 aligns with [33] study, emphasizing their necessity for competitiveness and survival. [34] underscores the role of educators as agents of change in the era of education 4.0, emphasizing the increasing importance of graduates' ability to make creative decisions.

Conversely, communication skills were underscored by academicians in public HEIs, reflecting their essential role in future professional endeavors as indicated by [35], who emphasized its positive impact on students' employment readiness. Finally, time management, identified as crucial by public HEIs, is recognized universally as a critical aspect of personal skills necessary for discipline and punctuality [36]. Despite this, [37] stresses the relevance of time management in conjunction with hard skills, indicating its significance in the broader context of professional development.

Table 1: Academicians' Perception on the Importance by Category of Soft Skills in Manufacturing Industry

No.	Soft Skills	Mean (μ)	SD (σ)	Description	Rank According to Importance by Category
	Cognitive skills				
1	Analytical thinking skills	9.05	0.898	Most Important	2
2	Creative thinking skills	8.81	1.006	Most Important	5
3	Critical thinking skills	8.97	0.942	Most Important	4
4	Decision making skills	9.08	0.878	Most Important	1
5	Innovative thinking skills	8.63	1.266	Most Important	6
6	Problem-solving/complex problem-solving skills	9.03	1.083	Most Important	3
	Interpersonal skills				
1	Agility and adaptability skills	8.84	1.042	Most Important	4
2	Autonomous leadership skills	8.50	1.168	Most Important	9
3	Communication skills	9.23	0.938	Most Important	1
4	Coordinating with others/coordination skills	8.91	1.003	Most Important	3
5	Emotional Intelligence	8.63	1.442	Most Important	6
6	Flexibility skills	8.73	1.073	Most Important	5
7	Intercultural skills	8.22	1.291	Most Important	11
8	Negotiation skills	8.53	1.333	Most	7

9	Networking skills	8.53	1.259	Important Most Important	8
10	Project management skills	8.45	1.321	Most Important	10
11	Teamwork skills	9.08	1.028	Most Important	2
	Personal skills				
1	Driving and manage to change	8.72	1.228	Most Important	5
2	Entrepreneurial skills	7.83	1.386	Important	9
3	Ethics and professionalism	9.13	1.062	Most Important	2
4	Language proficiency	7.97	1.436	Important	8
5	Lifelong learning	8.30	1.550	Most Important	7
6	Self-development	8.64	1.132	Most Important	6
7	Self-management	8.86	1.037	Most Important	4
8	Stress management	8.94	1.139	Most Important	3
9	Time management	9.20	0.995	Most Important	1

Table 2 presents the findings regarding hard skills as perceived by academicians in public Higher Education Institutions (HEI). The academicians regarded all hard skills as highly important, except for coding and programming skills, which were deemed important solely for the future workforce in the industry. In the digital skills category, ICT literacy ranked highest ($\mu = 8.83$, $\sigma = 0.952$), followed by technology use ($\mu = 8.70$, $\sigma = 1.150$), and new media literacy ($\mu = 8.36$, $\sigma = 1.045$). Among technical skills, organizational capabilities ranked first ($\mu = 8.44$, $\sigma = 1.246$), followed by troubleshooting ($\mu = 8.41$, $\sigma = 1.281$), and data analytics ($\mu = 8.36$, $\sigma = 1.373$). Notably, coding and programming skills ($\mu = 7.61$, $\sigma = 1.769$) were considered less crucial compared to other hard skills.

Table 2: Academicians' Perception on the Importance by Category of Hard Skills in Manufacturing Industry

No.	Hard Skills	Mean (μ)	SD (σ)	Description	Rank According to Importance by Category
	Digital skills				
1.	ICT literacy	8.83	0.952	Most Important	1
2.	New media literacy	8.36	1.045	Most Important	3
3.	Technology use	8.70	1.15	Most Important	2
	Technical skills				
1.	Coding and programming skills	7.61	1.769	Important	7
2.	Data analytics	8.36	1.373	Most Important	3
3.	Design skills	8.02	1.409	Most Important	6
4.	Organizational capabilities	8.44	1.246	Most Important	1
5.	Research skills	8.27	1.36	Most Important	4
6.	Troubleshooting	8.41	1.281	Most Important	2
7.	Writing skills	8.25	1.208	Most Important	5

In the digital skills category, ICT literacy emerged with the highest frequency, indicating its significance. Within the technical skills category, organizational capabilities were deemed the most crucial. Notably, ICT literacy ranked among the top three most important skills across all six ASEAN countries. According to [38], proficiency in ICT literacy, encompassing social media usage, e-commerce, e-payments, and other applications, is highly valued. Therefore, exposing students to ICT and fostering proficiency in this skill is essential for shaping a competent future workforce aligned with the demands of Industry 4.0.

D. Perceptions of Manufacturing Industry Players on Soft Skills and Hard Skills

Table 3 presents the outcomes concerning soft skills among E&E industry players. In the cognitive skills section, decision-making skills emerged as paramount, followed by analytical-thinking and problem-solving abilities. This section encompasses six subskills. Conversely, the interpersonal skills category encompasses 11 subskills, with teamwork recognized as the most critical ($\mu = 8.36$, $\sigma = 1.938$), closely followed by agility and adaptability ($\mu = 8.27$, $\sigma = 1.616$). Within the personal skills category, comprising nine subskills like discipline, driving, change management, and entrepreneurial skills, time management emerged as the most pivotal ($\mu = 8.36$, $\sigma = 1.767$), followed by stress management ($\mu = 8.14$, $\sigma = 1.959$) and self-development ($\mu = 8.11$, $\sigma = 1.738$). The findings underscored the significance of decision-making skills as paramount among cognitive

skills for future workforce readiness. Within the interpersonal skills category, teamwork emerged as the most pivotal subskill, while time management stood out as paramount in facilitating interpersonal effectiveness. According to the [38], decision-making remains fundamentally human-centric and is crucial for graduates to navigate the complexities of modern businesses, where decisions can impact organizational success or failure. In a WEF survey conducted in 2019, some youths expressed job changes in pursuit of enhanced decision-making roles, reflecting the growing demand for individual adept in this skill by employer.

In the perspective of manufacturing industry players, teamwork skills garnered significant favor, as emphasized by [27], who highlighted the importance of mastering teamwork abilities for success in Industry 4.0. They suggested that industrial training programs be extended to allow students ample time to refine these skills, along with other essential competencies like communication and critical thinking, deemed vital for Industry 4.0 readiness. Additionally, [39] noted that soft skills such as time management are integral components of Industry 4.0, as employers increasingly expect graduates to possess these skills to effectively execute organizational objectives.

Table 3: Manufacturing Industry Players' Perception on the Importance by Category of Soft Skill in Manufacturing Industry

No.	Soft Skills	Mean (μ)	SD (σ)	Description	Rank According to Importance by Category
	Cognitive skills				
1	Analytical thinking skills	8.20	1.720	Most Important	2
2	Creative thinking skills	8.02	1.496	Most Important	4
3	Critical thinking skills	7.97	1.736	Important	5
4	Decision making skills	8.27	1.596	Most Important	1
5	Innovative thinking skills	7.75	1.553	Important	6
6	Problem-solving/complex problem-solving skills	8.13	1.786	Most Important	3
	Interpersonal skills				
1	Agility and adaptability skills	8.27	1.616	Most Important	2
2	Autonomous leadership skills	7.91	1.725	Important	6
3	Communication skills	8.22	1.964	Most Important	3
4	Coordinating with others/coordination skills	7.95	1.855	Important	5
5	Emotional Intelligence	7.91	1.466	Important	7
6	Flexibility skills	7.75	1.533	Important	10
7	Intercultural skills	7.53	1.662	Important	11
8	Negotiation skills	7.81	1.726	Important	9
9	Networking skills	7.91	1.823	Important	8
10	Project management skills	8.00	1.671	Most Important	4
11	Teamwork skills	8.36	1.938	Most Important	1
	Personal skills				
1	Driving and manage to change	7.98	1.608	Important	5
2	Entrepreneurial skills	7.45	1.790	Important	8
3	Ethics and professionalism	8.08	1.739	Most Important	4
4	Language proficiency	7.45	1.877	Important	9
5	Lifelong learning	7.56	1.798	Important	7
6	Self-development	8.11	1.738	Most Important	3
7	Self-management	7.98	1.898	Important	6
8	Stress management	8.14	1.959	Most Important	2
9	Time management	8.36	1.767	Most Important	1

Table 4 presents the findings regarding hard skills as perceived by academicians in public Higher Education Institutions (HEI). According to the academicians, all hard skills were deemed highly important, except for coding and programming skills, which were considered important solely for the future workforce in the industry. In the digital skills category, ICT literacy ranked highest ($\mu = 8.83$, $\sigma = 0.952$), followed by technology use ($\mu = 8.70$, $\sigma = 1.15$), and new media literacy ($\mu = 8.36$, $\sigma = 1.045$). Among technical skills, organizational capabilities ranked highest ($\mu = 8.44$, $\sigma = 1.246$), followed by troubleshooting ($\mu = 8.41$, $\sigma =$

1.281), and data analytics (μ = 8.36, σ = 1.373). However, coding and programming skills (μ = 7.61, σ = 1.769) were considered less important compared to other hard skills.
Within the digital and technical skills category, technology use and troubleshooting skills emerged as the most critical subskills, respectively. Notably, the utilization of technology ranked among the top three most crucial skills across all six ASEAN countries. According to [38], proficiency in technology use, encompassing social media, e-commerce, e-payments, and various applications, is widespread. Consequently, it is imperative for industries to prioritize educating the future workforce on technology use.

Table 4: Manufacturing Industry Players' Perception on the Importance by Category of Hard Skills in Manufacturing Industry

No.	Hard Skills	Mean (μ)	SD (σ)	Description	Rank According to Importance by Category
	Digital skills				
1.	ICT literacy	8.83	0.952	Most Important	1
2.	New media literacy	8.36	1.045	Most Important	3
3.	Technology use	8.70	1.15	Most Important	2
	Technical skills				
1.	Coding and programming skills	7.61	1.769	Important	7
2.	Data analytics	8.36	1.373	Most Important	3
3.	Design skills	8.02	1.409	Most Important	6
4.	Organizational capabilities	8.44	1.246	Most Important	1
5.	Research skills	8.27	1.36	Most Important	4
6.	Troubleshooting	8.41	1.281	Most Important	2
7.	Writing skills	8.25	1.208	Most Important	5

E. Perceptions of Manufacturing Industry Players on Soft Skills and Hard Skills

The gaps analysis in this study utilized data obtained from the second survey. It involved measuring the discrepancies in skills perception between stakeholders. Following the approach outlined by Patacsil and Tablatin (2017), the analysis was conducted using a specific formula:

$$\text{Skills Gap} = \Sigma = [(\text{industry player perception} - \text{academician } i-1 \text{ perception}) / n]$$

where,
i = ith respondents
n = total number of respondents

According [40], a higher mean gap score indicates greater disparities in perceptions between academicians from public HEIs and E&E industry players regarding soft and hard skills. A positive mean gap score suggests that a skill is deemed more crucial by industries, while a negative score indicates greater importance perceived by academicians. Additionally, an independent sample t-test was employed to examine mean differences between the two stakeholder groups. This gaps analysis utilized the t-test as a parametric test.
In summary, Table 5 exhibits substantial disparities were observed across all categories between the two stakeholder groups. Within the cognitive skills category, significant gaps were evident in analytical thinking, critical-thinking, decision-making, and problem-solving abilities. In the interpersonal skills category, pronounced differences surfaced regarding agility and adaptability, communication, coordination, flexibility, and teamwork skills. Moreover, the personal skills category highlighted notable gaps in language proficiency, self-development, stress management, and time management subskills.

Table 5: Gap Analysis of Soft Skills

No.	Soft Skills	Mean (μ)		Mean difference (Gap)	t	Sig.
		Industry Players	Academicians			
	Cognitive skills					
1	Analytical thinking skills	8.20	9.05	-0.844	-3.479	0.000**
2	Creative thinking skills	8.02	8.81	-0.797	-3.536	0.085
3	Critical thinking skills	7.97	8.97	-1.000	-4.050	0.002**
4	Decision making skills	8.27	9.08	-0.813	-3.568	0.000**
5	Innovative thinking skills	7.75	8.63	-0.875	-3.493	0.249
6	Problem-solving/ complex problem-solving skills	8.13	9.03	-0.906	-3.47	0.006**
	Interpersonal skills					
1	Agility and adaptability skills	8.27	8.84	-0.578	-2.405	0.019**
2	Autonomous leadership skills	7.91	8.50	-0.594	-2.28	0.085
3	Communication skills	8.22	9.23	-1.016	-3.733	0.000**
4	Coordinating with others/coordination skills	7.95	8.91	-0.953	-3.615	0.002**

5	Emotional Intelligence	7.91	8.63	-0.719	-2.796	0.938
6	Flexibility skills	7.75	8.73	-0.984	-4.21	0.034*
7	Intercultural skills	7.53	8.22	-0.688	-2.614	0.113
8	Negotiation skills	7.81	8.53	-0.719	-2.636	0.252
9	Networking skills	7.91	8.53	-0.625	-2.256	0.098
10	Project management skills	8.00	8.45	-0.453	-1.702	0.282
11	Teamwork skills	8.36	9.08	-0.719	-2.62	0.001**
	Personal skills					
1	Driving and manage to change	7.98	8.72	-0.734	-2.904	0.602
2	Entrepreneurial skills	7.45	7.83	-0.375	-1.325	0.065
3	Ethics and professionalism	8.08	9.13	-1.047	-4.110	0.053
4	Language proficiency	7.45	7.97	-0.516	-1.746	0.027*
5	Lifelong learning	7.56	8.30	-0.734	-2.475	0.227
6	Self-development	8.11	8.64	-0.531	-2.049	0.061
7	Self-management	7.98	8.86	-0.875	-3.236	0.002**
8	Stress management	8.14	8.94	-0.797	-2.813	0.002**
9	Time management	8.36	9.20	-0.844	-3.328	0.001**

** Significant at the 0.01 level (2-tailed); * Significant at the 0.05 level (2-tailed)

Table 6: Gap Analysis of Hard Skills

No.	Soft Skills	Mean (μ)		Mean difference (Gap)	t	Sig.
		Industry Players	Academicians			
	Digital skills					
1	ICT literacy	7.50	8.83	-1.328	-4.607	0.000**
2	New media literacy	7.50	8.36	-0.859	-3.329	0.000**
3	Technology use	8.00	8.70	-0.703	-2.431	0.069
	Technical skills					
1	Coding and programming skills	7.34	7.61	-0.266	-0.697	0.053
2	Data analytics	8.06	8.36	-0.297	-1.050	0.364
3	Design skills	7.56	8.02	-0.453	-1.519	0.026*
4	Organizational capabilities	7.80	8.44	-0.641	-2.34	0.047*
5	Research skills	7.67	8.27	-0.594	-2.119	0.293
6	Troubleshooting	8.23	8.41	-0.172	-0.593	0.059
7	Writing skills	7.64	8.25	-0.609	-2.231	0.013*

** Significant at the 0.01 level (2-tailed); * Significant at the 0.05 level (2-tailed)

The digital skills category exhibited the highest mean difference, as illustrated in Table 6, whereas technology use displayed the lowest mean difference. Additionally, t-test analysis uncovered significant disparities between stakeholders' perceptions for ICT literacy and new media literacy. Furthermore, an independent sample t-test highlighted notable differences in the technical skills category, particularly in design skill, organizational capabilities, and writing skills.

The interview data underwent manual transcription before being analyzed thematically for each response provided by the experts. In evaluating the quality of graduates entering the manufacturing industry, the researcher initially examined the weaknesses encountered by today's graduates. As reported by participants, many graduates exhibit deficiencies in soft skills such as communication skills and language proficiency. Furthermore, some participants noted a lack of hard skills, particularly in hands-on tasks. Consequently, graduates still possess areas of weakness that require attention before they can be gainfully employed. This observation is substantiated by the following interview transcripts:

The weakness is more towards... talking from my experience. But I think most of the fear revolves around whether we can do the job or not. Because, as fresh graduates, we haven't been exposed to many hands-on jobs or tasks yet. So, we don't know whether we are doing things correctly or not.
(A1)

Theoretically, most of them are okay. Because those students, all of them are selected, with good matriculation results, and so on. So, it means they are smart. So, if we talk about cognitive abilities, knowledge, theory, there is no problem. Skills also are not an issue.
(A2)

The main weakness, for me, lies in terms of application skills—the ability to apply the knowledge learned at university when working in the industry..
(A4)

Throughout my experience, having observed several cohorts of graduates, the main weakness of fresh graduates lies in their ability to demonstrate good soft skills during interviews and when starting to work.
(A6)

Yes, sometimes universities are unable to meet industry requirements. For example, each industry has different skill sets based on the types of technology they use. So, it's quite challenging for universities to fulfill

specific skills tailored to each industry. However, fundamental skills such as communication, teamwork, critical thinking, problem-solving, and digital skills are crucial in the current era.
(IP1)
What I can observe, even within my own department, some individuals are recruited as fresh graduates. From my perspective, their communication skills are somewhat lacking. The way they interact, some are too quiet and hesitant to ask questions, displaying shyness.
(IP2)

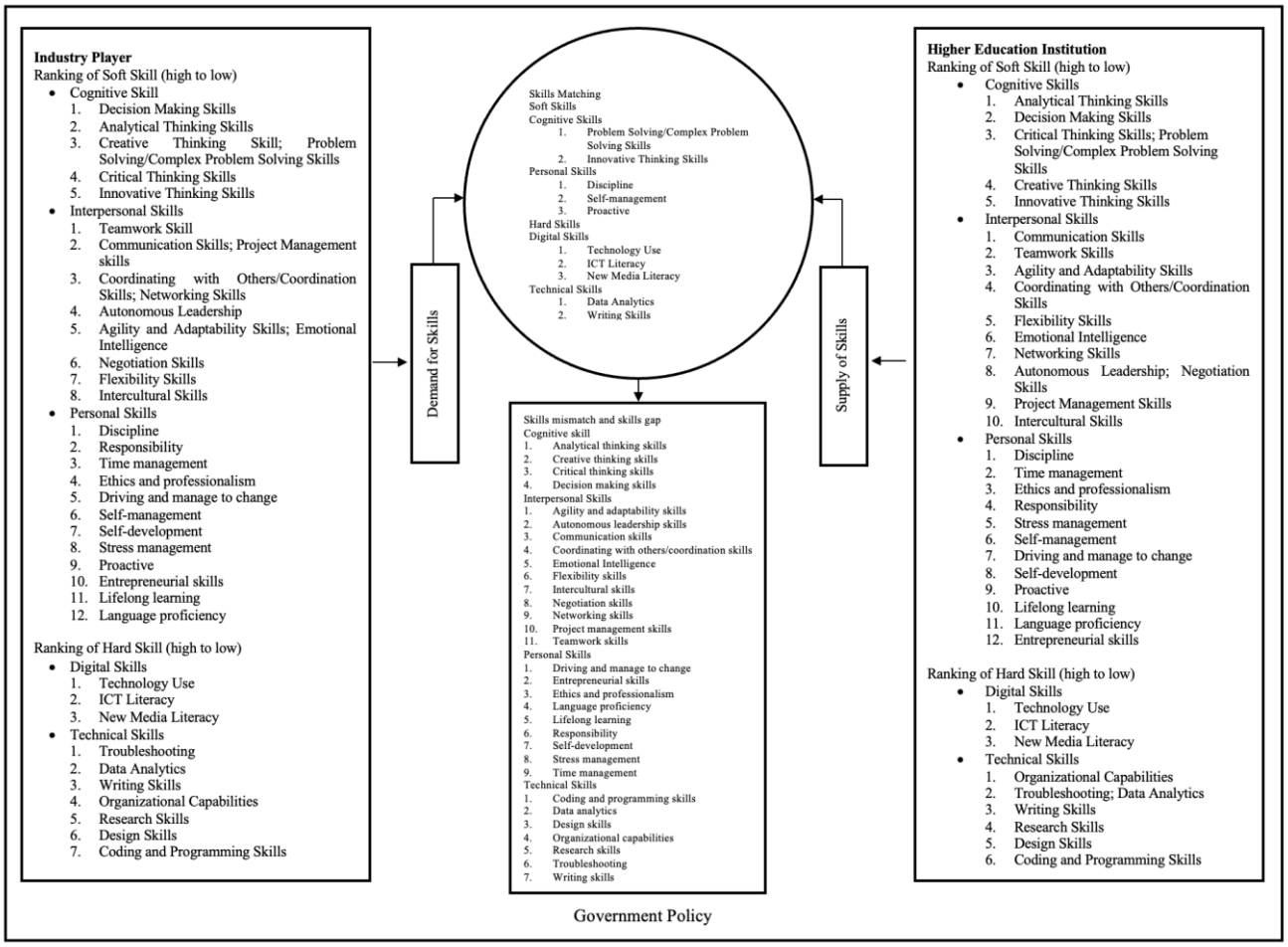

Figure 1: A Future Workforce Skills Framework

In my opinion, perhaps current graduates are hesitant to try something new because in this industry, they usually require individuals who are hands-on. I mean, they are given tasks, and maybe seniors or the team will demonstrate once or twice. After that, the student needs to learn on their own or ask more experienced colleagues to settle a particular task.
(IP3)
In the process of identifying concurrent gaps, the researcher compiled a comprehensive list of skills from both stakeholder groups. These skills were presented to participants for validation regarding their relevance to the future workforce, particularly in the context of Industry 4.0. Most participants affirmed the relevance of the listed skills. Industry players emphasized the importance of future workforce mastery of these skills, while academicians stressed the need for updates and alignment of the teaching and learning systems with industry demands. Analytical thinking was favored by public HEIs, whereas the manufacturing industry players placed greater emphasis on decision-making skills. However, despite these divergent perceptions, both skills are regarded as critical. This issue is substantiated by excerpts from the following interview transcript:

If we look at the differences, it is quite apparent, and in my opinion, within this framework, it is necessary to align with the needs and demands of the job sector. Therefore, perhaps in the future, educational institutions can improve these skills based on the specific demands that we require.
(IP1)
Based on that framework, I believe these are among the skills that every new graduate, fresh graduate, or student should possess. Perhaps during their internship, they can refine and enhance their skills. I think this is something that should be present in fresh graduates.
(IP2)

Yes if you follow the real-world scenario, both of these should go hand in hand because in the real industrial world, decision-making is crucial. Making decisions is the most important aspect because every decision made has an impact on a company.
(IP4)
In my opinion, I agree. From the perspective of academicians, our focus is on the cognitive aspect, particularly analytical skills, which are highly important. Everything involves data, and we need to analyze it using certain apps and tools to obtain results. So, from these results, we can make informed decisions. At the end of the day, it's all about the decision-making process, as emphasized by the industry; decision-making is crucial and an integral part of management.
(A2)
It is highly important and beneficial for future generations. This needs to be translated into an action plan and considered for further improvement of existing programs. We can prioritize, identifying what is more critical and what is more neutral, and implement it now. This means there should be both short-term and long-term plans based on the framework that has been outlined.
(A4)
Based on these skills gap analysis, the researchers have designed a future workforce skills framework based on the results in survey and interview with the experts. The framework has been validated by both stakeholders, academicians and manufacturing industry players using focus group approach. The framework is illustrated in Figure 1.
The skills gap within the conceptual framework shows as the mismatch between the perceptions of employers and the academicians towards the skills. Based on the perceptions of employers for soft skills, in the cognitive skills category shows that decision making skills are most important as compared to perceptions from academicians which recorded analytical thinking skills as the most important. Furthermore, in the interpersonal skills category, employers perceived more on teamwork skills while academicians perceived more on communication skills as the most important. In addition, the last category, which is personal skills recorded the same from both stakeholders which is discipline as the most important. For the hard skills, there are two categories included which are digital skills and technical skills. In digital skills category, both stakeholders perceived the same for all the skills whereby technology use as the most important followed by ICT literacy and new media literacy. Moreover, in technical skills, employers perceived troubleshooting as the most important, while academicians perceived more on organizational capabilities. As a conclusion, the conceptual framework illustrated in Figure 1 stated that there are skills mismatch and skills gap in all categories for soft skills and hard skills.

CONCLUSION

In today's rapidly evolving job market, the persistent skills gap has become a significant concern for employers, academicians and policymakers alike. The mismatch between the skills demanded by employers and skills supplied by the academicians as well as skills possessed by the workforce has led to challenges in recruiting the future workforce. To comprehend and effectively address the skills mismatch, it is crucial to analyze through a conceptual framework which considers various dimensions including education, technology and industry itself. By addressing the conceptual framework, stakeholders can develop effective strategies to bridge the gap as well as reduce the loop in ensuring the skills are possess and adaptable by the future workforce that meets the demands of the ever-changing job market.

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