Human Management Competencies of Manufacturing Firms: A Pilot Study from Malaysia

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Abstract

The Fourth Industrial Revolution or Industry 4.0 is capable of triggering revolutionary (strategic) and evolutionary (operational) changes. Nonetheless, assessing human management competencies in Industry 4.0 has largely been a challenge. Thus, this empirical study aimed to understand the employee competencies and skills needed in Industry 4.0. The scope of the study involved electronic and electrical small and medium Malaysian manufacturing firms. Utilising a research framework based on the human capital theory, a questionnaire-based cross-sectional survey technique was adopted to collect pilot study data from 100 respondents. The results highlighted that competencies of threshold, distinguishing, task requirement, communication and language, and creativity and innovation are necessary to gain employment in Industry 4.0. Additionally, creativity and innovation competencies are considered more important among respondents. The outcome of this pilot study bridged the theoretical gap and provided original contributions to current literature. As a recommendation, the findings can act as a stepping stone for managers and organisations transitioning towards Industry 4.0.

Keywords: Human management; Competencies; Skills; Industry 4.0

1. Introduction

Presently, digitalisation has become a focus among researchers and practitioners. Moreover, the Fourth Industrial Revolution or Industry 4.0 (IR4.0 henceforth) has been rapidly spreading worldwide. The term "IR4.0" refers to the radical transformation of industries driven by the integration of emerging technologies, such as big data, artificial intelligence, networking, and machine learning. In other words, IR4.0 has impacted all facets of daily life.

The "IR4.0" concept was coined in Germany in 2011, after which many terms now fall under the concept umbrella. Earlier studies on IR4.0 mostly focused on technology. Later, researchers understood that IR4.0 was the integration of social/human and technology (Ali and Johl, 2021a). The Future of Jobs Report 2020 by World Economic Forum (WEF) reported that more than half (50%) of the employees will need reskilling by 2025 (WEF, 2020). Moreover, the COVID-19 pandemic has unprecedentedly altered the work world, in which more than 1 billion people will need to reskill by 2030 (WEF, 2022). As the digital transformation has evolved and the demand for new skills and competencies has increased, hiring managers are focusing less on educational degrees and more on talents whose skills and competencies align with the present needs. The latest report from Harvard Business School (2021) indicated that more than 88% of university graduates were unemployed because they lacked new competencies and skills, which thus requires interventions.

Past studies highlighted efforts to develop competency models for IR4.0. For instance, Flores et al. (2020) developed a human competence typology in the IR4.0 setting, which is referred to as Human Capital 4.0; the study focus was on industrial employees. Furthermore, Jerman et al. (2020) developed a conceptual key competency model for production industries. Moreover, Hernandez-de-Menendez et al. (2020) developed a set of competencies for IR4.0 in the industrial world. Lastly, Kannan and Garad (2020) adopted a case study approach to identify the current and future competencies of an electronics manufacturer in Malaysia. The above literature indicates that most of the competency models or frameworks were developed for the industrial workforce (Flores et al., 2020; Santos et al., 2021) and less for manufacturing industries, especially in emerging economies (Kanwal and Isha, 2022). Yet, few studies have developed IR4.0 competency models or frameworks in the education sector. For example, Kowang et al. (2020) examined IR4.0 competencies among lecturers in Malaysia and Silveyra et al. (2021) developed a teachable entrepreneurship competency scale among college students. Overall, research on competency models that focus on university graduates in emerging economies, such as Malaysia, is lacking. Hence, the following research question (RQ) is developed to address this research gap.

RQ1: What are the attributes necessary for employee skills and competencies in IR4.0?
RQ2: Is there any relationship between these attributes and employability in IR4.0?

The remainder of the article is organised as follows: Section 2 highlights past literature on existing terminologies within IR4.0, human capital, and competencies. The next section entails the methodology, followed by a discussion of the findings. The last section highlights the conclusion, limitations, and implications of the study.

2. Literature Review and Theoretical Framework

Industrial Revolution 4.0

The term "IR4.0" refers to the digitalisation age, in which the transformation of production or manufacturing-based industries towards leveraging technologies integration occurs. These technologies include cyber-physical systems, Internet of things, cloud computing, and cognitive computing (Ghobakhloo et al., 2022). Generally, IR4.0 enables real-time and decentralised communication, monitoring, coordination, and control of physical process value streams (i.e. machinery and equipment to maximise the use of available resources while also meeting the customers' needs. Resultantly, the novelty of IR4.0 can be understood from one of four different perspectives; interconnection, information transparency, technical assistance, and decentralised decision-making (Kowang et al., 2020).

Competencies

Competencies are a set of behaviours, talents, skills, analysis, decision-making, and information transmission required by an individual to successfully perform occupational duties associated with the position they hold. Additionally, competencies are personal

abilities to produce a consistently adequate or high-performance level in a work function. Hence, competencies also reflect an individual's potential. The term "competency" can be classified into three subcategories, namely technical, behavioural, and contextual competency. Alternatively, competency is a process in which employees explore their prior experiences to gain new skills and enhance their existing ones based on their organisational learning environment.

Competencies in the IR4.0 Domain

Higher learning institutions are claimed to be the development site of the necessary competencies in IR4.0. Higher learning institutions must provide students with an innovative, open, and flexible learning environment to prepare students for the mentality or skills required for the future working ecosystem. Concurrently, students must acquire the necessary knowledge and skills to adapt to the emerging educational landscape, which may include elements of digital creativity, virtual collaboration, technological convergence, global connectivity, and online communities. Furthermore, students must also demonstrate their creativity concerning the curricular activities by presenting problem-based, integrated, and draw-on-people assignments. Relevant literature review highlighted four essential components of IR4.0 competencies; information and communication technologies, organisational learning, innovative management, and the environment.

Competency-Based Models

Prior literature has highlighted the importance of human competency to perform any task. For instance, Rosman et al. (2022) developed a competency-based human resources model and divided them into task requirements, thresholds, and distinguishing competencies. Resultantly, the organisation would gain a competitive advantage. The model necessitates the understanding of the needs of a task or role, including the performance level. Threshold competence or basic competence is the minimum set of skills, knowledge, abilities, and personal behaviours required to perform occupational tasks (Nagata, 2010; Rosman et al., 2022). Distinguishing competencies are competencies that can separate outstanding from average performance as reported in various countries (Schutte et al., 2016). Distinguishing competencies are also competencies that managers need to excel in their jobs. For example, a manager should have general competencies, such as performance orientation, proactivity, and self-confidence (Boyatzis, 2008; Jackson and Chapman, 2012). For university graduates, the task requirements competencies have been consistent with long-standing in-depth studies of job descriptions by scholars (Boyatzis, 2008). The scholars defined competency in the employability discourse as encompasses attributes that contribute to meeting competition and job requirements (Suleman, 2018).

Competent communication skills are a necessary form of communication to support daily operations, build relationships, gain commitment, and be persuasive in a highly valued environment; these tasks are essential requirements for graduates (Suleman, 2018). Creativity and innovation are highly demanded skills that 21st-century industries seek to compete in the current global economy in all academic subjects and educational, vocational, and social settings (Kipper et al., 2021). Moreover, there is also a great hiring demand for graduates with 21st-century skills to compete globally. Therefore, Malaysian higher learning institutions face the constant challenge of providing students with 21st-century skills to

enable them to compete in the current globalised knowledge-based society (Ali and Johl, 2022).

This study focused on competency-based human resources and 21st-century competency due to the broad perspective of competency. Competencies consist of five categories; threshold competencies, distinctive competencies, task requirements, communication and language skills, and creativity and innovation. Nevertheless, there is a problem with the competency framework informing competencies in IR4.0 (Ibidunni et al., 2021). Therefore, the relevant competencies must be identified to maximise employee performance in the transition towards IR4.0.

Competencies in Industry 4.0

Threshold competencies refer to the vital knowledge or skills required by an organisation to perform any job or task (Stewart, 2006). Threshold competencies consist of three clusters; experience and expertise, knowledge, and basic cognitive competencies (Boyatzis, 2008), which are essential in the 21st century. Prior literature has empirically validated the role of competencies in achieving long-term firm growth. For example, Ibidunni et al. (2021) investigated the role of different competencies (organisational, conceptual, learning, risk-taking, strategic, relationship building, and opportunistic) to promote innovation performance in Nigerian manufacturing firms. Additionally, Tehseen et al. (2018) argued that strategic and ethical competencies are necessary for Malaysian small and medium enterprises (SMEs henceforth) in the services sector to achieve high performance. Chaka's (2020) review study argued that soft skills (communication, creativity, and problem-solving), hard skills (programming), and competencies are predominantly important in IR4.0. Similarly, Hernandez-de-Menendez et al. (2020) concluded that creativity, problem-solving, conflict-solving, decision-making, analytical, research, and efficiency competencies are vital in IR4.0. Kipper's et al. (2021) empirical study affirmed that employees' digital competency consists of different skills that had a positive effect on employability in Malaysian manufacturing firms. Flores et al. (2020) presented the Human Capital 4.0 competencies framework, which consists of flexible and social, professional and dexterous, intelligent and analytical, self-aware and empathetic, and digitally literate and interactive competencies. Finally, Kannan and Garad's (2020) case study of Malaysian electronic manufacturers identified four IR4.0 competencies required, which are technical, methodological, social, and personal skills. Prior literature demonstrated the well-grounded theoretical relationship between competencies and employability in IR4.0. Notwithstanding, there is a lack of empirical work on said relationship.

Human Capital Theory

Human competencies are vital for a successful transition towards IR4.0. Therefore, different human competencies have gained an advantage in the business world. Based on the human capital theory, people are instrumental in the proper implementation of any new product or service, and proper investment in human capital can enhance the performance of the individual, organisation, and country. Historically, the initial concept of the human capital theory is that individuals consist of skills, knowledge, and abilities acquired from education, training, and experiences Becker (1960). Moreover, human capital is akin to other organisational resources, such as goods and services (ibid.). Generally, the human capital

theory is based on two assumptions. Firstly, training is considered an investment that is subject to risks and returns. Secondly, there are significant differences between general and specific training; the former is transferable to other organisations, whereas the latter is limited in transferability.

The human capital theory has been adopted in the IR4.0 context. For instance, Carvache-Franco et al. (2022) examined the human capital variables and innovation performance among Colombian manufacturing firms. Likewise, Zeynalli (2021) examined the workforce capacity for IR4.0 among Azerbaijan manufacturing firms. This study further argued that organisations require a holistic framework for workforce development. Figure 1 shows the complete research model.
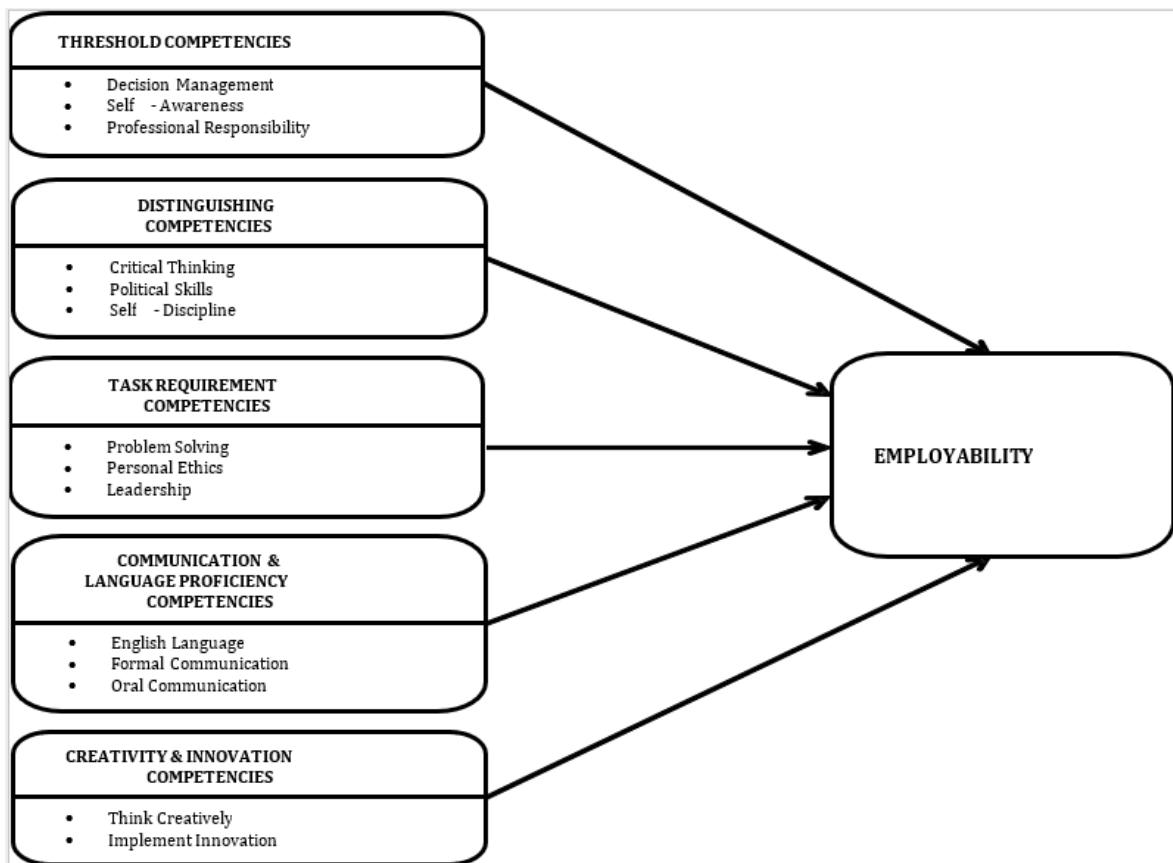

Figure 1: Research model

3. Methodology

This pilot study explored the role of different employee competencies in achieving employability within Malaysian electrical and electronics (E&E henceforth) firms in IR4.0 to gain fundamental insights into competencies and skills. Thus, a questionnaire-based cross-sectional survey approach was adopted, in which the questionnaires were provided to the employees of Malaysian E&E SMEs through simple random sampling. The selection of SMEs depended on several factors, such as higher establishment and the highest workforce attached to the sector. Before completing the survey, the respondents provided informed consent and completed a self-report questionnaire. Afterwards, a total of 100 respondents

completed the study without financial incentives. Lastly, a seven point-Likert scale was utilised in the questionnaire to measure the responses, where "1" indicates "strongly disagree" and "7" represents "strongly agree".

Research Instruments and Data Collection

The questionnaire-based cross-sectional survey was divided into three sections. The first section consisted of questions related to the demographic information of the employees and their organisation. The second section presented questions related to different employee competencies and skills. The last section contained questions related to the dependent (employability) variables.

To measure the four study variables, a total of 45 competencies items (15 items for each competencies variable) and eight employability items were adapted from past studies. The threshold competencies variable consisted of three factors, which were decision management (TDM), self-awareness (TSA), and professional responsibility (TPR). The distinguished competencies variable consisted of critical thinking (DSCT), political skills (DSPS), and self-discipline (DSSD). Furthermore, the construct of task requirement competencies consisted of problem-solving (TRSPS), personal ethics (TRSPE), and leadership (TRSL). Moreover, the communication and language proficiencies competencies variable consisted of English language (CLPEL), formal communication (CLPFC), and oral communication (CLPOC). Finally, the creativity and innovation competencies consisted of thinking creatively (CRTC) and implementing innovation (CRII). In the final section, eight items of employability (EMP) variables were included.

A Google form was created and disseminated to target respondents. The SME Corporation and Company Commission Malaysia (CCM henceforth) database were selected as a sample frame. Out of 210 emailed questionnaires, 100 usable responses were received. This present pilot study obtained a 47.62% response rate contrary to Kumar's et al. (2021), which obtained a response rate of over 40%. Figure 2 illustrates the research methodology steps involved.
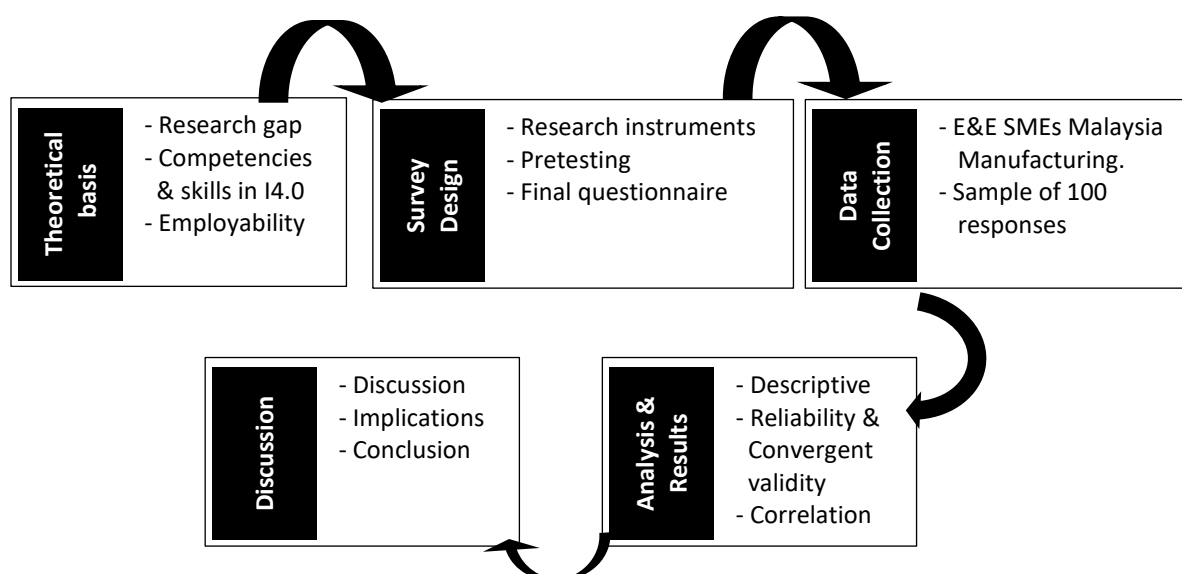
Figure 2: Research methodology steps

4. Data Analysis

Demographic Analysis

Table 1 shows the demographic characteristics of the sample data. Based on the analysis, 55% of the respondents were male and 45% were female. The respondents' age was divided into four age groups; 20-30 years old (32%), 31-40 years old (44%), 41-50 years old (12%), and 51-60 years old (12%). Moreover, 64% of respondents possessed a degree, and 30% a master's degree. In terms of marital status, most respondents (51%) were married. Furthermore, 41% of respondents worked in a small firm, whereas 59% belonged to medium firms. In terms of experience, most respondents (36%) have more than 10 years of experience. Finally, 26% of respondents held executive and managerial positions.

Table 1: Demographic analysis

Demographic variables		Frequency	Percentage (%)
Gender	Male	55	55.0
	Female	45	45.0
Age	20-30	32	32.0
	31-40	44	44.0
	41-50	12	12.0
	51-60	12	12.0
Education	Secondary	1	1.0
	Diploma	2	2.0
	Degree	64	64.0
	Master	30	30.0
	PhD	3	3.0
Marital status	Single	49	49.0
	Married	51	51.0
Firm Size	Small	41	41.0
	Medium	59	59.0
Experience	< 2	18	18.0
	2-3	11	11.0
	4-6	19	19.0
	7-8	7	7.0
	9-10	9	9.0
	>10	36	36.0
Current Position	Business Owner	1	1.0
	Director	2	2.0
	Executive	26	26.0
	Head of Unit	12	12.0
	Senior Manager	8	8.0
	Manager	26	26.0
	Supervisor	23	23.0
	Employees	2	2.0

Pilot Study Results

Descriptive analysis, internal consistency test, convergent validity test, correlation analysis, and employees' IR4.0 competencies and skills level analysis were conducted. Before the analysis, the common method bias (CMB henceforth) test was performed through the Harman Single Factor test. The results indicated that a single factor means the maximum

variable was approximately 44% of 78 items. The CMB test would be unproblematic if a single factor fails to account for more than 50% of the variance.

Table 2 illustrates the descriptive analysis, in which the mean value of all study variables ranged from 5.340 to 6.025. The analysis indicated the skewness and kurtosis of all study variables. The threshold value of skewness and kurtosis between ±1 is considered excellent and ±2 is acceptable levels (Gravetter and Wallnau, 2013). Based on the table, all the variables achieved the threshold.

Table 2: Descriptive statistics

Variables	Mean	SD	Skewness	Kurtosis
TDM	5.835	0.940	-0.420	-0.631
TSA	5.585	0.998	-0.263	-0.673
TPR	6.025	0.911	-0.781	-0.341
DSCT	5.770	0.965	-0.793	0.482
DSPS	5.340	1.087	-0.235	-0.394
DSSD	5.860	0.943	-0.608	-0.140
TRSPS	5.795	1.015	-0.584	-0.176
TRSPE	5.825	1.083	-0.722	-0.341
TRSL	5.785	0.930	-0.415	-0.662
CLPEL	5.690	1.087	-0.900	1.167
CLPFC	5.780	0.962	-0.375	-0.799
CLPOC	5.785	1.021	-0.576	-0.561
CRTC	5.870	0.950	-0.763	-0.035
CRII	5.750	1.011	-0.516	-0.556
EMP	5.630	1.044	-0.442	-0.455

Reliability and Validity

Internal consistency, which refers to the measurement variables of the degree to which items in the set are homogenous (Kumar et al., 2021), can be estimated through Cronbach's Alpha, rho_A, and composite reliability (CR). The threshold value of Cronbach's Alpha, rho_A, and CR was ≥ 0.60, ≥ 0.70, and ≥ 0.70 respectively, which all study variables achieved. Furthermore, the average variance extracted (AVE) indicator was used to measure the validity. The threshold value of AVE is ≥ 0.50, and all the study variables achieved the threshold value.

Table 3: Internal consistency and convergent validity

Variables	Factors	Cronbach's Alpha	rho_A	CR	AVE
Threshold Competencies	TDM	0.856	0.867	0.897	0.637
	TSA	0.830	0.865	0.881	0.601
	TPR	0.870	0.872	0.906	0.660
Distinguish Competencies	DST	0.826	0.850	0.876	0.587
	DSP	0.829	0.829	0.870	0.575
	DSSD	0.864	0.868	0.902	0.650
Task requirement	TRSPS	0.886	0.890	0.916	0.688
	TRSPE	0.904	0.920	0.928	0.719
	TRSL	0.820	0.831	0.874	0.582
Communication & Language	CLPEL	0.917	0.927	0.938	0.753
	CLPFC	0.906	0.915	0.930	0.728
	CLPOC	0.914	0.916	0.936	0.745
Creativity and Innovation	CRTC	0.906	0.913	0.930	0.728
	CRII	0.923	0.928	0.942	0.766

Variables	Factors	Cronbach's Alpha	rho_A	CR	AVE
Employability	EMP	0.903	0.911	0.922	0.598

The correlation analysis was performed to measure the degree of association between competencies (independent variables) and employability (dependent variables), which is displayed in Table 4. Overall, a positive and significant association between study variables was identified. The correlation coefficient of 0-0.2 is considered very weak or negligible, 0.2-0.4 weak or low, 0.4-0.7 moderate, 0.7-0.9 strong or high, and 0.9-1.0 very strong or very high (Kumar et al., 2021).

Table 4: Correlation analysis

Variables	TDM	TSA	TPR	DSCT	DSPS	DSSD	TRSPS	TRSPE	TRSL	CLPEL	CLPFC	CLPOC	CRTC	CRII
TDM	1													
TSA	.300**	1												
TPR	.577**	.481**	1											
DSCT	.450**	.495**	.621**	1										
DSPS	.216*	.451**	.430**	.591**	1									
DSSD	.577**	.555**	.701**	.608**	.572**	1								
TRSPS	.676**	.486**	.691**	.696**	.451**	.690**	1							
TRSPE	.502**	.554**	.787**	.724**	.480**	.774**	.725**	1						
TRSL	.563**	.311**	.474**	.611**	.248*	.512**	.651**	.499**	1					
CLPEL	.253*	.281**	.482**	.497**	.428**	.386**	.395**	.432**	.273**	1				
CLPFC	.431**	.359**	.643**	.611**	.476**	.636**	.553**	.607**	.449**	.581**	1			
CLPOC	.526**	.395**	.772**	.631**	.510**	.708**	.674**	.774**	.525**	.479**	.743**	1		
CRTC	.425**	.438**	.617**	.678**	.481**	.535**	.580**	.719**	.583**	.482**	.626**	.721**	1	
CRII	.527**	.374**	.654**	.670**	.551**	.567**	.690**	.681**	.576**	.549**	.706**	.779**	.768**	1
EMP	.557**	.450**	.576**	.627**	.444**	.537**	.647**	.621**	.568**	.446**	.668**	.645**	.669**	.701**

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

The next objective was to measure the level of employee competencies and skills in IR4.0, which the level of threshold competencies (TDM, TSA, and TPR) is revealed in Figure 3. Resultantly, more than 80% of respondents indicated agreement (agree to strongly agree) that TDM was necessary to achieve employability in IR4.0. Likewise, 81% of respondents agreed that TSA competencies were vital in IR4.0. Finally, 87% of respondents agreed that TPR was necessary for employability.
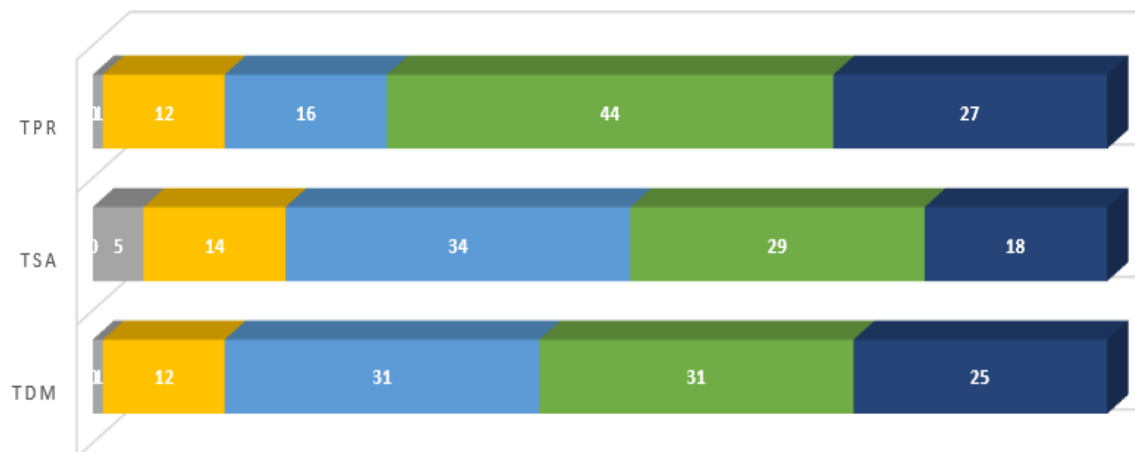
Figure 3: Threshold competencies scores

Figure 4 entails the level of distinguishing competencies (DSCT, DSPS, and DSSD). The results indicated that 84% of respondents provided agreement (agree to strongly agree) that DSCT was necessary to achieve employability in IR4.0. Likewise, 70% of respondents agreed that DSPS was vital in IR4.0. Finally, 87% of respondents agreed that DSSD was necessary for employability in IR4.0.
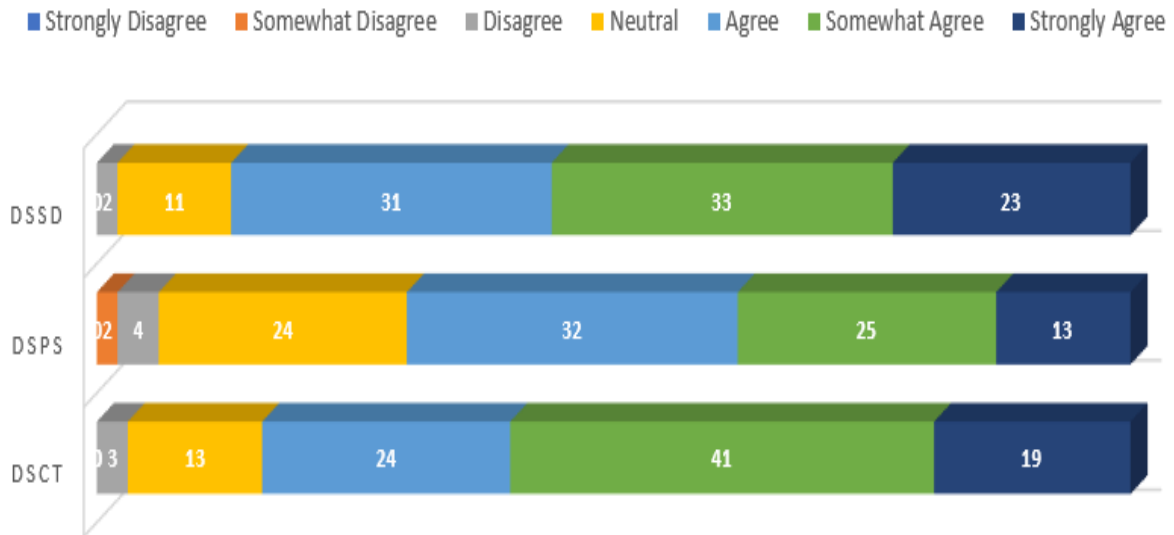

Figure 4: Distinguish competencies scores

Figure 5 shows the level of task-requirement competencies (TRSPS, TRSPE, and TRSL), where 86% of respondents indicated agreement (agree to strongly agree) that TRSPS skills were necessary to achieve employability in IR4.0. Likewise, 82% of respondents agreed that TRSPE was vital IR4.0. Finally, 84% of respondents agreed that TRSL skills were necessary for employability in IR4.0.
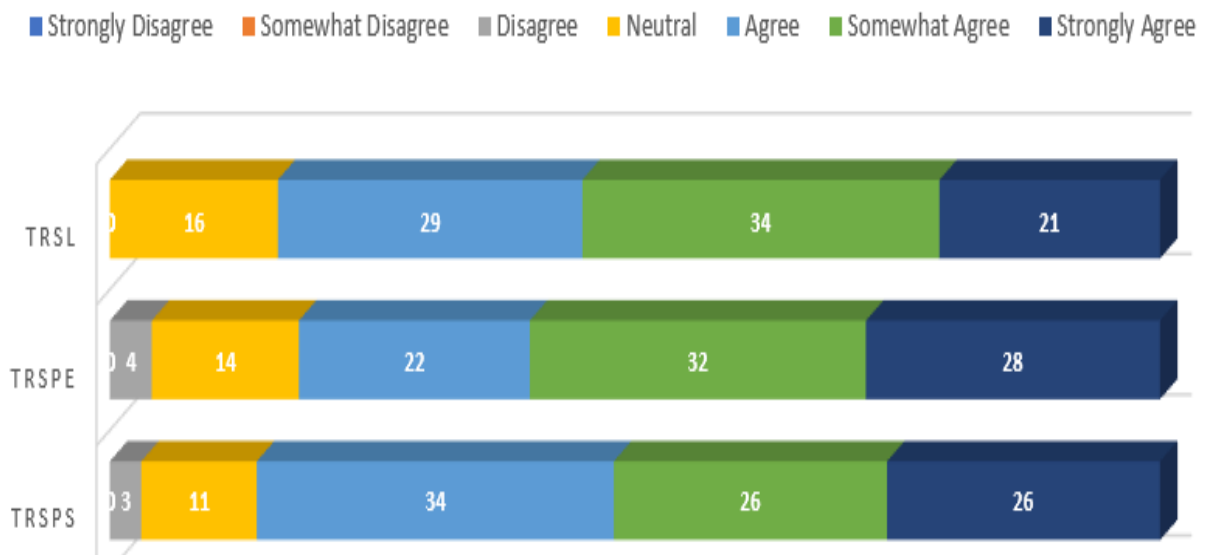

Figure 5: Task requirements scores

Figure 6 presents the level of communications and language proficiency competencies (CLPEL, CLPFC, and CLPOC). 83% of respondents provided agreement (agree to strongly agree) that CLPEL skills were necessary to achieve employability in IR4.0. Likewise, 85% of respondents agreed that CLPFC skills were vital in IR4.0. Finally, 82% of respondents agreed that CLPOC skills were necessary for employability in IR4.0.
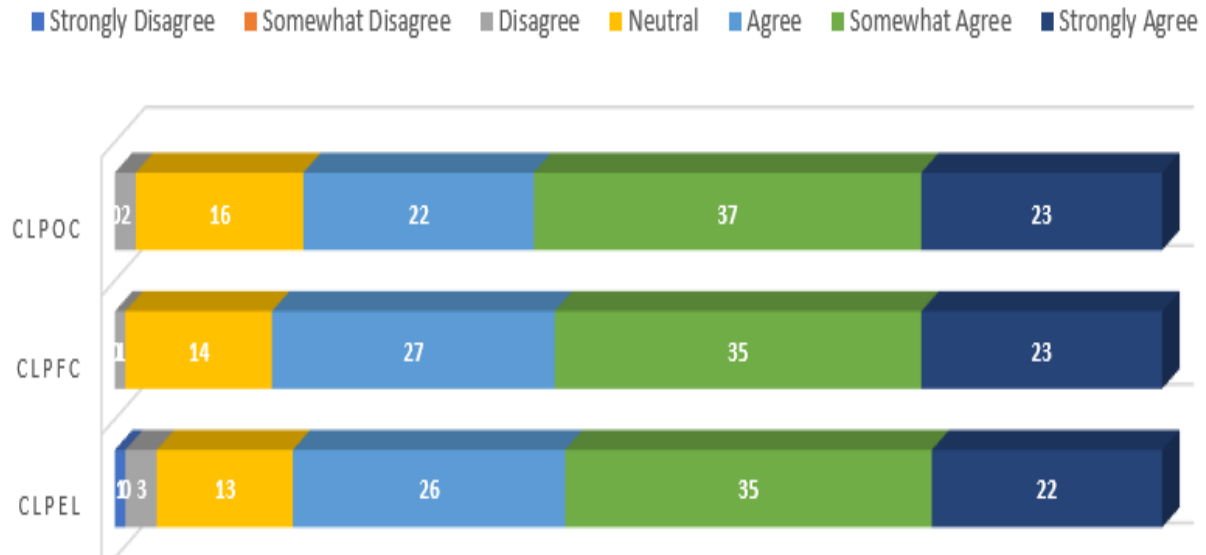
Figure 6: Communication competencies scores

Finally, Figure 7 demonstrates the creativity and innovation competencies (CRTC and CRII). The results indicated that 88% of respondents provided agreement (agree to strongly agree) that CRTC skills were necessary to achieve employability in IR4.0. Finally, 82% of respondents agreed that CRII skills were necessary for employability in IR4.0.
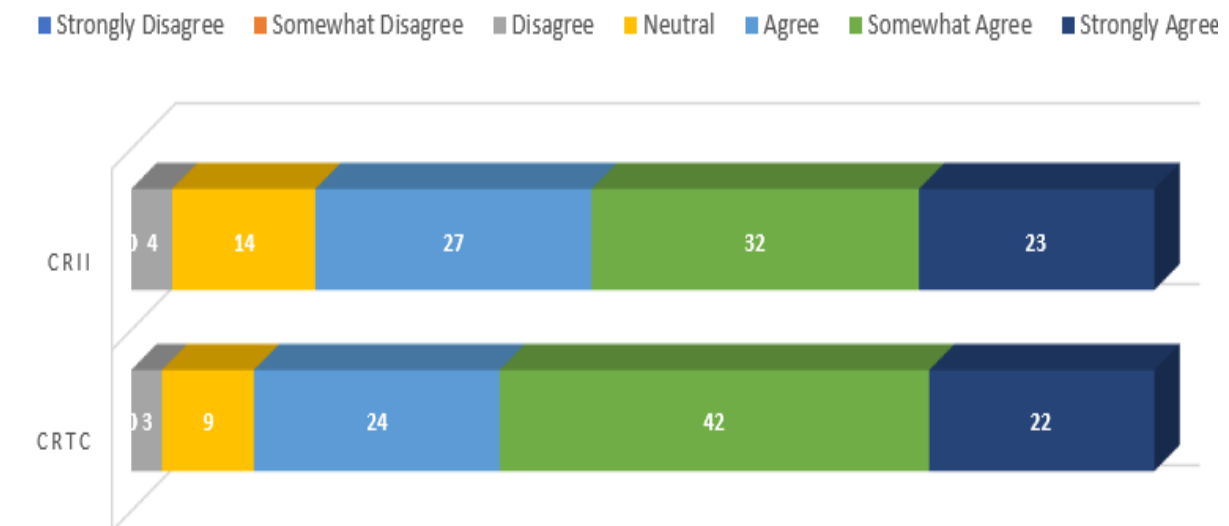
Figure 7: Creativity and innovation competencies scores

5. Discussion and Conclusion

The prime objective of this study was to assess and test human skills and competencies in IR4.0 among Malaysian E&E manufacturing firms. The literature review revealed divergent opinions on the competency requirements of professionals, which have led to role misperceptions, such as the interchangeable use of terminology regarding roles, responsibilities, purposes, practices, and competencies. For example, the term "role" has been used interchangeably with 'responsibility', and 'practice' with 'competence'. Thus, the lack of consensus in the literature has reinforced the need to develop a holistic and empirically tested competency model in the Malaysian context that also considers specific responsibilities and job functions. Similarly, the interchangeableness of terminologies, and definitions and lacking literature may also contribute to further studies on competencies and employability (García-Álvarez et al., 2022). Therefore, it is vital to develop a competency model that considers specific skills and their uses (Ali and Johl, 2021b; García-Álvarez et al., 2022).

The analyses revealed five elements of HRM competencies and 21st-century skills; threshold competencies, distinguishing competencies, task requirements, communication and language proficiency, creativity and innovation, and employability. The results confirmed three factors each for threshold competencies with good to excellent reliability, for distinguishing competencies with good to excellent reliability, and finally, for the task requirements with good to excellent reliability.

The results for communication and language proficiency contradicted the literature that oral communication should not be part of the factors. The results confirmed two factors for English and formal communication and proficiency with excellent reliability, and two factors for creativity-innovation with exceptional reliability. The results were consistent with academic postulates that emphasised the importance of business knowledge and technology as competencies. Moreover, equipping employees and organisations with up-to-date skills to improve their performance has also been emphasised (Gan and Yusof, 2019; Sima et al., 2020).

Implications of Study

The study provided a theoretical contribution to research on human resource competencies and skills in IR4.0 due to the lack of empirical studies on said topic. This study allows an understanding of the employee's competencies in the manufacturing sectors, which implies greater knowledge of what is being practised in the unique characteristics and dynamics sector. Moreover, this study has advanced the literature on employee competencies in social and technical skills. Additionally, the literature on employability in the manufacturing sector has also been elucidated; although empirically marginal, the implications are relevant for theory and practices. Finally, the study also contributes to advancing research on manufacturing organisations, filling a literature gap.

The empirical findings have generated practical implications for manufacturing managers. For example, managers should supervise their employees' skills and competencies and encourage IR4.0 employee competencies. Resultantly, IR4.0 technologies can be implemented for performance improvement. For instance, managers must be aware of their employees' technical and social competencies, that they are complementary and related to different performances. This study highlighted the empirical knowledge of, and

consequently, proposed and examined a model of competency-based human resources and 21st-century skills in IR4.0. The competency-based human resources model was conceptualised as a process of designing, implementing, and managing IR4.0 programmes and activities focusing on developing specific competencies and skills. The model was designed to facilitate organisations in better understanding, identifying, developing, and assessing IR4.0 competencies and skills necessary for success in the 21st century. Moreover, the model utilised a valid and reliable knowledge framework for future research and practice. Furthermore, this study enables focusing on and refining key employee competencies to provide a more holistic, condensed approach to IR4.0 professionalism.

Limitations and Future Research Directions

Firstly, the study adopted a cross-sectional study approach, which resultantly has limited inferences of long-term causes and effects. A longitudinal study, contrastingly, would enable identifying the long-term importance of competencies and consequently applying them to the current needs of companies. Secondly, the result interpretation was complicated by the divergent opinions on and the lack of empirical studies on competencies. To validate the instrument, the sample size should be increased for future endeavours. This tool should also be tested in specific industries to effectively apply its roles and responsibilities across multiple industries. Thirdly, the study only considered the Malaysian manufacturing sector as the target population. In future studies, data from different sectors and countries could be examined instead to generalise the findings for other countries and sectors. Lastly, future research on the inter-relationship between the attributes of human skills and competencies may also be conducted.

In summary, employees play an essential role in the competitiveness and sustainability of organisations. Nevertheless, the outcomes can only be achieved with clearly defined competencies. This study presented a reliable measure for assessing the required competency-based human resources and 21st-century skills in the Malaysian context, which will promote practitioners' professionalism and subsequent value creation.

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