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Original Article

Employability Model Evaluation of Engineering Technology Graduates: A PLS-SEM Approach

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Abstract: The paper evaluated a four-construct employability model for engineering technology graduates in the context of globalisation and job insecurity. Four constructs of fifty-two items in the model involve i) Technical knowledge; ii) Technical skills; iii) Generic skills; and iv) Attitude and other attributes. Survey data were collected from 153 industry employers that used engineering technology graduates and analysed using a partial least-squares structural equations modelling (PLS-SEM) technique. Measurement and structural models were assessed to examine the quality of outer and inner models. The findings showed that the measurement model was reliable. Five items were removed due to internal consistency reliability problems. The results of re-performing the PLS-SEM algorithm confirmed that the adjusted model of four constructs and forty-seven items was reliable. The structural model assessment recorded the fit of inner models, with eight inner models having statistical significance. The research contributes to developing highly qualified engineers by confirming the tailored employability model for graduates of engineering technology disciplines. Future studies could apply the model to measure the employability of engineering technology graduates from specific higher education institutions in Vietnam.

Keywords: Model evaluation, employability, engineering technology.

1. Introduction

The rapid growth of globalization, job insecurity, and new universities have created precarity for the labour market and higher education, which brings new challenges preventing fresh graduates from finding and partaking in employment [1]. In addition, a mismatch exists between employer requirements and higher education institutions' supplies, which primarily causes a contrasting picture of graduates' employment. Specifically, employers expect to recruit graduates who are ready to work. However, they cannot recruit suitable graduates, although universities provide more university graduates than needed in the employment market [2]. Many university graduates cannot find jobs qualified for

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university degree holders, so they take jobs requiring a high school education [3].

In such an unstable context, employability is fresh graduates' "a key factor determining the success" (pp. 844) [1]. Employability is considered an asset that can provide graduates with a competitive advantage and promote workplace performance. Employability is necessary for fresh graduates to transition smoothly to the workplace and from one organization to the other. Moreland (2006) [4] identified employability as "a set of skills, knowledge and personal attributes that make an individual more likely to secure and be successful in their chosen occupation(s) to the benefit of themselves, the workforce, the community and the economy" (pp. 21).

Small et al., (2018) stated that tertiary education institutions worldwide were constantly pressured to provide work-readiness graduates [5]. Tight (2023) [6] also agreed that higher education was urged to produce graduates who could "make immediate and productive inputs to the economy" (pp. 551). As a solution to release social pressure, universities were expected to help graduates show their employability or "the economic worth of a student" (pp. 293) [7] at graduation time to prove high-quality human resources to the labour market.

Employability is also crucial for employers in recruiting and using high-quality graduates who are ready to work and continuously contribute to their organizations [1]. After graduates have been recruited, employers put more money into employability because it can sustain their employees' "high levels of commitment" (pp. 2) [8]. According to Wang et al. (2022), there was a strong relationship between fostering enterprise staff's employability in the context of fast changes in the outside environment and improving the enterprise's "competitiveness, adaptability, and flexibility" (pp. 4) [9].

Employability has been studied worldwide, with a noticeably increasing number of publications between 2015 and 2019. The United Kingdom, Australia, the United States, and the Netherlands are the top countries with outstanding publications [10]. In Vietnam, employability is likely to be a novel concept. Most employability studies have been published from undergraduate and graduate perspectives; for example, students at the University of Foreign Language Studies under The University of Danang [11] or Information technology graduates [12]. A few studies focused on assessing graduate employability from employers' viewpoints, for example, employers' assessment of law graduates [13] or economics graduates [2]. Allen et al., (2005) argued that the best way to measure employability competencies was to test them in a practical work environment where graduates took jobs after graduation [14]. Though employers make crucial decisions in hiring, using, and assessing universities' program outcome quality, previous studies in Vietnam appeared to concentrate less on employers' perceptions than students' perspectives.

Furthermore, employability models have been evaluated by a few studies, such as, in the industry or business sector. Specifically, Chhinzer et al., (2018) built an employability model of 10 factors to measure employer views of Canadian graduate students who were working in a variety of industry sectors by performing exploratory factor analysis in Phase 1 and a critical incident technique in Phase 2 [15]. They showed their limitation for not conducting "a confirmatory assessment of employability" (pp. 118) and advised the subsequent study to follow up on their work [15]. Likewise, Hossain et al., (2020) developed an employability model of the relationship between graduate skills and the employability of business graduates in Bangladesh. By applying the partial least squares (PLS) technique, they confirmed that the three factors (technical skills, soft skills, and social mobility skills) had positive relationships with employability [16]. Nevertheless, their study was limited to graduates without involving "employers' and academics' perceptions on graduate employability" (pp. 306) [16], so they suggested that future studies should put efforts into employers' assessment to add viewpoints because the employer is a key stakeholder. Although a few studies were related to employability model assessment with different participants in some disciplines, to the best of our knowledge, few past studies have dealt with evaluating the employability model of engineering technology graduates from the employers' perspectives. Therefore, the present study fills the gap. Wu et al., (2016) [17] ascertained that employability model evaluation was a vital step prior to implementing measurement.

2. Literature Review

2.1. USEM Model of Employability

USEM model of employability stands for four constructs: Understanding, Skills, Efficacy, and Metacognition [18]. Understanding includes subject knowledge and how an organization operates. Skills comprise generic and specific ones. Efficacy, part of personal qualities, shows the students' confidence. Metacognition refers to how students react to their awareness, learning process, and eagerness to learn (see Figure 1). Although it is considered the popular framework in higher education literature, the USEM model is criticized for its lack of clarity, which leads to little understanding and difficulty in exploiting [19]. Based on the strong and weak points of the USEM model, employability in the paper covers i) Knowledge: technical knowledge and how to operate in the enterprise; ii) Generic skills and specific skills. Specific skills in engineering technology majors refer to technical skills; and iii) Personal qualities: attitude and other qualities. Metacognition is unclear and complicated to understand and assess in an enterprise environment, so it is not included in the study's employability model.

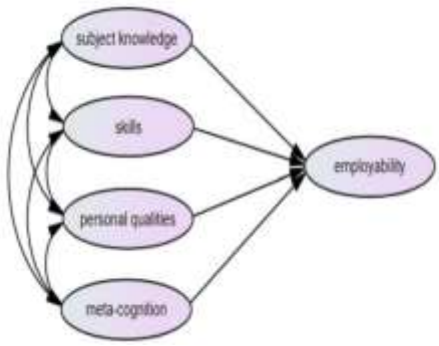

Figure 1. USEM model.
Source: [20], pp. 79.

2.2. Competence-based Approach to Employability

Fast changes in the market during the last decades of the twentieth century have transformed human resource management from a job-based system to an employee competence-based one [21]. Competence is often viewed at an individual level as "a set of observable performance dimensions, including individual knowledge, skills, attitudes, and behaviours, as well as collective team, process, and organizational capabilities, that are linked to high performance, and provide the organization with a sustainable competitive advantage" (pp. 216) [22]. It can be inferred that employees who obtain better knowledge and skills can perform better than others.

In the light of competence theory, employability, viewed at an individual level, can cover personal elements: ability, personality, attitudes, and motivation, and is "the combination of specific and more generic competence" (pp. 453) [21]. Froehlich et al., (2018) [23] insist that the components of employability can exist independently and develop based on each other. Competence-based approaches to employability have widely been used in higher education and the workplace. Higher education exploits competence-based approaches to employability to prepare students for the "uncertainties, changes and challenges" (pp. 2590) [19] they can encounter during their careers. In contrast, the workplace focuses on identifying and improving the knowledge, skills, and attitudes for effective performance in the labour market. In summary, competence-based approaches to employability concentrate on their graduates' growth in the enterprises' environment.

2.3. Employability Components

The employability model of engineering technology graduates was proposed based on the USEM model, the competence-based approach to employability, and previous employability-related studies. It covers four constructs: i) Technical knowledge; ii) Technical skills; iii) Generic Skills; and iv) Attitude and other attributes.

Technical knowledge is a crucial employability component [24]. Technical knowledge covers understanding scientific and technological principles and existing engineering-related issues [24, 25]. Engineering technology is related to the application of technology in engineering, so graduates are required to follow technology trends to develop their careers [26]. Employability at a higher level enables graduates to put the theoretical knowledge learned at university into their practical work quickly [27, 28].

Technical and generic skills contribute to the "skills" component in the USEM model [18]. Technical skills are obtained by learning and using various software/computer applications to design or present technical solution thoughts [16]. Technical skills are also concerned with hardware with manual skills for using technical tools/equipment [24]. Technical drawings are recognized as the brain of the engineering sector, and their comprehension keeps graduates imagining specific components of technical products and the steps to process and assemble them.

Generic skills can be called by different names, such as soft, key, transversal, or transferable skills/competencies, and employability skills, which help graduates work in various jobs or contexts. Many generic skills exist without "one definitive list" (pp. 1) [29]. Employability skills tend to become a preferred term over generic skills by enterprises in the industry sector. National Centre for Vocational Education Research mentioned communication, teamwork, problem-solving, adaptability, and lifelong learning skills as generic skills employers seek because they are "the main requirement for the modern worker" (pp. 2) [29].

Attitude and other attributes are concepts with few items to reflect in literature. Attitude is the feelings, beliefs, and behaviours expressed about the work [30]. Attitude is among the critical employability components in the study in China by Su & Zhang (2015) [31] and in South Africa by Steurer et al., (2023) [32]. They shared that managers and supervisors highly value the new graduates' positive attitude. They hired graduates for attitude instead of skills that could be trained. Other attributes are related to employees' work ethic. Work ethic can cover four dimensions: thoughtfulness, interpersonal skills, dependability, and initiative [33]. Because interpersonal skills may overlap with generic skills, three other dimensions of work ethic were selected to develop scales in the study.

2.4. Employability Model

Several attempts have been made to develop employability models. Firstly, aiming to help Malaysian engineers become ready for international and local labour markets, Zaharim et al., (2010) reviewed international and national engineering accreditation criteria and employers' perspectives to introduce the employability model [24]. The model covered three components: knowledge, personal skills, and personal attributes. Knowledge is related to the understanding of scientific and technological principles. Personal skills refer to generic skills (e.g. Communication skills, Teamwork, Problem-solving skills). Personal attributes are concerned with abilities to work well with others on a job and in society (e.g. Professionalism). Secondly, P. Vrat and S. Sangwan (2016) proposed an employability model of attitude, knowledge and skills for master graduates in business administration and developed a regression model of employability [34]. Thirdly, in Vietnam, L. T. Tran et al., (2022) [35] interviewed five graduates in different disciplines (IT, teaching, business, economics, and agriculture) in the Northern mountainous region on graduate employability. They revealed that the employability model was constituted by knowledge, employability skills (or generic skills), and attributes [35] (pp. 151). However, L. T. Tran et al., (2022) did not develop a specific questionnaire to measure the employability levels of graduates.

Items in the study's employability model originated from the academic works of international researchers. Afterwards, the group interviews, which included groups of lecturers, hiring team leaders, and technical managers [36], supplied additional items and generated the model of fifty-two items. Technical knowledge has six items. Technical skills also comprise five items. Generic skills include 23 items for five sub-groups: communication (5 items), problem-solving (5 items), adaptability (4 items), teamwork (5 items), and life-long learning (4 items). Attitude and other attributes consist of 18 items for four sub-groups: attitude (6 items), dependability (4 items), thoughtfulness (4 items), and initiative (4 items) (Appendix 1). A measurement model is suitable when it ensures reliability and validity. Reliability is related to "the stability of measures administered at different times to the same individuals" (pp. 2277) [37], and validity is "the extent to which an instrument measures what it purports to measure" (pp. 2278) [37]. An instrument model is good when the graduates' employability is reflected well through four constructs.

3. Research Methodology

3.1. Research Context

The study was conducted at a Vietnamese university based in Hanoi, with a long history of 126 years. University A (pseudo name) has 1.500 lecturers and support staff to implement training and education for over 30.000 students at three levels: vocational training, higher education, and postgraduate education. Among higher education programs at University A, engineering technology disciplines have enrolled the most students.

In terms of enterprise cooperation, University A established a functional unit supporting undergraduate employment in 2014. After ten years, more than 3.000 enterprises have set up cooperation relationships with University A in many ways, such as welcoming groups of students for field trips and internships and recruiting graduates. Enterprises that recruit engineering technology graduates maintain win-win long-term relationships with University A due to the demand for high-quality technicians and engineers.

3.2. Data Collection and Analysis

The survey questionnaire includes an introductory part and two content parts. The introductory part mentions the study purpose, object and content assessment, explanation of two terms regarding employability and engineering technology and how the repondents' answer is counted to be valid. Prior to the specific assessment contents, the question "Have you ever worked with engineering technology graduates?" was designed for the respondents to determine whether they were suitable and competent to join the survey. Part one involves 52 items: 6 for technical knowledge, 5 for technical skills, 23 items for generic skills and 18 for attitude and other attributes. For each item, the employers were required to select one number from one to five, equivalent to the increasing competence assessment level from "Very low" to "Very high". Part two of the questionnaire covers the participant's personal information and their enterprises' characteristics. The online survey questionnaire (http://bit.ly/SVTN-CNKT) was designed online in Vietnamese and took the participants 10 minutes to complete.

The questionnaire was sent to participants in two ways. The first way was to email the enterprise's human resources department and ask them to send the questionnaire to technical groups. The other was to call the technical divisions guiding the final-year undergraduates of University A for internships. If they agreed, a questionnaire was sent through the Zalo-based application and attached with guidance.

After two weeks, from 19 January to 1 February 2024, 161 respondents were recorded. Eight responses were unusable because the participants were sent twice by the same participants or they were not working in technical divisions in the department. One hundred fifty-three usable responses were used to analyze the data.

The current study uses the partial least squares (PLS) technique, a variance-based structural equation modelling (SEM) method, to test the model, which covers the measurement and structural models. It is an appropriate technique when the sample size is relatively small, considering the population [38] and does not require data with normal distribution [39]. Based on the above considerations, PLS-SEM is the most appropriate technique for this study.

The study's measurement model is a higher-order SEM one in the form of reflective–reflective relationships. Four sources of employability include technical knowledge (KT), technical skills (ST), generic skills (GS), and attitude and other attributes (AA), which act as separate exogenous sources. GS and AA are higher-order constructs with dimensions acting as lower-order constructs. GS has five lower-order constructs: communication skills (GSC), problem-solving skills (GSP), adaptability (GSA), teamwork skills (GST) and lifelong learning skills (GSL). AA has four lower-order constructs: attitude (AAA), dependability (AAD), thoughtfulness (AAT) and initiatives (AAI). Only lower order constructs: GSC, GSP, GSA, GST, GSL, AAA, AAD, AAT, AAI, KT and ST were analyzed for validity and reliability of the model.

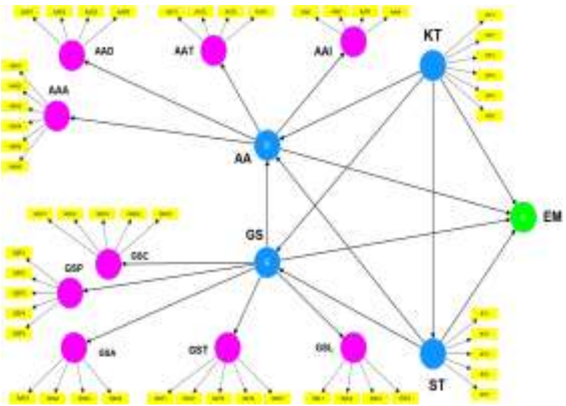

Figure 2. The proposed measurement model.

The validity and reliability of the measurement model were tested through the confirmatory factor analysis method (CFA) using the partial least squares structural equation modelling (PLS-SEM) method. The model reliability was assessed through (CR) and outer loading values. Meanwhile, convergent validity for this model was assessed through the average variance extracted (AVE) values. In this study, discriminant validity was determined through the HTMT criterion. Table 1 summarises the acceptance criteria to ensure the validity and reliability of the model.

Table 1. Acceptance criteria to ensure the validity and reliability of the model

Indicator loadings	≥ 0.7
Internal consistency reliability	- Minimum 0.70 (or 0.60 in exploratory research) - Maximum of 0.95 to avoid indicator redundancy - Recommended 0.80 to 0.90
Convergent validity	AVE ≥ 0.50
Discriminant validity	HTMT < 0.90

Source: [38] and [39].

The employability structural model was assessed through VIF values, R^2 for model explanation power and path coefficients (Hair et al., 2019) [38]. Firstly, there are three ranges for collinearity issues. It is problematic in case VIF (Variance Inflation Factor) values are more than five. If VIF values are below five and above or equal to three, there might exist a slight possibility of collinearity. It is best if the VIF value is smaller than three. Hair et al., (2014, pp. 186) [39] suggested that each variable's VIF value should be lower than 5. Otherwise, it is necessary to remove or combine variables. Secondly, the R^2 value accounts for the "amount of explained variance of the endogenous constructs in the structural model" (pp. 198) [40]. R^2 value can vary from 0 to 1, in which 0.75, 0.50 and 0.25 can be regarded as "substantial, moderate and weak". R^2 value, which obtains 0.1, can be accepted in stock return prediction (pp. 118) [40]. Similarly, the R^2 value, which obtains 0.91, can be plausible in predicting student or customer satisfaction [41].

4. Results and Discussion

4.1. Sample Characteristics

The participants involved in the online survey from 19 January to 1 February 2024. Table 2 presents the personal characteristics of the 153 survey participants and their enterprises' characteristics. Specifically, among these 153 employers, 135 (or 88.24%) were male, and 18 (11.76%) were female. Most respondents earned bachelor's degrees (130 people or 84.97%), whereas the rest held higher or lower degrees.

Table 2. Sample characteristics

Characteristics	Category	Overall (N=153)	
		N	%
Gender	Male	135	88.24
	Female	18	11.76
Qualifications	Doctorate	3	1.96
	Master's degree	5	3.27
	Bachelor's degree	130	84.97
	Associate degree	12	7.84
	Others	3	1.96
Kinds of enterprises	State-owned	13	8.50
	Private-owned	83	54.25
	Foreign-owned	57	37.25
Enterprise address	Hanoi	90	58.82
	Bac Ninh	28	18.30
	Bac Giang	20	13.07
	Hai Phong	4	2.61
	Quang Ninh	4	2.61
	Hai Duong	2	1.31
	Vinh Phuc	2	1.31
	Other	3	1.96
Used graduates	Mechanical ET	38	24.84
	Mechatronic ET	36	23.53
	Automotive ET	25	16.34
	Thermal ET	9	5.88
	Electric and Electronic ET	97	63.40
	Electronics and telecommunication ET	37	24.18
	Control and automation ET	51	33.33

* Note: ET means engineering technology.

Most participants worked for private and foreign enterprises (54.25% and 37.25%, respectively), while the rest served state-owned companies (8.50%). Regarding working address, most respondents worked in enterprises which are in Hanoi (90; 58.82%), Bac Ninh (28; 18.30%) and Bac Giang (20; 130.7%). Understandably, Hanoi is the capital city of Vietnam, with considerable advantages in the input of new graduates from universities, logistics for import and export, and many consumers. Besides, Bac Ninh and Bac Giang were among the leading provinces with rapid development in foreign investment [42, 43]. Enterprises recruited graduates of seven engineering technology majors. Each company recruited graduates of one or a group of majors. Graduates of the electric electronic engineering technology major were recruited by the vastest proportion of enterprises (97; 63.40%), and graduates of thermal engineering technology were hired by the smallest number (9; 5.88%).

The research model was evaluated through measurement and structural models.

4.2. Measurement Model Assessment (MMA)

4.2.1. MMA with 52 Items

Indicator loadings

The value of outer loading represents the reliability of the indicator in the construct. The recommended value for outer loading should exceed 0.7. The square value of the standard outer loading represents communality [38]. However, when the outer loading value is between 0.4 and 0.7, the decision to maintain, change or delete an item depends on conditions such as high outer loading value for other items and criteria such as CR and AVE values. The AVE value is recommended above 0.5, which means that more than 50% variance for reflective indicators has been considered to explain the latent variable. The outer loading value, considered with the AVE value, was used to obtain convergent validity for the scale.

The outer loading of each factor is sufficient when it exceeds 0.70 [39]. There were forty six outer loadings which met the standard, and six other outer loadings were below the standard. They were AA2 (0.7, not exceeding 0.7), AAA3 (0.697<0.7), AAA4 (0.699<0.7), AAD4 (0.636<0.7), GSC1 (0.681<0.7), and KT4 (0.661<0.7). Therefore, six outer loadings were removed one by one from the lowest outer to the higher outer: AAD4 (0.636), KT4 (0.661), GSC1 (0.681), AAA3(0.697), AAA4 (0.699), and AA2 (0.7). After removing five indicators, AAD4 (0.636), KT4 (0.661), GSC1 (0.681), AAA3 (0.697), and AAA4 (0.699) and performing the analysis, the reliability and convergent validity of the scale were established.

Internal consistency reliability

Assessing internal consistency reliability is most often used by Jöreskog's (1971) [44] composite reliability. Higher values generally indicate higher levels of reliability. For example, reliability values between 0.60 and 0.70 are considered “acceptable in exploratory research”, and values between 0.70 and 0.90 range from “satisfactory to good”. However, values of 0.95 and higher are problematic since they indicate that the items are redundant, reducing construct validity [38].

Cronbach’s alpha is another measure of internal consistency reliability that produces lower values than composite reliability. Cronbach’s alpha is a less precise measure of reliability since the items are unweighted. In contrast, with composite reliability, the items of individual constructs are weighted based on the construct indicators’ loadings, and reliability is higher than Cronbach’s alpha. The construct’s true reliability is typically viewed as within extreme values of Cronbach’s alpha and composite reliability [38].

Table 3. Cronbach's alpha and the composite reliability indicator

Lower-order constructs	Cronbach's alpha	Composite reliability	Conclusion
AAA	0.81	0.87	Reliable
AAD	0.71	0.82	Reliable
AAI	0.78	0.86	Reliable
AAT	0.78	0.86	Reliable
GSA	0.77	0.85	Reliable
GSC	0.82	0.87	Reliable
GSL	0.83	0.89	Reliable
GSP	0.86	0.90	Reliable
GST	0.80	0.86	Reliable
KT	0.85	0.89	Reliable
ST	0.80	0.86	Reliable

Table 3 indicates that eleven scales have good internal consistency reliability. The composite reliability of the eleven scales outweighs the acceptance value of 0.7. Eleven scales' composite reliability is between 0.82 and 0.90. It can be concluded that the eleven scales are reliable.

Convergent validity.

Convergent validity is the extent to which the construct converges to explain the variance of its items. According to Hair et al., (2019), [38] "Convergent validity is the extent to which the construct converges to explain the variance of its items. The metric used for evaluating a construct's convergent validity is the average variance extracted (AVE) for all items on each construct. To calculate the AVE, one has to square the loading of each indicator on a construct and compute the mean value. An acceptable AVE is 0.50 or higher, indicating that the construct explains at least 50 per cent of the variance of its items" (pp. 9).

Table 4. AVE of lower-order constructs before adjustment

Lower-order constructs	AVE	Convergent validity	Conclusion
AAA	0.52	Beyond	Valid
AAD	0.54	Beyond	Valid
AAI	0.60	Beyond	Valid
AAT	0.61	Beyond	Valid
GSA	0.60	Beyond	Valid
GSC	0.58	Beyond	Valid
GSL	0.66	Beyond	Valid
GSP	0.64	Beyond	Valid
GST	0.55	Beyond	Valid
KT	0.58	Beyond	Valid
ST	0.55	Beyond	Valid

Table 4 shows that the eleven scales' Average Variance Extracted (AVE) value was superior to the required lowest threshold value of 0.50. In specific, AVE value of AAA (0.52), AAD (0.54), AAI (0.60), AAT (0.61), GSA (0.60), GSC (0.58), GSL (0.66), GSP (0.64), GST (0.55), KT (0.58), ST (0.55). Compared with the acceptance criteria for convergent validity, these eleven reflective scales surpassed the minimum threshold value. Accordingly, the models for measuring the eleven constructs reached high levels of convergent validity.

Discriminant validity

Discriminant validity is the extent to which a construct is empirically distinct from other constructs in the structural model. Fornell Larcker's criterion argues that the shared variance for all model constructs should not be larger than their AVEs, which is a traditional method for assessing discriminant validity [38]. However, Henseler et al., (2015) [45] show that the Fornell Larcker criterion performs poorly when the indicator loadings on a construct differ only slightly. Henseler et al., (2015) [45] proposed the HTMT ratio of the correlations in replacement of the Fornell Larcker criterion. Discriminant validity problems are present when HTMT values are high. Henseler et al., (2015) [45] indicate that the HTMT indicator is below 0.9; the model ensures its discriminant validity.

Table 5. Discriminant validity-HTMT matrix of lower-order constructs before adjustment

Lower-order constructs	AAA	AAD	AAI	AAT	GSA	GSC	GSL	GSP	GST	KT	ST
AAA											
AAD	0.84										
AAI	0.85	0.85									
AAT	0.66	0.80	0.76								
GSA	0.60	0.72	0.60	0.75							
GSC	0.44	0.64	0.59	0.68	0.77						
GSL	0.70	0.84	0.82	0.74	0.73	0.63					
GSP	0.42	0.63	0.53	0.80	0.74	0.87	0.72				
GST	0.68	0.78	0.76	0.78	0.73	0.73	0.83	0.75			
KT	0.44	0.57	0.47	0.70	0.75	0.82	0.59	0.83	0.63		
ST	0.53	0.69	0.63	0.7	0.85	0.84	0.73	0.80	0.73	0.86	

Table 5 shows the HTMT indicators are below 0.9, so all paths are discriminant. It is noticeable that HTMT for AAD-AAI (0.85), GSP-GSC (0.87) and ST-KT (0.86) are near 0.9, so these paths might have potential issues of being not discriminant from other ones.

4.2.2. MMA After Adjustment (47 Items)

Figure 3 displayed this study's measurement model of 47 items after removing five items of KT4, GSC1, AAA3, AAA4, and AAD4. Four higher-order constructs of employability include technical knowledge (KT: 5 items), technical skills (ST: 5 items), generic skills (GS: 15 items), and attitude and other attributes (AA: 22 items).

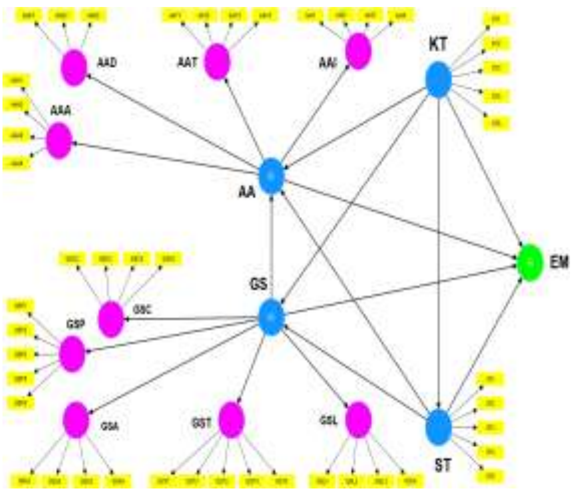

Figure 3. Measurement model with 47 items.

GS has five lower-order constructs: communication skills (GSC: 4 items), problem-solving skills (GSP: 5 items), adaptability (GSA: 4 items), teamwork skills (GST: 5 items) and lifelong learning skills (GSL: 4 items). AA has four lower-order constructs: attitude (AAA: 4 items), dependability (AAD: 3 items), thoughtfulness (AAT: 4 items) and initiatives (AAI: 4 items).

Indicator loadings.

The outer loading of each factor is sufficient when it exceeds 0.70 [39]. The matrix of outer loadings showed that 47 outer loadings, which ranged from 0.706 to 0.802, met and outweighed the standard.

Internal consistency reliability.

Cronbach's alpha and composite reliability indicators need to be tested to ascertain the reliability of individual constructs. Cronback's alpha is considered the lower bound for internal consistency reliability, while the other is regarded as the upper bound. Hair et al., 2019 [38] indicate that Cronbach's alpha and the composite reliability indicator must obtain at least 0.7 and a maximum of 0.95.

Table 6. Cronbach's alpha and the composite reliability indicator of lower-order constructs after adjustment

Lower-order constructs	Cronbach's alpha	Composite reliability	Conclusion
AAA	0.77	0.86	Reliable
AAD	0.72	0.84	Reliable
AAI	0.78	0.86	Reliable
AAT	0.78	0.86	Reliable
GSA	0.77	0.85	Reliable
GSC	0.81	0.88	Reliable
GSL	0.83	0.88	Reliable
GSP	0.86	0.90	Reliable
GST	0.80	0.86	Reliable
KT	0.85	0.89	Reliable
ST	0.80	0.86	Reliable

Table 6 reveals Cronback's alpha and the composite reliability indicator of all constructs are higher than 0.7 and lower than 0.95. Specifically, Cronback's alpha of eleven constructs ranges from 0.72 to 0.86, and the composite reliability indicator lies between 0.84 and 0.90. It can be concluded that all eleven scales have an acceptable internal consistency.

Convergent Validity

According to Fornell & Larcker (1981) [46], the convergent validity can be tested with the help of AVE. Then, there is the presence of convergent validity.

Table 7. CR and AVE of lower-order constructs after adjustment

Lower-order constructs	CR	AVE	Conclusion
AAA	0.86	0.6	Valid
AAD	0.84	0.64	Valid
AAI	0.86	0.60	Valid
AAT	0.86	0.61	Valid
GSA	0.85	0.60	Valid
GSC	0.88	0.64	Valid
GSL	0.89	0.66	Valid
GSP	0.90	0.64	Valid
GST	0.86	0.55	Valid
KT	0.89	0.63	Valid
ST	0.86	0.55	Valid

The convergent validity met the respective criteria: CR> 0.70, CR > AVE and AVE > 0.50. Thus, it can be concluded that the individual constructs were valid and reliable (Table 7).

Discriminant validity.

Henseler et al., (2015) [45]indicate that the HTMT indicator is below 0.85. The instrument ensures its discriminant validity. Table 8 shows that HTMT indicators between two variables (ranging from 0.39 to 0.84) are smaller than 0.9, so these variables are discriminant from other variables.

Table 8. Discriminant validity-HTMT matrix of lower-order constructs after adjustment

Lower-order constructs	AAA	AAD	AAI	AAT	GSA	GSC	GSL	GSP	GST	KT	ST
AAA											
AAD	0.76										
AAI	0.79	0.78									
AAT	0.65	0.73	0.76								
GSA	0.58	0.66	0.60	0.75							
GSC	0.41	0.64	0.59	0.63	0.73						
GSL	0.7	0.77	0.82	0.74	0.73	0.59					
GSP	0.43	0.61	0.53	0.80	0.74	0.84	0.72				
GST	0.64	0.74	0.76	0.78	0.73	0.74	0.83	0.75			
KT	0.39	0.49	0.41	0.66	0.75	0.75	0.60	0.82	0.59		
ST	0.52	0.62	0.63	0.7	0.85	0.79	0.73	0.80	0.73	0.81	

4.3. Structural Model Assessment VIF Values

According to Hair et al., (2019) [38], the variance inflation factor (VIF) is often used to assess collinearity problems. The higher the VIF values are, the greater the collinearity level is. VIF values of 5 or above reveal a critical multicollinearity problem. Collinearity issues are possible when VIF values are below 5. No collinearity issues are identified when the VIF values are close to 3 and lower.

As Table 9 depicts, the VIF values of constructs are below 5, indicating no severe collinearity issues among constructs. Most constructs in the model are not correlated (VIF values below 3). VIF values for GS -> EM is 4.24, which is below five and over three and is supposed to have the possibility for collinearity issues. In this study, the GS->EM path is regarded as having no severe multicollinearity problems and is kept in the model

Table 9. Collinearity statistics (VIF)

Paths	VIF	Multicollinearity problems
AA -> EM	2.28	No
GS -> AA	2.87	No
GS -> EM	4.24	Minor possibility
KT -> AA	2.21	No
KT -> EM	2.25	No
KT -> GS	1.86	No
KT -> ST	1	No
ST -> AA	2.66	No
ST -> EM	2.68	No
ST -> GS	1.86	No

R^2 for model explanation power.

Hair et al., (2019) [38] noted that R^2 is a measure of power that explains the model. The R^2 ranges from 0 to 1, with higher values showing greater explanation power depending on specific research cases. Table 10 indicates that technical skills independent variables can explain 45.8 per cent of the variance in technical skills. Generic skills independent variables can explain 64.7 per cent of the variance in generic skills. Attitude and other attributes independent variables can explain 55.2 per cent of the variance in attiude and other attributes. It is noted that R^2 for employability is

0.996. It is a composite reliability value of the model. The current study's good model explanation power is similar to the study finding by Sarayrah (2019) [41].

Table 10. Model explanation power

Constructs	R-square	R-square adjusted
ST (Technical skills)	0.462	0.458
GS (Generic skills)	0.652	0.647
AA (Attitude and other attributes)	0.561	0.552
EM (Employability)	0.996	0.996

Path coefficients.

The bootstrapping option was performed to determine the statistical significance of the path coefficient and calculate the t-values in this study. Table 11 presents the values in Path coefficients and t-values.

AA -> EM: The t-value of the hypothesized path of AA and EM is 18.58, above 1.96 (α=0.005; two-sided test), and the p-value is 0.000 < 0.05. So, the hypothesized path of AA and EM is statistically significant.

GS -> AA: The t-value of the hypothesized path of GS and AA is 8.45, above 1.96 (α=0.005; two-sided test), and the p-value is 0.000 < 0.05. So, the hypothesized path of GS and AA is statistically significant.

Table 11. Path coefficients

Inner model	Original sample	Sampl e mean	T statistics	P values
AA -> EM	0.27	0.27	18.58	0.000
GS -> AA	0.78	0.77	8.45	0.000
GS -> EM	0.27	0.27	18.96	0.000
KT -> AA	-0.14	-0.13	1.42	**0.156**
KT -> EM	0.29	0.29	15.05	0.000
KT -> GS	0.35	0.35	4.54	0.000
KT -> ST	0.68	0.69	10.50	0.000
ST -> AA	0.09	0.08	0.86	**0.388**
ST -> EM	0.33	0.33	23.97	0.000
ST -> GS	0.53	0.53	8.76	0.000

GS -> EM: The t-value of the hypothesized path of GS and EM is 18.96, above 1.96 (α=0.005; two-sided test), and the p-value is 0.000 < 0.05. So, the hypothesized path of GS and EM is statistically significant.

KT-> AA: The t-value of the hypothesized path of KT and AA is 1.42, below 1.96 (α=0.005; two-sided test), and the p-value is 0.156 > 0.05. So, the hypothesized path of KT and AA is NOT statistically significant.

KT -> EM: The t-value of the hypothesized path of KT and EM is 15.05, above 1.96 (α=0.005; two-sided test), and the p-value is 0.000 < 0.05. So, the hypothesized path of Kand EM is statistically significant.

KT -> GS: The t-value of the hypothesized path of KT and GS is 4.54, above 1.96 (α=0.005; two-sided test), and the p-value is 0.000 < 0.05. So, the hypothesized path of KT and GS is statistically significant.

KT -> ST: The t-value of the hypothesized path of KT and ST is 10.5, above 1.96 (α=0.005; two-sided test), and the p-value is 0.000 < 0.05. So, the hypothesized path of KT and ST is statistically significant.

ST -> AA: The t-value of the hypothesized path of ST and AA is 0.86, below 1.96 (α=0.005; two-sided test), and the p-value is 0.388 > 0.05. So, the hypothesized path of ST and AA is NOT statistically significant.

ST -> EM: The t-value of the hypothesized path of ST and EM is 23.97, above 1.96 (α=0.005; two-sided test), and the p-value is 0.000 < 0.05. So, the hypothesized path of ST and EM is statistically significant.

ST -> GS: The t-value of the hypothesized path of ST and GS is 3.36, above 1.96 (α=0.005; two-sided test), and the p-value is 0.000 < 0.05. So, the hypothesized path of ST and GS is statistically significant.

Results from the structural and measurement model assessment show that the employability model for engineering technology graduates covers 11 lower-order constructs and 47 items (Table 12).

Table 12. Employability lower-order constructs in the adjusted employability model

Lower-order constructs	Item number	Items
AAA	4	AAA: 1, 2, 5, 6
AAD	3	AAD: 1, 2, 3
AAI	4	AAI: 1, 2, 3, 4
AAT	4	AAT: 1, 2, 3, 4
GSA	4	GSA: 1, 2, 3, 4
GSC	4	GSC: 2, 3, 4, 5
GSL	4	GSL: 1, 2, 3, 4
GSP	5	GSP: 1, 2, 3, 4, 5
GST	5	GST: 1, 2, 3, 4, 5
KT	5	KT: 1, 2, 3, 5, 6
ST	5	ST: 1, 2, 3, 4, 5
Total	47	

The study‘s employability model was standardized to cover four components: technical knowledge (5 items), technical skills (5 items), generic skills (22 items), attitude and other attributes (15 items). This model was broader than the three-component model by Zaharim et al., (2010) [24]. While the model by Zaharim et al. focused on employability skills, which include foundational knowledge and generic skills, the study's model comprises two more components: technical skills, attitude and other attributes. The difference between the two models might be due to their scope. Zaharim et al.'s study concentrated on employability skills, which is one of the employability components. This study developed an employability model based on the employability definition by Moreland (2006) [4], which conceptualised employability with skills, knowledge and personal attributes. Skills are constituted by generic skills and technical skills. Personal attributes refer to attitude and other attributes.

5. Conclusion

Employability has widely been studied in Western contexts [19], but employability academic studies remain rare in Vietnam. Furthermore, employability instruments were developed in economics and marketing, but employability instruments in engineering are restricted. Instruments for measuring the employability of the engineering technology field have hardly been found.

This paper represents the model employability evaluation results. The sample for the questionnaire was 153 employers who recruited engineering technology graduates. They participated in an online survey by answering two parts: part one for general information about respondents and enterprises' characteristics and part two for employers' assessment on 52 employability competencies-related items. Most participants worked for private and foreign enterprises (54.25% and 37.25%, respectively), while the rest served state-owned companies (8.50%). Regarding working address, most respondents worked in enterprises in Hanoi (90; 58.82%), Bac Ninh (28; 18.30%) and Bac Giang (20; 13.07%). The partial least squares technique was employed to test the model. It was an appropriate technique because the sample size was relatively small considering the population, and it did not require data with normal distribution.

The model validity and reliability were tested through the confirmatory factor analysis method using PLS-SEM. The model's reliability was assessed through composite reliability (CR) and outer loading values. Meanwhile, convergent validity for this model was evaluated by the average variance extracted (AVE) values. The measurement model was assessed with VIF values. R^2 is a measure of power that explains the model. Technical skills, generic skills, attitude and other attributes independent variables can explain 45.8 per cent, 64.7 per cent and 55.2 per cent of the variance in technical skills, generic skills and attitude and other attributes respectively. It is noted that

R^2 for employability is 0.996. It is a composite reliability value of the model.

The model was adjusted with 11 lower-order constructs and 47 items. A questionnaire after adjustment (Appendix 2) is presented in the online link (https://bit.ly/KSSVTN2023) to collect data for measuring the employability of assessment of specific graduates.

The study has inevitable limitations regarding its scope and sampling in collecting and analysing data. Firstly, the study's scope is restricted. According to MOET (2022) [47], engineering technology is divided into seven groups of disciplines. The present study focused on two groups of engineering technology disciplines: the mechanical group of engineering technology and the electric, electronic and communication group of engineering technology, which attracted many students to enrol and great demands from the industry and society. Secondly, the study is limited to its sampling. 153 employers were invited to the research. Though most were ready, some were inaccessible. Therefore, future studies might be conducted with a longer time for enterprises to answer.

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