ĐẠI HỌC QUỐC GIA HÀ NỘI

TRƯỜNG ĐẠI HỌC GIÁO DỤC

PHẠM ĐỨC LONG

ĐO LƯỜNG NĂNG LỰC HÀNH NGHỀ CỦA SINH VIÊN TỐT NGHIỆP ĐẠI HỌC NHÓM NGÀNH CÔNG NGHỆ KỸ THUẬT: PHÂN TÍCH TỪ QUAN ĐIỂM CỦA NGƯỜI SỬ DỤNG LAO ĐỘNG

(MEASURING THE EMPLOYABILITY OF ENGINEERING TECHNOLOGY GRADUATES: AN ANALYSIS FROM EMPLOYERS' PERSPECTIVES)

LUẬN ÁN TIẾN SĨ
ĐO LƯỜNG VÀ ĐÁNH GIÁ TRONG GIÁO DỤC
Mã số: 9140115

HÀ NỘI – 2024

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Mã số: 9140115

Người hướng dẫn khoa học: 1. PGS.TS. Nguyễn Thúy Nga
2. TS. Tăng Thị Thùy

NGHIÊN CỨU SINH **CÁN BỘ HƯỚNG DẪN 1**

CÁN BỘ HƯỚNG DẪN 2

XÁC NHẬN CỦA ĐƠN VỊ ĐÀO TẠO

HÀ NỘI – 2024

DECLARATION

I certify that:

1. This thesis has been undertaken by my effort under the guidance of two supervisors.

2. To the best of my knowledge, the thesis contains no material previously published or written by another person except where due reference is made.

Hanoi, 30th December 2024

Pham Duc Long

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ABBREVIATIONS

Abbreviations	Meaning
ABET	Accreditation Board for Engineering and Technology
AA	Attitudes and other attributes
AAA	Attitude
AAD	Dependability
AAI	Initiative
AAT	Thoughtfulness
ANOVA	Analysis of Variance
AVE	Average Variance Extracted
CIPD	Chartered Institute of Personnel and Development
CFA	Confirmatory Factor Analysis
CR	Composite Reliability
EM	Employability
ET	Engineering technology
GS	Generic skills
GSC	Communication skills
GSL	Lifelong learning
GSP	Problem-solving skills
GST	Teamwork
HEIs	Higher education institutions
HTMT	Heterotrait-Monotrait ratio of correlations
IT	Information Technology
KSA	Knowledge, Skills, and Attitude
KT	Technical knowledge
M	Mean
MOET	Ministry of Education and Training
PLS-SEM	Partial Least Squares Structural Equation Modeling
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
ST	Technical skills
USEM	Understanding, Skills, Efficacy, and Metacognition
VIF	Variance Inflation Factor

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INTRODUCTION

1. Statement of the Problem

The Fourth Industrial Revolution has brought about incredible changes in the labour market. It has created many new jobs for fresh graduates. Simultaneously, it has caused unemployment among “the low skilled and lower educated” (Teng et al., 2019, p.591). In the context of the accelerating rate of the Fourth Industrial Revolution, Vietnam's socio-economic development has encountered human resource challenges to meet the national economic target due to "low quality of education, particularly at the tertiary level, low research capacity, and a mismatch between training and labour needs" (Australian Government, 2014, p.9). Furthermore, Vietnam needed skilled people in science and technology for the economic target, but Vietnamese-trained engineers found it challenging to keep pace with technology development (VOV, 2016).

The rapid growth of globalisation, job insecurity, and new university creation have caused precarity for the labour market and higher education, which brings new challenges preventing fresh graduates from finding and partaking in employment (Neroorkar, 2022). In addition, a mismatch exists between employer requirements and higher education institutions’ supplies, which primarily causes a contrasting picture of graduates’ employment. Employers expect to recruit graduates who are ready to work. However, they cannot recruit qualified graduates, although universities provide more graduates than the need of the employment market (Tran, 2019). Many university graduates cannot find jobs qualified for university degree holders, so they experience jobs which require a high school education (Li et al., 2006).

Globalisation has dramatically affected the manufacturing sector (Danielson et al., 2006), where jobs in “electronics, automotive, aerospace, consumer goods, energy” (Danielson et al., 2006, p.20) can be sought by engineering technology (ET) graduates after leaving university. Danielson et al., (2006) warned that engineering technology programs needed to prepare students to address new challenges due to the globalisation of industry, in which the appearance of smart factories put the high requirement of skills and qualifications for ET graduates (Azmi et al., 2018). Furthermore, employers tended to require engineering graduates to reach application skills at higher levels to "work in a multicultural work environment" (Chenicheri Sid Nair, 2009, p.137).

In such an unstable context, employability is "a key factor determining the success" (Neroorkar, 2022, p.844) of fresh graduates and securing their growth in the knowledge-based economy (Finch et al., 2013). Employability is considered an asset (Tran, 2016) that can provide graduates with a competitive advantage. Employability is necessary for fresh graduates to transition smoothly to the workplace and from one organisation to another. Moreland (2006, p.21) 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".

Small et al. (2018) state that tertiary education institutions worldwide are constantly pressured to provide work-readiness graduates. Tight (2023) also stresses that higher education needs to produce graduates who can "make immediate and productive inputs to the economy" (Tight, 2023, p.551). To release pressure, universities must help graduates show employability or "the economic worth of a student" (Glover et al., 2002, p.293) at graduation time to provide 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 organisations (Neroorkar, 2022). After graduates have been recruited, employers should keep putting their investment into employability enhancement because it can sustain their employees' "high levels of commitment" (Akkermans et al., 2019, p.2). According to Wang et al. (2022), there is a strong relationship between fostering enterprise staff's employability in the context of fast changes in the outside environment and improving enterprise's "competitiveness, adaptability, and flexibility" (Wang et al., 2022, p.4).

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 the highest number of publications (Dinh et al., 2022). Several international studies have been conducted on employers' assessments (Cheong et al., 2016; Chen et al., 2018; Khoo et al., 2020; Zaheer et al., 2020; Aliu & Aigbavboa, 2020; Hosain et al., 2021; García-Aracil et al., 2022).

In Vietnam, employment opportunities for graduates have received more attention from universities due to a compulsory requirement of educational quality accreditation activities. Moreover, the government has issued programs to support the labor market until 2023 and aimed to keep a stable rate of the jobless youth rate in urban areas at less than 7% (Prime Minister, 2021). However, the number of Vietnamese unemployed people at working age increased in the second quarter of 2023 compared with the previous quarter, of which the number of unemployed youths (including graduates) went up to 7.41% (MOLISA, 2023). Over 7% of unemployed young people can be considered one of the most crucial problems facing Vietnam's social and economic growth.

Employability seems to be a novel concept. A few studies in Vietnam have been researched from undergraduate and graduate perspectives; for example, Phan & Wongsurawat (2016) or Le & Pham (2019). Vietnamese graduates' employability development after the transition to the workplace has been less researched from employers' viewpoints.

Allen et al. (2005) argue that the best way to measure employability competencies is to test them in a practical work environment where graduates take jobs after graduation. Though employers make crucial decisions in hiring, using, and assessing universities' program outcome quality, the empirical studies that concentrate on employers' perceptions of employability in Vietnam are limited. Few studies have investigated graduate employability from employers' viewpoints in Vietnam, for example, employers' assessment of law graduates (Mai, 2018) or economics graduates (Le, 2021), and two majors in engineering and engineering technology (Nguyen & Nguyen, 2015), but little concern has been paid to only engineering technology graduates. The present study fills the gap by measuring the employability of engineering technology graduates from employer's perspectives.

2. Purposes and Research Questions of the Study

The study aims to construct and validate an instrument designed to measure the employability of engineering technology graduates. This study has two objectives: (1) to develop the employability scale based on four selected constructs and validate this scale and (2) to measure graduates' employability at a Vietnamese university and test whether the employers' assessments differ according to their age groups and kinds of enterprises. More specifically, the research seeks to answer the two following questions:

Research question 1: How is the scale to measure engineering technology graduates' employability developed? To what extent is the scale reliable and valid?

Research question 2: What are the levels of engineering technology graduates' employability? How do the employers' assessments differ among age groups and kinds of enterprises?

3. Research Design and Methodology Overview

The research was implemented through two phases, as shown in Table I.1. In the first phase, the scale was developed and validated. Scale development involves three steps: (i) identification of scale constructs, (ii) selection of items from previous studies and items proposed by the researchers from personal enterprise and university partnership experience and (iii) adjustment of items via the Delphi method. The validation of scale items acts as a pilot test for scale modification. SmartPLS 4.0 software was employed to test the scale's reliability and validity. In the second phase, the questionnaire was used to collect the assessments from employers for each ET graduate from a Vietnamese university (University A). Descriptive and inferential statistical analyses on graduate employability were reported before comparing them with the previous studies.

3.1. Participants

Employers who recruited and hired graduates from seven engineering technology majors at a Vietnamese university were selected to join the study. Employers belong to two groups. The first group involves hiring managers, who are directly involved in recruiting and evaluating employees. The second group includes technical managers and supervisors who evaluate, advise, and educate employees. Employer databases can be collected from different sources: graduate destination surveys, internship receiving databases, close connections with schools and faculties, and short courses for enterprise staff.

Employers in this study were restricted to geographical location. Specifically, employers who recruited university engineering technology graduates from a Vietnamese university and worked for enterprises in 10 provinces in Northern Vietnam and one province (Thanh Hoa) in the North Central Coast were selected to take part in this study.

3.2. Data Collection and Analysis

The study follows an exploratory sequential design combining qualitative and quantitative research design. Exploratory sequential design starts with qualitative data collection, implemented by interviews with a few participants. This study employed the Delphi technique as a qualitative data collection method. The Delphi technique is directly related to theory building and is suitable for developing concepts that need expert participation to make decisions. Based on the exploration of primary qualitative data, the design and development of a scale were reported. Then, quantitative data collection was carried out.

Qualitative instrument: Focus group discussions were useful in the early stages of scale construction. Focus group discussions were applied “to strengthen the design of the survey and develop a more valid instrument” (Hennik, 2014, p.17). In this study, three group discussions were conducted by participants from the manufacturing industry and university lecturers to reach a consensus on adjusting constructs and items of the scale.

Quantitative instrument: A survey questionnaire was conducted to validate the scale after focus group discussions. The questionnaire administration was effective in the “preliminary examination of construct and criterion-related validity” (Hinkin et al., 1997. p.107) of the scale. Furthermore, another set of employer data was collected to measure each graduate’s current competencies based on the validated scale. When employers’ assessment data for each graduate was collected, inferential statistics could be exploited to "test hypothesis about the differences in the groups or the relationships of variables" (Creswell, 2015, p. 181). In this study, inferential statistics were applied to test whether the differences were found in employers' assessments of employability means based on the participants' characteristics, namely employers’ age groups and two kinds of enterprises.

Table I. 1. The research process of the present research

No.	Steps	Data collection	Data analysis
1	**Developing and validating the scale**		
1.1	Developing the scale		
a	clarifying the construct	Articles and books to identify potential constructs	construct-based analysis
b	developing the items	Articles and books to identify potential items for each construct and the author's proposal	Selection of the items from valid sources
c	taking expert's feedback	Two rounds for the expert method to keep, add, delete, and adjust the items (15 employers and 5 lecturers).	Percentage of consensus for each item
1.2	validating the scale	Questionnaire for a pilot test (153 employers)	SPSS: descriptive statistics, PLS-SEM: scale reliability and validity
2	**Measuring the employability**		
	producing measurement	Questionnaire for an official test (employers' assessment on 234 ET graduates)	SPSS: descriptive and inferential statistics analysis

4. Significance of the Study

Employability has been extensively researched in developed countries to measure undergraduate competency more than graduates' employability. Similar studies remain limited in developing countries, including Vietnam. To the best of my knowledge, no single study has been published on the employability of graduates of engineering technology disciplines. This study was carried out to fill in the gap.

Employability is a complex concept that has become a heated topic for scholars and organisations. However, the successful implementation of this study can obtain some main contributions:

First, the scale of employability was developed due to the primary efforts of employers, who was less capable to attend in previous published studies in Vietnam. Furthermore, there were three main groups of employability-related studies: (i) employers' requirements and higher education institutions' preparation, (ii) stakeholders' perspectives of employability, and (iii) the role of work-integrated learning in fostering employability (Dinh et al., 2022). Based on Dinh et al.'s. (2022) classification of employability-related studies, measuring graduates' employability from employers' perspectives, theoretically contributes to the second group.

Secondly, the Delphi technique has been exploited extensively in economic and health research, but fewer studies in educational sciences exist. The study significantly contributes to research methods by applying the Delphi method in the education sector to reach an agreement among experts on standards, criteria, and items to assess graduates' employability.

Third, PLS-SEM has been used as a modern technique to validate structural and measurement models of employability. Finally, the present study contributes to the enhancement of human resource quality of engineering technology by presenting the components/subcomponents of graduate employability, which had the highest or lowest assessments from employers, followed by proposals for training program development and tightening university-enterprise partnerships.

5. Organization of the Study

The thesis includes an Introduction part, four chapters and a Conclusion part. The introductory part has presented the background for this thesis by putting the study in global and Vietnamese contexts, highlighting gaps in measuring employability from employers' perspectives. Furthermore, the Introduction outlines the basic information of the study: the research aims, methodology and scope, and the significance of the research. Chapter 1 clarifies critical terms for the study and reports the employability framework and employability components selected for the thesis. Chapter 2 reports on the research methodology of the thesis and follows a mixed-methods approach. The qualitative method was the application of the Delphi method in the development of the scale of employability. The quantitative method was reflected by using the questionnaire in the pilot and official surveys. Chapter 3 shows the validation of the measurement scale of graduate employability. After taking experts' feedback, the instrument continued to adjust with the participation of employers who recruited and used engineering technology graduates in their enterprises. The scale's validity and reliability were tested through the confirmatory factor analysis method. The scale was standardised for measuring in the next chapter. Chapter 4 presents the measurement of graduate employability at University A. Each graduate was assessed by their employer based on the standardised questionnaire in Chapter 3. Graduate employability was reported for each employability component and sub-component. ANOVA tests were exploited to explore the meaningful results in differences in employers' assessments. The conclusion summarises the study's contributions, limitations, and implications.

CHAPTER 1: LITERATURE REVIEW

This chapter aims to clarify three key terms: employability, engineering technology, and employer to provide a foundational basis for the thesis. Afterwards, the employability theory and model were reported and discussed. Thirdly, employability constructs were summarised from prior academic studies. Lastly, the theoretical model for this study was proposed.

1.1. Key terms

As the thesis's name mentioned, employability, engineering technology, and employer are three terms which need to be defined and clarified regarding their scope for this study. Firstly, the concept of employability was used in 1955 as a crucial determinant for ensuring a job. Since the late 1990s, employability has been studied from different angles and levels across various disciplines (Thijssen et al., 2008). Diverse definitions of employability can be found in previous academic works. This paper discusses what employability means and selects the employability approach for this thesis. Secondly, this chapter shows how engineering technology differs from engineering disciplines. Finally, the chapter presents the employer definition and discusses university and employer cooperation in forming and developing graduate employability.

1.1.1. Employability

According to Dinh et al. (2022), employability has become a heated topic in developed countries. The United Kingdom, Australia, and the United States of America have the highest number of employability articles recorded from 1972 until 2019. The United Kingdom published 280 articles, followed by Australia with 137 publications. The United States ranked third with 88 academic works. Regarding publications, Van der Heijden from the Netherlands, De Cuyper from Belgium, and Jackson from Australia were the three biggest names with 25, 25 and 19 articles, respectively.

Employability is a term frequently used in literature, but to date, organisations and authors have proposed several definitions of employability. Employability is defined by many organisations. In the United Kingdom, the Confederation of British Industry (CBI) is on behalf of the voice of employers from every sector of the economy. Confederation of British Industry (2009, p.8) defines employability as a set of knowledge, skills, and attributes that graduates are expected to possess to meet the industry requirements for the satisfaction of themselves, their labour users, and the general economy. Knowledge in CBI’s definition is related to strong academic and technical knowledge (p.2). At the same time, employability skills include *seven skills*: teamwork, problem-solving, communication, information technology (IT), numeracy, self-management, and business and customer awareness. As CBI mentioned, attributes refer to a positive attitude to work proactively and accept new ideas (p.8).

Like the United Kingdom, the Australian Chamber of Commerce and Industry serves Australian businesses of all shapes and sizes, and the Business Council of Australia acts for Australia’s largest employers. According to the Australian Chamber of Commerce and Industry & Business Council of Australia (ACCI & BCA, 2002), employability skills and personal attributes can contribute to overall employability (p.57), in which the employability skills framework includes *eight skills*: communication, teamwork, problem-solving, initiative and enterprise, planning and organising, self-management, learning and technology (p.58). Personal attributes comprise *thirteen attributes*: loyalty, commitment, honesty and integrity, enthusiasm, reliability, personal presentation, commonsense, positive self-esteem, sense of humour, balanced attitude to work and home life, ability to deal with pressure, motivation, and adaptability (p.46).

In the sense of survivability, the European Higher Education Area uses employability to refer to the ability to “purposefully use all the different competences in order to fulfil given professional tasks and/or to reach own professional targets and to adapt these competences to new environments and requirements” (European Higher Education Area, 2022, p.1). The European Higher Education Area mentions different competences to refer to knowledge, skills and competences which need to be cultivated and expanded to match the outside world's rapid changes. The definitions by the three organisations above share the view that employability is a critical concept that draws employers' attention. It includes knowledge, skills, and attributes to make graduates sustain their chosen jobs and create value for their organisations.

Several definitions of employability have been proposed by researchers. Hillage & Pollard (1998) contended that employability was a multifaceted construct which is composed of (i) the ability to obtain first employment, (ii) the ability to keep employment and transfer between positions at the same organisation, and (iii) the ability to gain employment from a new organisation. Hillage & Pollard (1998) further indicated that each individual possessed employability assets, including "knowledge, skills, and attitudes" (Hillage & Pollard, 1998, p.12). As they explained, knowledge was what each individual knows, skills were how each individual used what they knew, and attitudes were how each used what they knew (Hillage & Pollard, 1998). Tran et al. (2020) further identified that employability was often shown in the forms of skills and competences "located within, and owned by, the individual" (Tran et al., 2020, p.3) in searching and keeping employment.

Moreland (2006, p.21) 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". Employability's definition by Moreland is like the explanation by the Confederation of British Industry, which also covered the knowledge, skills, and personal attributes for the development of each graduate, their organisation, and the economy.

Moreover, Thijssen et al. (2008, p.167) indicated that employability is "a multidimensional and variegated concept". It has been investigated from individual, organisational, and societal angles across different academic disciplines, such as studies for human resource management, psychology, educational science, and career theory. At an individual glance, employability indicates their opportunity to get and secure an admirable job in the internal or external employment market. From an organisational perspective, employability indicates the reasonable arrangement of all the jobs in a developing organisation. From a societal point of view, employability indicates the labour force's opportunity to become fully employed (p.168).

Cheng et al. (2022) classified definitions of employability into three categories. The first group focuses on personal assets or individuals' possession of capabilities, skills, and attitudes to satisfy employers' requirements. The second group emphasises the roles of the labor market, such as social, institutional, and economic factors which primarily determine employability. The last one is a mixture of the two above groups.

In summary, employability definitions are diverse among organisations and authors. This study used the definitions proposed by Moreland (2006) and the Confederation of British Industry (2009), which viewed 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” (Moreland, 2006, p.21). Moreover, the thesis followed the instruction by Neroorkar (2022) by focusing on building a specific instrument to measure employability instead of putting more energy into defining what employability means, which has still been under debate and hard to reach a general definition.

1.1.2. Engineering Technology

As mentioned in the name of the thesis, the study concentrated on graduates from Engineering Technology disciplines. Therefore, the definition of “Engineering”, “Engineering Technology”, and differences between two areas were also depicted.

Engineering is defined as the profession of using scientific knowledge to design, generate and control machines, materials, systems, and processes. Specifically, engineers can design products and services, such as “cars, computers, aircraft, clothing, toys, home appliances, surgical equipment, heating and cooling equipment and so on” (Moaveni, 2010, p.9). Graduates can be awarded four-year bachelor’s degrees or five-year engineering degrees based on time spent on training programs. In the engineering program's first two years, students are equipped with introductory engineering, English, mathematics, chemistry, and physics. For the latter two years, they can study one-branch-related courses, such as "mechanics of materials, fluid mechanics, heat transfer, applied thermodynamics, and design" (Moaveni, 2010, p.15).

Engineering technology refers to transforming basic knowledge of mathematics and science to operate engineering systems (Sadiku et al., 2015). According to the Accreditation Board for Engineering and Technology (ABET), Inc, engineering technology programs emphasize application and implementation, which supply students with practical skills for working in the industry (ABET, 2022). Engineering technology (ET) programs focus more on the operation of technologies and processes. The difference between engineering and engineering technology is shown in Figure 1. Engineering technologists are less concerned about theory, mathematics and scientific concepts for complex designs than engineers (Moaveni, 2010, p.21). In other words, engineering disciplines have fewer applications and practices, while ET ones are less scientific and theory-oriented (Land, 2012, p.38). As highlighted by Danielson et al. (2006), ET students should be taught "how to learn and implement new technologies" (p.22) instead of the present technology.

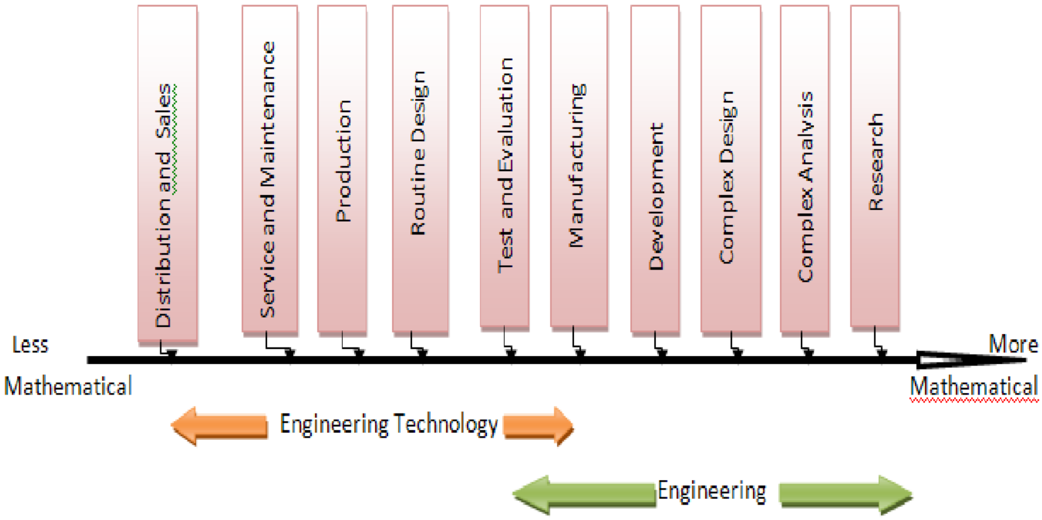


Figure 1. 1. Engineering technology and engineering (Sadiku. et al., 2015. p.83)

There are seventeen areas of study, in which engineering (code: 752) and engineering technology (code: 751) are two of the areas of study many universities have registered to open in the last several years due to the effects of the 4th Industrial Revolution and the high employment rates of graduates (Hoang, 2020). In September 2019, there were 114 universities (nearly 50% of universities) in Vietnam which had been training majors under two study areas of engineering and engineering technology (Hoang, 2020). According to the Ministry of Education and Training in Vietnam, engineering technology is "lĩnh vực đào tạo bao gồm các nhóm ngành, nghề chủ yếu là áp dụng những nguyên lý và kỹ năng kỹ thuật trong việc hỗ trợ kỹ thuật và những dự án có liên quan" (*The area of study includes groups of majors and occupations that mainly apply engineering principles and technical skills in technical support and related projects*) (Thủ tướng Chính phủ [Prime Minister], 2017, p.8). Engineering technology is extensive and covers the seven following groups of majors and twenty-four disciplines:

Group of majors 1 (Code 75101): architecture and construction (5 disciplines);

Group of majors 2 (Code 75102): mechanical ET (7 disciplines);

Group of majors 3 (Code 75103): electric, electronic and telecommunication ET (3 disciplines);
Group of majors 4 (Code 75104): chemistry, materials, metallurgy, and environment technology (4 disciplines);
Group of majors 5 (Code 75106): industry management (3 disciplines);
Group of majors 6 (Code 75107): oil and gas technology and extraction (1 discipline);
Group of majors 7 (Code 75108): printing ET, and so on (1 discipline)

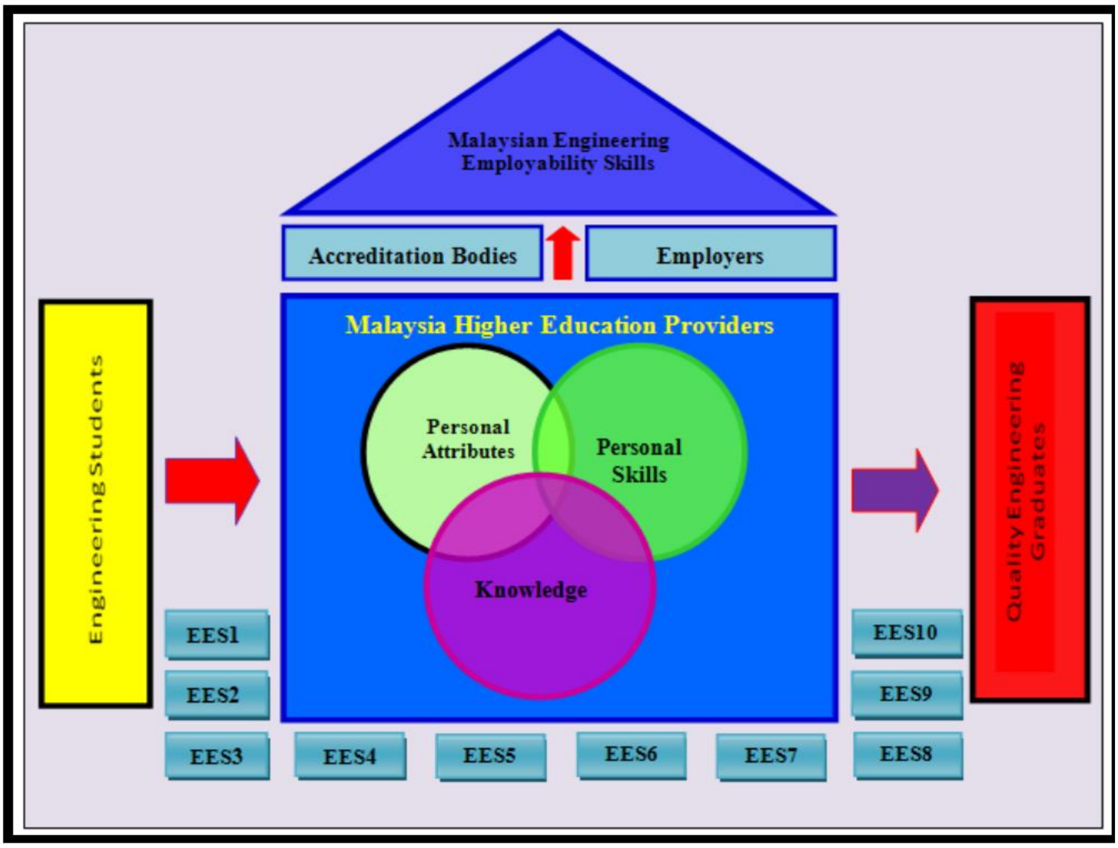
(MOET, 2022)

ABET includes a set of criteria used to accredit engineering technology, engineering, natural science, and computing at universities and colleges. Student outcomes of ABET-based engineering technology graduates at the time of graduation include 11 following abilities:

(1) an appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines;
(2) an ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology;
(3) an ability to conduct, analyze and interpret experiments and apply experimental results to improve processes;
(4) an ability to apply creativity in the design of systems, components, or processes appropriate to program objectives;
(5) an ability to function effectively on teams;
(6) an ability to identity, analyze and solve technical problems;
(7) an ability to communicate effectively;
(8) a recognition of the need for and an ability to engage in lifelong learning;
(9) an ability to understand professional, ethical, and social responsibilities;
(10) a respect for diversity and a knowledge of contemporary professional, societal, and global issues
(11) a commitment to quality, timeliness, and continuous improvement.

(Moaveni, 2010, p.21-22)

Although there have been a few studies concerning the employability of engineering graduates or a combination of engineering and engineering technology graduates, the focus on the employability of engineering technology graduates remains restricted.



EES1: Communication skills	EES6: Competent in application and practice
EES2: Teamwork	EES7: Knowledge of science and engineering principles
EES3: Lifelong Learning	EES8: Knowledge of contemporary issues
EES4: Professionalism	EES9: Engineering system approach
EES5: Problem-solving and decision-making skills	EES10: Competent in specific engineering discipline

Note: EES means Engineering Employability Skill

Source: Zaharim et al. (2010)

Figure 1. 2. Malaysian framework for engineering employability skills

Malaysian newly graduated engineers were required to perform engineering-related skills and knowledge effectively in the context of "major changes in knowledge, equipment, tools, systems and management" (Zaharim et al., 2010, p.92, p.921). To help Malaysia's engineers become ready for international and local labour markets, Zaharim et al. (2010) proposed a measurement tool for engineering employability skills based on national accreditation criteria and employers' perspectives. The scale covered three components: knowledge, personal skills, and personal attributes (Figure 1.2) for employability skills, which is one of the employability components. Knowledge is related to scientific and technologies principles (EES3, EES5, EES7, EES8, and EES9), personal skills refer to generic skills (EES1, EES2, EES5, EES6 and EES10), and personal attributes (EES1, EES2, EES3, EES4, and EES5).

Table 1. 1. Employability scale in engineering-technology majors

Constructs	Indicators
Technical skills	Ability to update new knowledge
	Research and creativity capacity
	Ability to think logically
	Information technology skills
	Specialised knowledge
	Foreign language proficiency
	Ability to apply specialised knowledge in practice
Cognitive skills	Participation in the general activities of the enterprise
	Self-control skills
	Resistance to work pressure
	Adaptability
	Leadership
	Eagerness for learning and self-study skills
Social and behavioural skills (mainly soft skills)	Presentation skills
	Analytical and critical thinking
	Negotiation skills
	Decision-making skills
	Communication skills
	Discipline
	Teamwork skills
	Time management skills

Source: Nguyen & Nguyen (2015)

Nguyen & Nguyen (2015) developed a scale for Vietnamese graduates in engineering-technology majors. They were interested in both engineering majors and engineering technology ones because graduates from such majors were vital human resources for mastering and innovating manufacturing technology, which brought high labour performance and fostered business competitiveness. The scale covered three factors: (i) technical skills, (ii) cognitive skills, and (iii) social and behavioural skills (mainly soft skills) (Table 1.1). The study findings indicated that different gaps existed between graduates' current knowledge, skills and employers' requirements. Employability of engineering-technology discipline graduates “did not meet enterprises’ and employers’ requirement” (Nguyen & Nguyen, 2015, p.12). They explained that job characteristics of engineering-technology disciplines required more practical skills, while engineering-technology programs covered theory-focused subjects.

1.1.3. Employer

Labor Code (2019) defines an employer to be "an enterprise, an agency, an organisation, a cooperative, a household, or an individual that can hire and use employee(s) to work for them according to their agreement.” (The National Assembly, 2019). As the Labor Code explains, employers can range from a narrow range of qualified individuals to a broader range of organisations, agencies, households, and businesses. In this study, employers are restricted to enterprises who used graduates from universities.

Cheng et al. (2022) state that the employer is identified to be an influential stakeholder in setting developmental directions for higher education and creating opportunities for students to explore their full potential. Specifically, they are expected to participate in higher education reform by making voices of the job market’s demands heard by universities. Furthermore, they can engage the students in work experience so that students can realize that employers need work readiness capabilities beyond subject knowledge. Cheng et al. (2022) also reveal that employers focus more on soft/generic skills and attitudes, which contradicts knowledge and vocational skills valued by the government.

Employers’ perceptions are crucial in defining the required skills for graduates (Suleman, 2016). However, employers have different perceptions of employability. Employers who consider the universities fully responsible for developing graduates’ skills request ready-to-work graduates. Other employers who recognize their partial responsibility in forming employability tend to recruit candidates who are willing to study because they consider workplace skills to be cultivated after hiring (Suleman & Laranjeiro, 2018). Akkermans et al. (2019) asked whether employers should invest in employee employability. The answer to their study’s finding is “yes” (p.9) because both employers and employees can win. Employees can improve their knowledge and skills, whereas employers can possess a committed workforce.

Shah et al., 2015 clarified four reasons why employer feedback on university graduates was crucial. Firstly, it ensured that university courses and curricula were adaptive to the growing needs of employers and industry. Secondly, it was used to foster links between employers and education suppliers. Thirdly, universities could recognize that graduate skill and attribute levels are rated highly important but lowly satisfactory. Lastly, it included information on trends and changes outside the university environment that could somewhat affect education providers. Based on findings by Shah et al. (2015), employer feedback which can be discovered in this study aims to foster the development of engineering technology disciplines in four contents: proposals to update university courses and curricula, proposals to tighten the link between university and employers, proposals to foster extra-curricular activities to listen to voices of employers directly, and proposals to consider opening new majors in response to employers' viewpoints.

It was shown that the quality of university graduates was a global issue, and it was urgent to receive employers' voices to help universities improve the quality of outcomes for social and economic development (Shah et al., 2015). Employer databases can be collected from different sources, including:

(1) graduate destination surveys;
(2) university careers and employment database;
(3) individual contacts in schools and faculties;
(4) a list maintained by schools where students undertake work placements;
(5) list of employers working closely with the university's engagement office;
(6) a list maintained by departments providing short courses to employers.

Source: Shah et al.(2015, p.267)

Reviewing employability studies from employers' perspectives in different countries shows that employers are divided into two groups. The first group is made up of human resource managers or hiring managers. They are directly related to the recruitment and evaluation of employees. The second group is supervisors, Chief Executive Officers (CEOs) and technical managers who evaluate, advise, and educate employees. This thesis takes the viewpoints from the two categories: human resource managers and technical managers.

Table 1.2. Types of university-enterprise collaboration for employability

	Types of university-enterprise collaboration	**Notes**
Universities going out Enterprise	• Student work placements • Student internships • Students conducting real-life projects in firms	Mobility of students
	• University academics/managers experience the work in firms. • University training for enterprises' orders	Mobility of academics
Enterprise engagement in university practices	Employer involvement in: • Curriculum development • Degree advisory board • Student assessment • Guest lectures • Student mentoring • Career fairs or events • Sponsorships/scholarships • Graduate recruitment	Employers' involvement in curriculum development and delivery
Universities and firms collaborate to deliver	• Work-based learning degree programs. • Research and development activities • Practical projects either on university campuses or in enterprises	

Source: Tran (2016, p.63)

There are some types of university-enterprise collaboration to foster employability for university graduates (Table 1.2). The activities may include (i) university visits to the enterprise, (ii) enterprise engagement with the university's work, and (iii) co-work between the university and enterprise. Firstly, universities can create opportunities to involve students and lecturers in enterprises through field trips, work placements, internships, and practical lessons. Secondly, the involvement of enterprises in university practices is shown in developing curricula, recruiting students, working as guest lecturers, and joining in the job fair. Finally, joint research projects can be implemented on university campuses or enterprise workshops.

In conclusion, employers in the thesis are enterprises who employ engineering technology graduates from universities. They are also influential stakeholders in consulting undergraduates better understand occupational knowledge and skills requirements in the actual work and help students identify their career preparation paths. Employer feedback is beneficial to universities in opening new majors, adjusting current training majors, implementing experiential learning to enterprises through industrial field trips to foster the preparation for employability, and tightening the win-win relationship between employers and universities for research and community purposes.

1.2. Employability theory, approach, and model

Several employability theories, approaches, and models have been proposed in the past twenty years. The most outstanding theory, approach, and model might include the human capital theory, a competence-based approach to employability by European Commission (2014), the USEM employability model by Yorke & Knight (2006), and the CIPD employability model by the Chartered Institute of Personnel and Development in the United Kingdom (2016).

1.2.1. Human capital theory

Employability is also viewed in terms of capital, which is shaped by changes in persons that generate capabilities and skills to enact in different ways. Human capital is characterised as intangible resources which cannot be separated from its owner. Human capital refers to KSA model, stands for Knowledge, Skills, and Attitudes (Peeters et al., 2019).

Table 1. 3. Human capital matrix for employability

Categories	Job related		Career related	Development-related
	Specific	Generic		
Knowledge “I know”	Knowledge needed to perform one’s current job	Knowledge needed to perform jobs	Knowledge needed to manage a transition and one’s career	Knowledge needed to adapt or develop oneself
Skills “I can”	Skills need to perform	Skills needed to	Skills needed to manage a	Skills needed to adapt or develop oneself

Categories	Job related		Career related	Development-related
	Specific	Generic		
	one's current job	perform jobs	transition and one's career	
Attitude "I want"	Attitudes that are needed to perform a job		Attitudes needed to manage a transition and one's career	Attitudes needed to adapt or develop oneself

Source: Peeters et al. (2019, p.83)

As indicated in Table 1.3, knowledge is what graduates know, and skills are related to what graduates can do and attitudes are concerned about what graduates want. KSA includes three types: job-related, career-related and development-related competencies. Job-related competencies are personal resources to perform a job. They cover specific job competencies (for example, occupational expertise and technical competencies), which are vital for good performance in the present job and generic job competencies (for example, communication and problem-solving), which are necessary to transfer to the new jobs. Career-related competencies are personal resources to make transitions between jobs and organizations. Development-related competencies, personal resources to make individuals grow over time, focus on the need to engage in lifelong learning.

1.2.2. Competence-based approach to employability

Employability can be classified into two primary types: employment-centered and competence-centered (European Commission, 2014). The first approach focuses on the capabilities to get the first job, keep the current job and switch to a new job if required. The employment-centered approach pays much attention to *labour market needs* (demand side), meaning higher education institutions must listen to the voices of employers or employers' organisations for training program adjustment. Another approach is the competence-centered one. It concerns competencies that university graduates must possess during school to meet employers' requirements. Such an approach focuses more on *graduates* (the supply side). In this case, higher education institutions are responsible for producing employable or ready graduates. A competency-based approach to employability is advantageous to measure "different components, to explore their interrelatedness, and to examine how employees may make progress in their employability" (Froehlich et al., 2018, p.231). For this study, a competence-centered approach to employability skills is selected.

Competence is 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 organisational capabilities, that are linked to high performance, and provide the organisation with a sustainable competitive advantage." (Athey & Orth, 1999, p.216). Likewise, Daelmans et al., (2005, p.158) defined competence as "the ability of a professional to handle complex situations or problems using professional knowledge, skills and attitudes in an integrative way". In other words, Le Deist & Winterton (2005) identified competence as "a combination of knowledge, skills and social competences that are necessary for particular occupations" (p.39). Social competences were presented through attitude and other behaviours. It can be said that employees who obtain better knowledge, skills, attitudes and other qualities can perform better than others. 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 (Van Der Heijde & Van Der Heijden, 2006).

In the light of competence theory, employability viewed at an individual level can cover personal elements: ability, personality, attitudes, motivation, and is "the combination of specific and more generic competence" (Van Der Heijde & Van Der Heijden, 2006, p.453). Froehlich et al. (2018) insist that the components of employability can exist independently and develop based on each other. For example, occupational expertise, concerned with knowledge and skills in a specific area, is vital to employability. It is a primary step in developing employees' flexibility, anticipation, and optimization abilities. Competence-based approaches to employability have widely been used in higher education and the workplace. Higher education aims to prepare students for the "uncertainties, changes and challenges" (Römgens et al., 2020. p.2590) 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 students' learning at universities and their growth in the enterprise's working environment.

In the nutshell, the thesis follows a competence-centered approach which concentrates on competencies that university graduates must possess during university training and education time to meet employers' requirements. The competence-centered approach to employability is appropriate to the purpose of the thesis because it helps measure employability components, explore their relationships, and identify the employability progress after being recruited to enterprises in a particular period time of work.

1.2.3. USEM model of employability

There are many employability models, in which the USEM model (Figure 1.3) is the most well-known. The USEM model has been widely recognized as "a major development in the area of graduate employability" (Sumanasiri et al., 2015, p.79). The model consisted of four employability constructs: **U**nderstanding, **S**kills, **E**fficacy, and **M**etacognition (Yorke & Knight, 2006). Understanding included subject knowledge and how an organisation operates. Skills comprised generic and specific ones. Efficacy, part of personal qualities, showed the students' confidence. Metacognition referred to how students reacted to their awareness, learning process, and eagerness to learn. Although it was considered the popular framework in higher education literature, the USEM model was criticised for "complexity and shortage of clarity" (Römgens et al., 2020. p.2595), which could lead to difficulty in exploiting.

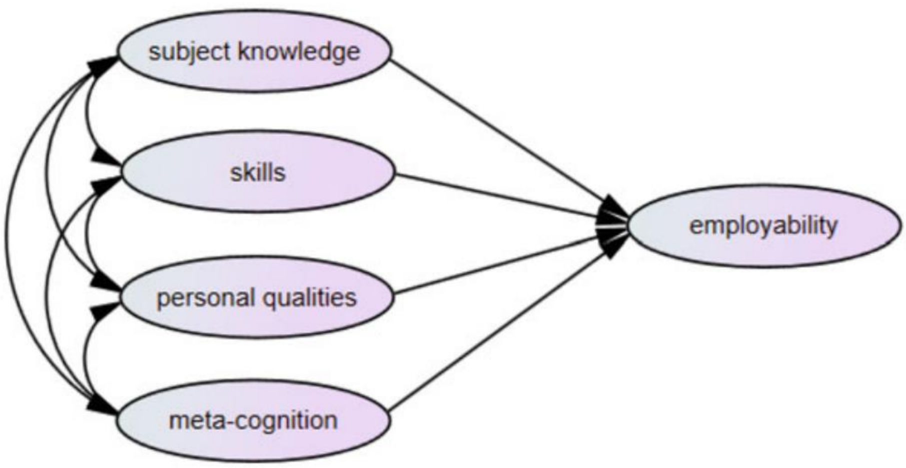


Figure 1. 3. USEM employability model (Tran et al., 2023, p.79)

USEM emphasizes learners' characteristics, which indicate "not only the importance of understanding, skills and qualities and attributes but the reflection on these" (Taylor, 2022, p.4).

After the strong and limited points of the USEM model has been considered, employability in the thesis covers (i) discipline-related knowledge (ii) generic skills and specific skills. Specific skills in engineering technology majors refer to technical skills, and (iii) personal qualities: attitude and other qualities. Small et al. (2018, p.9) gave the critique that the USEM model was "too academic and not easily understood by students or their parents", which could be more complicated to be understood and assessed in an enterprise environment. Considering four constructs in the USEM model, to the best of my knowledge, metacognition seemed to be the most unclear and academic to employers in enterprises, so it is not included in the thesis' employability model.

1.2.4. CIPD employability model

According to the Chartered Institute of Personnel and Development in the United Kingdom, employability could be regarded as both an outcome and an antecedent. Employability was considered an outcome because it helped individuals get meaningful jobs, progress, and succeed. It helped match the demand for labour in the labour market and the supply from higher education institutions (CIPD, 2016).

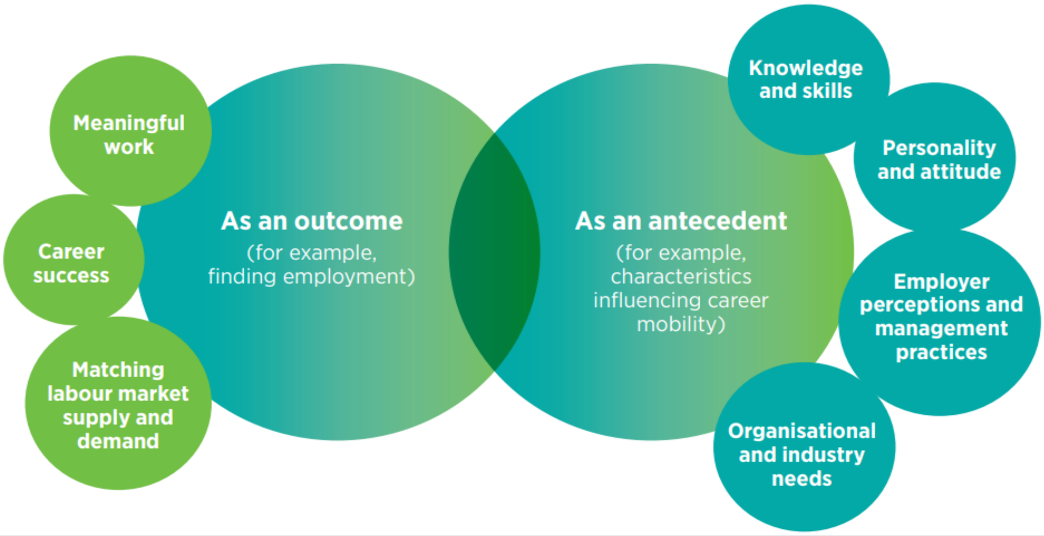


Figure 1. 4. CIPD employability model
(Source: CIPD, 2016)

Moreover, employability was seen as an antecedent to mobilise jobs because it contained the characteristics/resources such as personal knowledge, skills, attitude, personality, and organisational and industry needs, which were necessary conditions for transiting among different job positions in the same organisation or from one organisation to another one. This thesis exploited employability as an antecedent, including individual knowledge, skills, attitude, and personality, making graduates keep their current jobs and pursue career goals.

1.3. Employability constructs

Employability is a multidimensional terminology, making it challenging to identify the constructs of employability precisely. Graduates' employability "must be conceptualised broadly" with knowledge, skills, and attitudes, which help graduates exceed organisational borders and work effectively in related industries (Steurer et al., 2023). Tran.et al. (2022) interviewed five graduates in different disciplines (IT, teaching, business, economics, and agriculture) in the Northern mountainous region on graduate employability. They proposed graduates' employability with knowledge, employability skills (or generic skills), and attributes. However, they did not develop a questionnaire to measure the employability levels of graduates. Similarly, P. Vrat and S. Sangwan (2016) proposed the employability constructs, which included attitude, knowledge and skills for master graduates in business administration and developed a regression model of employability (Vrat & Sangwan, 2016). They admitted that their model of employability constructs were only applied to business graduates and suggested that "similar models can be developed for engineering and other graduates" (Vrat & Sangwan, 2016, p.330). Various categories of graduate employability have been reported by several studies. The noticeable similarity is that such studies mentioned knowledge, skills and attributes. The following is the summary of international and domestic studies on graduate employability, which includes the four constructs: (1) technical knowledge, (2) technical skills, (3) generic skills, (4) attitudes and other attributes:

Table 1. 4. Four employability constructs and their reference sources

No.	Construct	Source
1	technical knowledge	Ye & Jiang (2014), Zaharim et al. (2010), Osmani et al. (2015), Khoo et al. (2020), Aliu & Aigbavboa,

		(2020), Tran et al. (2022), Tong & Gao (2022), García-Aracil et al. (2022)
2	technical skills	Hysong (2008), Osmani et al. (2015), Hanapi et al., (2018), Hosain et al. (2021), Steurer et al. (2023), Pažur Aničić et al. (2023)
3	generic skills	Jackson, (2014b), Osmani et al. (2015), McArthur et al. (2017), Khoo et al. (2020), Leandro Cruz & Saunders-Smits (2022), Tran et al. (2022), Tong & Gao (2022), Pažur Aničić et al. (2023), Steurer et al. (2023)
4	attitudes and other attributes	Su & Zhang (2015), Osmani et al. (2015), Tran et al. (2022), Steurer et al. (2023)

Source: the author collected

Table 1.4 shows that technical skills are different from generic skills. Technical skills are the use of tools and programs to deal with specific technical tasks, for example computer-aided design skills, electrical installation skills, testing skills and finding faults for electronic mainboard. Generic skills can be called non-technical skills, which are general skills applied by different tasks in many jobs, for example communication skills and teamwork skills.

The following is the discussion of each employability component shown in Table 1.4 in detail.

1.3.1. Technical knowledge

Technical knowledge is a crucial employability component (Zaharim et al.,2010). Technical knowledge covers understanding scientific and technological principles and existing engineering-related issues (Zaharim et al., 2010; Iqbal Khan et al., 2016). Engineering technology is related to the application of technology in engineering, so graduates are required to follow technology trends to develop their careers (Aliu & Aigbavboa, 2020). Employability at a higher level enables graduates to put the theoretical knowledge learned at university into their practical work quickly (Ye & Jiang, 2014; Pažur Aničić et al., 2023).

Technical knowledge includes an appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines; an ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology (Moaveni, 2010, p.21-22);

1.3.2. Technical skills

Technical and generic skills contribute to the "skills" component in the USEM model (Yorke & Knight, 2006). Technical skills are obtained by learning and using various software applications to design or present technical solution thoughts (Hossain et al., 2020). Technical skills are also concerned with hardware with manual skills for using technical tools/equipment (Zaharim et al., 2010). Besides, high technical skill is required to become a competent engineer, which could be an asset to good management (Hysong, 2008). For electrical engineering graduates in Malaysia, Hanapi et al. (2018) insist that technical skills can be sharpened from basic to advanced levels, covering basic skills, design skills, installation skills, testing and maintenance skills. 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.

1.3.3. Generic skills

Steurer et al. (2023) argue that "skill sets alone are no longer adequate for building meaningful, long-term customer and employer relationships" (p.3). Moreover, industry tends to argue more about employability attributes/non-technical skills than technical skills. The gap between industry expectations and higher education outcomes will not be shortened if new graduates are not provided with the competencies the industry needs.

Generic skills can be called by different names, such as employability skills, soft, critical, transversal, or transferable skills/competencies, which help graduates work in various jobs or contexts. Many generic skills exist without "one definitive list" (National Centre for Vocational Education Research, 2003, p.1). Obtaining generic skills can significantly contribute to success in university to workplace transition (Pažur Aničić et al., 2023).

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" (National Centre for Vocational Education Research, 2003, p.2).

Employability skills are always changeable and renewable during everyone's working life. According to McGunagle & Zizka (2020), employability skills differ from employment or employee skills obtained in the workplace. Each different industry or field has sets of employability skills. Even within the same industry or area, sets of employability skills are dissimilar.

A pull-push circle is a cooperation model between employers and universities in promoting graduates' employability skills (Figure 1.5). This model implies that employers seek evidence of employability skills from graduates, so the graduates push the pressure on education and training suppliers to train, assess, and verify these skills. It is indicated that when employability skills are assessed and informed regularly by employers, education and training suppliers are likely to put more effort into preparing them (Curtis & McKenzie, 2001, p.55).

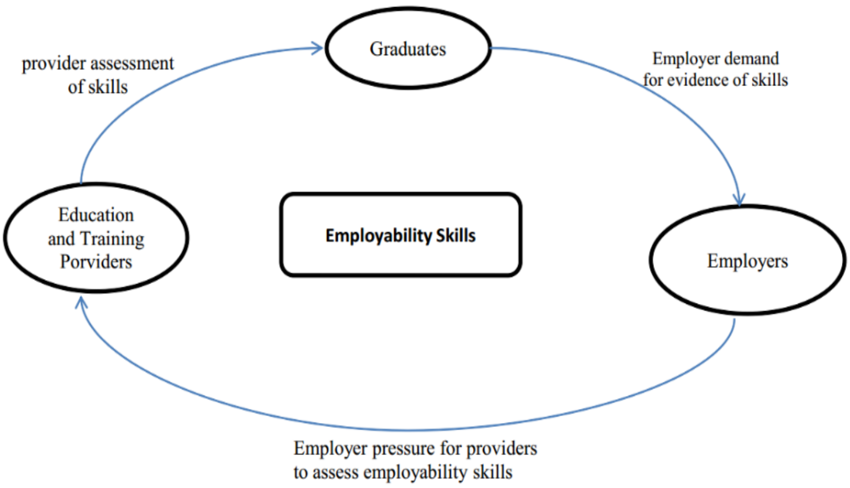


Figure 1. 5. Pull-push circle to foster employability skills

Source: Curtis& McKenzie (2001, p.55)

Surveys of generic skills are prevalent in studies of competencies because they are generic competencies stated in student outcomes of training programs and hoped to be found by university graduates after leaving university (McArthur et al., 2017; Jackson, 2014a). Jackson (2014a) stated that the skills-list approach was the central tendency in policies and practices of higher education institutions relating to developing and accessing graduate employability. He emphasized that, whether in the theoretical or modern model of graduate employability, generic skill outcomes were still a crucial and compulsory component even though each model of graduate employability could mention the role of specific skills (Jackson, 2014b).

Twenty-five generic skills (see Table 1.5), which include practical knowledge and its application, adaptability, intercultural competences, critical thinking and reasoning, entrepreneurial spirit, and leadership, were implemented in the Croatian national graduate survey in 2017, attracting 7201 graduates from several fields of education. The results show graduates from different areas of schooling share different views on the importance of generic skill components. For example, “ability to identify and resolve problems”, “ability to work autonomously”, and “taking responsibility and assessing the quality of one’s work” are among the top three competencies which are the most important for technical science graduates. In the meantime, social science graduates viewed the “ability to write and speak in a foreign language”, “ability to work autonomously”, and “ability to adapt to and act in new situations” as the three most significant generic skills (Pažur Aničić et al., 2023). Croatian study suggests that a survey questionnaire of graduates’ generic competences can be designed and implemented widely with twenty-five items or less. Additionally, “ability to identify and resolve problems”, which was one of three most important generic skills for technical science graduates, can be considered to be employed in the survey for engineering technology graduates in Vietnam.

Table 1. 5. List of generic competences in Croatian national survey 2017

Code	Generic competence content
G1	Mastery/practical knowledge of your field and discipline
G2	Ability to apply knowledge in practical situations
G3	Knowledge in other fields
G4	Analytical thinking that includes mathematical skills
G5	Ability to rapidly acquire new knowledge and skills
G6	Knowledge about research methods
G7	Ability to identify and resolve problems
G8	Ability to perform well under pressure
G9	Ability to adapt to and act in new situations
G10	Spirit of enterprise, ability to take initiative
G11	Capacity to generate new ideas (creativity and innovativeness)
G12	Ability to manage projects
G13	Ability to use time effectively
G14	Ability to work in a team
G15	Ability to motivate people and move toward common goals
G16	Ability to develop and argue your ideas/attitude

Code	Generic competence content
G17	Ability to argument and make reasoned decisions
G18	Ability to be critical and self-critical
G19	Ability to work autonomously
G20	Taking responsibility and assessing the quality of one’s work
G21	Ability to communicate both orally and through the written word in the mother tongue
G22	Ability to write and speak in a foreign language
G23	Ability to understand professional literature in a foreign language
G24	Professional knowledge of other countries in a part of a profession
G25	Ability to work with people from other cultural environments

Source: Pažur Aničić et al. (2023, p.410)

For Bangladeshi graduates, Hosain et al. (2021) reviewed the literature and showed contrasting or supporting views concerning the effect of academic performance, technical skills, communication skills, personality, leadership & motivational skills, teamwork, problem-solving skills (independent variables) and overall graduate employability (dependent variable). Their experimental results from 360 employers in 11 different job sectors revealed that (i) *communication skills, (ii) teamwork and problem-solving skills, (iii)personality, and (iv) academic performance* can positively and significantly affect overall graduate employability (see **Figure 1.6**).

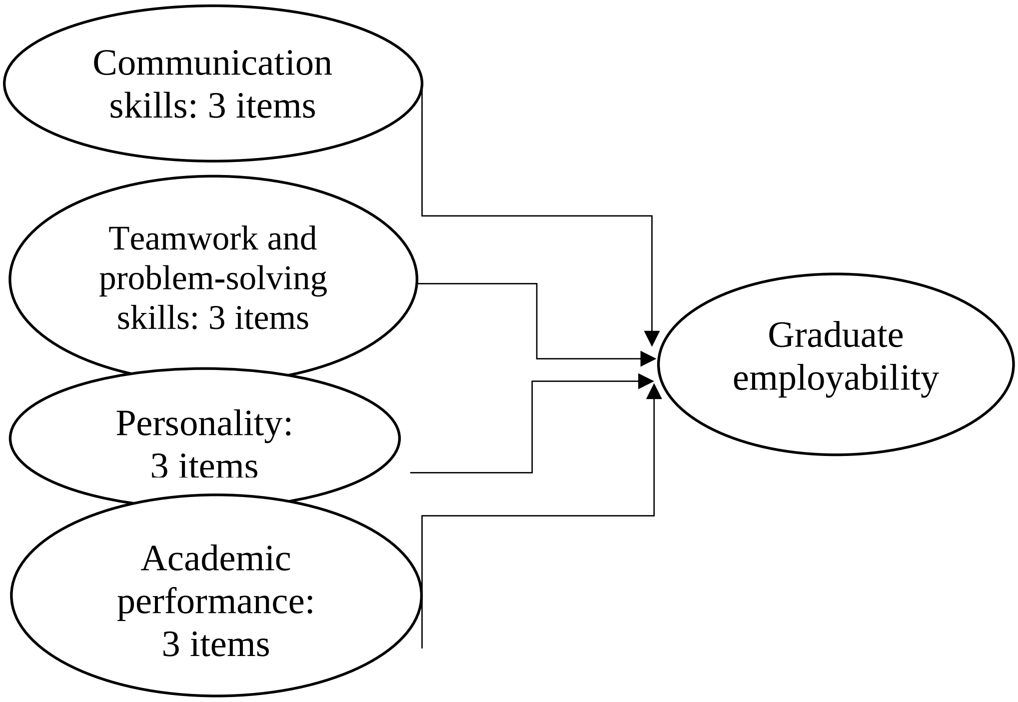


Figure 1. 6. Graduate employability from employers’ views in Bangladeshi
Source: Hosain et al. (2021) and illustraed by author

Osmani et al. sorted out 39 short-listed papers from 6,837 articles from the Scopus database from 2005 to 2015 to identify the names and frequency of graduate competencies in business and management, accounting, and computer science. Among 53 graduate attributes were *communication, teamwork, and problem-solving, adaptability* which wwere listed in the top 7 prominent graduate skills (see **Table 1.6**).

Table 1. 6. Scopus database's top 10 graduate attributes in 2005-2015 studies

Graduate attributes	Number of studies	Ranking
Communication	24	1
Teamwork	18	2
Problem-solving	11	3
Technological skills	11	3
Creativity	10	4
Interpersonal skills	8	5
Leadership skills	7	6
Self-management	6	7
Adaptability/ Flexibility	6	7

Source: Osmani et al. (2015, p.5)

Similarly, Khoo et al. (2020) asserted that communication and teamwork were two constructs employed to measure the competencies of engineering and science graduates in New Zealand from employers' viewpoints. Furthermore, lifelong learning, which was not found in the employability scale for business and management accounting graduates, as stated by Osmani et al. (2015), was applied to engineering graduates for engineering and science graduates. Khoo et al. (2020) explained that engineering and science graduates needed to learn from peers and learn to upgrade their professional competencies in a "rapidly changing and complex workplace" (p.1) after graduation. The generic skill indicators in the study by Khoo et al. (2020) were presented in Table 1.7, which might act as a suitable reference source for ET graduates studied in this study.

Table 1. 7. Generic employability skill scale for engineering and science graduates in New Zealand

Generic skills' second-order constructs	**Indicators**
Communication skills	Oral communication (effective verbal communication with various audiences across different situations and contexts)
	Written communication (writing clear emails, technical reports, letters, etc. for various audiences)
	Interpersonal relationships (can get along with, understand, and empathize with others)
Teamwork skills	Teamwork (can work effectively with groups of diverse people)
Lifelong learning	Adaptability (willing to learn to fit and adjust into new or changing organisational culture, ethics and values)
	Help seeking (can effectively learn from peers and confident to ask questions when needing help from others)
	Continuous learning (can and willing to continuously learn to advance professional and self-development)

Source: Khoo et al. (2020, p.118)

Sharing the same view as Khoo et al. (2020), Leandro Cruz & Saunders-Smits (2022) employed the three employability constructs of communication, teamwork, and lifelong learning skills to measure engineering graduates' generic skills in the context of Northern European countries. As presented in Table 1.8, lifelong learning was a typical construct for Siemens, a worldwide employer of engineers from the Netherlands. The scales were developed by human resource representatives and managers who worked with graduate engineers for different numbers of working years and had the best experience in the work performed by young engineers. Siemens' generic competencies model is an effective way for educators to improve engineering programs and can be applied to assessing students' learning outcomes.

Table 1. 8. Siemens' employability scale of generic skills

Generic skills' second-order constructs	Indicators
Lifelong learning	Strengths and weaknesses awareness
	Professional role awareness
	Actively seeking learning
	Autonomous work
	Non-credit activity participation
Teamwork skills	Cross-cultural understanding
	Interdisciplinary thinking
	Goal settings
	Collaborative goal oriented
	Engagement in teamwork
	Giving constructive feedback
	Time management
	Managing conflict
Communication skills	Quality of presentation method
	Presentation skills
	Adaptive communication style
	Self-confidence
	English language skills
	Listening skills
	Writing skills

Source: Leandro Cruz & Saunders-Smits (2022, p.36); illustrated by the author

Adaptability scale was used in the studies by Pažur Aničić et al. (2023) and García-Aracil et al. (2022). As one out of 25 Croatian graduate competencies, adaptability is related to the "ability to adapt to and act in new situations" (Pažur Aničić et al., 2023). García-Aracil et al. (2022) used the adaptability scale to measure the competencies of graduates after three years of leaving university in the Belarusian Higher Education survey. They used two indicators, "the ability to work under pressure" (García-Aracil et al., 2022, p.8) and "adapt to changes" (García-Aracil et al., 2022, p.8), for the adaptability scale.

Generic skills were diverse and different from studies due to their differences in participants, disciplines and countries. The thesis concentrated on five second-order constructs of generic skills (Table 1.9) because they were assessed to be the most critical in the Vietnamese context (Osmani et al., 2015; Tran et al., 2022).

Table 1. 9. Five generic skills components used in the study

Generic skills' Second-order constructs	Source
Communication skills	Osmani et al. (2015), Mai (2018), Khoo et al. (2020), Hosain et al. (2021), Leandro Cruz & Saunders-Smits (2022), Pažur Aničić et al. (2023)
Teamwork	Osmani et al. (2015), Mai (2018), Khoo et al. (2020), Hosain et al. (2021), Leandro Cruz & Saunders-Smits (2022), Pažur Aničić et al. (2023)
Problem-solving skills	Osmani et al. (2015), Mai (2018), Khoo et al. (2020), Hosain et al. (2021), Tran et al. (2022), Pažur Aničić et al. (2023)
Adaptability	Osmani et al. (2015), Khoo et al. (2020), Tran et al. (2022), García-Aracil et al. (2022), Pažur Aničić et al. (2023)
Lifelong learning skills	Robinson (2006), Mai (2018), Leandro Cruz & Saunders-Smits (2022)

1.3.4. Work attitude and other attributes.

Attitude and other attributes are concepts with few items to reflect in literature. Attitude is the feelings, beliefs, and behaviours expressed about the work (Dipboye, 2018). Attitude is among the critical employability components in the study in China by Su & Zhang (2015) and in South Africa by Steurer et al. (2023). 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. Su & Zhang (2015) report that graduate employability has received more attention in China since 2005, when more than 1,000 graduates could not gain employment. Working attitude is one of five critical employability components of university graduates in China extracted from interviews with human resource management and career experts and questionnaires with 100 employers. An active attitude from Chinese employers' perspective refers to initiative, responsibility, and faith. Likewise, managers in South Africa highly value new graduates with a positive attitude towards life and work, humility, resilience, strong work ethic, and hope (Steurer et al., 2023). Steurer et al. (2023) revealed that some managers asserted to hire graduates for attitudes instead of skills which could be trained. Additionally, other managers were impressed by graduates who are willing to learn at work, ready to put more effort into tasks, and can ask for more work, which expresses their hunger and dedication.

Other attributes are related to employees' work ethic. Park & Hill (2018) shared that Korean workers' work ethic covered three factors: dependability, thoughtfulness, and initiative. Dependability relates to the ability to follow instructions and competencies to fulfilled the tasks as planned. Thoughtfulness refers to good manners and work carefulness and initiative refers to goal completion and work accomplishments. The initiative is one of twenty-five criteria to assess the graduates' employability in Croatia (Pažur Aničić et al., 2023). They declared that the initiative was concerned about the enterprise's spirit. Australian Chamber of Commerce and Industry & Business Council of Australia (2002) reported that initiatives included seven elements:

- adapting to new situations
- developing a strategic, creative, long-term vision
- being creative
- identifying opportunities not obvious to others
- translating ideas into action
- generating a range of options; and
- initiating innovative solutions

Source: ACCI & BCA (2002, p.42)

Table 1.10 presented four second-order constructs of attitude and other attributes: attitude, dependability, thoughtfulness, and initiative, which were used in previous studies.

Table 1. 10. Four components for attitude and other attributes

Attitude and other attributes' second-order constructs	**Source**
Attitude	Su & Zhang (2015), Osmani et al. (2015), Dipboye (2018), Tran et al. (2022), Steurer et al. (2023),ažur Aničić et al.(2023)
Dependability	Park & Hill (2018), Tong & Gao (2022)
Thoughtfulness	Park & Hill (2018), Leandro Cruz & Saunders-Smits, 2022, Tran et al. (2022)
Initiative	Park & Hill (2018), ACCI&BCA (2002), Byrne et al. (2020), Pažur Aničić et al. (2023)

1.4. Previous studies on development and validation of employability scale

A reliable and valid employability scale was formed based on seven steps (Hinkin et al., 1997). Items creation and content adequacy assessment are the two initial steps in a seven-step process. Items generation can be conducted deductively or inductively, but the minimum number of items is required so that the domain of interest can be measured adequately. For each subconstruct, four or more items are gathered to ensure internal consistency (Hinkin et al., 1997). Content adequacy assessment can involve the participation of panelists. The questionnaire can be sent quickly to experts to collect assessments extensively, but the questionnaire provides a limited assessment of contents which are under conflict. Thus, qualitative interviews can be conducted as a follow-up activity to review the results of the previous step. Group discussions need to be implemented so that the group decision can be made.

Some academic works on the construction and validation of the employability scale have been carried out. Senan & Sulphey (2022) developed an employability scale for accounting graduates in Saudi Arabia. Literature review and expert discussion have shown a source of 50 items in five constructs: "soft skills, general business requirements, audit and assurance, conceptual knowledge and special topics in accounting" (Senan & Sulphey, 2022. p.145). 420 accounting professionals took part in a Likert five-point survey questionnaire. SPSS and the Python program were applied for exploratory factor analysis and confirmatory factor analysis (CFA). Results have indicated a validated tool of 20 items to measure accounting graduates.

Malaysia is the country where several papers were published on the construction of scales for student competence development.

Yusof et al. (2012) validated the employability skills measurement model for engineering students in Malaysia. The participants were 280 final-semester students. Items for the initial version of the questionnaire were taken from prior academic works. CFA was performed by AMOS software. Nine factors, which were confirmed in the measurement model, include “critical and problem solving, ability to pursue lifelong learning and information management skills, communication skills, teamwork, technology utilising skills, entrepreneurship, leadership, ethic and moral and social responsibility” (Yusof et al., 2012, p.355).

Hanapi et al. (2018) combined the Delphi technique and CFA to develop a measurement scale of technical skills in Malaysia. For the Delphi step, they interviewed seven experts who were college lecturers and engineers in the electrical engineering field. In the next step, 462 participants who were employers, college lecturers and graduates were invited to the survey questionnaire. AMOS software was exploited to determine the number of items. The study findings indicated that the technical skill measurement scale was verified to include 23 items categorised into five components.

Instead of using AMOS software for CFA, Mohd Dzin & Lay (2021) employed the partial least square structural equation modelling (PLS-SEM). 109 high school students in Malaysia joined the survey questionnaire in 2020. The reliability and validity of self-efficacy scales were assessed by outer loadings, composite reliability, average variance extracted, and the HTMT criterion.

Awwad (2021) also applied PLS-SEM to confirm factors in measurement scale of employability skills for at a college level in the United States. 303 students attended the survey questionnaire, in which they rated each employability skill by selecting one out of five levels: “very high competence, high competence, moderate competence, low competence, or very low competence” (Awwad, 2021, p.5). Nine factors ascertained in the measurement model covered (1) ability to conceptualize, visioning, lifelong learning, creative & innovation change; (2) decision-making & problems solving; (3) risk-taking, & oral communication; (4) organisation & time management, (5) leadership &

influence, coordinating, (6) interpersonal relation listing, (7) motivation personal strengths, (8) written communication, and (9) managing conflict.

Tentama & Anindita (2020) analyzed the employability scale validity and reliability with the participation of 90 students in Indonesia. Career identity, personal adaptability, and social and human capital were identified as three factors after analyzing confirmatory factors by the SmartPLS 3 software. Additionally, the employability scale, which was justified to be reliable and valid, comprised three dimensions and 36 items. This employability measurement scale had a value of composite reliability of 0.909.

1.5. Previous studies on the measurement of graduate employability

Graduate employability has been measured in many countries, such as Vietnam, Malaysia, New Zealand, Belarus and Colombia. However, there are still gaps to be filled in.

In Vietnam, the employability assessment of graduates from engineering and engineering technology majors was reported by Nguyen & Nguyen (2015). By investigating enterprises in Hanoi, Ho Chi Minh, the northern and southern provinces of Vietnam, Nguyen & Nguyen (2015) concluded that the technical skill group, which was core skills for engineering and engineering technology majors, was rated the lowest compared with two other groups of cognitive skills and social and behavioural skills. As they explained, many contents in engineering training programs were more outdated compared with industrial manufacturing requirements. Besides, universities' paying attention to student's employability skills development was restricted. Another interesting finding was that foreign enterprises rated graduates' employability at lower levels than private ones. Nguyen & Nguyen (2015) presented the foundation for the development of the measurement scale, but developing and validating procedure was discussed to a limited extent.

Three years later, Mai (2018) conducted a questionnaire survey to explore 25 employers' evaluations of the employability of VNU School of Law's graduates. Her study results revealed that seven generic competencies, which employers highly evaluated, but graduates' competencies were found to be weak, comprised "teamwork, problem-solving, communication, interpersonal, critical thinking, and life-long learning skills" Mai (2018, p.7). She mentioned the reasons for such above reality due to the quick development of IT in the 4th Industrial Revolution and globalisation, which resulted in the progress in trade, migration, and travel. Mai (2018)'s study was limited to only 25 employers who agreed to join in the survey questionnaire. Her description for participants were restricted.

Unlike Mai (2018), who studied employers of graduates from a member of a national university, Dang et al. (2019) evaluated the competence of graduates from non-public universities from the viewpoints of employers. Their measurement instrument covers four constructs: the attitude, the skill, the suitability of the training disciplines and the outcome of their jobs. The employers who participated in the survey came from different business areas: service, commerce, manufacturing, electronics, telecommunication, and IT. Their findings indicated that the graduates' competency was good. Non-public university graduates' attitudes were evaluated the best by employers compared with graduates' skills, job achievement, and appropriateness between the trained expertise and employment. However, Dang et al. (2019) did not mention which graduates' specific disciplines, which enterprises recruited and evaluated.

Similar to Dang et al. (2019) in Vietnam, García-Aracil et al. (2022) in the Belarusian context was unable to provide information on university disciplines of graduates. García-Aracil et al. (2022) compared graduates' present competencies and their required competencies for their current work from employers' perception based on 24 items developed from the project "Fostering Competencies Development in Belarusian Higher Education". The findings revealed that young graduates in Belarus achieved a lower level of competency (all the items were rated higher than three on average) than was needed for the job (most items obtained scores higher than four on average). However, they were not weak in knowledge and ability for the workplace, as assessed by 261 Belarusian employers in an online survey.

In Malaysia, Cheong et al. (2016) investigated employers' perceptions of graduates by sending the structured questionnaire to a list of 776 firms, which comprise different business sectors via email. The study confirmed that the employability cognition of Malaysian employers also differed based on the enterprise type. While the graduate's ability to reason and analyze was weakest ascertained by 87.5% of employers, followed by subject matter-related knowledge and skills (75% of participants), research ability received the most positive feedback from 56.2% of respondents. They continued to state that employability in Malaysia was more dependent on "soft skills and graduates' intrinsic personality and attitude toward work" than hard skills (Cheong et al., 2016, p.12). Even a firm which was interviewed in their study asserted that "I think attitude is the number one factor. It doesn't matter whether they are foreign-trained or locally trained. I think if you get one with the right attitude, you would be surprised they can do fairly well" (Cheong et al., 2016, p.12). The main weakness in the study by Cheong et al. (2016) was the failure to invite enough large numbers of employers to their study. Only 102 responses were recorded to be usable.

Like Cheong et al. (2016) in Malaysia, Khoo et al. (2020) in New Zealand also failed to address the small sample size. Khoo et al. (2020) measured the current competency level of new science and engineering graduates from the viewpoints of employers and teaching staff. 1,159 employers were invited to join the survey, but only 248 responses were, and 210 usable responses were used for analysing data. The study achieved a low return rate (18%). The measurement scale in their study was a survey questionnaire and focus group interviews. The findings showed that gaps in graduates' competency were identified for technical knowledge, problem-solving skills, critical thinking, creative thinking, and conceptual thinking. The problem could originate from universities' education, which lacked "real problems" (Khoo et al., 2020, p.10) with the restricted reflection of "real-world workplaces" (Khoo et al., 2020, p.10) in their training programs. Another interesting result was that the employers predict that problem-solving skills, teamwork and written communication could be ranked in the top five competencies in terms of importance in 2030.

In the same situation as Cheong et al. (2016) and Khoo et al. (2020), employers' engagement to the study was recorded to be limited in Colombia. Yepes Zuluaga (2024) studied the employability skills of engineering graduates (e.g. electronic engineering, mechatronics engineering and telecommunications engineering) from the perspectives of students, graduates and employers. Only 102 employers out of 607 participants were involved in the study, which contributed 16.8% to the sampling size. About 75% of employers received Bachelor's degrees, the majority of whom had more than ten years of working experience. The study asserted that participants' age was significantly linked with the growth of engineers' employability skills.

1.6. Proposed employability components model

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 (Chhinzer & Russo, 2018). 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 (Chhinzer & Russo, 2018). 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 (Hossain et al., 2020). Nevertheless, their study was limited to graduates without involving "employers' and academics' perceptions on graduate employability" (Hossain et al., 2020, p.306), 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 by developing and validating the employability model of engineering technology graduates.

Curtis indicated that measuring individual achievements was one of three popular purposes of assessment activities. Assessing graduates' achievements could provide fruitful value to employers by reporting the graduates' strong and weak competence areas. He also asserted that no assessment model covered all strengths without weaknesses and could be effectively applied across all higher education and workplaces (Curtis, 2004). This study's employability model of engineering technology graduates was developed based on a competence-based approach to employability and the USEM employability model.

Firstly, a competence-based approach to employability was applied in the current study. Van Der Heijde & Van Der Heijden (2006) ascertained that human resource management had transformed from a job-based system to an employee competence-based one during the last decades of the twentieth century because of fast changes in the market. From the employee's level, competence is defined as "a set of observable performance dimensions, including individual knowledge, skills, attitudes, and behaviours, as well as collective team, process, and organisational capabilities, that are linked to high performance, and provide the organisation with a sustainable competitive advantage." (Athey & Orth, 1999, p.216). To maintain work continuity and development in the enterprises, employees or graduates must present their competence through personal elements: ability, personality, attitudes and motivation because employees who obtain better knowledge and skills can perform better than others (Van Der Heijde & Van Der Heijden, 2006).

Secondly, USEM is one of the famous employability models in higher education. It has been widely accepted as "a major development in the area of graduate employability" (Sumanasiri et al., 2015, p.79). USEM emphasizes learners' characteristics, which indicate "not only the importance of understanding, skills and qualities and attributes but the reflection on these" (Taylor, 2022, p.4). However, USEM has shortcomings in understanding and applying. As Small et al. (2018) stated, this model is "too academic and not easily understood by students or their parents" (p.9). Considering both good and limited points of USEM, the present study exploited and adjusted three constructs in the USEM model and added one construct in the employability measurement model for engineering technology graduates. They include (i) knowledge, (ii) generic skills and technical skills, and (iii) personal qualities.

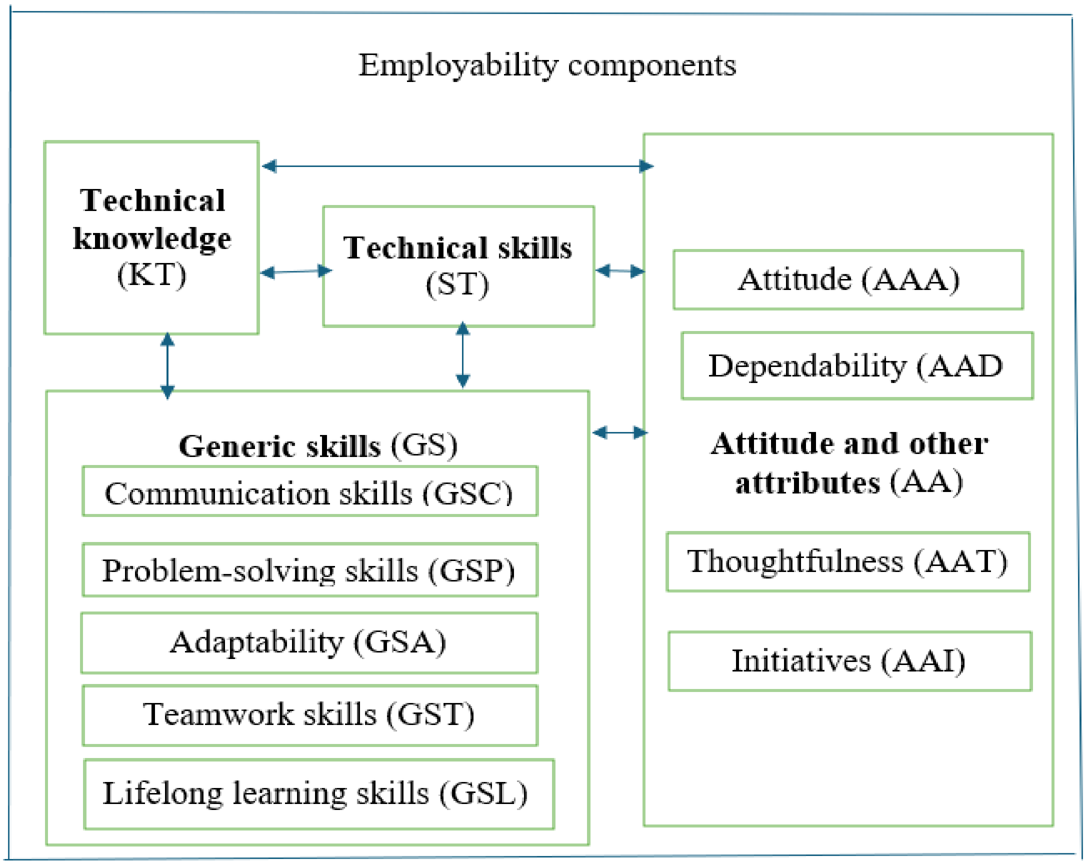


Figure 1. 7. Proposed employability component model of the present research

Source: The author's proposal

Figure 1.7 displays this study's employability components model. 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 first-order constructs with dimensions acting as second-order constructs. GS has five second-order constructs: communication skills (GSC), problem-solving skills (GSP), adaptability (GSA), teamwork skills (GST) and lifelong learning skills (GSL). AA has four second-order constructs: attitude (AAA), dependability (AAD), thoughtfulness (AAT) and initiatives (AAI). Only second-order constructs: GSC, GSP, GSA, GST, GSL, AAA, AAD, AAT, AAI, KT and ST were analysed for validity and reliability of the scale.

1.7. Conclusion

From the literature review of prior research, this chapter has clarified the employability scope and employability model.

Firstly, employability is a multidimensional terminology, which makes it difficult to precisely identify the contents of employability because it is where "employers' needs and individuals' attributes meet" (Boden & Nedeva, 2010, p.42) and constantly changes over time and places. Furthermore, Chen et al. (2018, p.269) argue that employability has no consolidated view because it is “a complex construct” that cannot be identified comprehensively and briefly. So far employability definitions have been diverse among organizations (e.g. Confederation of British Industry, the Australian Chamber of Commerce and Industry, and the European Higher Education Area) and authors (e.g Hillage & Pollard, Moreland, Thijssen et al. and Cheng et al.). This thesis selected the employability definition stated by Moreland (2006) and Confederation of British Industry (2009) to develop the measurement scale. Accordingly, employability is defined “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” (Moreland, 2006, p.21). As the definition by (Moreland, 2006) mentions, employability and employability skills are two different terms, in which the first one is broader and includes the second one. Employability skills have been widely researched from employers’ perspectives in different disciplines, such as marketing and sales (Chowdhury & Miah, 2019), human resource management (Mansour & Dean, 2016), engineering (Chithra & Banumati, 2014; Prof & Mishra, 2016), maritime business (Chen et al., 2018), multi-disciplines (Collet et al., 2015), sports and recreation (Tsitskari et al., 2017), construction (Aliu & Aigbavboa, 2020), and banking (Al-Shehab et al., 2020). Prior research has not shown much empirical research on employability from the viewpoint of employers. A few employability studies have been published in equipment manufacturing (Wang et al., 2022) and hospitality (Ngoepe & Wakelin-theron, 2023) and muti-disciplines (Hosain et al., 2021; Steurer et al., 2023). They are good reference sources for the present study in engineering technology discipline.

Secondly, this study follows a competence-based approach to employability. This approach focuses more on graduates and concerns competencies that university graduates must possess during school to meet employers' requirements. A competency-based approach to employability is advantageous to measure “different components, to explore their interrelatedness, and to examine how employees may make progress in their employability” (Froehlich et al., 2018, p.231). Different employability models were proposed in higher education literature in light of the competency-based approach to employability. The USEM employability model by Yorke & Knight (2006) is regarded as the most famous model and has been cited widely. This study exploited the adjusted USEM employability model, which covers (i) knowledge (ii) generic skills, (iii) technical skills and (iv) attitude and other attributes.

CHAPTER 2: RESEARCH DESIGN AND METHODOLOGY

2.1. Research design

This study exploits a mixed-methods approach, including using and integrating both qualitative and quantitative methods (Tashakkori & Creswell, 2007). The key benefit of qualitative data is that it gives "actual words of people in the study" (Creswell, 2012, p.535) and provides different viewpoints on the study topic. The main advantage of quantitative data is to supply specific numbers for statistical analysis to draw frequency or describe trends about a large number. New knowledge can be created by the use of the qualitative and quantitative approaches more than just the sum of the two parts, even "equivalent of equation 1 + 1 = 3" (Fetters & Freshwater, 2015, p.204).

This study applies the type of exploratory sequential design for mixed methods. Exploratory sequential design refers to a two-phase model in which "the procedure of first gathering qualitative data to explore a phenomenon, and then collecting quantitative data to explain relationships found in the qualitative data" (Creswell, 2012, p.543). The exploratory research design starts with qualitative data collection, implemented by interviews with a few participants. The exploration of primary qualitative data can bring about "detailed, generalizable results through the second quantitative phase" (Cresswell, 2012, p.544). Quantitative data collection is carried out by surveying many participants. Figure 2.1 outlines the steps of exploratory sequential design for the mixed method study.

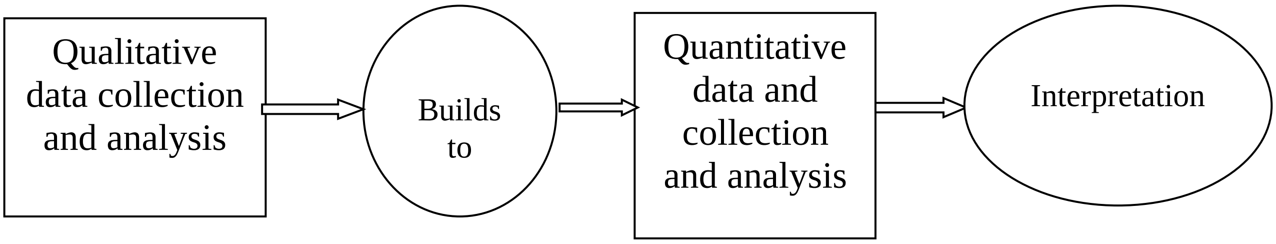


Figure 2. 1. Exploratory sequential design

Source: Creswell (2012, p.541)

The thesis aims to develop an instrument and use its tool for measuring graduate employability. As Creswell (2012) describes, the exploratory sequential design matches the purposes of the study.

> "Develop an instrument: Obtain themes and specific statements from individuals that support the themes. In the next phase, use these themes and statements to create scales and items as a questionnaire. Alternatively,

> look for existing instruments that can be modified to fit the themes and statements found in the qualitative exploratory phase of the study. After developing the instrument, test it out with a sample of a population."
>
> (Creswell, 2012, p.551)

Qualitative research has four data collection forms (Creswell, 2012). The qualitative data collection form, which was selected to apply in the thesis, is the second kind called "interviews and questionnaires" (Creswell, 2012, p.214). There are six techniques for the second form, which cover four ways for interviews, one for a questionnaire, and the last for both (Table 2.1). Interviews, "one of the most powerful ways in which we try to understand our fellow human beings" (Fontana & Frey, 2000, p.645), can be classified into different forms and uses, such as individual, group, telephone, and electronic email interviews. Group interviews, the "systematic questioning of several individuals simultaneously in a formal or informal setting" (Fontana & Frey, 2000, p.651), are selected to apply in this thesis because they are suitable for collecting rich data. Group interviews are advantageous because they allow the respondents to interact more, reconsider and even adjust their responses. However, group interviews are unlikely to produce generalized results and may be affected by the opinion of someone higher in age or position (Fontana & Frey, 2000).

Table 2. 1. Types of interviews and questionnaires in qualitative research

No.	Interviews and questionnaires
1.	Conduct an unstructured, open-ended interview and take interview notes.
2.	Conduct an unstructured, open-ended interview; audiotape the interview and transcribe it.
3.	Conduct a semi-structured interview; audiotape the interview and transcribe it.
4.	*Conduct focus group interviews; audiotape the interviews and transcribe them*.
5.	Collect open-ended responses to an electronic interview or questionnaire
6.	Gather open-ended responses to questions on a questionnaire

Source: Creswell (2012, p.213)

Quantitative research has two data collection methods: scales and documents with numeric score data. Scales may include questionnaires, closed-ended interviews, and closed-ended observations. Documents may cover census and attendance records (Creswell, 2012). The questionnaire was chosen as a quantitative research scale for the thesis in a mixed-method study. A questionnaire is “a form used in a survey design that participants in a study complete and return to the researcher. The participant chooses answers to questions and supplies basic personal or demographic information.” (Creswell, 2012, p.382). The research process is summarized in Table 2.2.

Table 2. 2. Research process

Phase 1: Developing and validating an assessment scale	**Contents**
Step 1.1 (Chapter 1)	Building a theoretical model
Step 1.2 (A proposed scale)	Items generation
Step 1.3 (Qualitative method)	Receiving feedback from 20 experts
Step 1.4 (Qualitative method)	Analyzing experts' opinion to adjust items
Step 1.5 (Quantitative method)	Collecting data for a pilot test
Step 1.6 (Quantitative method)	Analyzing and adjusting research model
Phase 2: Measuring	
Step 2.1 (Quantitative method)	Measuring the employability
Step 2.2 (Quantitative method)	Difference testing

A reliable and valid employability scale was formed based on seven steps (Hinkin et al., 1997). Items creation and content adequacy assessment are the two initial steps in a seven-step process. Items generation can be conducted deductively or inductively, but the minimum number of items is required so that the domain of interest can be measured adequately. For each construct, four or more items are suggested to be gathered to ensure internal consistency (Hinkin et al., 1997). Content adequacy assessment can involve the participation of panelists in several rounds. Qualitative interviews can be conducted as a follow-up activity to review the results of the previous step. Group discussions need to be implemented so that the group decision can be made. In the third step, the questionnaire can be sent to collect assessments extensively. The next three steps are related to the scale analysis and assessment. The last step is the test of scale with a new data set.

2.2. Items creation for the proposed scale

The employability scale for engineering technology graduates was proposed based on the USEM model, competence-based approach to employability, human capital theory, and empirical employability studies in several countries. The proposed scale included four components or first-order constructs: (i) Technical knowledge, (ii) Technical skills, (iii) Generic Skills, (iv) Attitude, and other attributes. Both technical knowledge and technical skills comprise second-order construct for each. Generic skills included five second-order constructs: communication, problem-solving, adaptability, teamwork, and life-long learning. Attitude and other attributes consisted of 4 second-order constructs: attitude, dependability, thoughtfulness, and initiative. The distribution of constructs and items in the competency framework is shown in Table 2.3.

Table 2. 3. Components in the proposed employability scale

No.	First-order constructs	Second-order constructs	Items
1	Technical knowledge	1	7
2	Technical skills	1	5
3	Generic skills	5	21
4	Attitude and other attributes	4	18
	Total	11	51

Forty-seven items of the fifty-one items originated from the academic works of researchers. Four items the author proposed were added to the questionnaire (Table 2.4). Report the work plans and results (GSC_1), Feel comfortable working with colleagues (AAA_4), Advertise the enterprise’s brand image (AAA_6), and Complete the work as planned (AAD_1) are four proposed new items. Four items were taken from employers’ sharing when they told University A undergraduates about the skills and attributes required at work during the field trips to manufacturing enterprises for experiential learning (Pham & Nguyen, 2022).

Table 2. 4. Initial questionnaire

Code	Items	Source
I	**TECHNICAL KNOWLEDGE (KT-7 items)**	
KT_1	Demonstrate knowledge of basic science	Zaharim et al., 2010, Iqbal Khan et al., 2016
KT_2	Demonstrate knowledge of the social sciences	Moaveni, 2010
KT_3	Identify technology trends	Aliu & Aigbavboa, 2020
KT_4	Build technological processes	Moaveni, 2010
KT_5	Understand workplace safety requirements	Curtis & McKenzie, 2001; MOLISA, 2019
KT_6	Analyze professional problems	Zaharim et al., 2010
KT_7	Apply theoretical knowledge to solve specific work problems	Ye & Jiang, 2014; Pažur Aničić et al., 2023
II.	**TECHNICAL SKILLS (ST-05 items)**	
ST_1	Arrange the order of work to be done	Nguyen & Nguyen, 2015
ST_2	Exploit technical documentation	Zaharim et al., 2010
ST_3	Understand technical drawings	Zaheer et al., 2020
ST_4	Use engineering software to solve technical problems	Hossain et al., 2020
ST_5	Use proper engineering tools for specific tasks	Zaharim et al., 2010
III.	**GENERIC SKILLS (GS-21 items)**	
3.1.	**Communication skills (GSC-5 items)**	
GSC_1	Report the work plans and results	The author's proposal
GSC_2	Use a foreign language at work	Pažur Aničić et al., 2023; Leandro Cruz & Saunders-Smits, 2022
GSC_3	Comprehend opinions and comments at work	Chen et al., 2018
GSC_4	Communicate about technical issues through written words in the mother tongue	Pažur Aničić et al., 2023
GSC_5	Communicate about technical problems orally in the mother tongue	Robinson, 2006; Pažur Aničić et al., 2023

Code	Items	Source
3.2.	**Problem-solving skills (GSP-4 items)**	
GSP_1	Identify the problems to be solved	Zaharim et al., 2010 Al-Shehab et al., 2020
GSP_2	Prioritize the problem to solve	Robinson, 2006
GSP_3	Identify the cause of the problem	Robinson, 2006
GSP_4	Propose the right solution	Zaharim et al., 2010
3.3.	**Adaptability (GSA-4 items)**	
GSA_1	Adapt to changes in work	Chen et al., 2018
GSA_2	Work in a multicultural environment	Chen et al., 2018; Pažur Aničić et al., 2023
GSA_3	Perform well under pressure	García-Aracil et al., 2022; Pažur Aničić et al., 2023, Tran et al. 2022
GSA_4	Give initiatives in work	Pažur Aničić et al., 2023
3.4.	**Teamwork (GST-4 items)**	
GST_1	Set the team's common goals	Leandro Cruz & Saunders-Smits, 2022
GST_2	Collaborate with colleagues	Chen et al., 2018
GST_3	Promote teamwork spirit	Pažur Aničić et al., 2023, García-Aracil et al., 2022
GST_4	Implement the team decisions	Chen et al., 2018
3.5.	**Lifelong learning (GSL-4 items)**	
GSL_1	Acquire new knowledge steadily and continuously	Robinson, 2006
GSL_2	Actively participate in courses for personal development	Leandro Cruz & Saunders-Smits, 2022
GSL_3	Stay up to date with new methods for professional development	Leandro Cruz & Saunders-Smits, 2022
GSL_4	Identify your strengths and weaknesses to suggest appropriate improvement methods.	Leandro Cruz & Saunders-Smits, 2022

Code	Items	Source
IV.	**ATTITUDE AND OTHER ATTRIBUTES (AA-18 items)**	
4.1.	**Attitude (AAA-6 items)**	
AAA_1	Work seriously	Dipboye, 2018
AAA_2	Work autonomously	Pažur Aničić et al., 2023
AAA_3	Feel ready to receive more work	Dipboye, 2018
AAA_4	Feel comfortable working with colleagues	The author's proposal
AAA_5	Have a long-term commitment to work at the enterprise	Dipboye, 2018
AAA_6	Advertise the enterprise’s brand image	The author's proposal
4.2.	**Dependability (AAD-4 items)**	
AAD_1	Complete the work as planned	The author's proposal
AAD_2	Comply the workflow	Park & Hill, 2018
AAD_3	Get the job done correctly	Park & Hill, 2018
AAD_4	Comply with honesty at work	Park & Hill, 2018
4.3.	**Thoughtfulness (AAT-4 items)**	
AAT_1	Show industry manners	Park & Hill, 2018
AAT_2	Consider carefully to avoid making careless mistakes	Park & Hill, 2018
AAT_3	Manage pressure in difficult situations	Tran et al., 2022
AAT_4	Give constructive advice to colleagues	Leandro Cruz & Saunders-Smits, 2022
4.4.	**Initiative (AAI-4 items)**	
AAI_1	Accept work challenges	Park & Hill, 2018
AAI_2	Generate new ideas at work	Pažur Aničić et al., 2023; ACCI&BCA, 2002
AAI_3	Keep eager to complete work	Park & Hill, 2018
AAI_4	Keep committed to doing good work	Park & Hill, 2018

The scale was developed and adjusted through the Delphi method. The reliability and validity of the scale were examined through the pilot questionnaire.

2.3. Qualitative method

2.3.1. Sampling

A questionnaire was adjusted by exploiting the Delphi method. The Delphi technique is directly related to theory building and is appropriate for developing concepts that need expert participation to make decisions. The study applied the Delphi method in the education sector to reach an agreement among experts on employability constructs and items to assess graduates' employability.

The Delphi technique does not rely on "a statistical sample that attempts to be representative of any population" (Okoli & Pawlowski, 2004, p.6). It can be understood that the Delphi method does not need to perform the sampling technique for the population's representative but depends on a group decision mechanism that needs qualified experts with a profound understanding of the issues. Therefore, choosing qualified experts is one of the most critical steps in the Delphi technique (Bayona-Ore et al., 2018).

The experts who were selected for the thesis were representatives of the groups of lecturers and employers involved in teaching and using university graduates. Because the number of experts for each group can range from 10 to 18 people (Okoli & Pawlowski, 2004; Bayona-Ore et al., 2018) or 15 to 35 people (Gordon, 1994, p.1) or below 50 people (Nworie, 2011, p.26; Ye & Jiang, 2014), the study is proposed to select 20 experts above the minimum level and as shown to be most suitable size by Mullen (2003, p.42). Fifteen employers and five lecturers were invited to attend interviews about which construct is suitable for the employability of ET graduates. Their criteria for selecting experts are described in **Table 2.5**. The experts who agreed to attend in reference to the requirements in Table 2.5 had their detailed characteristics presented in **Table 2.6**.

Criteria for selecting experts from enterprises are classified into two categories: head/deputy head of technical division and human resource recruiting team leaders. For the ten members, technical division leaders need five criteria. Graduates can work in foreign-owned enterprises, private-owned enterprises or state-owned enterprises. Still, experts from foreign-owned enterprises are preferred because they continuously intend to recruit talented engineers each year and set specific job criteria for working positions. Private-owned enterprises may not be included because they tend to have temporary needs for recruiting technicians and seem to have unclear requirements for different working positions. Furthermore, they must directly supervise and manage engineering technology graduates in their working divisions. Thirdly, technical division leaders can graduate from different engineering or technology disciplines. Because there exist differences in the training in the two groups of these disciplines, those who graduated and possessed the Bachelor of Arts in Engineering Technology disciplines are chosen. The fourth criterion is that experts need at least five years of working in enterprises to understand the enterprise’s working culture and have experience in manufacturing practices. Lastly, the technical knowledge and skills that differentiate engineering technology jobs from other jobs are vital foundations for thriving careers. The leaders of technical departments must have in-depth views of the theoretical and practical requirements of graduate competencies to keep their jobs stable and move forward.

The second group of experts from enterprises are five members who work as human resources recruiting team leaders. Four criteria are set for this group. First, the employment survey from previous years indicates that private enterprises used to recruit a few graduates for their companies due to small-scale manufacturing, and the recruiting team's roles seem unclear. On the other hand, recruiting teams in foreign-owned companies are an independent division under the human resource department. The thesis focuses on recruiting team leaders in different foreign-owned companies to search for experts' feedback in the context of international integration. Second, the second group needed those who directly recruited ET graduates from other universities which trained ET majors. Through their professional activities, they mastered generic skills and attribute requirements to be accepted into enterprises and contribute to enterprises' long-term development. Third, this group is required to obtain their qualifications in human resource management. Fourth, besides the requirement of solid knowledge through their qualifications in human resource development, it is compulsory to have at least five years of working time. It is preferred for members of the recruiting team group to be selected if they joined in academic collaboration between university and enterprise, such as group interviews by ET program accreditation experts in advance.

Criteria for choosing experts from the university cover three criteria. Regarding qualifications, experts need to have doctorate degrees with diverse professional activities. Second, they directly manage or participate in training engineering technology undergraduates. Lecturers with experience developing training programs for engineering technology majors or preparing reports to accredit their training programs are preferred. The third criterion is related to teaching experience, which requires at least five years of giving lectures.

Table 2. 5. Criteria for selecting experts to answer the draft question

No.	Title	Criteria	Number of experts
1	Head/Deputy head of technical division	- Working in foreign-owned enterprise. - Current job: supervising and guiding ET graduates - Qualification: Bachelor of Arts related to engineering technology - Number of years of practical experience in the field: 5 – 20 years. - Technical skill: master technical knowledge and technical skills for career growth of ET graduates.	10
2	Human resource recruiting team leader	- Working in foreign-owned enterprise. - Current job: recruiting new ET graduates (Understanding vital soft skills and attributes for ET graduate development) - Qualification: Bachelor of Arts related to human resource - Number of years of practical experience in the recruiting field: 5 – 15 years + Feedback experience: prefer those who have previously participated in group interviews with ET program accreditation experts.	5
3	University lecturer or both university lecturer and department leader	- Qualification: Doctor - Current job: managing and operating ET programs (Professional experience in teaching ET courses, developing, operating or preparing for the accreditation of an ET program). - Number of years of teaching experience: 5 – 15 years.	5

Twenty experts accepted the invitation to give their viewpoints in the expert feedback rounds.

For the technical group, ten experts met the selected requirements. They have the following specific characteristics. First, they worked for six large-scale enterprises owned by Japan, Korea and China, Taiwan (China). Their enterprises' names were coded into DEN, HYU, LGH, WIS, LUX, and CAN. The enterprises were located in Hanoi, Hai Duong, Hai Phong, Ha Nam and Bac Giang. Second, they were confirmed by their enterprises' human resource departments to have worked with ET graduates from different universities. Their technical tasks were related to product design, manufacturing, quality assurance, research and development. Third, the ten technical experts comprised 90% who received Bachelor's degrees in ET and 10% who achieved a Master's degree in ET. 90% with Bachelor's degrees consisted of 40% who got a Bachelor's degree in Electronics and Telecommunications ET, 10% who got a Bachelor's degree in Mechanical ET, 10% who got a Bachelor's degree in Mechatronic ET, 10% who got Bachelor degree of Automobile ET, 10% who got Bachelor degree of Electric and Electronic ET, and 10% who got a Bachelor's degree in Control and Automation ET. Fourth, the technical experts were all men. Their working experience ranged from 9 to 17 years. Lastly, they comprehended technical knowledge and technical skills for the career growth of ET graduates. In the journey to becoming leaders of technical divisions, they experienced individual and team-based technical improvement activities, which required solid technical knowledge and practical technical skills. They also trained new graduates for practical knowledge and skills for specific work positions.

Regarding the human resource group, five chosen members were human resources recruiting team leaders in foreign enterprises owned by Taiwan (China), China, Switzerland, and Korea. Their enterprises' names were coded into DEN, HYU, NES, LUX, WIS and ARC. The enterprises were located in Hanoi, Hai Duong, Hung Yen, Ha Nam and Vinh Phuc. Second, all of them were females who directly recruited ET graduates from universities such as Hanoi University of Industry, Hung Yen University of Technology and Education and the University of Economics-Technology for Industries. Third, this group members obtained their qualifications relating to human resource management, which preferred graduates in economics-related majors (accounting, economics, and business administration) or English-related majors (commercial English and English Linguistics) for effective communication with foreign owners.

Furthermore, they had working experience of five to twelve years in the profession of recruiting, which was suitable for comprehending and updating generic skills and attributes of graduates who belonged to Generation Z or people born in 1997-2013 (Schroth, 2019). One member of the recruiting team attended one university's Industrial Consultation Board possessed various experiences in group interviews to adjust and update ET training programs.

The last expert group is five university lecturers. First, all members obtained doctorates degrees. Four members received doctorate degrees in engineering, such as automobile engineering, mechatronic engineering, automation engineering, electronics and telecommunications engineering. One member had a doctorate degree in educational management, and his thesis's research object concerned thermal engineering. Second, 100% of the members had lectures for ET undergraduates. Noticeably, 60% of members had the position of heads of department. The remaining 40% of the members took part in preparatory activities for ABET accreditation. Third, experts who were selected from lectures had long years of experience in teaching undergraduates. All members had taught at higher education institutions for at least nine years. 40% of members had worked with ET undergraduates for over 20 years.

Table 2. 6. Experts' detailed characteristics

No.	Code	Organization	Qualifications	Sex	Working unit	Experience (years)
I	**Technical group**		Note: F means Female, M means Male			
1	ETD.DEN.01	Japan-owned company	Bachelor (Automobile ET)	M	Design	17
2	ETD.DEN.02	Japan-owned company	Bachelor of Mechanical ET	M	Manufacturing	16
3	ETD.HYU.03	Korea-owned company	Bachelor (electronics and telecommunication ET)	M	Production technology	14
4	ETD.HYU.04	Korea-owned company	Bachelor (Electric-Electronic ET)	M	Production	15
5	ETD.LGH.05	Korea-owned company	Master (Electric ET)	M	Research and development	13
6	ETD.LGH.06	Korea-owned company	Bachelor (electronics and telecommunications ET)	M	Research and development	9
7	ETD.WIS.07	Taiwan (China)-owned	Bachelor (electronics and telecommunications	M	Quality assurance	11

No.	Code	Organization	Qualifications	Sex	Working unit	Experience (years)
		company	ET)			
8	ETD.WIS.08	Taiwan (China)-owned company	Bachelor (electronics and telecommunications ET)	M	Production engineering	9
9	ETD.LUX.09	China-owned company	Bachelor (Control and Automation ET)	M	Production and Experiment	10
10	ETD.CAN.10	China-owned Company	Bachelor (Mechatronic ET)	M	Manufacturing engineering	15
II	**Human resource group**					
11	EHR.HYU.11	Korea-owned company	Bachelor (Accounting)	F	Recruiting	10
12	EHR.NES.12	Switzerland-owned company	Bachelor (Commercial English)	F	Labor Relations	10
13	EHR.LUX.13	China-owned company	Bachelor (Business Administration)	F	Recruiting	8
14	EHR.WIS.14	Taiwan (China)-owned company	Bachelor (English Linguistics)	F	Human resource	5
15	EHR.ARC.15	Taiwan (China)-owned company	Bachelor (Economics)	F	Human resource	12
III	**Lecturer group**					
16	L.AUT.01	State-owned university	Doctor (Automobile Engineering)	M	Automobile technology	9
17	L.MEC.02	State-owned university	Doctor (Mechatronic Engineering)	M	Mechatronic engineering	12
18	L.THE.03	State-owned university	Doctor (Education Management)	M	Thermal technology	23
19	L.CON.04	State-owned university	Doctor (Automation Engineering)	M	Automation	11
20	L.ELE.05	State-owned university	Doctor (Electronics and Telecommunications Engineering)	M	Electronic technology	23

2.3.2. Instrument

The thesis applied the Delphi method to clarify and determine the scale’s constructs and items. The expertise or Delphi method was developed by the RAND Corporation in the United States in the early 1950s to reach expert groups' agreement on military issues (Gordon, 1994). Still, it has recently become more attractive to educational researchers (Tran et al., 2020) due to the development of technology-based communication methods.

The Delphi technique is directly related to theory building, which allows researchers to identify variables and propose propositions (Okoli & Pawlowski, 2004). The Delphi technique is suitable for developing concepts that need expert participation to make decisions. Agreement on any particular issue by experts is better than non-experts (Gordon, 1994).

As Hsu & Sandford (2007) described, there are often four iterations of the feedback process. The first round starts with an open-ended questionnaire. It is noticeable that the open-ended questionnaire in the initial round is subject to change if basic information from an extensive literature review is usable and available. The second round asks experts to review the report of the first round and make changes if possible. It is feasible for investigators to ask the experts to explain reasons for adjusting or deleting. The third and fourth rounds can continue if the second round has items to reconsider.

2.3.3. Data collection

Context of study

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 attracted the most significant number of students to enrol each year. Identified as a central technical school of Vietnam, this institution was paid visits by President Ho Chi Minh four times. University A is also one of the leading application-oriented universities in the modern period. In the light of three UA-JICA projects, the 50ha-large university has promoted a close partnership with enterprises to provide high-quality graduates for Vietnam's national targets.

In terms of enterprise cooperation, University A established a functional unit supporting employment for undergraduates in 2014. After ten years, more than 200 strategic 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.

Delphi rounds

There are two or more rounds in the Delphi process based on the consensus level at the prior round (Keeney et al., 2006, Bayona-Ore et al., 2018).

The first round of applying the Delphi method

The first round was to ask respondents to finish the questionnaire designed with a numerical rating scale. Twenty experts were asked to give their feedback. The experts were asked to provide their assessment. They were requested to select "Agree" or "Neutral", or "Disagree" to decide whether the item is suitable for evaluation of graduate employability.

The second round of applying the Delphi method

Onwuegbuzie et al. (2009) suggest that many groups should be used "to assess if the themes that emerged from one group also emerged from other groups" (p.6). Following the guide by Onwuegbuzie et al. (2009), twenty participants, including ten heads of technical divisions, five human resource recruiters and five university lecturers, who joined the first round, were invited for group interviews. Experts were introduced to the interview aims. Afterwards, the report for the first round was presented, and participants were asked to clarify the statements below 75% agreement. They were asked whether they wanted to change their ratings in the first round and revised the scale by answering the following questions: Are such constructs appropriate? Do any constructs need to be added/deleted? For each dimension, is the number of items enough to reflect each dimension? Which items are not clear? Why? How to adjust? Which items should be removed? Why? Which items should be added? Why?

Lecturers were directly interviewed in one group because they worked in one university. Employers who came from different enterprises located in different provinces were arranged to join online group interviews for their convenience in working time. The first group discussion was a lecturer group, followed by a human resource group, and the last was a technical group. In the second and third groups, the previous round result report was presented at the beginning of an online meeting.

2.3.4. Data analysis

The Delphi technique is exploited to achieve expert agreement on a particular topic, but standards for agreement in Delphi have never been created (von der Gracht, 2008). The Delphi studies are applying several ways to measure expert consensus. Firstly, a certain level of consensus is identified by descriptive statistics. Some argue 51%, some propose at least 60%, some suggest 67% for the yes/no scale, some mention 75%, 80% on the 5-Point Likert scale, and others define *agreement* as 95% for the first round (von der Gracht, 2008, p.53). In our thesis, the author follows the proposal of a consensus level of three-quarters of respondents by Keeney et al. (2006). It means that if one item reached agreement with 75% of participants, such items were accepted for further use.

2.4. Quantitative method

2.4.1. Sampling

a. For a pilot test

The entire process of inviting participants and taking the survey responses by the 153 employers from technical groups was conducted in January and February 2024. Technical groups were identified through events such as job fairs at university campuses, field trips to enterprises or internships. Table 2.7 presents the personal characteristics of the 153 survey participants. Specifically, among these 153 participants, 135 (or 88.24%) were male, and 18 (11.76%) were female. Regarding qualifications, most respondents earned bachelor's degrees (n=130, 84.97%), whereas the rest held a higher or lower degree level. Most participants worked for private and foreign enterprises (54.25% and 37.25%, respectively), while the rest served state-owned companies (n=8, 8.50%). Regarding working location, most respondents worked in enterprises which are in Hanoi (n=90; 58.82%), Bac Ninh (n=28; 18.30%) and Bac Giang (n=20; 13.07%). A possible explanation for this might be the advantage in economic geography. 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 (Việt Nam News, 2023; Viet Nam News, 2024). Enterprises recruited graduates of seven ET majors. Each company recruited graduates of one or a group of majors. Graduates of electric and electronic ET majors were recruited by the most significant proportion of enterprises (n=97; 63.40%), and graduates of thermal engineering technology were hired by the smallest number (n=9; 5.88%).

Table 2. 7. Sample characteristics in the pilot test

Characteristics	Category	Overall (N=153)	
		N	%
Gender	Male	135	88.24
	Female	18	11.76
Qualifications	Doctorate degree	3	1.96
	Master's degree	5	3.27
	Bachelor's degree	130	84.97
	Degree of Associate	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
Working location	Ha Noi	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
Graduates' majors	Mechanical ET	38	24.84
	Mechatronic ET	36	23.53
	Automotive ET	25	16.34
	Thermal ET	9	5.88
	Electric, Electronic ET	97	63.40
	Electronics and Telecommunication ET	37	24.18
	Control and Automation ET	51	33.33

* Note: ET means Engineering Technology

b. For an official test

Participants in the official test were different from the respondents for the pilot test. Participants who joined the pilot test recruited and used ET graduates in general without worrying about graduation year and specific ET discipline. The participants in the official test were chosen based on the report by graduates in 2023 about their workplace and their employers. The questionnaire was sent to the employers to assess each graduate from 7 Engineering Technology disciplines at University A with the following discipline codes and names:

7510201: Mechanical Engineering Technology

7510203: Mechatronic Engineering Technology

7510205: Automotive Engineering Technology

7510206: Thermal Engineering Technology

7510301: Electric, Electronic Engineering Technology

7510302: Electronics and Telecommunication Engineering Technology

7510303: Control and Automation Engineering Technology

The graduates' employment survey in August 2023 showed that 2.241 graduates attended the compulsory survey, in which 555 graduates (nearly 25%) confirmed to have gained jobs, and the others (above 75%) did not intend to find jobs or wanted to pursue a master's degree. The thesis focused on the assessment of employers who managed 555 ET graduates.

Table 2. 8. Number of graduates in August 2023 at University A

Code / Number	7510201	7510203	7510205	7510206	7510301	7510302	7510303	Total
Graduates confirmed to have jobs in August 2023	70	94	67	16	120	106	82	**555**

Source: Author collected from University A's website and survey

Code of discipline:

7510201: Mechanical ET, 7510203: Mechatronic ET, 7510205: Automotive ET, 7510206: Thermal ET, 7510301: Electric, electronic ET, 7510302: Electronics and telecommunication ET, 7510303: Control and automation ET

The study used convenient sampling techniques. The official questionnaire of 47 items for rating and respondent-related information was sent to 350 employers in three months in 2024. After removing invalid responses, the 234 usable responses were employed to analyze.

The number of enterprises that recruited 555 ET graduates of seven engineering technology majors is 307. About 36% of the enterprises are joint stock companies, and 64% are limited companies. It was shown that some enterprises recruited one or some groups of graduates. Some enterprises, such as LG Display, Canon, or Nissan Automotive Technology, hired many graduates from one or several majors.

The participants were involved in the official test from 26th February to 3rd April 2024. The demographic information is presented in Table 2.9.

Most participants were male (n=177 out of 234), accounting for 75.64 per cent. They almost earned Bachelor's degrees before entering enterprises and maintained their qualifications until the survey time (n=175; 74.79%). The second largest participants were those with advanced diplomas (n=36; 15.38%). Over 90% of participants likely finished tertiary education before accessing enterprises' working environment. It can be assumed that higher education and vocational education are suitable to work at enterprises.

Regarding working years, participants have worked for up to 25 years. It is noticeable that the most significant number of respondents have five to ten years of experience (90; 38.46 %), followed by three groups of 10 to 15 years of experience (n=58; 24.79%), group of below five years (n=43; 18.38%), and group of 15 to 20 years (n=35; 14.96%).

Concerning working divisions in enterprises, most respondents (over 76%) worked for three departments: design or research and development, manufacturing technique, and human resources. Specifically, nearly 30% of respondents worked in design, research, and development. 27.35% worked in manufacturing techniques, and 19.23% held jobs in human resources. For some companies, assessing the employability of graduates was implemented by human resource departments after taking feedback from technical and other related divisions, for example, an enterprise which manufactures LED and OLED TV monitors in Hai Phong or a tech company which produces electronic components for Apple and Samsung in Bac Giang.

Regarding the kinds of enterprise, 100% of participants served foreign-owned and private-owned companies. Specifically, participants who worked for foreign-owned companies (n=197; 84.19%) were more than those who had jobs in the private sector (n=37; 15.81%)

Table 2. 9. Sample characteristics in the official test

Characteristics	Category	Overall (N=234)	
		N	%
Gender	Male	177	75.64
	Female	57	24.36
Qualifications	Doctorate	1	0.43
	Master’s degree	5	2.14
	Bachelor’s degree	175	74.79
	Advanced Diploma	36	15.38
	Diploma	17	7.26
Working years	Below five years	43	18.38
	5 ≤ 10 years	90	38.46
	10 ≤ 15 years	58	24.79
	15 ≤ 20 years	35	14.96
	20 ≤ 25 years	8	3.42
Name of working division	Design/ R&D	69	29.49
	Maintenance	5	2.14
	Manufacturing technique	64	27.35
	Production management	25	10.68
	Quality management/Quality assurance	6	2.56
	Production	19	8.12
	Human resource	45	19.23
	Others	1	0.43
Kinds of enterprises	Foreign owned	197	84.19
	Private-owned	37	15.81
Enterprise address	Ha Noi	98	41.88
	Bac Ninh	20	8.55
	Bac Giang	84	35.90
	Vinh Phuc	3	1.28
	Hai Duong	6	2.56
	Hai Phong	15	6.41
	Hung Yen	1	0.43
	Ha Nam	2	0.85
	Hoa Binh	1	0.43
	Thai Nguyen	3	1.28
	Thanh Hoa	1	0.43

Characteristics	Category	Overall (N=234)	
		N	%
Used graduates	Mechanical ET	23	9.8
	Mechatronic ET	44	18.80
	Automotive ET	31	13.25
	Thermal ET	12	5.13
	Electric, Electronic ET	41	17.52
	Control and automation ET	36	15.38
	Electronics and telecommunication ET	47	20.09

Regarding enterprise address, respondents reported working for enterprises located in 11 provinces in Vietnam. It can be inferred that University A graduates in 2023 selected to serve enterprises which were close to their study. Ha Noi, Bac Giang, Hai Duong and Hai Phong are five provinces where 95.3% of graduates of engineering technology selected to work after leaving university, in which Hanoi (98; 41.88%) attracted the vastest number of graduates of engineering technology, followed by Bac Giang (n=84; 35.90%). It is understood that many FDI companies changed their working locations from China to northern Vietnam after the COVID-19 pandemic, which brought many job opportunities for university graduates.

Lastly, 234 graduates of seven ET majors were recruited by enterprises. The survey received the employers' most extensive responses for employability assessment of electronics and telecommunication technology graduates (n=47; 20.09%) and the smallest number for graduates of thermal engineering technology (n=12; 5.13%). However, compared with 16 engineering graduates in graduates August 2018, the survey recorded a reasonable response rate.

2.4.2. Instrument

In the 1930s, Rensis Likert invented the Likert scale as a part of his thesis. Since then, the Likert scale has been used widely to measure attitude with the 5-point and 7-point Likert scale, which the 5-point Likert scale has been applied more popularly because it is easy to write questions and is convenient to respond to (Patten ML., 2016). The thesis used the five-point Likert scale to measure items.

The pilot and official questionnaire include two parts. The first part covers items to be assessed by employers and the second is participants' demographic information. As Vaus (2002, p.141) suggests, demographic questions should not be included in the first part because they can cause the respondents to have uncomfortable psychological feelings. Because of its simple administration and easy access, Google Form was exploited as the tool for the online survey questionnaire.

For a pilot test

The questionnaire was designed online: http://bit.ly/SVTN-CNKT. The questionnaire includes two parts: part one with 52 items, which requires employers to select one number from one to five, equivalent to the increasing agreement from "Very low" to "Very high" (Table 2.10) and part two with participant's personal information. The survey took the participants 10 minutes to complete.

Table 2. 10. Scale score giving and its descriptors

Score	Employability level	Equivalent to assessment level
1	Very low	Experts assess graduate(s) to have very low competencies for maintaining and succeeding in their current job.
2	Low	Experts assess graduate(s) to have low competencies for maintaining and succeeding in their current job.
3	Medium	Experts assess graduate(s) to have neither high nor low competencies for securing and succeeding in the current job.
4	High	Experts assess graduate(s) to have high competencies for maintaining and succeeding in the current job.
5	Very high	Experts assess graduate(s) to have very high competencies for maintaining and succeeding in the current job.

2.4.3. Data collection

For a pilot test

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 respondents' 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 participants’ 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 different ways. The first way was to email the enterprise’s human resources department and ask them to send the questionnaire to technical groups. The second way was to call the technical divisions guiding the final-year undergraduates for internships. If they agreed, the questionnaire was sent to the Zalo-based application and attached with guiding text to complete.

After two weeks, from 19th January to 2nd February 2024, 161 respondents were recorded. Eight responses were unusable because they were sent twice by the same participants, and the participants were not working in technical divisions in the department. 153 usable responses were used for analyzing the data.

For an official test

The online questionnaire (https://bit.ly/KSSVTN2023) was sent to 350 participants in different ways. The first way was to call and email the enterprise's human resources department and ask them to send the questionnaire to the leader of technical groups or divisions where graduates are working to assess. The second way was to call graduates to contact the head of technical groups or supervising divisions. In case graduate managers’ email or phone numbers were collected, the questionnaire was sent to them after the researcher called and asked for agreement.

The ID graduate code (coded as ID student code), which was linked to the graduate’s name and discipline was sent to employers to confirm the current status of working prior to assessment. When the employer evaluated each graduate, they typed ID graduate into an online questionnaire

After six weeks, from 26th February to 3rd April 2024, 321 answers were recorded. 43 responses were invalid because they were sent twice by the same participants, and the other 44 responses were removed because the respondents only selected one answer for forty-seven items, which was contradictory to survey instructions. 234 usable responses were used to analyze the data. This sampling size exceeds the minimum of 228 from a population size of 555 (confidence level: 95%) (calculator.net, 2024).

The advantage of collecting data is that the researcher has worked at a university department in charge of enterprise partnerships and international cooperation. Additionally, the university's Rector approved the researcher's proposal of using graduate employment data extracted from the survey of graduate employment at the time of graduation in 2023. However, there were two main disadvantages of getting an assessment from employers. Firstly, many graduates worked in enterprises which are private firms and recruited only one or two graduates. They were not ready or refused to take their time answering the questionnaire. Secondly, some graduates who got a job at graduation stopped their careers to learn further and upgrade their competency or return to their hometown to look for new employment opportunities.

The back translation technique was applied to make employability scales translated into Vietnamese for Vietnamese participants and then translated into English as the language of the thesis. Two experts, which included one specialist in English linguistics and another in Educational Measurement and Assessment, were invited to the translation. Two experts got their doctoral degrees in Australia and Taiwan (China). They were at high levels of using academic English in writing international articles and reading books in developing and validating the instruments.

2.4.4. Data analysis

The structural equation model (SEM) has been a widely used multivariate analysis technique in social sciences (Magno et al., 2022). Its outstanding feature is to test the relationships (i) between independent and dependent variables and (ii) links among dependent variables by connecting factor analysis and regression. It is well known that SEM covers two types: CB-SEM to confirm or reject the theories and PLS-SEM to develop theories. For theory development, the PLS-SEM technique is preferred to CB-SEM (Hair et al., 2014).

For a pilot test, the current study uses the partial least squares (PLS) technique, a variance-based structural equation modelling (SEM) method, to test the model because of the following reasons.

Firstly, the PLS-SEM technique is appropriate when the sample size is relatively small, considering the population (Hair et al., 2019). Willaby et al. (2015) revealed that PLS-SEM with "much smaller sample sizes" (Willaby et al., 2015, p.4) in comparison to CB-SEM can still produce similar findings. Noticeably, they proposed that PLS-SEM should be selected when "a sample is smaller than 250" (p.4) but is likely to perform less effectively for a "small sample size of 100" (Sarstedt et al., 2016, p.4008).

Furthermore, as Hair et al. (2014) indicated, the PLS-SEM technique can work well with complicated structural models, which can combine reflective and formative measurement models, while the CB-SEM technique is restricted to "estimating formative measurement models" (Sarstedt et al., 2016, p.4003). Thirdly, the PLS-SEM technique does require data with nonnormal distribution, while CB-SEM "requires the data must be normal" (Dash & Paul, 2021, p.8).

In agreement with Hair et al. (2014), Magno et al. (2022) reported that the small sample size, nonnormal data, and high model complexity were the top three reasons for choosing PLS-SEM after reviewing 50 quality management studies. The typical disadvantage is that PLS-SEM is limited to assessing overall model fit (Faizan et al., 2018), which could be performed better by the CB-SEM technique. Based on the above-mentioned considerations, PLS-SEM seems to be the most appropriate technique for this study. Besides PLS Graph and R, SmartPLS is one of three popular software packages which are friendly for users to provide PLS-SEM results (Hair et al., 2019**)**

According to Hair et al. (2014), as its name refers to "partial", the PLS-SEM path model consists of two parts: the measurement model, which shows the relationships between the variables and their indicators and the structural model, which represents the links among the variables. Therefore, the PLS-SEM path model can be assessed by the measurement model and structural model.

Assessing measurement model

The measurement model developed in the study was the reflective measurement model, which covers four steps: indicator loadings, internal consistency reliability assessment, convergent validity, and discriminant validity

(Hair et al., 2019**)**. Table 2.11 presents criteria to assess the measurement model. Specifically, the model reliablity is reflected by indicator loadings and internal consistency reliability, while the model validity was examined through convergent and discriminant validity. Firstly, indicator loadings are recommended to be "above the common threshold of 0.7" (Hair et al., 2014, p.20). Secondly, internal consistency reliability can be assessed through composite reliability. Composite reliability levels are interpreted differently. If the reliability value gets between 0.7 to 0.9, it is classified from "satisfactory to good" (Hair et al., 2021, p.77) and meets the requirement of internal consistency. Thirdly, the model's convergent validity was assessed through the average variance extracted (AVE) values. The minimum value of AVE is 0.50, which means that the construct can be explained by 50 percent from the indicator's variance, which contributes to the construct (Hair et al., 2021). Lastly, discriminant validity was determined through the HTMT criterion. The threshold of below 0.90 is accepted in case the constructs are similar, whereas the stricter threshold of below 0.85 is applied if the constructs are different. In the study, the constructs cover knowledge, skills and attributes which are similar in terms of concept, so a threshold of below 0.9 is selected to assess discriminant validity.

Table 2. 11. Acceptance criteria for reliability and validity for reflective measurement model assessments in PLS-SEM

Measurement model assessments	**Acceptance criteria**
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	-For conceptually similar constructs: HTMT < 0.90 -For conceptually different constructs: HTMT < 0.85 -Test if the HTMT is significantly lower than the threshold value

Source**:** Hair et al. (2019**)** and Hair et al. (2014)

Assessing structural model

After the measurement model satisfies the requirement of the model's reliability and validity, the structural model can be assessed. There are four steps to assess: Collinearity (VIF), R^2 value, (Table 2.12).

Table 2. 12. Acceptance criteria for structural model assessments in PLS-SEM

Structural model assessments	**Acceptance criteria**
Collinearity (VIF)	Probable (i.e. critical) collinearity issues when VIF ≥ 5 Possible collinearity issues when VIF ≥ 3-5 Ideally show that VIF < 3
R^2 value	R^2 values of 0.75, 0.50 and 0.25 are considered substantial, moderate and weak. R^2 values of 0.90 and higher are typical indicative of overfit

Source**:** Hair et al. (2019**)** and Hair et al.(2014)

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, p.186) 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" (Hair et al., 2014, p.198). 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 (Hair et al., 2021, p.118). Similarly, the R^2 value, which obtains 0.91, can be plausible in predicting student or customer satisfaction (Sarayrah, 2019).

The SPSS (version 26) was used to analyze the data. Firstly, descriptive statistics were performed to present employers' assessments of employability components and subcomponents. Creswell (2015) indicated that descriptive statistics can provide general tendencies (for example, "mean" value) or percentages. Employers' assessments of employability components and subcomponents were evaluated through the mean value of employers' ratings from

1 to 5, equivalent to the increasing competence assessment level from "Very low" to "Very high". Secondly, inferential statistics could be exploited to "test hypothesis about the differences in the groups or the relationships of variables" (Creswell, 2015, p. 181). In this study, inferential statistics were applied to test whether the differences were found in employers' assessments of employability means based on the participants' characteristics, namely their four age groups and two kinds of enterprises (private-owned and foreign-owned) (Table 2.13). Statistical significance was defined as $p < 0.05$ in this study.

Table 2. 13. The data analysis technique to measure graduates' employability

No.	Content	Sub-content	Data analysis
1	Employability constructs	4 first-order constructs, 11 second-order constructs	Descriptive statistics: mean, SD.
2	Analysis of variance (ANOVA)	Difference test towards employability components	Inferential statistics: Difference testing

2.5. Ethical Assurances

The consent forms were given to the participants in the Delphi process. The researcher contacted enterprise representatives to ask for permission for the head or deputy head of technical groups and human resource recruiting team leaders to join the study. After the name and contact information were sent back through email or Zalo-based application, the researcher contacted the intended participants and sent them the invitations. In the invitation email, the research explained the aims of the study, tasks of participants, planned time, expected outcomes, and request for agreement to participate in different rounds. When the participants refused to join the study, the researcher accepted and contacted the enterprise representatives to introduce new experts.

For group discussions via Zoom meetings, the researchers introduced the results of the prior round, contents to discuss and expected results before asking permission to record the online working session. The participants were asked to open their video image if they were comfortable. In case they worked in their office or expected to turn off the camera due to rules of enterprise data security, they could turn on the audio voice only when they stated.

The study data for the scale validation and employability measurement of graduated students in 2023 were collected and analyzed with the approval of participants and the leader of University A, respectively. For participants who were invited to the questionnaire for scale validation, a question for the use of their responses was designed on the first page after the introductory part of general information. For University A, which trained engineering technology graduates, a proposal letter, which presented the study aims and the proposal to use its graduated students' information was agreed by the Rector of University A.

2.6. Conclusion

This chapter presents the thesis's research design. This study exploits a mixed-methods approach, including using and integrating both qualitative and quantitative methods (Tashakkori & Creswell, 2007). A exploratory sequential design was applied to the study by collecting qualitative data via Delphi technique prior to quantitative data collection via survey questionnaire.

Employability studies remain novel in Vietnam, and the Delphi technique is suitable for developing concepts that need expert participation to make decisions, so the thesis applied the Delphi technique to develop a measurement scale of employability. The Delphi process includes 20 experts from 15 employers and five lecturers. They were selected because employers recruited, managed, and supervised graduates, while lecturers built the training program, taught, and supported undergraduates for job employment. Employers consist of hiring and technical departments, while lecturers cover those working in five different majors in engineering technology.

The sample for the pilot of the questionnaire is 153 employers who recruited ET graduates. They participated in an online survey by answering two parts: part one for general information of respondents and part two for employers' assessment on 52 employability competencies-related items. The sample for the official survey is employers who recruited 555 graduates in 7 majors in engineering technology in August 2023 and were working at 307 enterprises.

Findings of the scale reliability and validity assessment are explained in the upcoming chapter.

CHAPTER 3. RELIABILITY AND VALIDITY OF THE SCALE

The chapter reported the answer to the first research question. Firstly, the findings for developing an employability scale were shown. Afterwards, the reliability and validity of the employability scale were revealed.

Research question 1: How is the scale to measure engineering technology graduates' employability developed? To what extent is the scale reliable and valid?

3.1. Development of employability scale

3.1.1 Expert feedback results in the first round

Expert feedback results were presented for the first and second rounds. The first-round result of expert feedback was reported for each construct which corresponded to Table 3.1 (technical knowledge), Table 3.2 (technical skills), Table 3.3 (generic skills), and Table 3.4 (attitude and other attributes). There were 43 items which received high agreement from at least 75% of experts. Keeney et al. (2006) set a 75% level of consensus as the minimum standard for keeping items for future use. According to the standard set by Keeney et al. (2006), 43 items were qualified. These items could be adjusted in expressions to achieve better semantic meaning. On the other hand, eight items (KT_2, KT_4, GSC_4, GSP_4, GSA_4, GSL_4, AAA_5, and AAT_4) reached a lower agreement from 50% to 70% experts, so they needed to be clarified to keep or remove in the next round. In the second round, 20% to 50% of experts who expressed neutral opinions were required to adjust the neutral ratings into agreement or disagreement.

For technical knowledge, five items were good, and two items needed more expert discussions. KT_1, "Demonstrate knowledge of basic science", was assessed to be the highest (95% agreement) by 20 experts, followed by KT_5 "Understand workplace safety requirements" (80% agreement). As reported in Table 3.1, three items, including KT_3, KT_6, and KT_7, ranked third in expert consensus (75%). KT 2 "Demonstrate knowledge of the social sciences" received the second lowest agreement (65% agreement) with the highest neutrality (35% neutral), while KT_4 "Build technological processes" obtained the lowest agreement (60% agreement) and the highest disagreement (20% disagreement).

Table 3. 1. Expert feedback on technical knowledge for the first round

Code	Items	Agree (%)	Neutral (%)	Disagree (%)
KT_1	Demonstrate knowledge of basic science	95	5	0
KT_2	Demonstrate knowledge of the social sciences	65	35	0
KT_3	Identify technology trends	75	25	0
KT_4	Build technological processes	60	20	20
KT_5	Understand workplace safety requirements	80	15	5
KT_6	Analyse professional problems	75	20	5
KT_7	Apply theoretical knowledge to solve specific work problems	75	15	10

As presented in Table 3.2, all items regarding technical skills were assessed to be suitable, with agreement levels ranging from 75% to 80%, which met the standard set by Keeney et al. (2006). ST_2, “Exploit technical documentation”, ST_3 “, Understand technical drawings”, and ST_5 “, Use proper engineering tools for specific tasks”, were assessed to the proper items to explain graduates’ technical skills by 80% of experts. Moreover, ST_1, “Arrange the order of work to be done”, and ST_5 “, Use proper engineering tools for specific tasks”, were accepted as the indicators of technical skills by 75% of specialists. Noticeably, 15% to 25% of experts neither agreed nor disagreed with the four items for technical skills. Such items were considered more in the second round because some experts might find something unsuitable to be adjusted or rejected.

Table 3. 2. Expert feedback on technical skills for the first round

Code	Items	Agree (%)	Neutral (%)	Disagree (%)
ST_1	Arrange the order of work to be done	75	25	0
ST_2	Exploit technical document	80	20	0
ST_3	Understand technical drawings	85	15	0
ST_4	Use engineering software to solve technical problems	75	15	10
ST_5	Use proper engineering tools for specific tasks	80	20	0

Table 3.3 shows the result of the experts’ assessment of generic skills. Among the five second-order generic skills was teamwork with all items, which received agreement from over 95% of experts. The remaining four sub-constructs of generic skills obtained high consensus from experts (over 75% agreement) and contained four items (GSC_4, GSP_4, GSA_4, and GSL_4), which reached agreements at a lower level than 75% with high levels of neutrality (35% to 50%).

Table 3. 3. Expert feedback on generic skills for the first round

Code	Items	Agree (%)	Neutral (%)	Disagree (%)
3.1.	**Communication skills**			
GSC_1	Report the work plans and results	75	25	0
GSC_2	Use a foreign language at work	75	15	10
GSC_3	Comprehend comments at work	90	10	0
GSC_4	Communicate about technical issues through written words in the mother tongue	70	30	0
GSC_5	Communicate about technical problems orally in the mother tongue	80	20	0
3.2.	**Problem-solving skills**			
GSP_1	Identify the problems to be solved	85	15	0
GSP_2	Prioritise the problem to solve	75	25	0
GSP_3	Identify the cause of the problem	75	25	0
GSP_4	Propose the right solution	60	40	0
3.3.	**Adaptability**			
GSA_1	Adapt to changes in work	90	10	0
GSA_2	Work in a multicultural environment	90	10	0
GSA_3	Perform well under pressure	90	10	0
GSA_4	Give initiatives in work	65	35	0
3.4.	**Teamwork**			
GST_1	Set the team's common goals	90	10	0
GST_2	Collaborate with colleagues	95	5	0
GST_3	Promote teamwork spirit	90	10	0
GST_4	Implement the team decisions	90	10	0
3.5.	**Lifelong learning**			
GSL_1	Acquire new knowledge steadily and continuously	95	5	0
GSL_2	Actively participate in courses for personal development	85	15	0
GSL_3	Stay up to date with new methods for professional development	85	15	0
GSL_4	Identify your strengths and weaknesses to suggest appropriate improvement methods.	50	50	0

Furthermore, attitude and other attributes covered four second-order constructs of "Attitude", "Dependability", "Thoughtfulness", and "Initiative". As illustrated in Table 3.4, sixteen out of eighteen items were accepted by 75% of specialists or more. Two items (AAA_5 and AAT_4) received below 75% of the experts' agreement level. Such two items could be considered deleted after receiving the specialists' assessment in the second round. The two second-order constructs of "dependability" and "initiative" contained the items with good internal consistency. All items in such second-order constructs were accepted by at least 75% of experts. On the other hand, two other sub-constructs of "attitude" and "Thoughtfulness" involved one item with high neutrality for each, which made the question incompatible in explaining to their second-order constructs.

Table 3. 4. Expert feedback on attitude and other attributes for the first round

Code	**Items**	**Agree (%)**	**Neutral (%)**	**Disagree (%)**
4.1.	**Attitude**			
AAA_1	Work seriously	95	5	0
AAA_2	Work autonomously	85	15	0
AAA_3	Feel ready to receive more work	95	5	0
AAA_4	Feel comfortable working with colleagues	95	5	0
AAA_5	Have a long-term commitment to work at the enterprise	60	35	5
AAA_6	Advertise the enterprise's brand image	75	25	0
4.2.	**Dependability**			
AAD_1	Complete the work as planned	90	10	0
AAD_2	Comply the workflow	85	15	0
AAD_3	Get the job done correctly	75	25	0
AAD_4	Comply with honesty at work	95	5	0
4.3.	**Thoughtfulness**			
AAT_1	Show industry manners	95	5	0
AAT_2	Consider carefully to avoid making careless mistakes	80	20	0
AAT_3	Manage pressure in difficult situations	80	20	0
AAT_4	Give constructive advice to colleagues	65	35	0
4.4.	**Initiative**			
AAI_1	Accept work challenges	95	5	0

Code	Items	Agree (%)	Neutral (%)	Disagree (%)
AAI_2	Generate new ideas at work	80	20	0
AAI_3	Keep eager to complete work	90	10	0
AAI_4	Keep committed to doing good work	95	5	0

3.1.2 Expert feedback results in the second round

Three groups of experts who had attended the initial round were invited to participate in the second round to provide their group discussion. The lecturers' groups were interviewed first, followed by the human resources and technical groups. The result of assessing four scale constructs in the first round was reported before the interview groups began. Items for technical knowledge were discussed by the lecturer group directly. Afterwards, the first-round report and the lecturer group's second-round findings were presented to the human resource group at the beginning of an online meeting with the human resource group. For the following online meeting, the first-round result and summary of second-round findings, with the participation of the lecturer group and human resource group, were announced to the technical group.

The expert discussion group for technical knowledge was summarised in Table 3.5. The report for the first round indicated the focus on KT_2 and KT_4. Item KT_2, which received the second-lowest agreement and the highest neutrality among experts in the first round, reached the agreement to remove it from the scale because it was not related much to technical knowledge as expressed by the lecturer group. It was a secondary criterion as evaluated by technical experts. Furthermore, item KT_4 was suggested to adjust the verb "Build", which was difficult to obtain by the graduates, as stated by the lecturer group. According to the technical group, building technological processes involves several high-level competencies and is suitable for managerial-level positions. The three groups of experts reached approval to modify from "Build" to "Describe". There were three other items (KT_3, KT_6, and KT_7) which needed to change. In conclusion, the construct "technical knowledge" changed from seven to six items after the second round.

Table 3. 5. Expert feedback on technical knowledge for the second round

Code	Items	Lecturer group	HR group	Technical group
KT_1	Demonstrate knowledge of basic science	Demonstrate→ Apply; add "to solve technical problems"	✓	✓
KT_2	Demonstrate knowledge of the social sciences	Delete	✓	✓
KT_3	Identify technology trends	Technology→engineering technology	✓	Identify → update
KT_4	Build technological processes	Build→ Describe	✓	Build→ Describe
KT_5	Understand workplace safety requirements	Agree	✓	✓
KT_6	Analyse professional problems	Analyze→ Recognize	✓	Analyze→ Recognise the suitable tool
KT_7	Apply theoretical knowledge to solve specific work problems	theoretical knowledge→ specialised knowledge	✓	✓

* Note: "✓" means "Agree with the previous group"

Similarly, expert group discussions were implemented for technical skills. As Table 3.6 summarises, all five items (ST_1, ST_2, ST_3, ST_4, and ST_5), assessed to be good in the first round, continued to be highly approved in the second round. Only one item, ST_3, needed to be edited. The lecturer group asserted that graduates' good reading skills in technical drawings helped develop their enterprise jobs. Reading to comprehend technical drawings was a core technical skill of ET graduates who were required to achieve at the primary level for most jobs at graduation instead of just understanding to know.

Moreover, the technical group agreed with all items and clarified item ST_2. To be specific, popular technical documents at enterprises are manual guidebooks which graduates could use for their work or for training fresher groups. The construct "technical skills" was kept stable with five items after the second round.

Table 3. 6. Expert feedback on technical skills for the second round

Code	Items	Lecturer group	Human resource group	Technical group
ST_1	Arrange the order of work to be done	Agree	✓	✓
ST_2	Exploit technical document	Agree	✓	✓
ST_3	Understand technical drawings	Understand→Read	✓	✓
ST_4	Use engineering software to solve technical problems	Agree	✓	✓
ST_5	Use proper engineering tools for specific tasks	Agree	✓	✓

* Note: "✓" means "Agree with the previous group"

The expert viewpoints on generic skills in the second round were reported in Table 3.7. Specifically, three items were added, one was deleted, and ten were modified. Three added items included GSP_5, GSA_5, and GST_5. One deleted item was GSA_4. Ten modified items were GSC_1, GSC_2, GSC_4, and GSC_5 (Communication skills), GSP_4 (Problem-solving skills), Adjust: GST_2 (Teamwork), GSL_1, GSL_2, GSL_3, and GSL_4 (Lifelong learning).

The human resource group added GSP_5, "Implement the proposed solution", and GSA_5, "Adapt to workplace environment after graduation". They explained that graduates had to put the solution into practice after giving the potential solution to the problem. Furthermore, the workplace environment after graduation was novel to new graduates. The graduates were required to get used to enterprise regulations such as coming to the office early and making the workplace clean before leaving the workplace in the afternoon. Graduates were also expected to make their voices heard in the group meeting instead of just sitting and following the instructions, which contradicted their lecture in the university hall.

The lecturer group added GST_5 "Contribute to teamwork's results". They stated that it was a circle of teamwork that started with team goal setting, then maintained good communication among team members, and overcame teamwork conflicts to reach decisions as a team. After the plan and a list of specific works had been presented, each graduate needed to implement the assigned work and could finish with outstanding individual contributions to teamwork achievement.

In summary, the construct "generic skills" increased in 2 items in the second round. Specifically, problem-solving skills and teamwork changed 4 to 5 items per sub-construct. Communication skills, adaptability, and lifelong learning preserved their items after the second round with 5, 4, and 4 items, respectively.

Table 3. 7. Expert feedback on generic skills for the second round

Code	Items	Lecturer group	HR group	Technical group
3.1.	**Communication skills**			
GSC_1	Report the work plans and results	Agree	Add "on time"	✓
GSC_2	Use a foreign language at work	Use→ Communicate by	Add "at the basic level"	✓
GSC_3	Comprehend comments at work	Agree	✓	✓
GSC_4	Communicate about technical issues through written words in the mother tongue	Agree	✓	Communicate → Communicate in written Vietnamese
GSC_5	Communicate about technical problems orally in the mother tongue	Agree	✓	Communicate → Communicate in spoken Vietnamese
3.2.	**Problem-solving skills**			
GSP_1	Identify the problems to be solved	Agree	✓	✓
GSP_2	Prioritise the problem to solve	Agree	✓	✓
GSP_3	Identify the cause of the problem	Agree	✓	✓
GSP_4	Propose the right solution	Agree	Right → possible	✓
GSP_5			**Add** "Implement the proposed solution"	✓
3.3.	**Adaptability**			

Code	Items	Lecturer group	HR group	Technical group
GSA_1	Adapt to changes in work	Agree	✓	✓
GSA_2	Work in a multicultural environment	Agree	✓	✓
GSA_3	Perform well under pressure	Agree	✓	✓
GSA_4	Give initiatives in work	**Delete**	✓	✓
GSA_5			**Add** "Adapt to workplace environment after graduation"	✓
3.4.	**Teamwork**			
GST_1	Set the team's common goals	Agree	✓	✓
GST_2	Collaborate with colleagues	Colleagues→ team members	✓	✓
GST_3	Promote teamwork spirit	Agree	✓	✓
GST_4	Implement the team decisions	Agree	✓	✓
GST_5		**Add** "Contribute to teamwork's results"	✓	✓
3.5.	**Lifelong learning**			
GSL_1	Acquire new knowledge steadily and continuously	steadily and continuously→ frequently	✓	✓
GSL_2	Actively participate in courses for personal development	Courses→ self-study activities	✓	✓
GSL_3	Stay up to date with new methods for professional development	Methods→ science and technology applications	✓	Stay up to date→ Update
GSL_4	Identify your strengths and weaknesses to suggest appropriate improvement methods.	Add "in each period to make learning plans" after "weakness"	✓	suggest appropriate improvement methods→ to make learning plans

* Note: "✓" means "Agree with the previous group"

The number of items in the construct “attitude and other attributes” in the second round is the same as in the first round (18 items). As indicated in Table 3.8, seven out of eighteen items were modified: AAA_4, AAA_5, AAA_6 in “attitude”, AAD_3 in “dependability”, AAT_3, AAT_4 in “thoughtfulness”, and AAI_2 in “initiative”. The lecturer group was the most proactive group, with five proposals to make the items (AAA_4, AAA_5, AAD_3, AAT_3, and AAI_2) clear and measurable. The human resource group suggested word choice modification for two items (AAA_6 and AAT_4). Similarly, the technical group recommended changes in two items (AAA_4 and AAA_5) belonging to the “Attitude” subconstruct.

Specifically, AAA_4 and AAA_5 in the subconstruct “Attitude” were given feedback to change by the lecturer and technical groups. Attitude can be classified into “cognitive, affective, and behavioural” components (Gelisli & Kazykhankyzy, 2021, p.466). As the lecturer and technical groups commented, items AAA_4 should be modified from an affective attitude into a behavioural attitude. At the same time, AAA_5 could be changed from a cognitive attitude to a behavioural attitude.

For the subconstruct “dependability”, four items got the agreement of three expert groups except the minor change for the item AAD_3. The lecturer group proposed that getting the job completed correctly was a good item for assessing the dependability of high school leavers or advanced associate graduates, not for university graduates. Instead, the AAA_3 item could be changed to “getting the job finished effectively”.

The four items in the third subconstruct of “thoughtfulness” were assessed as appropriate. Two items of AAT_3 and AAT_4 were advised to make changes to reflect the subconstruct better. Firstly, managing stress in difficult situations was hard for new graduates. The lecturer group suggested that the ability to self-monitor in problem situations was practical for engineering technology graduates, while managing work pressure was a higher competency level for personnel working at managerial levels. Secondly, from the perspective of the human resource group, newly graduated students were perceived to be troublesome in providing constructive advice to their co-workers. Preferably, they were expected to have a more straightforward ability. As explained, the engineering technology graduates tended to be independent and silent, so they were shown to be thoughtful when they were concerned about their colleagues' problems and could offer their solutions without considering much about issues in the implementation of their colleagues.

Regarding the subconstruct "Initiative", three groups of experts approved three items: AAI_2, AAI_3, and AAI_4. There was a slight adjustment in AAI_1. The challenges at work were perceived to come frequently, so the graduates were proposed to develop their competencies to fight against the disadvantages in work rather than accept them without showing a positive perspective.

To sum up, the "attitude and other attributes" component in the employability scale contained 18 good indicators after the second round of expert feedback. The four second-order constructs of the first-order construct, "attitude and other attributes," were kept like the first round.

Table 3. 8. Expert feedback on attitude and other attributes for the second round

Code	Items	Lecturer group	HR group	Technical group
4.1.	**Attitude**			
AAA_1	Work seriously	Agree	✓	✓
AAA_2	Work autonomously	Agree	✓	✓
AAA_3	Feel ready to receive more work	Agree	✓	✓
AAA_4	Feel comfortable working with colleagues	Feel comfortable working → Cooperate actively	✓	Cooperate actively with colleagues →Cooperate with colleagues actively
AAA_5	Have a long-term commitment to work at the enterprise	Have a long-term commitment to work at→Contribute effectively to development	✓	Contribute effectively to development at the enterprise- →Contribute to enterprise's development
AAA_6	Advertise the enterprise's brand image	Agree	Advertise → Respect	✓

4.2.	**Dependability**			
AAD_1	Complete the work as planned	Agree	√	√
AAD_2	Comply the workflow	Agree	√	√
AAD_3	Get the job done correctly	Correctly→ effectively	√	√
AAD_4	Comply with honesty at work	Agree	√	√
4.3.	**Thoughtfulness**			
AAT_1	Show industry manners	Agree	√	√
AAT_2	Consider carefully to avoid making careless mistakes	Agree	√	√
AAT_3	Manage pressure in difficult situations	Manage pressure→ Self-control	√	√
AAT_4	Give constructive advice to colleagues	Agree	Constructive advice → some advice	√
4.4.	**Initiative**			
AAI_1	Accept work challenges	Accept→Face	√	√
AAI_2	Generate new ideas at work	Agree	√	√
AAI_3	Keep eager to complete work	Agree	√	√
AAI_4	Keep committed to doing good work	Agree	√	√

* Note: "√" means "Agree with the previous group"

3.1.3. Scale components after taking expert feedback

The demand for measuring the employability of engineering technology graduates has acquired interest in both engineering universities and manufacturing enterprises. However, previously published studies were restricted to developing employability scales for engineering technology graduates. The study recommended a scale to address the above issue. Furthermore, the study followed the procedure to implement the Delphi process proposed by Hsu and Sandford (2007) to modify the proposed employability scale. As Keeney et al. (2006) stated that no strict rule was applied to the number of rounds because the Delphi process depends on the experts' time condition and a broad level of questions. The employability scale was revised in two rounds. The study applied an online questionnaire for the first round. The initial round results indicated that 43 out of 51 items were evaluated to be appropriate. The second round concentrated on discussing eight items (KT_2, KT_4, GSC_4, GPS_4, GSA_4, GSL_4, AAA_5, and AAT_4) which reached a lower agreement than 75% in the first round. The degree of consensus on these eight items was improved after three discussion groups. After two rounds of receiving feedback from three groups of lecturers, human resources, and technical divisions, the employability scale for engineering technology graduates included four constructs and an increase of one item from 51 to 52 items (Table 3.9). The technical knowledge decreased by one item, "KT_2", compared with the proposed scale. The items in two constructs of "Attitude and other attributes" and "technical skills" were stable with 18 and 5 items, respectively. Generic skills received the most expert feedback by deleting one item and adding three items.

Table 3. 9. Scale components after taking expert feedback

Components	**Second-order construct (Before)**	**Second-order construct (After)**	**Items (Before)**	**Items (After)**	**Notes**
Technical knowledge	1	1	7	6	***Delete***: KT_2; Adjust: KT_1, KT_3, KT_4, KT_6, KT_7
Technical skills	1	1	5	5	Adjust: ST_3
Generic skills	5	5	21	23	
Communication skills			5	5	Adjust: GSC_1, GSC_2, GSC_4, GSC_5
Problem-solving skills			4	5	Adjust: GSP_4 **Add:** GSP_5
Adaptability			4	4	***Delete***: GSA_4, **Add**: GSA_5
Teamwork			4	5	Adjust: GST_2; **Add**: GST_5
Lifelong learning			4	4	Adjust: GSL_1, GSL_2 GSL_3, GSL_4
Attitude and other attributes	4	4	18	18	
Attitude			6	6	Adjust: AAA_4, AAA_5, AAA_6
Dependability			4	4	Adjust: AAD_3
Thoughtfulness			4	4	Adjust: AAT_3, AAT_4
Initiative			4	4	Adjust: AAI_1
Total	**11**	**11**	**51**	**52**	

Table 3.10 presents the code inversion after the Delphi method and the new item code for a pilot test. After applying the Delphi method, two items were deleted, and three were added, so numerical numbers were discontinued. The new

item code was formed to keep the items coded in numerical numbers continuously, from 1 to consecutive numbers. Specifically, items before the Delphi technique were coded KT_, ST_, GS_ and AA_ for four employability constructs: technical knowledge, technical skills, generic skills, and attitude and other attributes. Second-order constructs of generic skills were coded with GS + the first letter of subconstructs. They were GSC_ (Communication skills), GSP_ (Problem-solving skills), GSA_ (Adaptability), GST_ (Teamwork), and GSL_ (Lifelong learning). The same was applied to attitude and other attributes (AA). Attitude was coded AAA_, dependability was coded AAD_, thoughtfulness was coded AAT_ and initiative was coded AAI_. After exploiting the Delphi method, the items were recoded continuously with the structure KT_numerical number_n, ST_numerical number_n, GS_numerical number_n, and AA_numerical number_n, in which "n" means "new". For the pilot test, the item code was shortened with the structure KT_ numerical number_n converted into KT+ numerical number, ST_ numerical number_n converted ST+ numerical number, GS_ numerical number_n converted into GS+ numerical number, AA_ numerical number_n converted into AA+ numerical number.

Table 3. 10. Code switch table after the Delphi method and for a pilot test

Construct	**Item code before the Delphi method**	**Item code after Delphi method**	**Item code after Delphi method (new)**	**Item code for pilot test**
TECHNICAL KNOWLEDGE				
	KT_1	KT_1	KT_1_n	KT1
	KT_2	**Deleted**		
	KT_3	KT_3	KT_2_n	KT2
	KT_4	KT_4	KT_3_n	KT3
	KT_5	KT_5	KT_4_n	KT4
	KT_6	KT_6	KT_5_n	KT5
	KT_7	KT_7	KT_6_n	KT6
TECHNICAL SKILLS				
	ST_1	ST_1	ST_1_n	ST1
	ST_2	ST_2	ST_2_n	ST2
	ST_3	ST_3	ST_3_n	ST3
	ST_4	ST_4	ST_4_n	ST4
	ST_5	ST_5	ST_5_n	ST5

Construct	Item code before the Delphi method	Item code after Delphi method	Item code after Delphi method (new)	Item code for pilot test
GENERIC SKILLS				
Communication skills	GSC_1	GSC_1	GSC_1_n	GSC1
	GSC_2	GSC_2	GSC_2_n	GSC2
	GSC_3	GSC_3	GSC_3_n	GSC3
	GSC_4	GSC_4	GSC_4_n	GSC4
	GSC_5	GSC_5	GSC_5_n	GSC5
Problem-solving skills	GSP_1	GSP_1	GSP_1_n	GSP1
	GSP_2	GSP_2	GSP_2_n	GSP2
	GSP_3	GSP_3	GSP_3_n	GSP3
	GSP_4	GSP_4	GSP_4_n	GSP4
		GSP_5 **(Add)**	GSP_5_n	GSP5
Adaptability	GSA_1	GSA_1	GSA_1_n	GSA1
	GSA_2	GSA_2	GSA_2_n	GSA2
	GSA_3	GSA_3	GSA_3_n	GSA3
	GSA_4	**(Delete)**		
		GSA_5 **(Add)**	GSA_4_n	GSA4
Teamwork	GST_1	GST_1	GST_1_n	GST1
	GST_2	GST_2	GST_2_n	GST2
	GST_3	GST_3	GST_3_n	GST3
	GST_4	GST_4	GST_4_n	GST4
	GST_5	GST_5	GST_5_n	GST5
Lifelong learning	GSL_1	GSL_1	GSL_1_n	GSL1
	GSL_2	GSL_2	GSL_2_n	GSL2
	GSL_3	GSL_3	GSL_3_n	GSL3
	GSL_4	GSL_4	GSL_4_n	GSL4
ATTITUDE AND OTHER ATTRIBUTES				
Attitude	AAA_1	AAA_1	AAA_1_n	AAA1
	AAA_2	AAA_2	AAA_2_n	AAA2
	AAA_3	AAA_3	AAA_3_n	AAA3
	AAA_4	AAA_4	AAA_4_n	AAA4
	AAA_5	AAA_5	AAA_5_n	AAA5
	AAA_6	**Deleted**		
		AAA_7 **(Add)**	AA_6_n	AAA6

Construct	Item code before the Delphi method	Item code after Delphi method	Item code after Delphi method (new)	Item code for pilot test
Dependability	AAD_1	AAD_1	AAD_1_n	AAD1
	AAD_2	AAD_2	AAD_2_n	AAD2
	AAD_3	AAD_3	AAD_3_n	AAD3
	AAD_4	AAD_4	AAD_4_n	AAD4
Thoughtfulness	AAT_1	AAT_1	AAT_1_n	AAT1
	AAT_2	AAT_2	AAT_2_n	AAT2
	AAT_3	AAT_3	AAT_3_n	AAT3
	AAT_4	AAT_4	AAT_4_n	AAT4
Initiative	AAI_1	AAI_1	AAI_1_n	AAI1
	AAI_2	AAI_2	AAI_2_n	AAI2
	AAI_3	AAI_3	AAI_3_n	AAI3
	AAI_4	AAI_4	AAI_4_n	AAI4

The 52 items and their new code for the pilot test are shown in Table 3.11. Compared with the initially proposed questionnaire, the questionnaire in Table 3.11 appeared to reflect the experts' most concern about generic skills. After three items had been added, one item had been removed, and several items had been adjusted, an increase of two items from 21 to 23 was recorded in generic skills. Moreover, technical knowledge would likely receive the expert groups' most severe consideration. Six out of seven items were considered to be deleted or modified, which brought about a decrease in one item.

Table 3. 11. Questionnaire for a pilot test

Code	Items	1	2	3	4	5
I	**TECHNICAL KNOWLEDGE (06)**					
KT1	Apply knowledge of basic science to solve technical problems	①	②	③	④	⑤
KT2	Update engineering technology trends	①	②	③	④	⑤
KT3	Describe technological processes	①	②	③	④	⑤
KT4	Understand workplace safety requirements	①	②	③	④	⑤
KT5	Recognize the suitable tool to analyze professional problems	①	②	③	④	⑤

Code	Items	1	2	3	4	5
KT6	Apply specialized knowledge to solve specific work problems	①	②	③	④	⑤
II.	**TECHNICAL SKILLS (05)**					
ST1	Arrange the order of work to be done	①	②	③	④	⑤
ST2	Exploit technical document	①	②	③	④	⑤
ST3	Read technical drawings	①	②	③	④	⑤
ST4	Use engineering software to solve technical problems	①	②	③	④	⑤
ST5	Use proper engineering tools for the specific task	①	②	③	④	⑤
III.	**GENERIC SKILLS (23)**					
3.1.	**Communication skills (5)**					
GSC1	Report the work plans and results on time	①	②	③	④	⑤
GSC2	Communicate in a foreign language at a basic level at work	①	②	③	④	⑤
GSC3	Comprehend comments at work	①	②	③	④	⑤
GSC4	Communicate in written Vietnamese about technical problems	①	②	③	④	⑤
GSC5	Communicate in spoken Vietnamese about technical problems	①	②	③	④	⑤
3.2.	**Problem-solving skills (5)**					
GSP1	Identify the problems to be solved	①	②	③	④	⑤
GSP2	Prioritize the problem to solve	①	②	③	④	⑤
GSP3	Identify the cause of the problem	①	②	③	④	⑤
GSP4	Propose the possible solution	①	②	③	④	⑤
GSP5	Implement the proposed solution	①	②	③	④	⑤
3.3.	**Adaptability (4)**					
GSA1	Adapt to changes in work	①	②	③	④	⑤
GSA2	Work in a multicultural environment	①	②	③	④	⑤
GSA3	Perform well under pressure	①	②	③	④	⑤

Code	Items	1	2	3	4	5
GSA4	Adapt to workplace environment after graduation	①	②	③	④	⑤
3.4.	**Teamwork (5)**					
GST1	Set the team's common goals	①	②	③	④	⑤
GST2	Collaborate with team members	①	②	③	④	⑤
GST3	Promote teamwork spirit	①	②	③	④	⑤
GST4	Implement the team decisions	①	②	③	④	⑤
GST5	Contribute to teamwork’s results	①	②	③	④	⑤
3.5.	**Lifelong learning (4)**					
GSL1	Acquire new knowledge frequently	①	②	③	④	⑤
GSL2	Participate in self-study activities for personal development actively	①	②	③	④	⑤
GSL3	Update science and technology applications for professional development	①	②	③	④	⑤
GSL4	Identify strengths and weaknesses in each period to make learning plans	①	②	③	④	⑤
IV.	**ATTITUDE AND OTHER ATTRIBUTES (18)**					
4.1	**Attitude (6)**					
AAA1	Work seriously	①	②	③	④	⑤
AAA2	Work autonomously	①	②	③	④	⑤
AAA3	Feel ready to receive more work	①	②	③	④	⑤
AAA4	Cooperate with colleagues actively	①	②	③	④	⑤
AAA5	Contribute to the enterprise’s development	①	②	③	④	⑤
AAA6	Respect the enterprise’s brand image	①	②	③	④	⑤
4.2.	**Dependability (4)**					
AAD1	Complete the work as planned	①	②	③	④	⑤
AAD2	Comply the workflow	①	②	③	④	⑤
AAD3	Get the job done effectively	①	②	③	④	⑤
AAD4	Comply with honesty at work	①	②	③	④	⑤
4.3.	**Thoughtfulness (4)**					

Code	Items	1	2	3	4	5
AAT1	Show industry manners	①	②	③	④	⑤
AAT2	Consider carefully to avoid making careless mistakes	①	②	③	④	⑤
AAT3	Self-control in difficult situations	①	②	③	④	⑤
AAT4	Give some advice to colleagues at work	①	②	③	④	⑤
4.4.	**Initiative (4)**					
AAI1	Face work challenges	①	②	③	④	⑤
AAI2	Generate clear ideas at work	①	②	③	④	⑤
AAI3	Keep eager to complete work	①	②	③	④	⑤
AAI4	Keep committed to doing good work	①	②	③	④	⑤

3.2. Validation of employability scale

The reliability and validity of the employability scale were assessed through measurement and structural models.

3.2.1. Measurement model of 4 first-order constructs and 52 items

Figure 3.1 displays this study's employability measurement model of 52 items. Four sources of employability include technical knowledge (KT: 6 items), technical skills (ST: 5 items), generic skills (GS: 23 items), and attitude and other attributes (AA: 18 items). GS has five lower-order constructs: communication skills (GSC: 5 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: 6 items), dependability (AAD: 4 items), thoughtfulness (AAT: 4 items) and initiatives (AAI: 4 items).

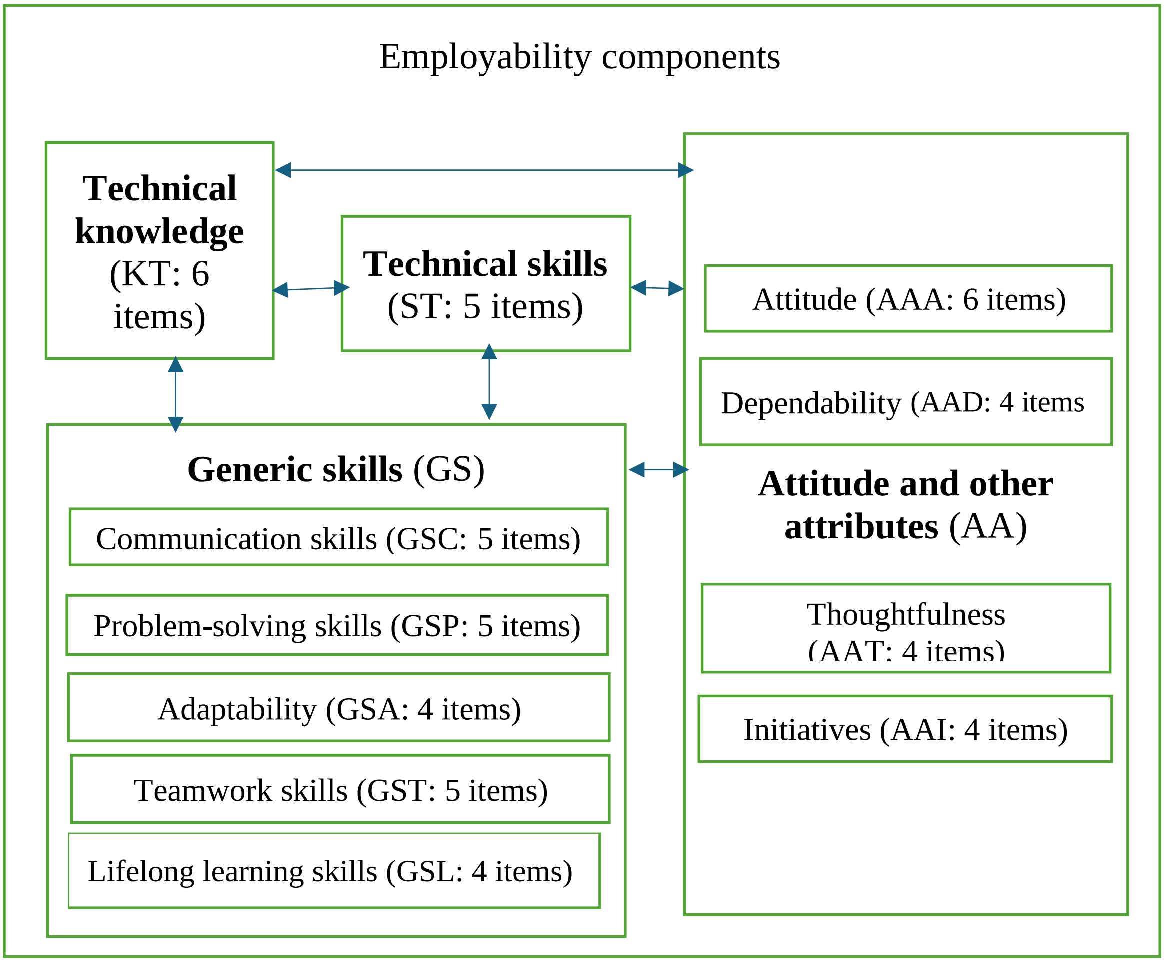


Figure 3. 1. Measurement model with 52 indicators

The measurement model was evaluated through internal consistency reliability, outer loading, and convergent and discriminant validity.

Internal consistency reliability

Assessing internal consistency reliability is most used by Jöreskog's (1971) 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 (Hair et al., 2019).

Cronbach's alpha is another measure of internal consistency reliability that produces lower values than composite reliability (CR). Cronbach's alpha is a less precise measure of reliability since the items are unweighted. In contrast, with CR, the items 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 CR (Hair et al., 2019).

Table 3.12 indicates that eleven second-order constructs have good internal consistency reliability. The composite reliability of the eleven second-order constructs outweighs the acceptance value of 0.7. Eleven second-order constructs' composite reliability is between 0.82 and 0.9, so the eleven scales are reliable.

Table 3. 12. Cronbach's alpha and the CR indicator of subconstructs

	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

Outer loading

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 (Hair et al., 2019). 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 (Hair et al., 2019). Table 3.7 shows that there are 46 outer loadings which meet the standard, and six other outer loadings which cover AA2 (0.7, not exceeding 0.7), AAA3 (0.7, not exceeding 0.7), AAA4 (0.7, not exceeding 0.7), AAD4 (0.64<0.7), GSC1 (0.68<0.7), and KT4 (0.66<0.7) are below the standard.

Therefore, six outer loadings should be removed from with the lowest outer to higher outer: AAD4 (0.64), KT4 (0.66), GSC1 (0.68), AAA3 (0.697), AAA4 (0.7), and AA2 (0.7). After removing fives indicators AAD4 (0.64), KT4 (0.66), GSC1 (0.68), AAA3 (0.7), and AAA4 (0.7), respectively and performing the analysis, the reliability and convergent validity of the scale were established.

Table 3. 13. Outer loadings matrix of constructs before adjustment

	AAA	AAD	AAI	AAT	GSA	GSC	GSL	GSP	GST	KT	ST
AAA1	0.72										
AAA2	**0.7**										
AAA3	**0.7**										
AAA4	**0.7**										
AAA5	0.76										
AAA6	0.74										
AAD1		0.75									
AAD2		0.80									
AAD3		0.74									
AAD4		**0.64**									
AAI1			0.74								
AAI2			0.71								
AAI3			0.81								
AAI4			0.83								
AAT1				0.74							
AAT2				0.81							
AAT3				0.74							
AAT4				0.82							
GSA1					0.75						
GSA2					0.71						
GSA3					0.78						
GSA4					0.84						
GSC1						**0.68**					
GSC2						0.75					
GSC3						0.73					
GSC4						0.80					
GSC5						0.837					
GSL1							0.80				
GSL2							0.83				
GSL3							0.84				
GSL4							0.79				
GSP1								0.81			
GSP2								0.82			
GSP3								0.82			
GSP4								0.81			
GSP5								0.73			
GST1									0.80		
GST2									0.77		

	AAA	AAD	AAI	AAT	GSA	GSC	GSL	GSP	GST	KT	ST
GST3									0.72		
GST4									0.73		
GST5									0.71		
KT1										0.71	
KT2										0.78	
KT3										0.79	
KT4										**0.66**	
KT5										0.76	
KT6										0.82	
ST1											0.72
ST2											0.75
ST3											0.71
ST4											0.79
ST5											0.76

Five items of AAD4, KT4, GSC1, AAA3, and AAA4 were removed from the scale after the pilot test, in which two items of GSC1 and AAA4 were initially proposed to be put into the scale by the thesis author and the three other items of AAD4, KT4, and AAA3 were collected from papers by Park & Hill (2018), Moaveni (2010), and Dipboye (2018) respectively.

Firstly, the author proposed two items of GSC1, “Report the work plans and results on time”, and AAA4, “Cooperate with colleagues actively”, as a result of taking enterprise viewpoints on skill development in field trips for engineering technology undergraduates (Pham & Nguyen, 2022). Firstly, communication skills in an enterprise environment can cover information exchange in written and spoken forms. Reporting the work plans and results can be implemented in verbal communication (direct talk or via phone) and written reports (internal email or paper report). The pilot test was taken part in by 54% of participants from private-owned enterprises and 37% from foreign-owned ones. Item assessment was affected more by respondents from private companies. The deletion of Item GSC1 can result in the respondent data. It can be predicted that employees in private companies did not need report skills as much as in foreign-owned enterprises. Secondly, AAA4 “Cooperate with colleagues actively” belongs to the “Attitude” subconstruct. D. Q. Nguyen, (1998) finding can be used to explain the deletion of item AA4. She shared that industry employers highly evaluated attitude characteristics which are related to the individual’s internal competency. Another reason is that the respondent assessment in the pilot test depended on their experience in working with graduates. Most respondents (63%) recruited and worked with electric and electronic engineering technology graduates. The attitude item for the individual's independent competency was more emphasised than the item for team competency, as in the case of the Philippines (Pontillas, 2018).

Secondly, three items of KT4, AAA3, and AAA4 were taken from academic papers. KT4 "Understand workplace safety requirements" is one of the basic competencies for employees in industrial sectors (MOLISA, 2019). Accordingly, employees are required to ensure work safety by wearing protective clothing and reporting on machine and equipment working conditions on time. Item KT4 seemed to be more suitable for graduates from vocational education institutions than higher education institutions. The working positions for graduates from vocational education institutions are jobs related to operating industrial machines in manufacturing workshops. Therefore, their workplace and personal safety are required strictly. Engineers who have graduated from universities can work as supervisors of workers and machine operators. The requirement of work safety for university graduates appeared to be less strict.

AAA3, "Feel ready to receive more work", and AAD4, "Comply with honesty at work", are two items which seemed to be suitable to assess the attitude of graduates. However, they did not work as evaluated by employers in Northern Vietnam provinces. Rejection of item AA3 can be explained as taking more work depended on manufacturing orders, and university graduates would not have been expected to take more time in their working divisions if they had not served their working shifts. This result came as a surprise to the author who believed that working hard in the enterprises reflected graduates' work engagement attitude. Furthermore, the item AAD4, which was used in the subscale "Dependability" by Park & Hill (2018) for workers in South Korea gained the lowest outer loading (0.64) in the subconstruct "Dependability" for university graduates in Vietnam.

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, p.9), *"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.”.*

Table 3.14 shows that the eleven subconstructs' AVE value is superior to the required lowest threshold value of 0.50. In specific, AVE values of AAA (0.52), AAD (0.54), AAI (0.6), AAT (0.61), GSA (0.6), GSC (0.58), GSL (0.66), GSP (0.64), GST (0.55), KT (0.58), and ST (0.55). Accordingly, the scale to measure the eleven subconstructs has reached high levels of convergent validity.

Table 3. 14. AVE of individual constructs before adjustment

	Composite reliability	Average variance extracted (AVE)	Compared with acceptance criteria for convergent validity (0.5)	Conclusion
AAA	0.87	0.52	Beyond	Valid
AAD	0.82	0.54	Beyond	Valid
AAI	0.86	0.60	Beyond	Valid
AAT	0.86	0.61	Beyond	Valid
GSA	0.85	0.60	Beyond	Valid
GSC	0.87	0.58	Beyond	Valid
GSL	0.89	0.66	Beyond	Valid
GSP	0.90	0.64	Beyond	Valid
GST	0.86	0.55	Beyond	Valid
KT	0.89	0.58	Beyond	Valid
ST	0.86	0.55	Beyond	Valid

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 more significant than their AVEs, which is a traditional method for assessing discriminant validity (Hair et al., 2019, p.9). However, Henseler et al. (2015) show that the Fornell Larcker criterion does not perform well when the indicator loadings on a construct differ only slightly.

Henseler et al. (2015) proposed the heterotrait-monotrait (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)

indicate that the HTMT indicator should be below 0.9; the scale ensures its discriminant validity.

Table 3.15 shows that 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.

Table 3. 15. Discriminant validity-HTMT matrix of constructs before adjustment

	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	0.782	0.73	0.73	0.83	0.75			
KT	0.44	0.57	0.47	0.701	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**	

3.2.2. Measurement model of 4 first-order constructs and 47 items

Figure 3.2 displays this study's measurement model of 47 items after removing five items of KT4, GSC1, AAA3, AAA4, and AAD4. Four sources of employability include technical knowledge (KT: 5 items), technical skills (ST: 5 items), generic skills (GS: 22 items), and attitude and other attributes (AA: 15 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).

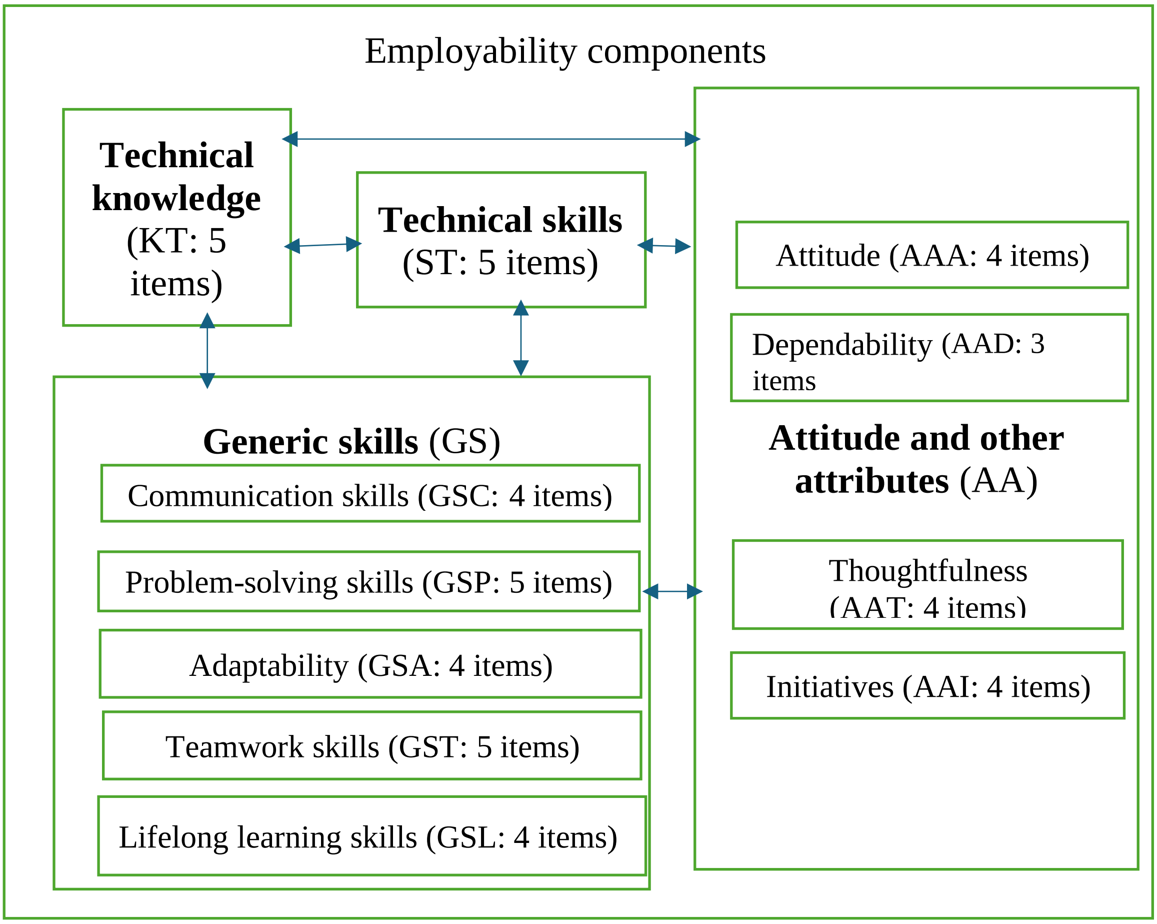


Figure 3. 2. Measurement model with 47 indicators

Internal consistency reliability

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

Table 3.16 reveals Cronbach's alpha, and the composite reliability indicator of all constructs are higher than 0.7 and lower than 0.95. Specifically, Cronbach's alpha of eleven constructs ranges from 0.72 to 0.86, and the composite reliability indicator lies between 0.84 and 0.9. It can be concluded that all eleven scales have an acceptable internal consistency.

Table 3. 16. Cronbach's alpha and CR indicators of second-order constructs after adjustment

	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

The outer loading of each factor is sufficient when it exceeds 0.7 (Hair et al., 2019). Table 3.17 shows that 47 outer loadings met and outweighed the standard.

Table 3. 17. Outer loadings matrix of subconstructs after adjustment

	AAA	AAD	AAI	AAT	GSA	GSC	GSL	GSP	GST	KT	ST
AAA1	0.80										
AAA2	0.76										
AAA5	0.76										
AAA6	0.77										
AAD1		0.82									
AAD2		0.81									
AAD3		0.77									
AAI1			0.74								
AAI2			0.71								
AAI3			0.81								
AAI4			0.83								
AAT1				0.74							
AAT2				0.81							
AAT3				0.74							
AAT4				0.82							
GSA1					0.75						
GSA2					0.71						
GSA3					0.78						
GSA4					0.84						
GSC2						0.74					
GSC3						0.75					

	AAA	AAD	AAI	AAT	GSA	GSC	GSL	GSP	GST	KT	ST
GSC4						0.84					
GSC5						0.87					
GSL1							0.80				
GSL2							0.83				
GSL3							0.84				
GSL4							0.79				
GSP1								0.81			
GSP2								0.82			
GSP3								0.82			
GSP4								0.81			
GSP5								0.73			
GST1									0.80		
GST2									0.77		
GST3									0.72		
GST4									0.73		
GST5									0.71		
KT1										0.75	
KT2										0.80	
KT3										0.81	
KT5										0.76	
KT6										0.84	
ST1											0.72
ST2											0.75
ST3											0.71
ST4											0.79
ST5											0.76

Convergent Validity

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

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 3.18).

Table 3. 18. CR and AVE of second-order constructs after adjustment

	Composite reliability (CR)	Average variance extracted (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

	Composite reliability (CR)	Average variance extracted (AVE)	Conclusion
GSP	0.90	0.64	Valid
GST	0.86	0.55	Valid
KT	0.89	0.63	Valid
ST	0.86	0.55	Valid

Discriminant Validity

HTMT indicators can assess discriminant validity.

HTMT matrix

Henseler et al. (2015) indicate that the HTMT indicator is below 0.9. The scale ensures its discriminant validity. Table 3.19 shows that HTMT indicators between two variables are smaller than 0.9, so these variables are discriminant from other variables.

Table 3. 19. Discriminant validity-HTMT matrix of subconstructs after adjustment

	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	

After assessing the measurement model, the questionnaire, after adjustment, covers 11 subconstructs and 47 items, as indicated in Table 3.20. The online official questionnaire after validation is shown in Appendix 1 and 2.

Table 3. 20. Employability components in the official questionnaire

First-order Constructs	Second-order constructs	Number of Items	Items
AA	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
GSS	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	KT	5	KT: 1, 2, 3, 5, 6
ST	ST	5	ST: 1, 2, 3, 4, 5
	Total	**47**	

3.2.3. Assessing structural model

The measurement model is reliable and valid with 4 first-order constructs, 11 second-order constructs and 47 items. There are two proposed structural models to be assessed by SmartPLS 4.0. This is an additional part of the thesis. These exploratory study results of assessing structural models need to be enriched by future studies

a. The first structural model

The first employability structural model (Figure 3.3) was assessed through R^2 for model explanation power and Path coefficients. VIF values were not assessed in the formative model of employability.

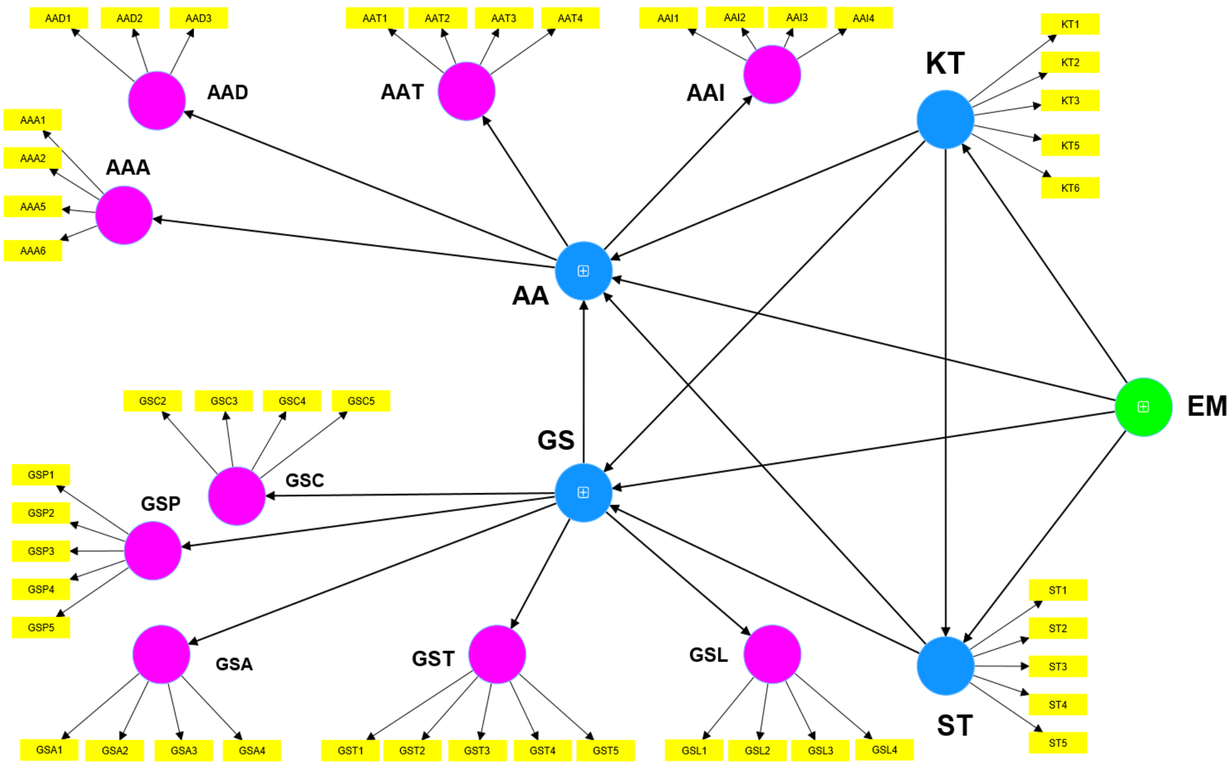


Figure 3. 3. The first structural model with 47 indicators

R^2 for model explanation power

Hair et al. (2019) noted that R^2 is a measure of power that explains the model. The R^2 ranges from 0 to 1. Its higher values show greater explanation power. Table 3.20 indicates that R^2 for technical knowledge, technial skills, generic skills, attitude and other attributes. According to Hair et al. (2019), the R^2 value can vary from 0 to 1 and depend on specific research cases. It reveals that technical knowledge independent variables can explain 68.7 per cent of the variance in technical knowlege. Techincal skills independent variables can explain 80.1 per cent of the variance in generic skills. Generic skills independent variables can explain 89.1 per cent of the variance in generic skills. It is noted that attitude and other attributes independent variables can explain 95.5 per cent of the variance in attitude and other attributes. Employability, which is a composite value of the model, can be counted by the following fomular:

EM= KT*0.687+ST*0.801+GS*0.891+AA*0.955

Table 3. 21. The first structural model explanation power

	R-square	**R-square adjusted**
KT (Technical knowledge)	0.689	0.687
ST (Technical skills)	0.804	0.801
GS (Generic skills)	0.893	0.891
AA (Attitude and other attributes)	0.956	0.955

Path coefficients

PLS-SEM depends on a "nonparametric bootstrap procedure" (Hai et al, 2014, p.130) to examine whether outer loadings and path coefficients have statistical significance. Thus, the bootstrapping technique was performed to determine the path coefficient is significant. Table 3.22 presents the values in Path coefficients.

Table 3. 22. The first structural model's path coefficients

Hypothesised path (Inner model)	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV)	P values
EM -> AA	3.367	3.360	0.164	20.583	0.000
EM -> GS	1.457	1.454	0.106	13.800	0.000
EM -> KT	0.830	0.834	0.031	26.861	0.000
EM -> ST	1.052	1.053	0.083	12.688	0.000
GS -> AA	-0.822	-0.809	0.071	11.651	0.000
KT -> AA	-0.996	-0.999	0.087	11.477	0.000
KT -> GS	-0.263	-0.264	0.068	3.861	0.000
KT -> ST	-0.195	-0.196	0.105	1.858	**0.063**
ST -> AA	-1.105	-1.101	0.073	15.108	0.000
ST -> GS	-0.352	-0.346	0.080	4.386	0.000

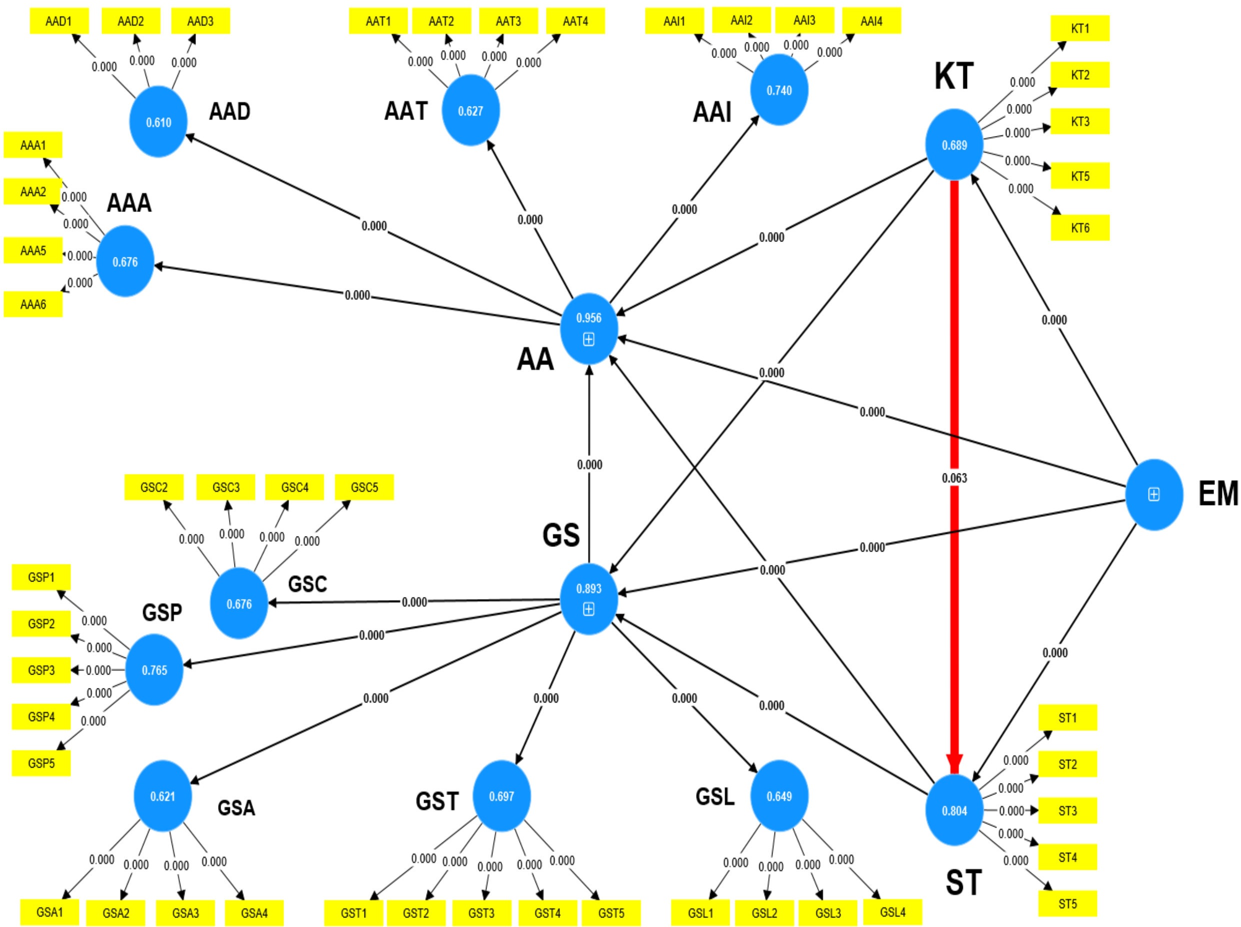


Figure 3. 4. The first structural model's hypothesized path evaluation

Figure 3.4 presents the ten hypothesized path evaluation in the first structural model. Nine paths are seen to be statistically significant, and one path is not. In specific,

1. EM -> AA: The t-value of the hypothesised path of EM and AA is 20.583, above 1.96 (α=0.005; two-sided test), and the p-value is 0.000 < 0.05. So, the hypothesized path of EM and AA of the inner model is statistically significant.

2. EM -> GS: The t-value of the hypothesised path of EM and GS is 13.8, above 1.96 (α=0.005; two-sided test), and the p-value is 0.000 < 0.05. So, the hypothesized path of EM and GS of the inner model is statistically significant.

3. EM -> KT: The t-value of the hypothesised path of EM and KT is 26.861, above 1.96 (α=0.005; two-sided test), and the p-value is 0.000 < 0.05. So, the hypothesized path of EM and KT of the inner model is statistically significant.

4. EM -> ST: The t-value of the hypothesised path of EM and ST is 12.688, above 1.96 (α=0.005; two-sided test), and the p-value is 0.000 < 0.05. So, the hypothesized path of EM and ST of the inner model is statistically significant.

5. GS -> AA: The t-value of the hypothesised path of GS and AA is 11.651, 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 of the inner model is statistically significant.

6. KT-> AA: The t-value of the hypothesised path of KT and AA is 11.477, 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 AA of the inner model is statistically significant.

7. KT-> GS: The t-value of the hypothesised path of KT and GS is 3.861, 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 of the inner model is statistically significant.

8. **KT-> ST**: The t-value of the hypothesised path of KT and ST is 1.858, over 1.96 (α=0.005; two-sided test), and the p-value is 0.063> 0.05. So, the hypothesized path of KT and ST of the inner model is **NOT** statistically significant.

9. ST-> AA: The t-value of the hypothesised path of ST and AA is 15.108, 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 AA of the inner model is statistically significant.

10. ST-> GS: The t-value of the hypothesised path of ST and GS is 4.386, 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 of the inner model is statistically significant.

b. The second structural model

The second employability structural model (Figure 3.5) was assessed through VIF values, R^2 for model explanation power and Path coefficients.

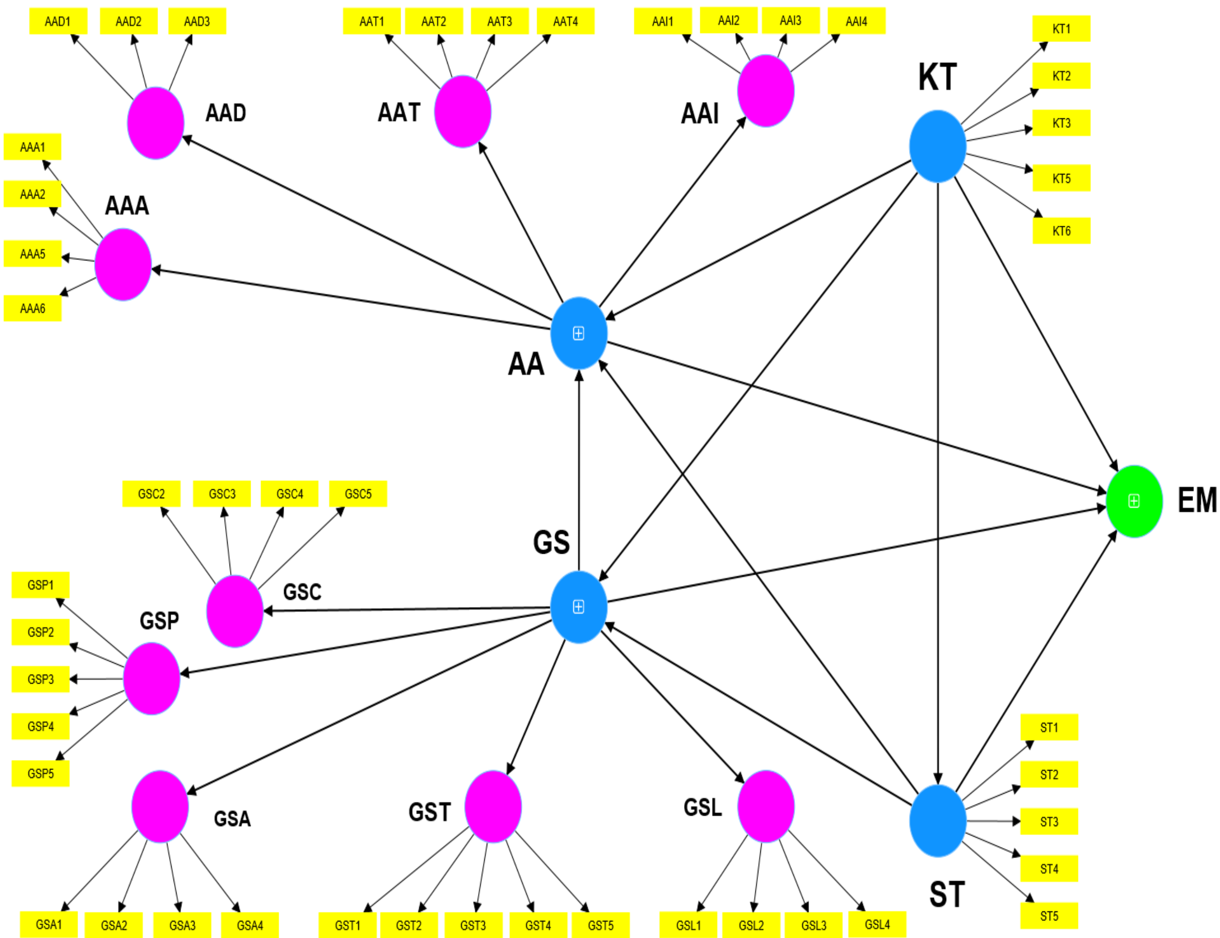


Figure 3. 5. The second structural model with 47 indicators

VIF values

According to Hair et al. (2019), the variance inflation factor (VIF) is 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 3.23 depicts, the VIF values of constructs are below 5, indicating no severe collinearity issues among constructs. Most constructs in the model are not correlated with VIF values below 3. VIF value for GS -> EM is 4.24, which is below five and over three and is supposed to have the possibility for collinearity issues. Still, in this study, the GS -> EM path is regarded as having no severe multicollinearity problems and is kept in the model.

Table 3. 23. Collinearity statistics (VIF)

Paths	VIF	Multicollinearity problems
AA -> EM	2.28	No

Paths	VIF	Multicollinearity problems
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) indicate that the R^2 value can vary from 0 to 1 and depend on specific research cases. As indicated in Table 3.24, technical skills independent variables can explain 45.8% 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 attitudes 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 findings by Sarayrah (2019). Employability in this study can be counted by:

$$EM * 0.996 = ST*0.458 + GS* 0.647+ AA*0.552$$

Table 3. 24. The second structural model explanation power

	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 run to determine the statistical significance of the path coefficient and test the t-values in this study. Table 3.25 presents the values in Path coefficients.

Table 3. 25. The second structural model's path coefficients

Hypothesised path (Inner model)	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV)	P values
AA -> EM	0.27	0.27	0.01	18.58	0.000
GS -> AA	0.78	0.77	0.09	8.45	0.000
GS -> EM	0.27	0.27	0.01	18.96	0.000
KT -> AA	-0.14	-0.13	0.10	1.42	**0.156**
KT -> EM	0.29	0.29	0.02	15.05	0.000
KT -> GS	0.35	0.35	0.08	4.54	0.000
KT -> ST	0.68	0.69	0.07	10.50	0.000
ST -> AA	0.09	0.08	0.10	0.86	**0.388**
ST -> EM	0.33	0.33	0.01	23.97	0.000
ST -> GS	0.53	0.53	0.06	8.76	0.000

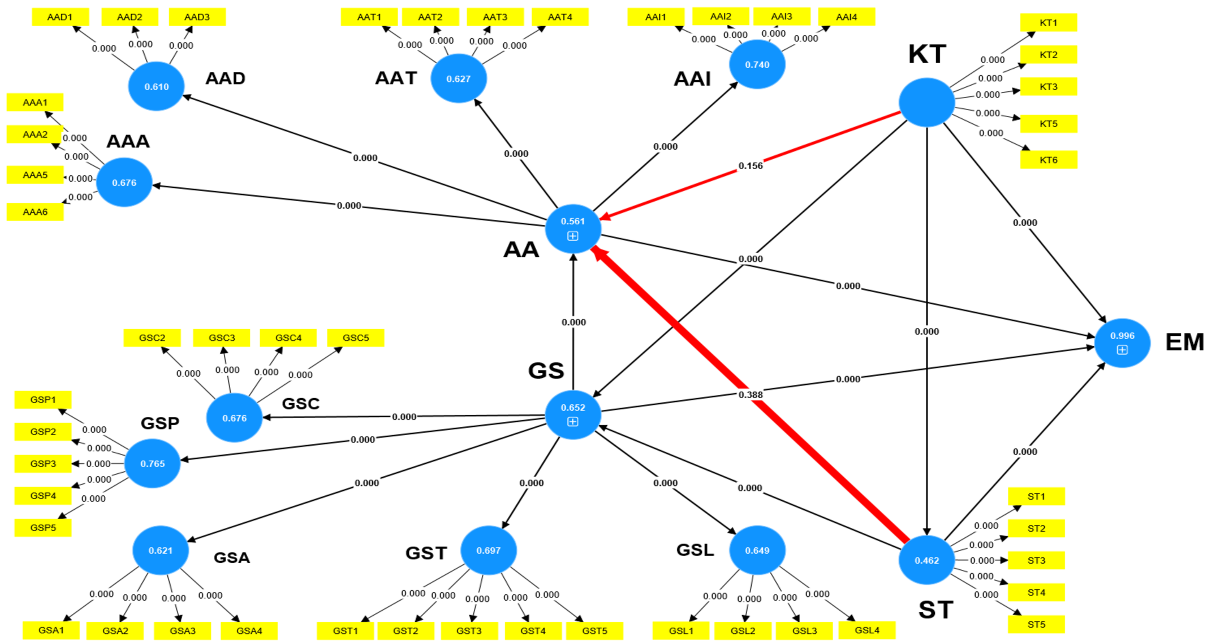


Figure 3. 6. The second structural model's hypothesized path results

Figure 3.6 presents the ten hypothesized paths results in the second structural model. Eight paths are seen to be statistically significant, and two paths are not. In specific,

1. AA -> EM: The t-value of the hypothesised 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 of the inner model is statistically significant.

2. 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 of the inner model is statistically significant.

3. 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 of the inner model is statistically significant.

4. 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 of the inner model is **NOT** statistically significant.

5. 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 KT and EM of the inner model is statistically significant.

6. 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 of the inner model is statistically significant.

7. 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 of the inner model is statistically significant.

8. 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 of the inner model is **NOT** statistically significant.

9. 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 of the inner model is statistically significant.

10. 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 of the inner model is statistically significant.

3. 3. Discussions

Employability studies have witnessed greater interest from universities due to the requirement for providing work-readiness graduates to employers. Engineering technology graduates' employability has become more concern recently when many big high-technology enterprises invest in Vietnam after the COVID-19 outbreak, and universities tend to be more competitive in attracting Vietnamese high school students and international students to study and research. Prior employability scale studies focused more on developing the employability scale for vocational high school students (Tentama & Anindita, 2020) and college students (Awwad, 2021) but were limited to university graduates. This study acts as an initial step in contributing to constructing an employability scale for tertiary graduates in engineering technology.

Engineering technology graduates' employability scale was developed based on steps suggested by Hinkin et al. (1997). The essential stages following the guideline by Hinkin et al. (1997) consisted of item generation, content adequacy assessment, and the evaluation of the scale reliability and validity. Assessing the construct's content adequacy was conducted by the Delphi method. The scale reliability and validity were evaluated after surveying employers engaged with engineering technology graduates.

This study's scale was broader than the scale by Zaharim et al. (2010). While Zaharim et al.'s three-component scale focused on employability skills, which include foundational knowledge and generic skills, the study's scale comprises two more components: technical skills, attitude and other attributes. The difference between the two scales might be due to their scope. Zaharim et al's study concentrated on employability skills, which is one of the employability components. However, this study developed an employability scale based on the employability definition by Moreland (2006), which conceptualised employability with skills, knowledge and personal attributes.

The present study in engineering technology was similar to Senan & Sulphey (2022) in accounting. Firstly, there are skill-related constructs for generic skills or soft skills and technical skills for ET graduates or audit and assurance for accounting graduates. Furthermore, there is one construct for ET graduates' technical knowledge whereas accounting knowledge-related constructs include three domains: general business requirements, conceptual knowledge and special topics in accounting.

The current study was similar to the research by Hanapi et al. (2018) in applying the Delphi technique to reach a consensus view by groups of experts. While Hanapi et al. (2018) interviewed seven experts for two rounds before conducting a pilot test to analyze the confirmatory factor through AMOS software for a measurement scale of technical skills in Malaysia, the present study employed the two-round Delphi technique prior to implementing the pilot test to validate the measurement scale of employability through SmartPLS 4.0 software. The participants in the Delphi technique are the same. This study invited lecturers who taught at a university and technical managers working in engineering technology disciplines, while Hanapi et al. (2018) involved college lecturers and engineers in the electrical engineering field in their study.

3.4. Conclusion

This chapter found the answer to the first research question is "How is the scale to measure engineering technology graduates' employability developed? To what extent is the scale reliable and valid?". The development of graduates' employability scales was implemented based on steps suggested by Hinkin et al. (1997).

The initially proposed employability scale covered 51 items. This study exploited the Delphi technique to get panelist's assessments on the number of items and content adequacy. Both employers and lecturers were selected as participants because employers recruited, managed, and supervised engineering technology graduates, while lecturers designed the training program, taught, and supported undergraduates for job employment. There are two rounds to achieve agreement among experts. The first round asked 20 experts to rate 51 items for the questionnaire. For the second round, the experts were divided into three discussion groups to review the previous round's results, and further clarify as well as adjust the items. This iterative process ensured that the scale was thoroughly adjusted and validated by the experts, enhancing its relevance and validity. By applying the Delphi technique, the adjusted scale deleted 2 items, added 3 items, and adjusted 23 items compared to the initial employability scale. The employability scale updated after taking expert feedback had 52 items.

The scale's validity and reliability were tested through the confirmatory factor analysis method using the partial least squares structural equation modelling (PLS-SEM) method. The scale's reliability was assessed through composite reliability (CR) and outer loading values. Meanwhile, convergent and discriminant validity for this scale was evaluated by the average variance extracted (AVE) and HTML values. For the scale of 4 first-order constructs and

52 items, internal consistency reliability was ensured with composite reliability beyond 0.8. Forty-six outer loadings meet the standard, but six other outer loadings are below the standard. After removing five indicators, AAD4, KT4, GSC1, AAA3, and AAA4, respectively and performing the analysis, the reliability and convergent validity of the scale has been improved. Moreover, the scale has obtained convergent validity. Eleven second-order constructs have surpassed the minimum threshold value for convergent validity (lowest threshold value of 0.5). HTMT indicators for model paths are smaller than 0.9, so these variables are not discriminant from other ones. It was noteworthy that the HTML indexes for three paths, which include AAD-AAI, GSP-GSC and ST-KT, are near 0.9. They might have the potential for discrimination problems.

After removing five items of AAD4, KT4, GSC1, AAA3, and AAA4, internal consistency reliability was ensured with composite reliability beyond 0.84. Forty-seven outer loadings meet the standard. The 47-item scale has reached high levels of convergent validity, eleven second-order constructs have surpassed the minimum threshold value. HTMT indicators between two variables are smaller than 0.9, so these variables are discriminant from other variables.

The validity of the employability scale was summarised in the following table:

Table 3. 26. Reliability and validity of the employability scale

Assessment criteria	**A scale of 11 second-order constructs and 52 items**	**A scale of 11 second-order constructs and 47 items**
Reliability	Reliable with CR= (**0.82**, 0.9) > 0.7 +46 “good” outer loadings, **06** “not good” outer loadings	Reliable with better indicators: CR= (**0.84**, 0.90) > 0.7 + 46 “good” outer loadings; +**01** “not good” outer loadings **were improved** into “good” outer loadings; **05 “not good**” outer loadings were removed
Convergent validity	Validity with AVE = (**0.52**, 0.66) > 0.5	Validity with **better indicators** AVE = (**0.55**, 0.66) > 0.5
Discriminant validity	+Validity (HTMT indicators are below 0.9)	+Validity (HTMT indicators which are below 0.9).

Assessment criteria	A scale of 11 second-order constructs and 52 items	A scale of 11 second-order constructs and 47 items
	+ **3 paths with potential** problems with discriminant validity	**+No paths** with potential problems with discriminant validity
Conclusion	+ Delete six "not good" outer loadings in turn + Three paths have the potential to discriminant problems.	+**Improved reliability** after deleting five "not good" outer loadings, which resulted in transforming one "not good" outer loading into a "good" one.

The employability scale was valid to cover four components and 47 items: technical knowledge (5 items), technical skills (5 items), generic skills (22 items), attitude and other attributes (15 items). The next chapter continues to present the findings to the second question after applying the reliable and valid employability scale of 47 items.

CHAPTER 4. MEASUREMENT OF GRADUATES' EMPLOYABILITY

The chapter reported the answers to the second research question "What are the levels of engineering technology graduates' employability? How do the employers' assessments differ among age groups and kinds of enterprises?". Specifically, the chapter presented employers' assessment results on graduates' employability using the standardised scale indicated in the previous chapter. Additionally, an analysis of variance was performed to test differences among employers' characteristics regarding age range and kinds of enterprises where employers work and graduates' employability.

4.1. Graduates' levels of employability

Engineering technology graduates' employability covers 4 constructs with 11 components: technical knowledge, technical skills, five categories of generic skills, and four groups of attitude and other attributes.

4.1.1. Assessing first-order constructs of graduates' employability

ET graduates got a positive assessment of general employability (Mean = 3.54, SD=0.48). As illustrated in **Table 4.1**, attitude and other attributes were rated to be the highest (Mean= 3.65, SD=0.53), which were followed by technical skills (Mean=3.55, SD=0.50) and generic skills (Mean=3.51, SD=0.52). Technical knowledge (Mean=3.45, SD=0.55) was evaluated at the lowest level of employability among the 4 first-order constructs.

Table 4. 1. Employers' graduates' employability assessment based on first-order constructs.

No.	First-order constructs	Mean	SD	Ranking
1	Technical knowledge	3.45	0.55	4
2	Technical skills	3.55	0.50	2
3	Generic skills	3.51	0.52	3
4	Attitude and other attributes	3.65	0.53	1
	Total	**3.54**	**0.48**	

It can be shown that enterprises can retrain graduates with technical knowledge, technical skills, and generic skills when graduates enter the enterprises' workforce. However, graduates' attitudes and other attributes are most needed and emphasized by enterprises.

4.1.2. Assessing second-order constructs of graduates' employability

Graduates' employability was scored according to 11 second-order constructs. Technical knowledge and technical skills cover 1 second-order construct for each. Generic skills comprise 5 second-order constructs. Attitude and other attributes cover f4 second-order constructs.

As seen in Table 4.2, employability competencies are at a medium level. All employability subconstructs have a mean value above 3. Furthermore, the standard deviations of element criteria are below 1, which reveals that the response options have low variation, so the assessment levels of the survey participants are close to each other.

The graduates' attitude (Mean=3.73, SD=0.56) obtained the highest judgement from employers' perspectives out of 11 employability second-order constructs. It is thought that a good attitude can ensure graduates are ready to change their mindset, learn new things, and sharpen untrained skills, necessary for positions at enterprises. Furthermore, graduates' dependability (Mean= 3.69, SD=0.58) and adaptability (Mean=3.65, SD=0.59) were ranked the 2nd and 3rd highest in the employability competencies. It was noteworthy that graduates' thoughtfulness and their technical skills were all rated to be in the 6th position. Their mean values are the same (Mean = 3.55).

Problem-solving skills (Mean=3.39, SD=0.59) are the lowest and only skills with a mean value below 3.4 among 11 employability elements. It could be predicted that graduates' low problem-solving skills could come from employers' high expectations for ET graduates. Employers expected ET graduates to be ready to apply and implement technology in the product. However, graduates in a short period after leaving university remained to have limited competencies in identifying, analysing and solving technical problems. It is noticeable that technical knowledge (Mean=3.45, SD=0.55) and communication skills (Mean= 3.48, SD=0.54) have their mean values below 3.5. They were rated as the 2nd and 3rd lowest employability among 11 subconstructs.

Table 4. 2. Assessment of second-order constructs of graduates' employability

No.	Second-order constructs	Mean	SD	Ranking
1	Technical knowledge	3.45	0.55	9
2	Technical skills	3.55	0.50	6
3	Communication skills	3.48	0.54	8
4	Problem-solving skills	3.39	0.59	10
5	Adaptability	3.65	0.59	3
6	Teamwork skills	3.57	0.58	5
7	Lifelong learning skills	3.50	0.62	7
8	Attitude	3.73	0.56	1
9	Dependability	3.69	0.57	2
10	Thoughtfulness	3.55	0.58	6
11	Initiative	3.64	0.60	4

4.1.3. Assessment of graduates' employability levels

The employers' assessments for 47 items were categorized for three groups: low level, which includes option 1 or 2 to each item; medium level, which provides option 3 to each item; and high level, which consists of the option 4 or 5 to each item **(Appendix 3)**.

Graduates' employability was analysed into 4 categories. Therefore, graduates' employability levels were analysed based on 4 categories of constructs.

Firstly, graduates' technical knowledge was assessed at a medium level of employability (Mean=3.45, SD=0.55). As indicated in **Table 4.3**, in terms of mean values, employers assessed KT2 "Update engineering technology trends" at the highest (Mean=3.50, SD=0.66), followed by KT1 "Apply knowledge of basic science to solve technical problems" (Mean=3.47, SD=0.64), KT3 "Describe technological processes" (Mean=3.44, SD=0.65), KT5 "Apply specialised knowledge to solve specific work problems" (Mean= 3.43, SD=0.73). KT4, "Recognize the suitable tool to analyse professional problems", was assessed as the lowest (Mean=3.39, SD=0.69).

Table 4. 3. Graduates' employability levels of technical knowledge

No.	Items	Low level (%)	Medium level (%)	High level (%)	Mean	SD
1	KT1	2.99	48.72	48.29	3.47	0.64
2	KT2	3.42	46.58	50.00	3.50	0.66
3	KT3	4.27	50.43	45.30	3.44	0.65
4	KT4	6.84	50.85	42.31	*3.39*	0.69
5	KT5	8.97	43.59	47.44	3.43	0.73
	Total				**3.45**	**0.55**

More specifically, the group of low employability level for technical knowledge accounts for below 9% (2.99% for KT1, 3.42% for KT2, 4.27% for KT3, 6.84% for KT4, and 8.97% for KT5). Engineering technology graduates at University A had technical knowledge at the medium and high levels (over 91%).

For the group with high employability level, KT2 "Update engineering technology trends" was assessed as the highest (50%), followed by KT1 "Apply knowledge of basic science to solve technical problems" (48.29%), KT5 "Apply specialised knowledge to solve specific work problems" (47.44%), KT3 "Describe technological processes" (45.30%), and KT4 "Recognize the suitable tool to analyse professional problems" (42.31%).

For the group of medium employability level, KT4 "Recognize the suitable tool to analyse professional problems" was the highest (50.85%), followed by KT3 "Describe technological processes" (50.43%), KT1 "Apply knowledge of basic science to solve technical problems" (48.72%), KT2 "Update engineering technology trends" (46.58%), and KT5 "Apply specialised knowledge to solve specific work problems" (43.59%).

Similarly, graduates' technical skills were assessed at a medium level of employability with the average mean=3.55 and SD=0.45. All five indicators for technical skills were identified at the medium level by employers, with a mean range from 3.45 to 3.61 **(Table 4.4)**. Employers assessed ST4 "Use engineering software to solve technical problems" to be the highest (mean= 3.61, SD=0.64) and ST2 "Exploit technical documents" to be the lowest (mean=3.45, SD=0.66) among five indicators of technical skills. Among the three groups of employability levels, the group of low employability levels, which ranges from 2.99% to 4.27%, are nearly the same among indicators. For the group with a high employability level, ST4 "Use engineering software to solve technical problems" was assessed as the highest (61.54%), while ST2 “Exploit technical documents” was assessed as the highest in the group with a medium employability level (48.72%).

Table 4. 4. Graduates' employability levels of technical skills

No.	Items	Low level (%)	Medium level (%)	High level (%)	Mean	SD
1	ST1	2.99	41.88	55.13	3.58	0.65
2	ST2	4.27	48.72	47.01	3.45	0.66
3	ST3	4.27	38.03	57.69	3.57	0.63
4	ST4	3.42	35.04	61.54	3.61	0.64
5	ST5	2.99	41.88	55.13	3.55	0.62
	Total				**3.55**	**0.45**

Thirdly, graduates’ generic skills were reflected by GSC “communication skills”, GSP “problem-solving skills”, GSA “adaptability”, GST “teamwork skills”, and GSL “lifelong learning skills”, as depicted in **Table 4.5**. Five generic skill groups are at medium levels (**Figure 4.1**), which include GSC (mean=3.48, SD=0.54), GSA (mean=3.65, SD=0.59), GST (mean=3.57, SD=0.58), and GSL (mean=3.50, SD=0.62). Among generic skills, graduates’ adaptability received the best assessment (mean=3.65), and their problem-solving skills were at the lowest level (mean=3.39). Graduates’ problem-solving skills are the weakest generic skills due to moderate skills in identifying the problem cause (mean=3.34, SD=0.70) and proposing suitable solutions (mean=3.30, SD=0.76). Additionally, in the context of online learning in the Covid-pandemic period, graduates who spent their learning time from 2019 to 2023 had limited access to technology and restricted practice on machines compared with the previous cohorts.

Among 22 items for generic skills, GSC1 “Communicate in a foreign language at the basic level at work” received the lowest assessment from employers (3.08/5). GSC1 was also assessed to be the lowest among four items in the subconstruct “Communication skills”.

Table 4. 5. Graduates' employability levels of generic skills

No.	Items	Low level (%)	Medium level (%)	High level (%)	Mean	SD
	GSC				**3.48**	**0.54**
1	GSC1	17.95	55.56	26.50	3.08	0.69
2	GSC2	4.3	30.3	65.4	3.71	0.70
3	GSC3	6.41	38.46	55.13	3.54	0.70
4	GSC4	4.70	38.46	56.84	3.59	0.69
	GSP				**3.39**	**0.59**
5	GSP1	6.41	48.72	44.87	3.43	0.69
6	GSP2	7.69	45.73	46.58	3.43	0.70
7	GSP3	8.55	50.85	40.60	3.34	0.70
8	GSP4	11.97	50.85	37.18	3.30	0.76
9	GSP5	6.41	46.15	47.44	3.44	0.67
	GSA				**3.65**	**0.59**
10	GSA1	2.56	32.48	64.96	3.73	0.68
11	GSA2	3.42	32.48	64.10	3.73	0.72
12	GSA3	4.3	40.6	55.1	3.58	0.70
13	GSA4	2.99	43.16	53.85	3.56	0.64
	GST				**3.57**	**0.58**
14	GST1	4.70	40.17	55.13	3.55	0.66
15	GST2	2.99	31.20	65.81	3.74	0.69
16	GST3	6.41	46.15	47.44	3.46	0.69
17	GST4	4.70	39.74	55.56	3.56	0.69
18	GST5	4.70	41.88	53.42	3.54	0.68
	GSL				**3.50**	**0.62**
19	GSL1	5.13	40.17	54.70	3.57	0.71
20	GSL2	5.13	41.45	53.42	3.58	0.74
21	GSL3	7.26	45.30	47.44	3.46	0.73
22	GSL4	5.98	51.28	42.74	3.40	0.68

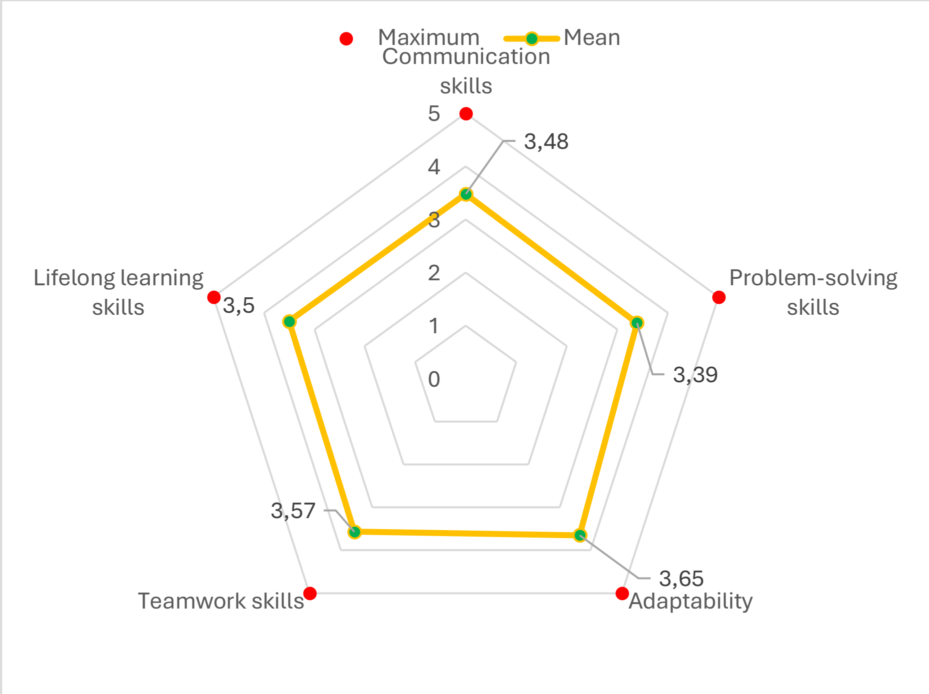


Figure 4. 1. Radar spider web diagram of graduates' generic skills

Finally, attitudes and other attributes for ET graduates were rated by four scales: AAA "attitude", AAD "dependability", AAT "thoughtfulness", and AAI "initiative". All four groups of attitude and other attributes are at medium levels, as presented in **Table 4.6**, which were assessed to be highest by attitude (mean=3.73), followed by three different attributes, AAD (mean= 3.69), AAI (mean= 3.64), and AAT (mean=3.57) (**Figure 4.2**). Graduates' attitudes were at the highest level, which means that graduates recognised their competence and showed suitable attitudes to their supervisors in the enterprises.

Item AAT4, “Give appropriate advice to colleagues at work”, was assessed to be the lowest among four items in the subconstruct “Thoughtfulness”. The item AAT4 also got the lowest assessment from employers (3.34/5) among 15 items for attitude and other attributes. On the other hand, AAA1 “Work seriously” obtained the highest assessment by employers in the subconstruct “Attitude”. The item AAA1 was also evaluated to be the highest among fifteen items for the construct “attitude and other attributes”.

Table 4.6. Graduates' employability levels of attitude and other attributes

No.	**Items**	**Low level (%)**	**Medium level (%)**	**High level (%)**	**Mean**	**SD**
	AAA				**3.73**	**0.56**

No.	Items	Low level (%)	Medium level (%)	High level (%)	Mean	SD
1	AAA1	1.28	20.51	78.21	3.90	0.63
2	AAA2	3.85	37.18	58.97	3.65	0.72
3	AAA3	3.85	43.16	52.99	3.54	0,65
4	AAA4	0.43	30.77	68.80	3.85	0.69
	AAD				**3.69**	**0.57**
5	AAD1	2.99	31.20	65.81	3.70	0.66
6	AAD2	1.28	29.06	69.66	3.80	0.65
7	AAD3	4.27	37.61	58.12	3.58	0.66
	AAT				**3.55**	**0.58**
8	AAT1	3.85	34.62	61.54	3.67	0.72
9	AAT2	2.56	33.76	63.68	3.71	0.68
10	AAT3	4.27	47.44	48.29	3.47	0.68
11	AAT4	8.55	51.28	40.17	3.34	0,68
	AAI				**3.64**	**0.6**
12	AAI1	4.70	37.18	58.12	3.63	0.72
13	AAI2	7.69	49.15	43.16	3.41	0.75
14	AAI3	1.71	29.91	68.38	3.79	0.66
15	AAI4	2.14	34.62	63.25	3.72	0.68

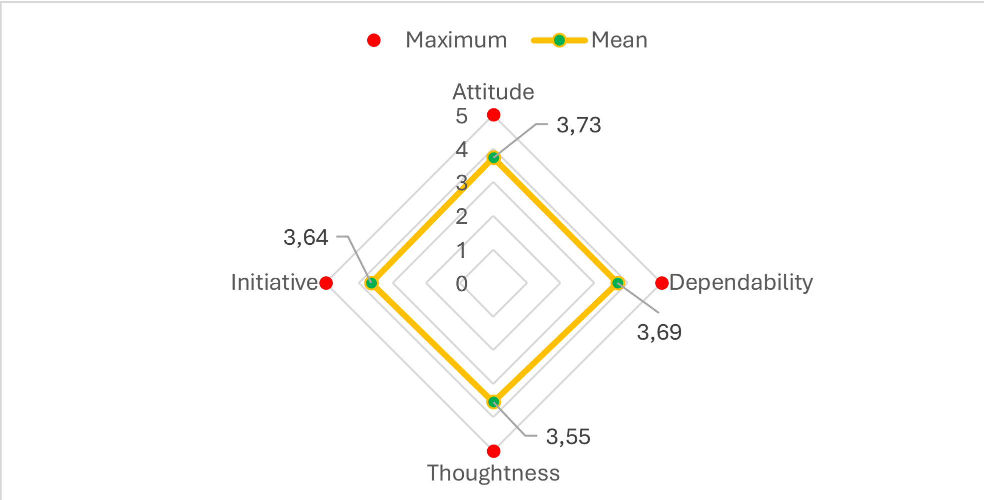


Figure 4. 2. Radar spider web diagram of graduates' attitude and other attributes

4.2. Difference testing

The Levene test can test whether some groups have the same variance in the population. In case the p-value for the Levene test is bigger than 0.05, there is not a significant difference between the variances. In such a case, the F test is run to test the quality of the means. It can be understood that the p-value for the Levene test is smaller than 0.05, variances are different from each other significantly. In this case, the Welsh test is employed, not the F test.

4.2.1 Difference in the age range to graduates' employability

Table 4.6 illustrates that the Sig of the Levene test can show whether there is a difference in the employers' age groups in their assessments of graduates' employability, so variances were found in the difference between the age groups. In the second step, the Welch test is used. The Sig of the Welch test is 0.66 > 0.05 (Table 4.7), showing that no significant differences in employability assessment were recognised among participants with 4 different age groups at the $p < 0.5$ level. As seen in Table 4.8, the employability means for the 4 groups of age are closer to each other, which indicates that all age groups highly adjusted graduate employability.

Table 4. 6. Test of Homogeneity of Variances in the age range

		Levene Statistic	df1	df2	Sig.
Employability	Based on Mean	4.54	3	230	**0.004**
	Based on Median	4.39	3	230	0.005
	Based on Median and with adjusted df	4.39	3	207.52	0.005
	Based on trimmed mean	4.71	3	230	0.003

Table 4. 7. Welch test in the age range

	Statistic[a]	df1	df2	Sig.
Welch	0.53	3	83,851	**0.66**

a. Asymptotically F distributed.

Table 4. 8. Descriptive statistics in age range

	Age range	N	Mean	Std. Deviation
Employability	<25	22	3.58	0.31
	25 ≤ 30	56	3.47	0.50
	30 ≤ 35	102	3.56	0,43
	40 ≤ 45	54	3.55	0,58

4.2.2. Difference in kinds of enterprise to graduates' employability

Furthermore, the Sig of the Levene test can show whether there is a difference in kinds of enterprise towards employers' assessments is 0.16 > 0.05 (Table 4.9), so there were not any differences in variance between the 2 kinds of enterprises. In the following step, the F test is run. Sig of F test is 0.003 < 0.05 (Table 4.10), so differences were significantly shown between participants from foreign and private enterprises at the p < 0.05 level. Table 4.11 makes it clearer that the employability means for 2 kinds of enterprises are at medium levels, and significant differences were found among participants serving private enterprises (M=3.76) and foreign enterprises (M=3.50) in employability assessment.

Table 4. 9. Test of Homogeneity of Variances in kinds of enterprises

		Levene Statistic	df1	df2	Sig.
Employability	Based on Mean	1.97	1	232	**0.16**
	Based on Median	2.04	1	232	0.15
	Based on Median and with adjusted df	2.04	1	230.73	0,15
	Based on trimmed mean	2.03	1	232	0.16

Table 4. 10. ANOVA in kinds of enterprises

		Sum of Squares	df	Mean Square	F	Sig.
Employability	Between Groups	2.03	1	2.03	9.24177	**0.003**
	Within Groups	50.92	232	0.22		
	Total	52.94	233			

Table 4. 11. Descriptive statistics in kinds of enterprises

	Enterprises' kind	N	Mean	Std. Deviation
Employability	Foreign-owned	197	3.50	0.48
	Private-owned	37	3.76	0,40

4.3. Discussions

The study was conducted in the first half of 2024 when graduates attended labor market more than six months after receiving the university bachelor's degree. It was the period of time when university and enterprise partnership activities, namely student internships and job fairs at University A were fostered.

The study found that ET graduates' employability competencies were very positive. All employability elements reached over moderate levels, while 90.9% of employability competence elements reached high levels. These results appear to be different from Nguyen & Nguyen's (2015) employability of ET graduates assessed. According to MOET (2022), ET disciplines include engineering disciplines (code: 752) and engineering technology engineering (code: 751). It is understood that Nguyen & Nguyen's (2015) graduate discipline scope was broader than the current study's. Nguyen & Nguyen (2015) indicated that various gaps existed between graduates' knowledge, skills, and attitudes and requirements from employers. The employability of engineering-technology graduates did not achieve expectations from employers. They explained that job characteristics required more practical skills, while programs covered theory-focused subjects. However, García-Aracil et al. (2022), in the Belarusian context, shared a similar result. Young graduates were assessed based on twenty-four items. The findings stated that young graduates in Belarus had a lower level of competency than was needed for the job.

The study findings showed that graduates' technical and generic skills were assessed higher than their technical knowledge. This result reconfirmed the findings in the previous study. Mai (2017) ascertained that generic skills, in several situations, are "more important than graduate's technical knowledge" (Mai, 2017, p.140).

Among 11 employability criteria, graduates' attitudes were evaluated at the highest level, which means that graduates recognised their competence and showed suitable attitudes to their supervisors and managers in the enterprises. There are the same findings between the roles of attitudes found in the thesis, Su & Zhang (2015) and Steurer et al. (2023). Attitude is one of 5 critical components analyzed from interviews and questionnaires with employers in China. Similarly, Steurer et al. (2023) indicated that managers in South Africa highly appreciated the new graduates with a positive attitude towards life and work. They were hired for attitudes, not skills. The study's findings are similar to those of non-public university graduates in Vietnam by Dang et al. (2019). They shared that graduates' attitudes were marked the best by employers in comparison with graduates' skills, employment achievement, and suitability between trained expertise and job.

Vezi-Magigaba and Utete (2023) indicated that problem-solving and the ability to learn were considered the most crucial non-technical skills. However, engineering technology graduates' problem-solving skills were the weakest generic skills among the 11 employability criteria. The first possible cause could come from the fast development of new technologies, while ET training programs and textbooks are burdensome to continuously update with enterprises' manufacturing innovations. The second possible reason might be that undergraduates used to learn in large, crowded classrooms in which lecturers gave lectures to over 40 students, and it was difficult for them to implement task-based activities effectively. This finding was the same as stated by Khoo et al. (2020) in a study in New Zealand. Khoo et al. (2020) interviewed employers on twenty-six competencies of engineering and science graduates. The majority of employers are managers and supervisors from enterprises. Employers certified that problem-solving skills were among the ten biggest gaps in graduates' competency. They also foresaw that problem-solving skills can be ranked in the top 5 competencies in terms of importance in 2030. Khoo et al. (2020) proposed that universities should take "real problems" (p.10) from enterprises' "real-world workplaces" (p.10) for undergraduates to sharpen their problem-solving skills further. Cases in New Zealand might have a suggestion that graduates' problem-solving skills at University A can be enhanced in the future time to keep their jobs and become more valuable due to preparation for employers' expected job skill requirements.

In Vietnam, English has been accepted as a crucial competence, so the foreign language, including English, is a compulsory subject for students from grade 3 to grade 12 in MOET's 2018 General Education Program (V. Van Hoang, 2022). Recently, the Politburo has documented the task of gradually making English become the second language in schools (VietnamNet, 2024). However, the item GSC1, "Communicate in a foreign language at the basic level at work", by engineering technology graduates was assessed to be the lowest among generic skill items by employers. This result is similar to that found in Nguyen & Nguyen (2015), who figured out that foreign language competence and applying specialized knowledge in practice were the two lowest-rated skills by 386 industry employers for Vietnamese graduates in engineering and technology disciplines. The role of engineering undergraduates' foreign languages (especially English) was also emphasized in the study in Saputra (2015) in Indonesia. He discovered that foreign language was the most expected among 15 work skills mentioned in 250 job advertisements. Some employers in Indonesia even highlighted the necessity of a foreign language so highly when they stated that "No skill is more valuable than a foreign language" (Saputra, 2015, p.225).

Focus and attention to work are two characteristics among the positive behaviours which employers could observe and mention in their assessment of their employees' work attitudes (Mathur et al., 2023). Item AAA1, "Work seriously", which refers to the employees' taking sufficient time and effort to finish their tasks effectively and taking full responsibility for work performance with a high level of focus, obtained the employers' highest assessment in the subconstruct "Attitude". The study's finding is consistent with the statement by Calvo (2011), who reported that university undergraduates were required to be aware of a severe work attitude necessitated in the period prior to official working, for example, in internships.

ET graduates' adaptability (M=3.69, SD=0.59) was rated as the third level by employers among the eleven second-order constructs for employability. The result was similar to the foreign language students' self-assessment in the study by Le and Pham (2019). Students' adaptability was self-rated to be the third level among students' skills for employability.

No differences in employability assessment were significantly recognised among participants who belonged to four age groups. This finding did agree with the study by Yepes Zuluaga (2024). Her study findings of engineering graduates asserted that age was not linked with the assessment of engineers' employability skills ($p=0.671 > 0.05$) significantly. However, young men between 26 and 35 illustrate the highest self-perception in employability skills.

Significant differences were indicated between participants from foreign and private enterprises for the assessment of employability. This finding agrees with that of Nguyen & Nguyen (2015). Nguyen & Nguyen (2015) discovered graduate employability assessments from foreign and private enterprises. They revealed that foreign enterprises rated graduates' employability at lower levels than private ones.

The measurement results of graduates' employability showed some issues which need to be considered for better preparation to foster graduates' employability. Firstly, graduates' technical knowledge was scored to gain the lowest level among the 4 first-order constructs. Secondly, the graduates' attitude obtained the highest judgement from employers' perspectives among eleven second-order constructs. Thirdly, communication skills in a foreign language at the basic level at work received the lowest assessment from employers among 22 items for generic skills.

Thus, three proposals are given to prepare undergraduates' employability. The first proposal is to implement field trips for undergraduates. Graduate employability responsibility must be shared between students, HEIs and employers (Cheng et al., 2022). The field trips are proposed as a feasible solution to better prepare undergraduates for graduate employability with the support of enterprise-university cooperation. Firstly, field trips are one of the extra-curricular activities that may be separate from the formal curriculum. Therefore, field trips can be held each week and each month during the academic year. The trips are complementary to revising the students' previous understandings and facilitating their practical skills, not enough time to be sharpened in the disciplinary curriculum (L. H. N. Tran, 2017). Secondly, field trips cost little. The field trips can be organized in a day or half a day (Higgins et al., 2012), which does not require expenses for renting overnight rooms. Enterprises can sponsor transportation for field trips. They can support the visits by the cars used to take their daily employee vehicles or leased ones.

Field trips cover three stages: pre-trip, while-trip, and post-trip. Pre-trip activities consist of different preparatory plans, such as selecting the field trip venue, arranging a reasonable time for school and enterprise, considering transportation, exchanging detailed schedules, and designing evaluation tools for student engagement (Behrendt & Franklin, 2014). During the trip, the roles of lecturers are emphasised. There are various ways to keep the students engaged. The first way is to make participants care about their tasks; another method is to create group work requiring students to observe, discuss and report their results.

After the trip, students are asked to write their reflections to inform the school organisers of the students' interests and the trip's values. The well-organized field trips can avoid the "zoo phenomenon" (Higgins et al., 2012, p.170) of not achieving educational intent or not supporting participants to make personally relevant meaning from the learning experience. The post-trip feedback from participants can suggest improvements for the following excursions.

The second proposal is to implement field trips for university lecturers. There have been many studies conducted on field trips for primary and higher education students, but few researchers have mentioned field trips for teachers or lecturers. Furthermore, there exists a contrasting picture of the professional development of lecturers. They are the "special production force that creates products as human resources" (Nguyen, 2021, p.164) but their main barrier to professional growth is "the lack of time due to high workload" (Pham & Duong, 2020, p.852). According to Tran (2016), universities can send academic staff to enterprises for practical lessons. Professional development of academic lecturers may include direct participation in practising and working in enterprises to promote "associate theory with practice" and "apply modern methods in teaching" (Nguyen, 2021, p.169). As suggested by Tran (2016), universities could consider making plans to send lecturers to enterprises in the summer when the university academic year is complete, and lecturers can take part in field trips for experiential learning in the enterprises besides taking summer holidays.

The last proposal is to promote training programs taught in English. International enterprises tended to invest or widen their production in Vietnam after the COVID-19 pandemic. Therefore, they needed Vietnamese technicians or engineers who were good at their technical competence and fluent in communication in English. As a result of the employability push-full circle between employers, higher education suppliers, and graduates (Curtis & McKenzie, 2001), international enterprise requirements have urged higher education institutions to update or change training programs which have primarily been taught in Vietnamese and some foreign language courses to meet a student outcome in foreign language competence. The Vietnamese universities should have some new training programs in engineering technology taught in English with a few courses (for example, Marxist-Leninist philosophy taught in combination with Vietnamese and English) to attract international students and upgrade Vietnamese students' competence in learning and group working with the use of English to enhance undergraduates' employability after graduation.

4.4. Conclusion

Employability was classified into the four following categories: technical knowledge, technical skills, generic skills, and attitude and other attributes. Among the four categories, graduates' technical knowledge had the lowest employability score. It was an area where graduates tended to perform less strongly compared to the three other employability components. On the other hand, attitude and other attributes were rated the highest. Employers put a significant value on the graduates' attitudes and other personal characteristics, viewing these as critical indicators of a graduate's ability to work well and contribute positively to an industry environment. Technical skills, which are closely related to technical knowledge but focus more on practical application, were ranked second (mean=3.55, SD=0.50). This finding highlights the importance of not just knowing technical content but being able to apply it effectively in real-world situations. Following technical skills, generic skills were slightly lower, with a mean of 3.51 and a standard deviation of 0.52. These skills are critical across various working positions in the industry sectors; they were seen as less crucial than the graduates' attitude, other attributes and technical skills.

Employability was divided into eleven subcategories: technical knowledge, technical skills, communication skills, problem-solving skills, adaptability, teamwork skills, lifelong learning skills, attitude, dependability, thoughtfulness, and initiative. Among eleven employability elements, graduates' attitude was rated the highest by employers, with a mean score of 3.73 and a standard deviation of 0.56. It was followed by dependability and adaptability which ranked 2^{nd} and 3^{rd}, respectively. Conversely, problem-solving skills were rated the lowest among the eleven subcategories, with a mean of 3.39 and a standard deviation of 0.59. In addition, technical knowledge (mean = 3.45, SD = 0.55) and communication skills (mean = 3.48, SD = 0.54) were also identified as lower-rated aspects of employability, ranking as the second and third lowest subconstructs, respectively.

The employability means were compared to assess differences in employers' evaluations of graduates' employability based on age range and enterprise type. The analysis found no significant differences in employability assessments among employers across the three age groups. However, there were significant differences between employers from foreign and private-owned enterprises, suggesting that these types of organizations evaluate employability differently. These results indicate that the type of enterprise plays a critical role in influencing graduates’ employability assessments.

The next chapter, therefore, sums up the results of two research questions to the study, its contributions, shortcomings and implications.

CONCLUSION

This conclusion summarises the study's main finding summary, contributions, implication for practice, limitations and recommendations for further studies.

Summary of main findings

The study has two questions. Each question has its following answers.

Research question 1: How is the scale to measure engineering technology graduates' employability developed? To what extent is the scale reliable and valid? The first question has two subparts

The answer to the first part of the first question "How is the scale to measure engineering technology graduates' employability developed?"

This study exploited the Delphi technique to construct a measurement scale of employability that required expert participation in making decisions. Both employers and lecturers were selected because employers recruited, managed, and supervised graduates, while lecturers built the training program, taught, and supported undergraduates for job employment.

There are two rounds to achieve agreement among experts on the proposed measurement scale. For the first round, 20 experts gave feedback on 51 items. For the second round, 20 experts were divided into three groups for interviews (5 experts for the lecturer group, 5 experts for the human resource group, and 10 experts for the technical group). The result is to delete 2 items, add 3 items, and adjust 23 items. The questionnaire, after expert feedback, includes 52 items for four first-order constructs.

The answer to the second part of the first question "To what extent is the scale reliable and valid?"

The scale's validity and reliability were tested through the confirmatory factor analysis method using the PLS-SEM method. The scale's reliability was assessed through composite reliability (CR) and outer loading values. Meanwhile, convergent validity for this scale was evaluated by the average variance extracted (AVE) values.

For the scale of 4 constructs and 52 items, forty-six outer loadings meet the standard, but six other outer loadings are below the standard. After removing five indicators, AAD4, KT4, GSC1, AAA3, and AAA4, respectively and performing the analysis, the reliability and convergent validity of the scale has been improved. Moreover, the scale has obtained convergent validity, and these variables are discriminant from other ones. Three paths, which include AAD-AAI, GSP-GSC and ST-KT, might have the potential for discrimination problems.

Scale assessment after removing five items: forty-seven outer loadings meet the standard. The scale has reached high levels of convergent validity, its variables are discriminant from other variables (HTMT indicators are smaller than 0.9). The study's employability scale was validated to cover four components: technical knowledge (5 items), technical skills (5 items), generic skills (22 items), attitude and other attributes (15 items).

Research question 2: What are the levels of engineering technology graduates' employability? How do the employers' assessments differ among age groups and kinds of enterprises?

The answer to the first part of the second question "What are the levels of engineering technology graduates' employability?"

Employability was classified into four first-order constructs: (i) technical knowledge, (ii) technical skills, (iii) generic skills, and (iv) attitude and other attributes. Employers' assessment findings showed that graduates' technical knowledge scored the lowest level of employability. Attitude and other attributes were evaluated to be the highest. Technical skills and generic ones ranked second and third.

Employability was further broken down into eleven second-order constructs: technical knowledge, technical skills, communication skills, problem-solving skills, adaptability, teamwork skills, lifelong learning skills, attitude, dependability, thoughtfulness, and initiative. It is noticeable that the graduates' attitude received the highest evaluation from employers, followed by graduates' dependability and adaptability, which ranked second and third, respectively. Conversely, problem-solving skills, technical knowledge and communication skills were identified as the three lowest second-order constructs in employability.

The answer to the second part of the second question "How do the employers' assessments differ among age groups and kinds of enterprises?"

The means were compared to examine the evaluation of graduates' employability differences in terms of the employers' age range and types of enterprises. The analysis revealed no significant differences in employability assessments among employers across the three age groups. However, significant differences were shown between participants from foreign-owned and private-owned enterprises in terms of employability assessment, indicating differing evaluations of employability between these types of organisations.

Significance of the study

The study is one of the first academic works which primarily focused on developing an employability scale specifically for engineering technology graduates. The scale's development was significantly informed by contributions from employers in enterprises, a perspective that has been comparatively neglected in previous research in Vietnam.

Secondly, the study contributed to the literature review in educational assessment and measurement by consolidating previous studies for employability constructs and the development of a measurement scale.

Thirdly, employability is a complex concept that has become a heated topic for scholars and organisations. While the Delphi technique has been widely employed in economic and health research, its application in educational sciences remains limited. The study significantly contributes to research methods by utilising the Delphi method within the education sector, facilitating consensus among experts on the constructs and items used to assess graduates' employability.

Furthermore, SEM (Structural Equation Modeling) has been used to explain the relationship among the constructs. Past studies predominantly exploited the Covariance-Based SEM (CB-SEM) technique to test and confirm individual hypotheses (Dash & Paul, 2021) of employability skills instead of employability, which covers knowledge, skills and attitude. This study applied Partial Least Squares SEM (PLS-SEM) to discover the most suitable relationship among constructs of employability, in which specific subscales with reliable items were developed for technical knowledge, attitude and some attributes.

Finally, the study is the first survey that implemented the employers' employability measurement for each engineering technology graduate. The previous surveys were conducted with employers’ assessments of groups of mixed-cohort graduates. By focusing on individual assessments, this study offers valuable insights for University A in developing engineering technology training programs to better align with the needs of industry and society.

Recommendation for practice

The survey results in the study are beneficial for University A. Firstly, the employability survey results help University A identify the graduates’ lowest level of technical knowledge in comparison with technical skills, generic skills, attitude and other attributes discovered from data of engineering technology graduates in 2023. It is advisable for University A to invite employers who hired ET graduates in 2023 to participate in the information-sharing meetings about labour market demands relating to technical knowledge to the second and third-year undergraduates. Secondly, the graduates’ attitude reached the employers’ highest evaluation among 11 surveyed employability elements, whereas problem-solving skills were rated the lowest. It is recommended that seven ET training programs at University A should integrate problem-solving skills into certain courses when revising their curricula. Thirdly, attitude and dependability were rated as two among the highest second-order constructs, so University A should cultivate these traits by inviting foreign enterprises (e.g. Honda, Denso, Samsung, Nestlé company) to share working culture and how attitude and dependability affect their choice in recruiting new graduates or promoting graduates to managerial positions in the enterprises.

The employability scale developed in the thesis is likely to be used by human resource managers for the assessment of fresh staff after each year working in the enterprise. Additionally, it can be employed for purposes of considering employees to managerial positions in technical departments after a long time of working at enterprises.

The measurement results of ET graduates’ employability in this study might give two proposals to enterprises. Firstly, foreign language proficiency was identified as the graduates’ lowest generic competence. It is recommended that enterprises can supply undergraduates with scholarships which include budgets for intensive foreign language training. Enterprises can select third-year students who have good technical competencies and agree to sign the commitment to serving enterprises after completing a university training program. While the third-year students study the courses for final year training in the morning or in the afternoon, they can be trained in the evening with communication skills in foreign language and technical courses which are needed to work in enterprises, but engineering technology training programs have not been supplied or provided briefly. Secondly, collaborations between industry and universities need to be installed to address skill gaps. Enterprises can sign MOUs with universities to implement expert exchanges. It is a win-win partnership in which lecturers can attend the training of new employees in the enterprises while experts from enterprises are funded to co-teach with university lecturers in the courses in Quality Management or Production Management or An introduction to engineering courses in the university lecture hall.

The thesis's results of graduates' employability levels might provide undergraduates with some following suggestions. Firstly, ET undergraduates are advised to have good plans for learning English which were assessed to be crucial by employers but achieved at a low level by graduates in 2023. Secondly, they should join work-integrated learning to improve problem-solving skills which were scored to be the lowest levels by employers at foreign and private enterprises. Lastly, ET students keep positive attitudes in learning new things and go on improving technical knowledge to prepare for their jobs after graduation in the context of the fast development of artificial intelligence and the high demand for technicians for semiconductor technology in Vietnam.

Limitations and recommendations for further research

Limitations

The study has inevitable limitations regarding its scope, sampling, and technical issues in collecting and analysing data.

Firstly, the study's scope is limited. According to MOET (2022), ET is divided into 7 groups of disciplines, in which each group of disciplines can cover one or more specific disciplines. The study focused solely on two groups: the mechanical group of engineering technology and the electric, electronic and communication group of engineering technology. These groups were selected due to their high enrollment rates and significant demand from industry and society.

Secondly, the study is constrained to its sampling. This study was conducted with enormous efforts to involve employers in participating in several rounds (the Delphi process and the measurement one), but employers' participation was limited. The technical and human resource experts in this study came from some Asian and European countries (Taiwan (China), China, Japan, Korea, and Switzerland). In contrast, experts from American and domestic private enterprises were excluded due to accessibility challenges. The second sampling limitation is 153 participants in a pilot test. They were invited to the research at the time of nearly the Vietnamese lunar new year. Though most were ready, some were inaccessible because they concentrated on the manufacturing orders to finish before the Tet holiday. The third sampling limitation is the sample size for the official test, in which 234 responses from participants were recorded. Although large and medium enterprises that recruited and used groups of ET graduates were invited to the study, small enterprises were restricted from participating. In addition, there were no ET graduates in 2023 who confirmed to work for the state-owned enterprises in the official test, which could cause shortcomings in the diversity of the participants.

Thirdly, the study encountered several technical limitations in data collection and analysis. Data collection was implemented in Vietnamese for the Delphi process, pilot, and official tests. Afterwards, the participants' answers were interpreted into English by the back-translation technique. Despite the researcher's efforts and experts' expertise in linguistics and educational assessment, it is acknowledged that the nuances of respondents' expressions may not have been captured with absolute precision in the translation process.

Recommendation for further studies

The study has the following implications for future research.

Firstly, future studies should continue to collect new data sets of employers to validate an employability scale for ET graduates as suggested in step 7 for a reliable and valid scale by Hinkin et al. (1997).

Secondly, the current study measured the employability of graduates from a public university in Vietnam. Further studies can be conducted with data collected from some universities in Vietnam. It is noted that other universities can use the measuring results of University A as a benchmark to compare with their survey results, thereby enhancing the validity and generalizability of the employability measurements.

Thirdly, this study was conducted to measure the employability of graduates who experienced offline and online learning before graduation due to the COVID-19 pandemic. Therefore, further research could involve employers who recruited graduates before the COVID-19 pandemic appeared or after it passed away, allowing for a more comprehensive understanding of how different learning environments impact employability outcomes.

Fourthly, the present study collected data from one stakeholder for measurement of graduates' employability. Future studies should be carried out from the perspectives of two other stakeholders, namely fresh graduates' self-assessment and lecturers' assessment for final-year undergraduates.

Moreover, differences in assessment among employers serving private-owned and foreign-owned enterprises were shown. The foreign-owned enterprises tended to assess graduates at lower levels of employability than private-owned enterprises. However, the reasons for differences were not found. Thus, further studies using semi-structured interviews could be carried out to discover the reason for differences in the evaluation of foreign-owned and private-owned enterprises.

Finally, the thesis investigated graduates' employability by applying the USEM model connected with a competence-based approach to the employability in the Vietnamese context. Future studies could explore employability-related issues in Vietnamese universities by applying other models of employability.

LIST OF PUBLICATIONS

Publications in Scholarly Journals:

[1] **Pham Duc Long**, Nguyen Thuy Nga. 2022. Students' evaluation on field trips as a means to prepare for graduate employability in a Vietnamese university. *Humanities and Social Sciences Letters (**Scopus Q3**,* Online ISSN: 2312-4318, Print ISSN: 2312-5659)*, 10(2), 198-212*, https://doi.org/10.18488/73.v10i2.3011.

[2] **Pham Duc Long**, Nguyen Thi Ha Thuy. 2022. Experiential learning through field trips: a perspective from students at Hanoi University of Industry. *Hanoi University of National Education: Journal of Science **(ISSN: 2354-1067)***, 67 (4), p.173-180, htts://doi.org/10.18173/2354-1067.2022-0072.

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Appendix 1. Official questionnaire (English version)

EMPLOYERS' ASSESSMENT OF THE EMPLOYABILITY OF ENGINEERING TECHNOLOGY GRADUATES

Dear Sir/Madam,

My name is Pham Duc Long, working at Hanoi University of Industry. I am also a PhD student at Vietnam National University, Hanoi. I am conducting a thesis on the employability of engineering technology graduates and in the period of collecting employer assessments on the employability of 2023 graduates working at the enterprises.

The assessment content includes **47 criteria** of technical knowledge, technical skills, general skills, attitude, and other attributes.

The survey may take 10 minutes. The survey results are coded, kept confidential, and only used for study purposes.

Note*:*

1. Engineering technology includes one of the following disciplines: mechanical engineering technology, mechatronic engineering technology, automotive engineering technology, thermal engineering technology, electric electronic engineering technology, electronics and telecommunication engineering technology, and control and automation engineering technology.
2. Employability: knowledge, skills, attitudes, and attributes that graduates need to (1) maintain their current jobs, (2) develop their careers, and (3) be promoted and succeed at enterprises.
3. Please DO NOT choose one number for all assessments; for example, select all 1, 2, 3, 4 or 5.
4. If you have any comments or questions about the survey, please inform me by phone at 0975.388.986 or email at longpd@dhcnhn.edu.vn

Assessed graduate ID (10 number, e.g. 2019601028): ……………………………

Which discipline of engineering technology (ET) graduate in 2023 do you assess their employability?

Mechanical ET Mechatronic ET Automotive ET

Thermal ET Electric, electronic ET Electronics and telecommunication ET Control and automation ET

I. Assessment contents

Please assess the employability level of engineering technology graduates working at your enterprise according to the criteria below. For each criterion, choose a number (from 1 to 5) where:

1	2	3	4	5
Very low	Low	Medium	High	Very high

1. TECHNICAL KNOWLEDGE (05)

KT1. Apply basic science knowledge to solve technical problems

Very low	①	②	③	④	⑤	Very high

KT2. Update engineering technology trends

Very low	①	②	③	④	⑤	Very high

KT3. Describe technological processes

Very low	①	②	③	④	⑤	Very high

KT4. Recognize the suitable tool to analyze professional problems

Very low	①	②	③	④	⑤	Very high

KT5. Apply specialized knowledge to solve specific work problems

Very low	①	②	③	④	⑤	Very high

2. TECHNICAL SKILLS (05)

ST1. Arrange the order of work to be done

Very low	①	②	③	④	⑤	Very high

ST2. Exploit technical documents

Very low	①	②	③	④	⑤	Very high

ST3. Read technical drawings

Very low	①	②	③	④	⑤	Very high

ST4. Use engineering software to solve technical problems

Very low	①	②	③	④	⑤	Very high

ST5. Use proper engineering tools for the specific task

Very low	①	②	③	④	⑤	Very high

3. GENERIC SKILLS (22)

3.1. Communication skills

GSC2. Communicate in a foreign language at the basic level at work

Very low	①	②	③	④	⑤	Very high

GSC3. Comprehend comments at work.

Very low	①	②	③	④	⑤	Very high

GSC4. Communicate in written Vietnamese about technical problems

Very low	①	②	③	④	⑤	Very high

GSC5. Communicate in spoken Vietnamese about technical problems

Very low	①	②	③	④	⑤	Very high

3.2. Problem-solving skills

GSP1. Identify the problems to be solved

Very low	①	②	③	④	⑤	Very high

GSP2. Prioritize the problem to solve

Very low	①	②	③	④	⑤	Very high

GSP3. Identify the cause of the problem

Very low	①	②	③	④	⑤	Very high

GSP4. Propose the possible solution

Very low	①	②	③	④	⑤	Very high

GSP5. Implement the proposed solution

Very low	①	②	③	④	⑤	Very high

3.3. Adaptability

GSA1. Adapt to changes in work

Very low	①	②	③	④	⑤	Very high

GSA2. Work in a multicultural environment

Very low	①	②	③	④	⑤	Very high

GSA3. Perform well under pressure

Very low	①	②	③	④	⑤	Very high

GSA4. Adapt to workplace environment after graduation

Very low	①	②	③	④	⑤	Very high

3.4. Teamwork

GST1. Set the team's common goals

Very low	①	②	③	④	⑤	Very high

GST2. Collaborate with team members

Very low	①	②	③	④	⑤	Very high

GST3. Promote teamwork spirit

Very low	①	②	③	④	⑤	Very high

GST4. Implement the team decisions

Very low	①	②	③	④	⑤	Very high

GST5. Contribute to teamwork's results

Very low	①	②	③	④	⑤	Very high

3.5. Lifelong learning

GSL1. Acquire new knowledge frequently

Very low	①	②	③	④	⑤	Very high

GSL2. Participate in self-study activities for personal development actively

Very low	①	②	③	④	⑤	Very high

GSL3. Update science and technology applications for professional development

Very low	①	②	③	④	⑤	Very high

GSL4. Identify strengths and weaknesses in each period to make learning plans

Very low	①	②	③	④	⑤	Very high

4. ATTITUDE AND OTHER ATTRIBUTES (15)

4.1. Attitude

AA1. Work seriously

Very low	①	②	③	④	⑤	Very high

AA2. Work autonomously

Very low	①	②	③	④	⑤	Very high

AA3. Contribute to the enterprise's development

Very low	①	②	③	④	⑤	Very high

AA4. Respect the enterprise's brand image

Very low	①	②	③	④	⑤	Very high

4.2. Dependability

AD1. Complete the work as planned

Very low	①	②	③	④	⑤	Very high

AD2. Comply the workflow

Very low	①	②	③	④	⑤	Very high

AD3 Get the job done effectively

Very low	①	②	③	④	⑤	Very high

4.3. Thoughtfulness

AT1. Show industry manners

Very low	①	②	③	④	⑤	Very high

AT2. Consider carefully to avoid making careless mistakes

Very low	①	②	③	④	⑤	Very high

AT3. Self-control in difficult situations

Very low	①	②	③	④	⑤	Very high

AT4. Give appropriate advice to colleagues at work

Very low	①	②	③	④	⑤	Very high

4.4. Initiative

AI1. Accept work challenges

Very low	①	②	③	④	⑤	Very high

AI2. Give new ideas at work

Very low	①	②	③	④	⑤	Very high

AI3. Keep eager to complete work

Very low	①	②	③	④	⑤	Very high

AI4. Keep committed to doing good work

Very low	①	②	③	④	⑤	Very high

II. Respondent's brief personal information

1. Gender Male Female
2. Age
   Below 25 25 < 30 30 < 35 35 < 40 40 < 45 45 < 50 Over 50
3. Qualifications
   Diploma Advanced diploma Bachelor's Master's Doctorate
4. Working years
   Below 5 5 ≤ 10 10 ≤ 15 15 ≤ 20
   20 ≤ 25 25 ≤ 30 Over 30
5. Job position

Technical department staff Head/Deputy head of Technical department
HR department staff Head/Deputy head of HR department
Other

6. Name of working division
Design/ R&D Maintenance Manufacturing technique
Production management Quality management/Quality assurance
Production Human resource Other (please specify:...)
7. Email: ……………….
8. Enterprise's business field
Processing, manufacturing Production Commerce
Repairment, maintenance Transport, Logistics
Fuel, electricity Design, R&D
Other (please specify:...)
9. Enterprise's kind of business
State-owned Private-owned Foreign-owned
10. Geographic location of enterprise
Hanoi Bac Ninh Bac Giang Ha Nam
Nam Dinh Hai Phong Vinh Phuc Thai Nguyen
Thanh Hoa Hung Yen Hai Duong Other

Thank you very much for participating in the survey!

Appendix 2. Official questionnaire (Vietnamese version)

ĐÁNH GIÁ CỦA DOANH NGHIỆP VỀ NĂNG LỰC HÀNH NGHỀ CỦA SINH VIÊN TỐT NGHIỆP NHÓM NGÀNH CÔNG NGHỆ KỸ THUẬT

Chào Anh/Chị,

Tôi là Phạm Đức Long, công tác ở Trường Đại học Công nghiệp. Tôi được Nhà trường cử đi nghiên cứu sinh tại Đại học Quốc gia Hà Nội. Tôi đang thực hiện đề tài nghiên cứu về năng lực hành nghề của sinh viên tốt nghiệp nhóm ngành công nghệ kỹ thuật và trong giai đoạn lấy ý kiến đánh giá của nhà tuyển dụng về năng lực hành nghề của sinh viên đã tốt nghiệp năm 2023 làm việc tại đơn vị.

Nội dung đánh giá gồm **47 tiêu chí** về kiến thức kỹ thuật, kỹ năng kỹ thuật, kỹ năng chung: thái độ và các phẩm chất khác

Thời gian thực hiên khảo sát từ 5-7 phút. Kết quả đánh giá của anh/chị được mã hoá, bảo mật và chỉ được sử dụng cho mục đích nghiên cứu của luận án.

Ghi chú*:*

1. Công nghệ kỹ thuật gồm một trong các ngành sau: CNKT Cơ khí; CNKT Cơ, điện tử; CNKT Ôtô; CNKT điện, điện tử; CNKT điện tử - viễn thông, CNKT nhiệt; CNKT điều khiển và tự động hóa
2. Năng lực hành nghề (Employability): kiến thức, kỹ năng, thái độ, phẩm chất mà sinh viên tốt nghiệp cần có để: (1) duy trì được công việc hiện tại đang làm, (2) phát triển được chuyên môn, (3) thăng tiến và thành công tại doanh nghiệp.
3. Anh/Chị vui lòng KHÔNG chọn 1 đáp án cho tất cả các nội dung đánh giá, ví dụ chọn toàn 1 hoặc toàn 2 hoặc toàn 3 hoặc toàn 4 hoặc toàn 5.
4. Nếu anh/chị có góp ý hay câu hỏi gì liên quan đến bảng khảo sát, vui lòng thông tin cho tôi theo Sđt: 0975.388.986, email: longpd@dhcnhn.edu.vn

Mã sinh viên tốt nghiệp (gồm 10 số, ví dụ: 2019601028): ……………………..

Anh/chị đánh giá năng lực hành nghề của sinh viên tốt nghiệp năm 2023 thuộc chuyên ngành công nghệ kỹ thuật NÀO dưới đây?

CNKT Cơ khí　　CNKT Cơ điện tử　　CNKT Ôtô

CNKT nhiệt　　CNKT điện, điện tử　　CNKT điện tử-viễn thông

CNKT điều khiển và tự động hóa

I. Các nội dung đánh giá

Anh/Chị đánh giá mức năng lực của sinh viên đã tốt nghiệp ngành công nghệ kỹ thuật đang làm việc tại doanh nghiệp của anh/chị theo các tiêu chí dưới đây. Với mỗi tiêu chí, lựa chọn 1 số (từ 1 đến 5), trong đó:

1	2	3	4	5
Rất thấp	Thấp	Trung bình	Cao	Rất cao

1. KIẾN THỨC KỸ THUẬT (05)

KT1. Áp dụng kiến thức khoa học cơ bản để giải quyết các vấn đề kỹ thuật

Rất thấp	①	②	③	④	⑤	Rất cao

KT2. Cập nhật xu hướng công nghệ kỹ thuật

Rất thấp	①	②	③	④	⑤	Rất cao

KT3. Mô tả được quy trình công nghệ

Rất thấp	①	②	③	④	⑤	Rất cao

KT4. Nhận biết được công cụ phù hợp để phân tích các vấn đề chuyên môn

Rất thấp	①	②	③	④	⑤	Rất cao

KT5. Áp dụng kiến thức chuyên ngành để giải quyết các vấn đề kỹ thuật cụ thể

Rất thấp	①	②	③	④	⑤	Rất cao

2. KỸ NĂNG KỸ THUẬT (05)

ST1. Sắp xếp công việc theo trình tự ưu tiên thực hiện

Rất thấp	①	②	③	④	⑤	Rất cao

ST2. Khai thác được tài liệu kỹ thuật

Rất thấp	①	②	③	④	⑤	Rất cao

ST3. Đọc hiểu bản vẽ kỹ thuật

Rất thấp	①	②	③	④	⑤	Rất cao

ST4. Sử dụng được phần mềm để giải quyết các vấn đề kỹ thuật

Rất thấp	①	②	③	④	⑤	Rất cao

ST5. Sử dụng được dụng cụ phù hợp để giải quyết vấn đề kỹ thuật cụ thể

Rất thấp	①	②	③	④	⑤	Rất cao

3. KỸ NĂNG CHUNG (22)

3.1. Kỹ năng giao tiếp

GSC2. Giao tiếp bằng ngoại ngữ ở cấp độ cơ bản

Rất thấp	①	②	③	④	⑤	Rất cao

GSC3. Tiếp thu được ý kiến nhận xét trong công việc.

Rất thấp	①	②	③	④	⑤	Rất cao

GSC4. Truyền đạt được bằng văn bản tiếng Việt về các vấn đề kỹ thuật

Rất thấp	①	②	③	④	⑤	Rất cao

GSC5. Truyền đạt được bằng lời nói tiếng Việt về các vấn đề kỹ thuật

Rất thấp	①	②	③	④	⑤	Rất cao

3.2. Kỹ năng giải quyết vấn đề

GSP1. Xác định được các vấn đề cần giải quyết

Rất thấp	①	②	③	④	⑤	Rất cao

GSP2. Thiết lập trình tự vấn đề cần giải quyết

Rất thấp	①	②	③	④	⑤	Rất cao

GSP3. Xác định được nguyên nhân của vấn đề

Rất thấp	①	②	③	④	⑤	Rất cao

GSP4. Đề xuất giải pháp khả thi

Rất thấp	①	②	③	④	⑤	Rất cao

GSP5. Thực hiện giải pháp được đề xuất.

Rất thấp	①	②	③	④	⑤	Rất cao

3.3. Kỹ năng thích ứng

GSA1. Thích ứng với những thay đổi trong công việc

Rất thấp	①	②	③	④	⑤	Rất cao

GSA2. Làm việc trong môi trường đa văn hóa

Rất thấp	①	②	③	④	⑤	Rất cao

GSA3. Làm việc trong môi trường áp lực

Rất thấp	①	②	③	④	⑤	Rất cao

GSA4. Thích ứng với môi trường làm việc sau tốt nghiệp

Rất thấp	①	②	③	④	⑤	Rất cao

3.4. Kỹ năng làm việc theo nhóm

GST1. Xây dựng được mục tiêu chung của nhóm

Rất thấp	①	②	③	④	⑤	Rất cao

GST2. Làm việc được với các thành viên trong nhóm

Rất thấp	①	②	③	④	⑤	Rất cao

GST3. Thúc đẩy tinh thần làm việc nhóm

Rất thấp	①	②	③	④	⑤	Rất cao

GST4. Thực thi các quyết định của nhóm

Rất thấp	①	②	③	④	⑤	Rất cao

GST5. Đóng góp vào kết quả làm việc nhóm

Rất thấp	①	②	③	④	⑤	Rất cao

3.5. Kỹ năng học tập suốt đời

GSL1. Tiếp thu kiến thức mới thường xuyên

Rất thấp	①	②	③	④	⑤	Rất cao

GSL2. Tham gia các hoạt động tự học để phát triển bản thân

Rất thấp	①	②	③	④	⑤	Rất cao

GSL3. Cập nhật các ứng dụng khoa học công nghệ để phát triển chuyên môn

Rất thấp	①	②	③	④	⑤	Rất cao

GSL4. Xác định điểm mạnh, điểm hạn chế của bản thân trong từng giai đoạn để xây dựng kế hoạch học tập.

Rất thấp	①	②	③	④	⑤	Rất cao

4. THÁI ĐỘ VÀ CÁC PHẨM CHẤT KHÁC (15)

4.1. Thái độ

AA1. Làm việc nghiêm túc

Rất thấp	①	②	③	④	⑤	Rất cao

AA2. Làm việc chủ động cao

Rất thấp	①	②	③	④	⑤	Rất cao

AA3. Đóng góp hiệu quả vào sự phát triển của doanh nghiệp

Rất thấp	①	②	③	④	⑤	Rất cao

AA4. Tôn trọng hình ảnh của doanh nghiệp

Rất thấp	①	②	③	④	⑤	Rất cao

4.2. Tin cậy

AD1. Hoàn thành công việc theo kế hoạch

Rất thấp	①	②	③	④	⑤	Rất cao

AD2. Tuân thủ quy trình làm việc

Rất thấp	①	②	③	④	⑤	Rất cao

AD3. Hoàn thành công việc một cách hiệu quả

Rất thấp	①	②	③	④	⑤	Rất cao

4.3. Chín chắn

AT1. Thể hiện được tác phong công nghiệp

Rất thấp	①	②	③	④	⑤	Rất cao

AT2. Suy xét cẩn thận trong công việc.

Rất thấp	①	②	③	④	⑤	Rất cao

AT3. Biết cách đối mặt với khó khăn

Rất thấp	①	②	③	④	⑤	Rất cao

AT4. Đưa ra lời khuyên phù hợp cho đồng nghiệp

Rất thấp	①	②	③	④	⑤	Rất cao

4.4. Cầu tiến

AI1. Chấp nhận những thách thức trong công việc

Rất thấp	①	②	③	④	⑤	Rất cao

AI2. Chủ động đưa ra đề xuất trong công việc

Rất thấp	①	②	③	④	⑤	Rất cao

AI3. Ham học hỏi để hoàn thành công việc

Rất thấp	①	②	③	④	⑤	Rất cao

AI4. Cam kết hoàn thành tốt công việc

Rất thấp	①	②	③	④	⑤	Rất cao

II. Một số thông tin chung về người trả lời khảo sát

1. Giới tính

   Nam Nữ

2. Độ tuổi

   Dưới 25 $25 \leq 30$ $30 \leq 35$ $40 \leq 45$ $45 \leq 50$ Trên 50

3. Trình độ đào tạo

   Trung cấp Cao đẳng Đại học Thạc sĩ Tiến sĩ

4. Số năm công tác

   Dưới 5 $5 \leq 10$ $10 \leq 15$ $15 \leq 20$

   $20 \leq 25$ $25 \leq 30$ Trên 30

5. Vị trí nghề nghiệp
    Nhân viên bộ phận kỹ thuật   Trưởng/phó bộ phận kỹ thuật
    Nhân viên bộ phận nhân sự   Trưởng/phó bộ phận nhân sự   Khác
6. Tên bộ phận người trả lời làm việc
    Thiết kế, R&D   Bảo dưỡng   Kỹ thuật sản xuất
    Quản lý sản xuất   Quản lý chất lượng/ Đảm bảo chất lượng   Sản xuất
    Nhân sự   Khác (xin ghi rõ: ...)
7. Email: ……………….
8. Lĩnh vực hoạt động của doanh nghiệp anh/chị là gì?
    Chế biến, chế tạo   Sản xuất   Thương mại   Sửa chữa, bảo dưỡng
    Vận tải, Logistic   Nhiên liệu, điện   Thiết kế, R&D
    Khác (xin ghi rõ: ...)
9. Doanh nghiệp nơi anh/chị công tác thuộc loại hình doanh nghiệp gì?
    Nhà nước   Tư nhân   Có yếu tố nước ngoài
10. Vị trí địa lý của doanh nghiệp?
    Hà Nội   Bắc Ninh   Bắc Giang   Hà Nam
    Nam Định   Hải Phòng   Vĩnh Phúc   Thái Nguyên
    Thanh Hóa   Hưng Yên   Khác

Trân trọng cám ơn anh/chị đã tham gia khảo sát.

Appendix 3: Analysis of scale items

1. Technical knowledge

KT1		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	2	0.85	2.99	0.85	0.85
	2	5	2.14		2.14	2.99
	3	114	48.72	48.72	48.72	51.71
	4	106	45.30	48.29	45.30	97.01
	5	7	2.99		2.99	100.00
Total		234	100.0	100.0	100.0	

KT2		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	2	0.85	3.42	0.85	0.85
	2	6	2.56		2.56	3.42
	3	109	46.58	46.58	46.58	50.00
	4	108	46.15	50.00	46.15	96.15
	5	9	3.85		3.85	100.00
Total		234	100.0	100.0	100.0	

KT3		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	4.27	0.43	0.43
	2	9	3.85		3.85	4.27
	3	118	50.43	50.43	50.43	54.70
	4	98	41.88	45.30	41.88	96.58
	5	8	3.42		3.42	100.00
Total		234	100.00	100.00	100.0	

KT4		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	6.84	0.43	0.43
	2	15	6.41		6.41	6.84
	3	119	50.85	50.85	50.85	57.69
	4	90	38.46	42.31	38.46	96.15
	5	9	3.85		3.85	100.00
Total		234	100.0	100.0	100.0	

KT5		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	8.97	0.43	0.43
	2	20	8.55		8.55	8.97
	3	102	43.59	43.59	43.59	52.56
	4	100	42.74	47.44	42.74	95.30
	5	11	4.70		4.70	100.00
Total		234	100.0	100.0	100.0	

2. Technical skills

ST1		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	7	2.99	2.99	2.99	2.99
	3	98	41.88	41.88	41.88	44.87
	4	115	49.15	55.13	49.15	94.02
	5	14	5.98		5.98	100.00
Total		234	100.0	100.0	100.0	

ST2		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	2	0.9	4.27	0.9	0.9
	2	8	3.4		3.4	4.3
	3	114	48.7	48.72	48.7	53.0
	4	102	43.6	47.01	43.6	96.6
	5	8	3.4		3.4	100.0
Total		234	100.0		100.0	

ST3		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	10	4.3	4.27	4.3	4.3
	3	89	38.0	38.03	38.0	42.3
	4	127	54.3	57.69	54.3	96.6
	5	8	3.4		3.4	100.0
Total		234	100.0	100.0	100.0	

ST4		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	2	0.85	3.42	0.85	0.85
	2	6	2.56		2.56	3.42
	3	82	35.04	35.04	35.04	38.46
	4	136	58.12	61.54	58.12	96.58
	5	8	3.42		3.42	100.00
Total		234	100.0	100.0	100.0	

ST5		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	2.99	0.43	0.43
	2	6	2.56		2.56	2.99
	3	98	41.88	41.88	41.88	44.87
	4	122	52.14	55.13	52.14	97.01
	5	7	2.99		2.99	100.00
Total		234	100.0	100.0	100.0	

3. Generic skills

GSC1		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	2	0.9	17.95	0.9	0.9
	2	40	17.1		17.1	17.9
	3	130	55.6	55.56	55.6	73.5
	4	61	26.1	26.50	26.1	99.6
	5	1	0.4		0.4	100.0
Total		234	100.0	100.0	100.0	

GSC2		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	10	4.27	4.27	4.27	4.27
	3	71	30.34	30.34	30.34	34.62
	4	131	55.98	65.38	55.98	90.60
	5	22	9.40		9.40	100.00
Total		234	100.0	100.0	100.0	

GSC3		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	15	6.41	6.41	6.41	6.41
	3	90	38.46	38.46	38.46	44.87
	4	116	49.57	55.13	49.57	94.44
	5	13	5.56		5.56	100.00
Total		234	100.0	100.0	100.0	

GSC4		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	11	4.70	4.70	4.70	4.70
	3	90	38.46	38.46	38.46	43.16
	4	117	50.00	56.84	50.00	93.16
	5	16	6.84		6.84	100.00
Total		234	100.0	100.0	100.0	

GSP1		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	15	6.4	6.41	6.4	6.4
	3	114	48.7	48.72	48.7	55.1
	4	94	40.2	44.87	40.2	95.3
	5	11	4.7		4.7	100.0
Total		234	100.0	100.0	100.0	

GSP2		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	18	7.69	7.69	7.69	7.69
	3	107	45.73	45.73	45.73	53.42
	4	99	42.31	46.58	42.31	95.73
	5	10	4.27		4.27	100.00
Total		234	100.0	100.0	100.0	

GSP3		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	2	0.85	8.55	0.85	0.85
	2	18	7.69		7.69	8.55
	3	119	50.85	50.85	50.85	59.40
	4	88	37.61	40.60	37.61	97.01
	5	7	2.99		2.99	100.00
Total		234	100.0	100.0	100.0	

GSP4		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	11.97	0.43	0.43
	2	27	11.54		11.54	11.97
	3	119	50.85	50.85	50.85	62.82
	4	75	32.05	37.18	32.05	94.87
	5	12	5.13		5.13	100.00
Total		234	100.0	100.0	100.0	

GSP5		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	15	6.41	6.41	6.4	6.4
	3	108	46.15	46.15	46.2	52.6
	4	103	44.02	47.44	44.0	96.6
	5	8	3.42		3.4	100.0
Total		234	100.00	100.0	100.0	

GSA1		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	6	2.6	2.56	2.6	2.6
	3	76	32.5	32.48	32.5	35.0
	4	127	54.3	64.96	54.3	89.3
	5	25	10.7		10.7	100.0
Total		234	100.0	100.0	100.0	

GSA2		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	8	3.42	3.42	3.42	3.4
	3	76	32.48	32.48	32.48	35.9
	4	121	51.71	64.10	51.71	87.6
	5	29	12.39		12.39	100.0
Total		234	100.0	100.0	100.0	

GSA3		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	4.27	0.43	0.4
	2	9	3.85		3.85	4.3
	3	95	40.60	40.60	40.60	44.9
	4	112	47.86	55.13	47.86	92.7
	5	17	7.26		7.26	100.0
Total		234	100.0	100.0	100.0	

GSA4		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	7	3.0	2.99	3.0	3.0
	3	101	43.2	43.16	43.2	46.2
	4	114	48.7	53.85	48.7	94.9
	5	12	5.1		5.1	100.0
Total		234	100.0	100.0	100.0	

GST1		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	11	4.70	4.70	4.70	4.70
	3	94	40.17	40.17	40.17	44.87
	4	118	50.43	55.13	50.43	95.30
	5	11	4.70		4.70	100.00
Total		234	100.0	100.0	100.0	

GST2		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	7	2.99	2.99	2.99	2.99
	3	73	31.20	31.20	31.20	34.19
	4	129	55.13	65.81	55.13	89.32
	5	25	10.68		10.68	100.00
Total		234	100.0	100.0	100.0	

GST3		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	15	6.41	6.41	6.41	6.41
	3	108	46.15	46.15	46.15	52.56
	4	99	42.31	47.44	42.31	94.87
	5	12	5.13		5.13	100.00
Total		234	100.0	100.0	100.0	

GST4		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	4.70	0.43	0.43
	2	10	4.27		4.27	4.70
	3	93	39.74	39.74	39.74	44.44
	4	116	49.57	55.56	49.57	94.02
	5	14	5.98		5.98	100.00
Total		234	100.0	100.0	100.0	

GST5		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	11	4.70	4.70	4.70	4.70
	3	98	41.88	41.88	41.88	46.58
	4	112	47.86	53.42	47.86	94.44
	5	13	5.56		5.56	100.00
Total		234	100.0	100.0	100.0	

GSL1		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	12	5.13	5.13	5.13	5.13
	3	94	40.17	40.17	40.17	45.30
	4	110	47.01	54.70	47.01	92.31
	5	18	7.69		7.69	100.00
Total		234	100.0	100.0	100.0	

GSL2		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	12	5.13	5.13	5.13	5.13
	3	97	41.45	41.45	41.45	46.58
	4	102	43.59	53.42	43.59	90.17
	5	23	9.83		9.83	100.00
Total		234	100.0	100.0	100.0	

GSL3		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	7.26	0.43	0.43
	2	16	6.84		6.84	7.26
	3	106	45.30	45.30	45.30	52.56
	4	97	41.45	47.44	41.45	94.02
	5	14	5.98		5.98	100.00
Total		234	100.0	100.0	100.0	

GSL4		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	5.98	0.43	0.43
	2	13	5.56		5.56	5.98
	3	120	51.28	51.28	51.28	57.26
	4	91	38.89	42.74	38.89	96.15
	5	9	3.85		3.85	100.00
Total		234	100.0	100.0	100.0	

4. Attitude and other attributes

AAA1		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	1.28	0.43	0.43
	2	2	0.85		0.85	1.28
	3	48	20.51	20.51	20.51	21.79
	4	152	64.96	78.21	64.96	86.75
	5	31	13.25		13.25	100.00
Total		234	100.0	100.0	100.0	

AAA2		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	3.85	0.43	0.43
	2	8	3.42		3.42	3.85
	3	87	37.18	37.18	37.18	41.03
	4	115	49.15	58.97	49.15	90.17
	5	23	9.83		9.83	100.00
Total		234	100.0	100.0	100.0	

AAA3		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	9	3.85	3.85	3.85	3.85
	3	101	43.16	43.16	43.16	47.01
	4	113	48.29	52.99	48.29	95.30
	5	11	4.70		4.70	100.00
Total		234	100.00	100.0	100.00	

AAA4		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	1	0.43	0.43	0.43	0.43
	3	72	30.77	30.77	30.77	31.20
	4	122	52.14	68.80	52.14	83.33
	5	39	16.67		16.67	100.00
Total		234	100.0	100.0	100.0	

AAD1		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	2.99	0.43	0.43
	2	6	2.56		2.56	2.99
	3	73	31.20	31.20	31.20	34.19
	4	137	58.55	65.81	58.55	92.74
	5	17	7.26		7.26	100.00
Total		234	100.0	100.0	100.0	

AAD2		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	3	1.28	1.28	1.28	1.28
	3	68	29.06	29.06	29.06	30.34
	4	136	58.12	69.66	58.12	88.46
	5	27	11.54		11.54	100.00
Total		234	100.00	100.0	100.00	

AAD3		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	4.27	0.43	0.43
	2	9	3.85		3.85	4.27
	3	88	37.61	37.61	37.61	41.88
	4	125	53.42	58.12	53.42	95.30
	5	11	4.70		4.70	100.00
Total		234	100.0	100.0	100.0	

AAT1		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	3.85	0.43	0.43
	2	8	3.42		3.42	3.85
	3	81	34.62	34.62	34.62	38.46
	4	121	51.71	61.54	51.71	90.17
	5	23	9.83		9.83	100.00
Total		234	100.0	100.0	100.0	

AAT2		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	6	2.56	2.56	2.56	2.56
	3	79	33.76	33.76	33.76	36.32
	4	126	53.85	63.68	53.85	90.17
	5	23	9.83		9.83	100.00
Total		234	100.0	100.0	100.0	

AAT3		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	2	0.85	4.27	0.85	0.85
	2	8	3.42		3.42	4.27
	3	111	47.44	47.44	47.44	51.71
	4	103	44.02	48.29	44.02	95.73
	5	10	4.27		4.27	100.00
Total		234	100.0	100.0	100.0	

AAT4		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	1	0.43	8.55	0.43	0.43
	2	19	8.12		8.12	8.55
	3	120	51.28	51.28	51.28	59.83
	4	88	37.61	40.17	37.61	97.44
	5	6	2.56		2.56	100.00
Total		234	100.0	100.0	100.0	

AAI1		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	11	4.70	4.70	4.70	4.70
	3	87	37.18	37.18	37.18	41.88
	4	114	48.72	58.12	48.72	90.60
	5	22	9.40		9.40	100.00
Total		234	100.0	100.0	100.0	

AAI2		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	1	2	0.85	7.69	0.85	0.85
	2	16	6.84		6.84	7.69
	3	115	49.15	49.15	49.15	56.84
	4	86	36.75	43.16	36.75	93.59
	5	15	6.41		6.41	100.0
Total		234	100	100	100	

AAI3		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	4	1.71	1.71	1.71	1.71
	3	70	29.91	29.91	29.91	31.62
	4	132	56.41	68.38	56.41	88.03
	5	28	11.97		11.97	100
Total		234	100	100	100	

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AAI4		Frequency	Percent		Valid Percent	Cumulative Percent
Valid	2	5	2.14	2.14	2.14	2.14
	3	81	34.62	34.62	34.62	36.75
	4	122	52.14	63.25	52.14	88.89
	5	26	11.11		11.11	100
Total		234	100.0	100.0	100.0	