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The HVAC Project Technologist Competency Profile

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Abstract

The main challenge of Higher Education Institutions (IPT) nowadays is to provide the human capability needed by the industry. There are most local IPT graduates do not have work skills and competencies required in the market and there seems to be a mismatch in the preparation of graduates for the local job. Therefore, the research carried out provides a comprehensive overview of the competency requirements that must be present in the Heat, Ventilation and Air Conditioning (HVAC) Project Technologist. The following may help the graduates of HVAC Technologist program at University Tun Hussein Onn Malaysia (UTHM) to be more prepared for the working environment. This study uses the Modified Delphi Technique (MDT) approach in order to obtain expert agreement on the construction of the questionnaire instrument. MDT is conducted three rounds. The first round is the process of developing a questionnaire using previous research methods, document analysis and interviews with three experts. Then the second and third round is to distribute the following questionnaire to get approval from seven experts. The data were processed using the Statistical Package for the Social Sciences (SPSS) software to obtain the mean, median and Interquartile Range (IQR) scores for each item. Preliminary research findings in the first round of MDT found 5 domains, 18 elements and 65 items. However, after the second and third round of MDT, it produced a Project Technology competency that has 5 domains, 18 elements and 78 items. The determination of the appropriateness of the HVAC Project Technology competence indicator is done through all round of MDT by the agreement industry experts with more than 10 years of experience in HVAC Project Engineering in the industry. So, the results of this research data are trusted and expected to give ideas also insights to course content for HVAC Technologist program by looking that matches career competencies according to industry tastes.

1. Introduction

Educational institutions face great challenges that are not just imparting knowledge but play a role in applying value added skills such as marketability skills in every human capital product produced (Abd Majid et al., 2019). This is because, the presence of education from an institution can produce human capital graduates in line with the demand of the industry immediately generating income and economic development of a country

(Department of Statistics Malaysia, 2021). Therefore, bilateral relations between educational institutions and industry especially the private sector, need to be intensified to open wider training opportunities in critical fields in the effort to produce highly skilled intellectual graduates (Adib, 2019). Omardin (2019), has also stated that vocational and technical education is a way to cultivate highly skilled, knowledgeable, and innovative energy resources, capable of facing competition, global and regional technological risks in the era of 4IR technology. Based on Ministry of Higher Education (2021), the production of High Value High Technology Program Development Framework (HTHV-PDF) is a sign of the commitment of the Department of Higher Education to advance the national agenda, producing quality TVET graduates under Leap 4 of the Malaysian Education Development Plan 2015-2025. The implementation policy of (Ministry of Higher Education, 2021), it focuses on the new program introduced recently which is Bachelor of Technology with honors (BTech) which was introduced in 2019.

This is because every desire of the industry has its own importance. Among them, the importance of manufacturing in the industry is to help formulate strategies taking into account the level to be achieved (Remeikienė et al., 2020). The presence of manufacturing transformation is the main factor that distinguishes a country from being successful or otherwise (Regnerova et al., 2021). In addition, the manufacturing sector promotes the development of a competitive industry with a strong industrial structure based on natural resources, innovation and technology (Reniati et al., 2022). One of the earliest and most important emphasis is on the manufacturing sector for optimal economic development (Regnerova et al., 2021).

Next, the importance of development in industry is an important sector because it has the ability to drive economic growth (Wolok et al., 2023). This is because, the impact of the development can contribute to the growth of the industrial sector by making it a productive component (Wolok et al., 2023). As a result of the impact, the service sector will grow, following the existence of banking and marketing organizations that can drive the growth of job prospects and people's income (Wolok et al., 2023). According to Gayatri (2021), industries involving development are the main contributors to job opportunities for a large number of people and the achievements of developed countries are determined by them.

Then, the importance of testing in the industry is an important phase in the technical field to ensure that the product is of high quality (Garousi et al., 2020). The testing sector also determines whether the actual system meets the intended specifications and ensures that it is free from defects (Alharbi et al., 2022). According to Azeem & Abhineet (2019), the presence of the industry involves potential testing to know how well something works with the process of checking, completeness and accuracy of something developed. Furthermore, the testing sector is cited as an important issue in developing the contribution and impact of research in general to improve quality (Garousi et al., 2020).

Furthermore, the importance of commissioning in the industry is to study the design, produce quality, and the main function as a whole in order to achieve something of quality according to the plan. In addition, it is also a quality assurance process that is done to improve performance and the possibility of something newly built meeting expectations and needs (Willard & Cooper, 2023). In line with work guidelines in the industry, commissioning can address and execute the most efficiently in terms of project cost, safety and schedule (Willard & Cooper, 2023).

Finally, the importance of maintenance in the industry is that maintenance represents a very important function in the overall production environment of activities that ensure system equipment works well by implementing prevention and improving capacity for a certain time (Raghavaiah & Hariprasad, 2019). If maintenance is done correctly in every industry sector by improving the work environment, it will implicitly improve performance (Coanda et, al., 2020). If the following happens, proper maintenance practices in every industry are able to maintain system capabilities while controlling costs (Raghavaiah & Hariprasad, 2019). Therefore, it is right that BTech program is emphasized because the program has all five wishes of the industry.

1.1 Background of Research

Technological changes nowadays have limited the skills of the human workforce when performing project work on the HVAC industry (Samuel et al., 2021). Therefore, it can cause unemployment issues because the HVAC industry will choose employees who are competent to carry out project work as technology is used in their industry (Joana et al., 2021). Of course one of the main factors in increase the number of unemployed is the mismatch of skills with existing careers (Saari, 2022). Although the graduates are from mechanical fields, there is still a skill mismatch with the following careers (Aggi Apriani, 2021).

Therefore, among the efforts of the BTech program is to solve problems in the project sector in the HVAC industry (HTHV-PDF, 2021). For example, the development problem in the HVAC project industry is the complexity brought to uncertainty about the future if no documentation planning is carried out (Machiels et al., 2023). Lack of details and principles also occurs when designing HVAC systems if not through the proper development process (Larsen et al., 2023). Taking for granted and ignoring uncertainty in planning documentation is also considered to be the main cause of poor HVAC project performance (Denicol et al., 2020).

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Investment in time and cost also increases if there is no preliminary preparation of the HVAC project by the organization (Khatib et al., 2022).

Then, the construction problem in the HVAC project industry is that field operations are usually scheduled separately, without taking into account their performance at the project level (Ahn et al., 2022). Inefficient management in the field can cause delays and disruption of productivity as well as clashes of manpower, materials and equipment (Magill et al., 2020). Lack of skilled manpower in the field related to HVAC can also cost a lot of time and money and affect efficiency and accuracy (Lee et al., 2022). At the end of the field work, there is a weakness during the management of the inefficient system installation waste, causing many negative effects on the environment, cost, productivity, time, social and economic (Fikri Hasmori et al., 2020).

In addition, the problem of testing in the HVAC project industry is that most of them use complex and expensive software, but there is a lack of skilled manpower to handle it (Riccio et al., 2020). Failure to test the HVAC system according to its specifications causes losses such as excessive energy waste, high maintenance costs, uncomfortable indoor thermal environment and poor air quality (Chen et al., 2023). Testing an inefficient HVAC system also leads to failure of sensors, equipment and operations and there are studies showing 15% to 30% of energy will be wasted from the actual system efficiency (Chen et al., 2023). The advantage of a workforce capable of testing HVAC systems for air quality, humidity and airflow in buildings is essential to avoid industrial problems occurring (Absar Alam et al., 2023).

Next, the commissioning problem in the HVAC project industry is the lack of manpower capable of operating the quality inspection system automatically by using mobile devices that support quality inspection, structural management and efficient work (Billie, 2019). In the meantime, the knowledge of the workforce is also at a minimum level towards providing the efficiency of the HVAC system according to the highest comfort to the customer (Absar Alam et al., 2023). Continuous failure of certification of these HVAC systems causes energy system issues not to be identified, risk management declines, increasing system energy consumption and costs (Gilani et al., 2020).

Finally, the maintenance problem in the HVAC project industry is the cost and reliability of the HVAC system due to the imperfect maintenance from the less skilled workforce (Es-sakali et al., 2022). This is because, HVAC systems now become more challenging when the system becomes more complex (Chen et al., 2022). Without proper maintenance can cause the effect of failure and shorten the lifespan of the system. Imperfect maintenance is also one of the main contributors to excessive energy and does not provide comfort to users (Alavi & Forcada, 2022). However, the competency standard for Technologists in Malaysia is still being worked on according to the breakdown of work and tasks according to specific fields (TVET Curriculum Design & Delivery Guidelines, 2021). Therefore, it is appropriate that the competency standards of the BTech HVAC program are drawn up directly from the HVAC industry.

1.2 Research Objective

The objectives of this study to be achieved are as follows:

i. Exploring the competency indicators of Project Technologist in the HVAC field.
ii. Determining the appropriateness of the domains and competency elements of the Project Technologist in the HVAC field.

2. Difference Between Technology Field and Engineering Field

Bachelor of Technology and Engineering is a closely related field of study with significant differences in the learning curriculum. Technology and Engineering are professionals responsible for building and creating, processes and products that solve problems found in a few industries. Although members of these two fields of work often work together, they have different skills and responsibilities that contribute to the success of a project. In general, engineers are designing or conceptualizing solutions while Technologists are building or creating solutions. Based on Table 1, discuss the difference between Engineer and Technology.

Table 1 *Difference between engineer and technology*

Item	Engineer	Technologist
Course Level and Syllabus	• Graduation of bachelor's degree • Emphasis on theoretical and design concepts • Syllabus such as higher-level mathematics, classes on pure science, calculus and courses in equations and differentiation (Differentiation vs Derivative).	• Graduation of bachelor's degree • Emphasis on skills and practical concepts • Syllabus such as mathematics, engineering, and survey science. Survey science courses deal with data collection including methods, survey design and interpretation.

	• Coursework covers design, concept creation, critical and analytical thinking. • The type of engineering taken will determine the advanced course.	• Coursework will include algebra and pre-calculus courses and will learn important engineering principles through foundational courses • Complete courses related to the practical application of skills and knowledge
Special Fields Related to Mechanical	• Advanced Manufacturing • Biomechanics • Mechanics and Design • Thermofluidic science • Mechanical engineer • Plant engineer • Industrial machinery and hardware engineers • Nuclear power engineer • Refrigeration and Air Conditioning (HVAC) Engineer • Automotive engineer • Aeronautical engineer • Design engineer	• Engineering technologists in various sectors including design, • testing and product development, • systems engineering, • field engineering, • technical operations, and quality control.
Career	• Engineering engineers in various fields including mechanical, civil, chemical, electrical, and electronic engineering, or researchers in research and development (R&D) units or academics in higher education institutions.	• Engineering technologists in various sectors including design, testing and product development, systems engineering, field engineering, technical operations, and quality control.
Graduate Challenge	• Use analysis and modeling to design engineering-based solutions. • Identify emerging techniques, skills, methods, and theories to solve engineering problems • Design infrastructure such as buildings, highways, and bridges	• Consultancy development for scope of work design for commercial purposes • Research and implementation capabilities for current technology • Exploring detection technology in current user technology exploration
Application	• Apply science and mathematics knowledge as well as the use of natural laws and products of the earth in designing products, manufacturing processes or systems capable of improving the standard and quality of life	• Apply science and engineering knowledge and methods combined with technical skills in using products, manufacturing processes or systems created by engineers.
Role	• Provide engineering products, processes and systems that are safe, effective, economical, and sustainable. • Finding solutions that balance the needs of built environment development while preserving nature.	• Plays an important role in technology-related areas that support industrial sectors such as air conditioning and refrigeration, aviation, and transportation.
Title	• The title of Ir. this is obtained after the engineer undergoes several tests and interviews conducted by the Malaysian Board of Engineers or the Malaysian Institute of Engineers. After passing the test or interview, then they are eligible to be given the title	• Individuals who are registered and have been approved by the Malaysian Technological Board will receive recognition by using the abbreviated title Ts. or Tc. The Malaysian Technological Board has opened registration for four categories, namely: i. Graduate Technologist, ii. Professional Technologist, iii. Qualified Technician, iv. Certified Technician

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2.1 Competency Profile Development

Referring to the Department of Higher Education (2021), competency profile development is the initial phase which is the planning phase in delivering the TVET curriculum. This matter is recorded in the TVET Curriculum Design and Delivery Guidelines (Department of Higher Education, 2021), the TVET curriculum development planning process involves the process of analysis work requirements until developing competency profiles. If Employment Standards already exist, then they can be referred to replace the process of job requirements analysis, job analysis, task verification, task selection, task standards and competence profile development.

The job requirements analysis process aims to provide necessary training recommendations based on supply and demand of HVAC work requirements. HVAC work requirements must be carried out based on sources issued by authoritative agencies such as the Labor Market Information and Analysis Institute (ILMIA), Malaysian Investment Development Authority (MIDA), Industrial Skills Committee, Department of Statistics Malaysia, Talent Corporation Malaysia Berhad (TalentCorp) and JobStreet. The main reference documents for local and international HVAC employment needs include the Critical Occupation List Report issued by TalentCorp and the Future of Jobs Report by the World Economic Forum. In addition, reports and directions of HVAC sectors and fields developed by related government or private agencies are also used as references.

Next, the job analysis process aims to identify the list of tasks in a HVAC work. It is conducted by a panel of HVAC curriculum developers consisting of representatives of skilled workers from HVAC industry and HVAC TVET program providers. Then, the task verification process aims to get the views of more HVAC skilled workers or their supervisors. The main outcome of the HVAC verification process is information on, (i) the percentage of employees who carry out each identified HVAC task; (ii) the position of the level importance of the HVAC task identified; (iii) the ranking of the level difficulty in learning an identified HVAC task; and (iv) additional HVAC task recommendations.

After that, the process of tasks selection in the education and training HVAC program aims to select tasks based on 3 main criteria, namely: (i) HVAC tasks performed by many employees (recommended more than 25% of employees in the HVAC field involved); (ii) important HVAC tasks; and (iii) HVAC tasks that are difficult to learn. This determination is important that will be included in the education and training HVAC program. This determination is also important in determining the amount of time allocated for education and training for each HVAC task.

In addition, analysis the task standard process aims to identify important aspects that become standard in a HVAC task. All types of HVAC jobs including skilled workers at managerial and professional levels can have standards or at least guidelines and good practices. It is for HVAC work activities and steps depending on the type of technology and application involved. For each HVAC task, identify the standards from the point of view of: (i) work activities and steps for each HVAC task; (ii) required HVAC knowledge; (iii) required HVAC skills; (iv) required attitude for handling HVAC works; (v) tools, equipment, materials, and supplies for HVAC works; (vi) safety factor for HVAC works; and (vii) performance HVAC criteria.

Finally, the process of developing a competency profile aims to develop a HVAC competency profile based on the results of the standard assignment analysis. The merger of these competency units aims to deliver education and it should be emphasized by understanding the true definition of HVAC competency through employment at all levels one to eight of the MQF. After the HVAC task standard analysis is done, the tasks that have the same knowledge, skills and attitudes for HVAC works need to be combined into the same competence. Figure 1, Competency Profile development flow and examples based on the HVAC field.

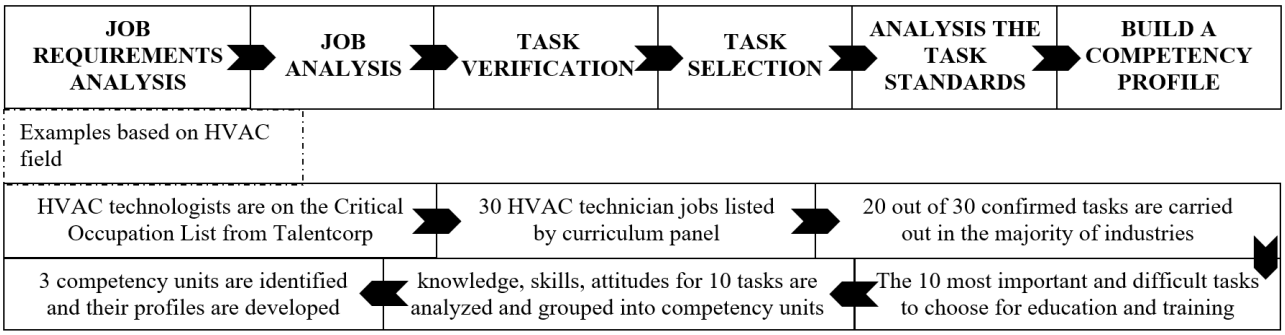

Fig. 1 *Competency profile development as well as examples based on the HVAC field; Source: TVET Curriculum Design and Delivery Guidelines Planning Phase (2021)*

2.2 Industrial vs. Technologist Based Design Model (2021)

Section 16 of the Technologists and Technicians Act (Act 768) states that the Board shall determine the allocation of Technology and Technical services under the Board of Directors. Table 2 outlines the main

Technology and Technical services that need to be covered in each program. It is required for every bachelor's degree program that is at MQF level 6, marking the minimum criteria for Technologist graduates to deal with 5 technological services. Meanwhile, programs that are at MQF levels 3, 4 and 5, signifying the minimum criteria for a Technician Qualification, should address 3 technical services. The respective requirements are set out in Table 2.

Table 2 *Difference between engineer and technology*
Source: (Malaysian Board Technologist, 2019)

Technologist	Technician
Manufacturing	-
Development	-
Testing	Testing
Commissioning	Commissioning
Maintenance	Maintenance

The technologists and technical services listed in Table 2 serve as a guide for the provision of education providing the best competence and skills training in relation to the specific field of technology and technical services, as agreed by the Technology Expert Panel during the establishment application session. Services are expected to be included in curriculum design. However, given the flexibility to modify the curriculum with strong evidence and justification, particularly about technological advances and service coverage, and supported by the core industries allowed by the agency. The researcher uses the Building & Construction Technology Profile for reference because it is among the technologies and technical competencies expected for the MBOT technology field.

This design model based on industry and technology is a collaboration or agreement between two parties, the industry, and the education sector, known as a Memorandum of Understanding (MoU) (KPP-HTHV, 2021). The main goal of the following MoU is to produce a competent and sustainable workforce that will have an impact on (i) the provision of professional and skilled workers; (ii) increased investment and high technology, (iii) high-income countries; and (iv) changes to 4IR. The presence of this MoU includes mastery or competence in five types of services, namely (i) development; (ii) manufacturing; (iii) testing: (iv) commissioning; and (v) maintenance of each profession. Each MoU process will go through four phases, namely (i) planning; (ii) development; (iii) implementation; and (iv) evaluation of the success of graduates will further achieve the goals of both parties. Since this study focuses on building the competency profile of Project Technology in the HVAC field, the researcher has referred to five types of services based on industry-based design models for Technologists, namely (i) development; (ii) manufacturing; (iii) testing: (iv) commissioning; and (v) maintenance in the professional field of work majors related to Project Engineering in the Malaysian industry.

3. Methodology

The research methodology is a draft guide for the researcher to conduct a study on the Construction of Technological Competence Profiles for the HVAC Field Project. According to Othman Mohamed (2001), methodology is an approach used in research to collect data. Therefore, the researcher will make a careful plan to launch the process to find, collect and get the desired research information. Each method and step that will be used consists of several aspects, namely, (i) Research design; (ii) Study design; (iii) Population and study sample; (iv) Research instruments; (v) Validity; (vi) Data collection procedures; and (vii) Data analysis procedures. This is because, without authentic support the purpose and objective of the study will not be achieved.

3.1 Research Design

This study conducted with a Modified Delphi Technique (MDT) approach to determine the domain requirements and competency elements of HVAC Project Technology. The advantage of the Delphi method is flexibility. That means, the age of the development of communication technologies such as the Internet, experts can be chosen from all over the world. So, this avoids cost and time constraints. Although this Delphi technique is one of the best methods, it also has its own shortcomings. According to Bojadziev and Bojadziev (2007) the shortcomings of the Delphi technique are (i) Reliability of data depends on expertise and data can be doubted if the researcher fails to choose a real expert and it is considered that the study will lose credibility; (ii) The existence of boredom that will happen to experts and researchers due to the repeated process in several rounds; (iii) The Delphi technique takes a long time and repeats where it causes inaccurate and incomplete data. In conclusion, the Delphi technique is very suitable in the study of Project Technologist Competency Profile Development for the HVAC field. However, it explains the researcher's cooperation from the selection of experts from the HVAC industry will be tired of the repeated round process to get a consensus. Therefore, the researcher will use the

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Modified Delphi Technique (MDT). The MDT method is a branch of the Delphi technique as well as one of the ways it is used that changes according to the suitability of the study (Ridhuan & Rabihah, 2020; Lingstone & Turoff, 1975). At the beginning of the study, the researcher obtained an indicator competence in HVAC Project Technology based on literature review and document analysis. Then, the researcher interviewed three panel of industry experts in a structured manner to obtain research indicators according to the industry's point of view directly. After that, the researcher has developed and distributed the questionnaire instrument obtained from the first round. After that, second and third round to determine the appropriate domains and elements for construction of the competence profile Project Technology in the field of HVAC by seven expert agreements by consensus.

3.2 Population and Sample

The population in this study are engineering experts with more than 10 years of experience and competent in work aspects of HVAC project. Thus, the selection of population and sample this study is divided into two, namely the interview protocol and the construct of the MDT questionnaire. Based on the selection of the population interview protocol is focused on criteria of experience as well as long working time in the field of HVAC projects. This is because domain and elements indicators through interview protocols are produced together with survey research and document analysis. Therefore, the sample selection by the researcher determined a total of 3 engineering experts with more than 10 years of experience and competence in aspects of HVAC project work. Meanwhile, the selection of the population construct MDT questionnaire is focused on the criteria of professional positions and a long period of service in the field of HVAC projects. This is because, agreement on domain indicators and elements of competency in the HVAC field Technology Project must be set by experts who hold positions in line with management. In addition, the researcher determined a total of seven HVAC project management experts according to the MDT method sample selection point of view. Although the selection of the seven experts was emphasized on the criteria of professional positions, the aspects of working for more than 10 years and being competent in aspects of HVAC project work were also taken into account.

3.3 Research Instrument

The population in this study are engineering experts with more than 10 years of experience and competent in work aspects of HVAC project. Thus, the selection of population and sample this study is divided into two, namely the interview protocol and the construct of the MDT questionnaire. In this study, the interviews conducted are structured interviews. A structured interview involves a formal interview, planned and conducted based on a list of questions to be answered by the respondent (Taherdoost, 2022). Therefore. The interview protocol developed by the researcher is divided into four parts, there are part A (Introduction), part B (Respondent demographics), part C (Questions) and part D (Follow-up questions). Respondents are required to answer the questions in part C if asked. However, follow-up questions will be proposed if the respondents do not answer the desired questions and deviate from the objectives of the study. Meanwhile, the questionnaire instrument of the second and third round of MDT is divided into six parts, there are part A (demographics), part B (development), part C (manufacturing), part D (testing), part E (commissioning) and part F (maintenance). In parts B, C, D, E, and F, respondents are required to answer the items provided by making choices based on a likert scale and are welcome to provide ideas for improvement if any.

Table 3 *Content of the second round of MDT questionnaire*

Constructs	No. item	Total
B. Development	1-14	14
C. Manufacturing	15-30	16
D. Testing	31-44	14
E. Commissioning	45-55	11
F. Maintenance	56-67	12

4. Modified Delphi Technique Results

The findings of the study carried out by the researcher are through the MDT method which takes three rounds. The first round is an analysis of past studies and related documents to collect information and then interviews of three experts from the HVAC industry. The second and third rounds of questions are distributed questionnaires that are developed based on the results of interviews and used to obtain expert agreement. A total of seven experts have participated in the second and third rounds to determine the domains and elements for HVAC Project Technology competencies. Overall, this chapter aims to answer the research questions below:

4.1 First Round Analysis

Through document analysis, the researcher referred to several documents namely (i) Technology and Technical Accreditation Manual 2019; (ii) TVET Curriculum Design & Delivery Guidelines; (iii) High Value High Technology Program Development Framework. After that, implementation of the analysis of previous studies used by the researcher is a meta-analysis method. The domain competency from the industry-based design model for Technologist (2021) found five types of services, while the skill requirement indicator from the MQF level 6 model (2017) has five skill requirements. Among the five services from the industry-based design model towards Technologists (2021) are (i) development; (ii) manufacturing; (iii) testing; (iv) commissioning; (v) maintenance. In the meantime, the skill requirements of HVAC Technologists need to emphasize aspects from the MQF model level 6 (2017) namely (i) knowledge and understanding; (ii) cognitive skills; (iii) personal and entrepreneurial skills; (iv) work skills; (v) ethics and professionalism.

Expert interviews are key to the success of this study. According to Jubri et al. (2019), an expert is a person who is very knowledgeable in a field or skilled in a particular field. Meanwhile, Link et al., (2021) also stated that credibility is an important factor in determining experts. According to Abdul Wahab (2018) he added that in addition to credibility, knowledge and experience factors are important criteria when used to explain the definition of an expert. This is because, long teaching experience can produce a better teaching process. So, experts are private company project managers, JKR senior assistant engineers and JKR assistant engineers who are knowledgeable about managing HVAC projects in Malaysia. The interview process was conducted based on the six levels of thematic analysis suggested by Braun & Clarke (2006). The six levels are (i) Familiarize yourself with the data; (ii) Generate initial codes; (iii) Find research themes; (iv) Review patterns; (v) Define and name patterns; (vi) Generate reports. The results of first round MDT analysis are 5 domains, 18 elements and 67 items.

Table 4 *Result of 1st round MDT*

DOMAIN	ELEMENT	ITEMS
Development	Basic Knowledge	3
	Drawing Design	3
	Document Management	5
	Entrepreneurial Management	3
Manufacturing	Basic Knowledge	3
	Drawing Design	2
	Planning and Supervision	2
	Field Management	6
	Entrepreneurial Management	3
Testing	Basic Knowledge	5
	Drawing Design	4
	performance compliance	5
Commissioning	Basic Knowledge	3
	Safety Standards	4
	Customer Specifications	4
Maintenance	Basic Knowledge	5
	Planning and Supervision	5
	Entrepreneurial Management	2

4.2 Second Round Analysis

This round, questionnaire items are formed as a result of constructs and dimensions that have been known for sure through the process of document analysis, past studies and interviews as mentioned before. The construct questionnaire items to answer the second research question by distributing 7 expert panels selected according to the study. Each expert is required to state their level of agreement with the indicators found and encouraged to submit and improve the indicators. The analysis in this round is divided into five domains, (i) Development; (ii) Manufacturing; (iii) Testing; (iv) Commissioning; and (v) Maintenance.

Results for this round, there are suggestions for improvement from experts for several domains. Domain Development has addition of 6 items, Domain Manufacturing has addition of 2 items while 2 items have been modified, Domain Testing the expert panels have agreed on achievement against the existing items, Domain Commissioning has addition of 1 items, and Domain Maintenance has addition of 2 items. After identifying domains, elements and items through mean, median and interquartile range analysis for the second round, a total of 78 questionnaire items were constructed. The items at the beginning of the second round had only 67 items, but the addition of 11 new items was obtained in the second round through the comments received from experts and the analysis carried out. However, this questionnaire was designed to answer the second research

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question. Therefore, the improvement of the questionnaire results of the second round will be carried out in the third round.

Table 5 *Result of 2nd round MDT*

DOMAIN	NO OF ITEMS	HIGH CONSENT (0-1)	MID CONSENT (1.01 – 1.99)	LOW CONSENT (≥2)
Development	20	20	-	-
Manufacturing	18	18	-	-
Testing	14	14	-	-
Commissioning	12	12	-	-
Maintenance	14	14	-	-

4.3 Third Round Analysis

For this third round, the questionnaire was distributed to the same 7 panel of experts, each expert being required to state their level of agreement with the indicators that were found and the addition of new indicators is highly encouraged if the experts wish to do so. The analysis in this round also divided into five domains, (i) Development; (ii) Manufacturing; (iii) Testing; (iv) Commissioning; and (v) Maintenance. Results for this round, all the expert panels agreed on a high level of achievement on each domain items. A total of 78 items received high approval from 7 experts who have extensive knowledge and more than 10 years in their field of expertise in line with the study. In conclusion, the results of three MDT rounds are 5 domains, 18 elements and 78 questionnaire items were produced.

Table 6 *Result of 3rd round MDT*

DOMAIN	NO OF ITEMS	HIGH CONSENT (0-1)	MID CONSENT (1.01 – 1.99)	LOW CONSENT (≥2)
Development	20	20	-	-
Manufacturing	18	18	-	-
Testing	14	14	-	-
Commissioning	12	12	-	-
Maintenance	14	14	-	-

5. Discussion

The industry-based design model for Technologists (2021) is the desire of the industry in Malaysia for future Technologists graduates. This point is the emphasis of learning and teaching at the university is based on skills that are in line with the wishes of the industry. This is because the employers of every Technologist student are the industrial parties. The presence of the desire of the five domains mentioned is a mandatory one. However, each of the following domains must comply with all aspects of MQF level 6 (2017) in order to meet the requirements for working in Malaysia for bachelor's degree. After that, the results of the previous study reinforce the findings for the description of the indicators for the study domains. Although the study has resource constraints, researcher used technique of forming PICO framework questions (Schardt et.al 2007) to search for previous studies to find indicators of the research domain that are not distorted. The success of the exploration of Technology competency indicators in the HVAC field through this past study fostered the initial idea to conduct an expert interview study. After the domain indicators have been identified through the exploration of previous studies, the researcher develops an interview protocol. After the interviews were conducted, the following interview findings were processed through the six stages of thematic analysis suggested by Braun & Clarke (2006). At this stage, the initial codes were identified 94 codes. Then, each of the following codes is categorized according to the research element. However, after reviewing the following codes according to the suitability of the elements reduced to 67 codes. The model used for the basis of the findings of the research element is the Expected Technology Efficiency model for the Building & Construction Technology Profile. The following model is taken from the Technology and Technical Accreditation Manual 2019. The elements agreed upon by two experts through Cohen kappa analysis are as follows (i) basic knowledge; (ii) document management; (iii) field management; (iv) planning and supervision (iv) performance compliance; (v) drawing design; (vi) safety standards; (vii) entrepreneurial management; (viii) customer specifications. Thoroughly, the Development domain has elements of (i) basic knowledge; (ii) document management; (iii) drawing design; and (iv) entrepreneurial management. The Manufacturing Domain also has elements of (i) basic knowledge; (ii) drawing design; (iii) planning and supervision; (iv) field management; and (v) entrepreneurial management. In addition, the Testing domain contains elements of (i) customer specifications; (ii) drawing

design; (iii) performance compliance. Next, the Commissioning domain has elements of (i) basic knowledge; (ii) safety standards; (iii) customer specifications. Finally, in the Maintenance domain there are elements of (i) basic knowledge; (ii) planning and supervision; and (iii) entrepreneurial management.

However, one of the limitations of the study is researcher does not have contact with experienced engineers. In the meantime, the researcher also worry that the expert will get tired and cause the data to not reach the objective. This is because high data validity requirements are essential, so determination of the appropriateness of the HVAC Project Technology competence indicators needs to be done through the second and third round of MDT through the agreement of seven industry experts with more than 10 years of experience in HVAC Project Engineering in the industry. All of these experts also need experienced in project development, manufacturing, testing, commissioning and maintenance. The selection criteria of experts are those who have experience with the issues discussed, are able to voice opinions and are able to make assessments and make decisions to reach a consensus (Pill, 1971). Therefore, the researcher's approach is to find a group of HVAC engineers who have contact with UTHM lecturers. So, the agreement of these seven experts was carried out after two rounds. The determination of indicators in the initial round of 67 items was developed based on document analysis, exploration of previous studies and interviews. The number of items by domain category is development are 14 items, Manufacturing are 16 items, Testing are 14 items, Commissioning are 11 items and Maintenance are 12 items. Improvements to the Development domain items are 6 according to expert comments which make the items for the final round to be 20 items. In addition, the Manufacturing domain added two items and modified two items based on expert comments making the items for the final round to be 18 items. In addition, the Testing domain has no additions, modifications or removals, leaving 14 items for the final round. Next, the Commissioning domain there is only one addition based on expert comments for the final round which makes 12 items for the final round. Finally, in the Maintenance domain there are two improvements to items based on expert comments which bring the number of items to 14 items for the final round. After that, the expert refined the following questionnaire based on the comments of all the experts. This is because, in order to determine the appropriateness of the HVAC Project Technology competency indicator, the researcher once again asked the same industry experts to determine the following items to obtain a consensus for each expert. After the third round of MDT, the researcher obtained a high level of consensus from the following experts. As a result of the determination of the appropriateness of the HVAC Project Technology competency items, the researcher concluded that there are 5 domains, 18 elements and 78 items.

6. Conclusion

In summary, this study has presented answers to related research questions about HVAC Project Technology Competence through three rounds of MDT. Role and competence is a very important requirement in all areas of work for an organization to achieve the performance that has been set. However, there is still no competency standard for the bachelor's degree level that leads to professions such as Technology. This success is very important in providing guidance to universities in designing and developing curriculum in line with industry requirements. This is because, the lack of cooperation between the institution and the industry will cause a gap in the development of the skill curriculum required by the industry with the skills of TVET graduates.

As a result of the findings and discussion of this study, there is still a need to improve and refine the profile of the HVAC Project Technology. Therefore, some recommendations for future researchers are as follows (i) Testing the applicability of the competency profile Technology HVAC field projects need to be done to see the effectiveness of the competencies developed; (ii) The study that focuses more on the importance and career direction related to the field of Technology in the Malaysian industry; and (iii) The first round of MDT research stage related to interviews for exploration the competency indicators of HVAC Project Technologists needs to involve a larger panel of experts. Overall, it is hoped that the findings obtained from this study will open up a space for further discussion and can help the parties involved to make improvements to further improve the quality of graduates, especially to produce a skilled workforce according to industry demand.

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