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Perspective Differences between Universities and Industries in Developing Engineering Students with Non-Technical Skills

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Abstract: Non-technical skill is the main attribute for a fresh engineering graduate to be employed. Recently, there are many complaints from industries regarding their non-technical skills. Many studies revealed that these skills could be developed effectively through industrial training. This paper is presenting the differences in the perspectives between universities and industries in non-technical skills development among engineering students. A qualitative study has been done on the experts which were five industrial training coordinators from universities and five employers from the industry. The experts were chosen based on are selected based on specific qualities to obtain the most relevant data. The transcribed interview data were analysed by using thematic analysis. The result reveals that there are some of miscommunication between universities and industries. It seems that universities are not able to fulfil what industry wants because of some unavoidable conditions. As mentioned before that industrial training is a very good time for student to develop their nontechnical skills. Five components are discussed namely placement in the industry, training duration, assessment, type of training or task given and learning outcomes. There are some similarities and differences between universities and industries regarding factors that are affecting non-technical skills development during industrial training. Universities should minimize the gap to ensure the students can get the most valuable experience during their industrial trainings as that can be the best platform for students to learn and enhance their non-technical skills.

Keywords: industrial training, engineering, non-technical skills, employability

1. Introduction

Non-technical skill is known as the main attributes for fresh graduates to be employed by industries (Rodzalan & Saat, 2012). The skills have changed according to the changes in the era from Industry Revolution 1.0 (IR 1.0) to Industry Revolution 4.0 (IR 4.0), recently. However, certain skills remain unchanged but with a bit of enhancement to complement the needs of today's industry.

The changes in the revolution of the industry may have a massive effect on the education of people especially in higher learning institutions (Benešová & Tupa, 2017). The linkage between university and industry should be strengthened to achieve the vision of Industry Revolution (IR 4.0) which is the emergence of "smart factories," which

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is connected to the production facilities named Cyber-physical System (CPS) (Baygin, Yetis, Karakose, & Akin, 2016). Using the Internet of Things, the Internet of Services and the Internet of People will make the connection: machine-machine, human-machine or human-human, and at the same time, an enormous amount of data will be obtained (Lee, Bagheri, & Kao, 2015). For this reason, it will be necessary to analyse large data (Big Data) to be able to predict possible failures and adapt in real-time to the changed conditions. Currently, the human is an operator of machines and these machines only passively follow the operator's commands. The main trend of Industry 4.0 will, therefore, replace this condition by the Prognostics-monitoring system (Richert, Shehadeh, Plumanns, Schuster, & Jeschke, 2016). Production processes have to allow effective production and at the same time, be flexible due to the changing customer demand for particular products (Lee, Kao, & Yang, 2014). Subsequently, the companies will produce smart products. The timely analysis of the obtained data is important for planning and managing of the flexible production (Nelles, Kuz, Mertens, & Schlick, 2016). The obtained data can contain classified information and this leads to increased demands on cybersecurity to prevent leaks of any data (Benešová & Tupa, 2017).

The curriculum that is designed in a university for engineering students should have all the elements for them to be employable since there are many complaints from employers that engineering graduates lack in non-technical skills. Many researchers from previous studies agreed that non-technical skills could be learned effectively during industrial training (Husain et al., 2013; Laguador, 2013; Osman et al., 2016; Renganathan, Ambri, Abdul, & Li, 2013). As industrial training is a part of university curriculum, it is a good chance for students to learn the real practices of engineer in an actual workplace (Ayob et al., 2013; Bhurtun, Jahmeerbacus, Oolun, & Feliachi, 1999; Jamil, Shariff, & Abu, 2013; Phang, Yusof, Saat, & Yusof, 2014). This experience is hard to get in the formal lecture at the university and industrial training is the only opportunity for students to get exposed to the industry.

2. Related Works

Industry revolutions happen when an industry is affected by technological change and innovation (Benešová & Tupa, 2017). Starting from revolution that cause by mechanization which is known as Industry Revolution 1.0 (IR 1.0), caused by the use of electrical energy which is known as Industry Revolution 2.0 (IR 2.0) and caused by electronics and automation which is known as Industry Revolution 3.0 (IR 3.0) (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014; Benešová & Tupa, 2017;). Recently, the world is facing the next revolution which is Industry Revolution 4.0 (IR 4.0) happens due to the development of robotics and digitalization. The effects of IR 4.0 are some of the old positions in the industry will be replaced. It will affect abruptly on the curriculum in the education system whereby only qualified and highly skills employees can control the new technologies (Benešová & Tupa, 2017). The skills and qualifications of the workforce will become the key to success of a highly innovative industry.

2.1 The Unemployment Issue among Engineering Graduates

Based on the basic description of IR 4.0 in the previous section, the role of human capital is very important for the future industry. The skills and qualifications of the workforce are essential for the success of an industry (Benešová & Tupa, 2017). For this reason, adequate training should be given to the students when they are still studying in the university. Requirements for the qualifications and skills of employees will be higher than at present because the industries will use modern technologies and smart media (Hecklau, Galeitzke, Flachs, & Kohl, 2016). Thus, the education system will be changed from Education 3.0 to Education 4.0 (Harkins et al., 2016). Education 4.0 is expected to combine real and virtual world information. The use of Virtual Learning Environment (VLE) and augmented reality (AR) in the learning in the higher institution are types of Education 4.0 that need a lot of costs to execute (Benešová & Tupa, 2017). The delay in education transformation will affect the graduates' skills developments, which can lead to unemployment among them because the demands of today's industries cannot be met.

The unemployment issue among graduates is a serious phenomenon that occurs nowadays. Statistics show that the output of fresh graduates from higher education institutions especially universities are still not able to cope with available job vacancies students and their marketability (Mahmud, Ahmad, Marzuki, & Ahmad, 2016). These policies and benchmarks are to support countries to achieve Vision 2020. The factors of the unemployment occur because the graduates are lack of non-technical skills such as communication skills, teamwork, critical thinking, and problem-solving skills, lifelong learning, computing skills and ethics (Azmi, Noordin, Kamin, & Nasir, 2018).

University graduates need knowledge and skills appropriate to the job market in the 21st century. Carnevale (2013) describes the skills related to careers in the 21st century is the cognitive efficiency, including in-depth knowledge in their areas of expertise, problem-solving skills and making decisions and the ability to maintain the personality traits associated with a career. This issue becomes a challenge for universities to provide a standard

curriculum to produce graduates who are multi-skilled and implicates the curriculum and the factors supporting the career development of students. As stated in Malhi (2008), the main weaknesses among graduates in Malaysia are management, problem-solving, communication, creativity, leadership, critical thinking, pro-active, self-confidence, and skills to interact. Also, at present many employers in industries demand young engineers who have good work ethics, high ability in communication skills and able to handle work-related problems (Malhi, 2008; Zaharim, Yusoff, Omar, & Basri, 2010; Carnevale, 2013).

3. Methodology

To obtain qualitative data, purposive sampling is used to identify interview participants who were included in the study. Selecting research participants according to specific qualities might increase the probability of obtaining the most relevant information to the study which is known as expert sampling. It requires participants who are known experts in the field of interest (Kumar, 2011). In this study, the qualitative part becomes important when the interview protocol is done with experts who are experienced employers from established industries. Based on Boshuizen, Bromme & Gruber (2004), experts are defined as either top performer who excels in a field or professionals who achieve at least a moderate degree of success in their occupation. There are two types of participants, the first are employers from industries and the second are industrial training coordinators from the Faculty of Engineering. In this case, some criteria are considered for employers' selection, and seven employers were involved in this study for the interviews.

i. At least qualified with the first degree of engineering field.
ii. Senior engineer to group manager positions.
iii. Has been working in well-known or multi-national companies or industries.
iv. Has more than ten years of experience in industries.
v. Has experience in supervising industrial trainees or interns.

Next, for the industrial training coordinators, the experts were selected based on the position that they hold. A total of twelve industrial training coordinators were selected throughout eight public and private universities in Malaysia. For the number of interview participants, Creswell (2012), and Collins, Onwuegbuzie, & Jiao (2007) suggested a sample for qualitative parts in the mixed method of four to ten samples and six samples, respectively. However, there is no minimum sample requirement in qualitative studies as the number of participants depends on the achievement of data saturation points (Suhairom, 2015).

The interview protocol instruments were built by the researcher based on previous studies and have been validated by three experts, two for content validity and one for face validity. Furthermore, after the interview transcriptions were done, the transcript was read again by the participants to validate the content. Finally, the transcript was signed as proof of content validity. Furthermore, after the interview transcriptions were done, the transcript was read again by the participants to validate the content. Finally, the transcript was signed as proof of content validity.

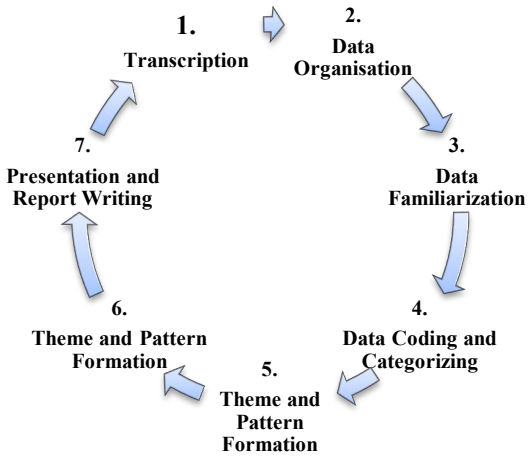

Figure 1: Step in Analysing Qualitative Data (Basit, 2003).

In this study, the qualitative part becomes important when the interview protocols were done with experts who are experienced employers from established industries and industrial training coordinators from universities. The interview protocol instruments were built by the researcher based on previous studies and have been validated by three experts from the same field for each instrument.

4. Findings

The perspective differences between universities and industries are based on five factors which are placement in the industry, training duration, assessment, type of training or task given and learning outcomes. These five components are essential in the industrial training program (Khairiyah *et. al*, 2016) which can affect the students' non-technical skills development.

4.1 Placement in the industry

Based on Azmi, Noordin, Kamin, & Nasir (2018), half of the employers said that the placement of industrial training in the industries is not really important. They thought that students should be motivated to perform in any industry. The most important is the appropriate job scope or type of task given to the students. However, half of them said that the relevant industry to the program is vital. Students should give their full effort while training and build networking which is important for their future career. Besides, with the relevant industry, students have a broader idea of what they will do to develop both their technical and non-technical skills.

Based on industrial training practices in the universities, some public universities such as Universiti Teknologi Malaysia (UTM), Universiti Tun Husein Onn Malaysia (UTHM), and Universiti Malaya (UM), have their online system for students to register and apply their placement for industrial training. Universiti Teknologi MARA (UiTM) is moving towards a fully online system while Universiti Sains Malaysia (USM) and Universiti Putra Malaysia (UPM) are still manually managing their application system. An online system is very important for universities with a large number of students that need to go for industrial training. An online system can reduce human error and is more organised. On the other hand, UPM and USM which have less than 100 students undergoing industrial training at one time, UTM, while UiTM, UTHM, and UTeM have around 300-500 students.

In this case, universities are trying hard to get the best placement for their students. Most universities have a database containing a list of universities based on faculty and program. For example, UTM has categorised a list of companies based on faculties and programs. However, if students insist on undergoing industrial training in a company not on the list, they must seek approval from the coordinator. The company will then be added to the list, so the students may now apply through the system. The response below is from Industrial Training Coordinator 1 (IT Coordinator 1):

"Each company has details such as an address, phone number and person in charge when it is registered in the system. A special form needs to be filled up by students and that company needs to endorse the form. Upon approval from the coordinator, only the career centre has the authority to add the company into the system."

IT Coordinator 1

In terms of the application of placement, students are responsible for applying their own placement. This would be a very good experience for them in preparation for the real job application. By going through this application process, students learn how to prepare a resume and cover letter which is necessary to apply for a job. You may find the response from Industrial Training Coordinator 2 (IT Coordinator 2) below:

"Students need to apply the placement on their own. In my philosophy, this is an exercise for them in finding a job when they are graduated. With our guidance, this will motivate them to search for their own placement."

IT Coordinator 2

All universities have a list of blacklisted companies that have issues in the past. This is to avoid students undergoing training in these companies. "supervision issue" and "improper training" are the two main reasons for getting them blacklisted. Read below the response from an Industrial Training Coordinator 3 (IT Coordinator 3):

In the past, we have blacklisted a company in Petaling Jaya because they were not giving appropriate training to the students. For example, a student was supervised by a foreign operator. This is not right. A student was asked to do

manual labour like lifting heavy equipment. We blacklisted the company upon receiving a complaint from the student to protect future students from going through the same ordeal in their placement.

IT Coordinator 3

4.2 Training Duration

Based on Azmi, Noordin, Kamin, & Nasir (2018), all employers we interviewed agree with 6 months of industrial training for engineering students. The reasons given are that the students will have ample time to do multiple projects and build a rapport during their placement as this is very important when they have graduated and looking for a career.

Based on the responses from five industrial training coordinators from different public universities, the training duration given to the students is between 8-12 weeks. On the contrary, employers need more than that (Azmi et al., 2018; Phang et al., 2014). Responses from the industrial training coordinators below:

"Will all the students get the same experience during the 6 or 8 months of industrial training? Since we know that the students will go to a wide variety of industries, perhaps some of the students would not get proper training. In my opinion, the engineering field is too wide and industrial training is not the career indicator for the students."

IT Coordinator 4

"When we look back to the main objective of industrial training, the duration of 10-12 weeks is enough. The objective of sending engineering students to industrial training is for them to get exposed to the engineering field and not to work or even to do a project in the company. 10 weeks is justifiable and enough for them to learn communication skills, teamwork and other soft-skills."

IT Coordinator 5

"The duration is enough because the Engineering Accreditation Council (EAC) has set for eight weeks with philosophy and specific criteria. Industrial training aims to give exposures in the engineering field. If the duration is extended to 6 months, some companies will take that opportunity chance to start giving manual labour tasks with minimal allowances. We have to avoid this."

IT Coordinator 2

4.3 Assessment

Based on Azmi, Noordin, Kamin, & Nasir (2018), many employers agreed with regular assessments on the students to make sure they managed to learn and progress based on the task given to them. The students should not be neglected because they need a lot of attention during the industrial training where it would be the first place for them in a real-world environment for professional engineers. The universities themselves will do these assessments. Based on feedback from one employer, the lecturer's visit is essential to strengthening the university-industry relationship. During a visit, they can discuss further their two-way demand and supply and also possible collaboration on their commercial projects.

The responses from 5 industrial training coordinators from different public universities mention that the students are usually evaluated based on rubric forms and logbooks. Presentations are not compulsory for some universities and even one university does not organize lecturer visits due to budget constraints. The responses from the industrial training coordinators below:

"We have no lecturer visits beginning from this year. We communicate through email and phone calls with the industry. We have four types of assessments namely logbook, rubric forms for faculty and industrial supervisors and final reports. Items in the rubric forms are easy to understand and can be done without lecturer visits. The lecturer's visit will only happen if there are issues and problems, to check on the situation."

IT Coordinator 4

4.4 Training and Learning Outcomes

Based on Azmi, Noordin, Kamin, & Nasir (2018), employers agreed that tasks or types of training given to the trainees should involve projects or mini-projects given to a team. Doing and understanding ground labour will be a great experience for the students for them to learn and understand on work responsibilities of the junior employees. Furthermore, the presentation is very important, and students should always get involved in presenting. It can help in developing their communication skills.

Based on the feedback of the industrial training coordinators, they are satisfied with the training from established or multi-national companies. However, some students are reporting to the technicians instead of the engineers. The advantage of this is they will experience a lot of hands-on, but they do not get to learn the actual job of an engineer. You can find the feedback from some industrial training coordinators below.

"The issue now is that the students are not reporting directly to the engineers, they follow the technician to the site and do a lot of groundwork. Even though that is not the real job of an engineer, the students should understand the engineering behind the jobs and report in the logbook."

IT Coordinator 4

"There are two types of training, they are schedule-based training and project-based training. In a project-based training, the project will expose the students to the flow of the project and will understand what is happening in the project daily. Only more prominent companies provide schedule-based training.

IT Coordinator 3

"Industrial training is not a place to learn about a specific technical skill, but if they can achieve that, it's like a bonus. Simple things like assisting the engineers with their paper-works are good enough. Even attending board meetings to jot down notes will expose them to new experiences. Everyone agrees that industrial training is a great place to develop soft-skills. The ways they interact with the engineers would help them in developing those skills."

IT Coordinator 2

In addition, learning outcomes for the industrial training that are set by the universities are essential as a guide for them and the industries on what students need to achieve after they undergo industrial training. As suggested by all interviewed employers, universities need to revise or update the learning outcomes accordingly based on the growing needs of the industries. These responses below come from the IT coordinators who indicate that the learning outcomes are fully achieved.

"Yes, the learning outcomes are achieved. Based on our deans, the management of industrial training in our faculty is the best and we do not face a lot of problems. The procedures are all clear."

IT Coordinator 3

"Alhamdulillah, the learning outcomes were achieved. Our graduates are employable. But what I can see that our students are lacking in communicating in English. We hope this can be improved."

IT Coordinator 1

"Alhamdulillah, we don't face major problems. 99% of the learning outcomes are achieved and all the students have passed."

IT Coordinator 5

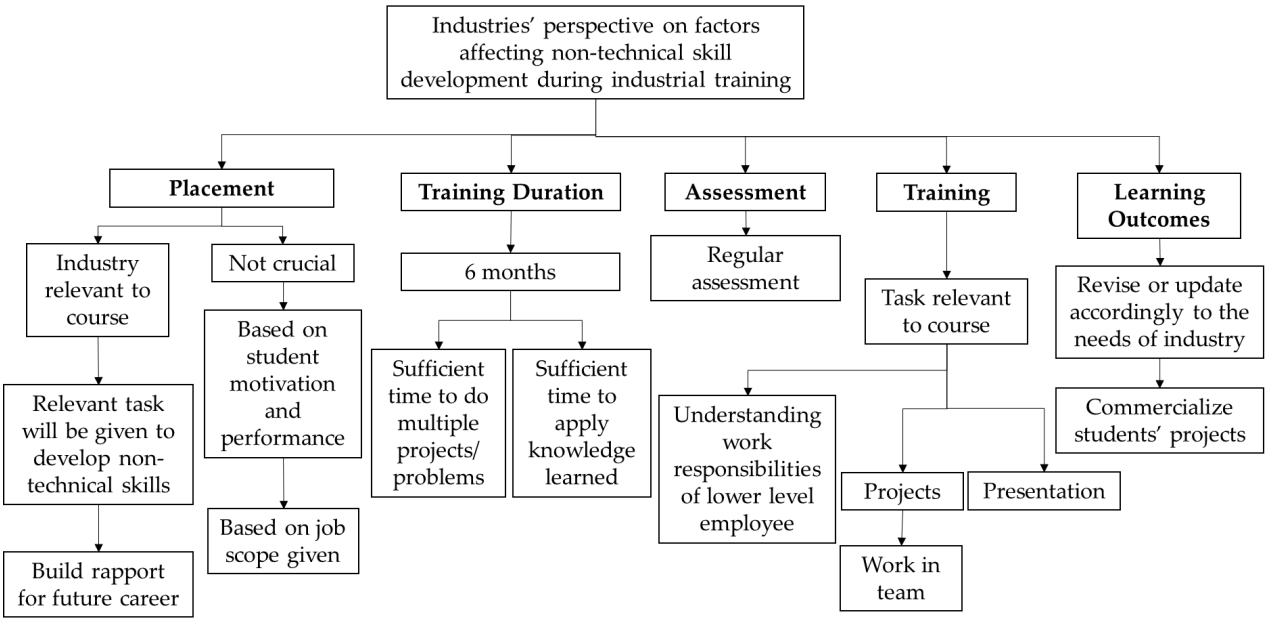

Figure 1: Themes of interview for the factors that influence trainees' non-technical skills development (Employer's perspectives) (Azmi et al., 2018).

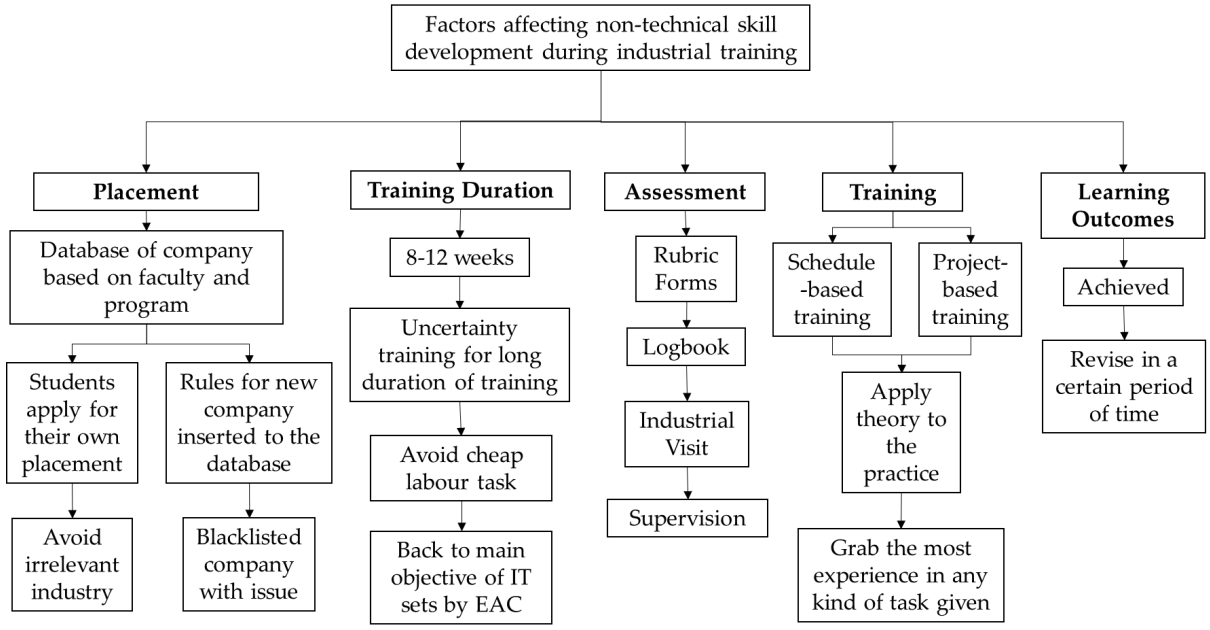

Figure 2: Themes of interview for the factors that influence trainees' non-technical skills development (IT coordinator's perspectives).

5. Findings and Discussions

Based on the perspectives from both sides, the similarities and differences somehow correspond between industries and universities. In terms of similarities, based on Azmi et al. (2018), half of the employers responded the "relevant" of the industry in the industrial training placement is important to develop students' non-technical skills effectively. Placement is one of the factors that is very challenging for the faculty to manage. As we can see the practice in the universities, they are trying hard to help students in finding the relevant industry for their industrial training placement.

There are strict rules and procedures to include new companies to ensure they are suitable for the students. They even blacklist companies with issues and un-rectified problems. Based on Collins (2002), the faculty should employ an adequate number and quality of staff to assist students. Also, the role of the industrial training committee should be made clear to each stakeholder, which are the students, the faculty and industries (organisations) (Collins, 2002). All the stakeholders have an important role to increase the possibility of graduates being selected in the competitive industries (Phang et al., 2014).

In addition, in terms of the training given, the universities accept any kind of training assigned to the students as long as they are relevant and appropriate. Students must know how to apply from the theory they have learned in the university to the practice in the real workplace (Ogilvie & Homan, 2012; Laguador, 2013; Renganathan et al., 2013). On top of that, both agreed that the students should know how to interact with colleagues in the workplace to gain as many skills and experience as they needed. Besides, they are also likely to be tested in situations that require them to practice all related skills during the training (Phang et al., 2014). Moreover, Jackson & Wilton (2016) had pointed out that learning at work is an excellent platform to build self-awareness competency among students; thus, it also has a positive influence on the development of decision-making skills, opportunity awareness, and transition learning.

On the other hand, the duration of the training is the main issue between universities and industries. As we can see, employers always request longer period of training because they need more time to train or the students need more time to apply the knowledge. The employers stated that six months of training or at least three months of the duration are suitable for industrial training, especially for engineering students (Phang et al., 2014; Yusof, Mohd Fauzi, Zainul Abidin, & Awang, 2013). They thought that this longer period of training would be more beneficial, giving more exposure to the trainees to allow them to understand the flow of a project. On the contrary, universities want to avoid uncertainties in the quality of training given to the students if they go for longer placements. At the same time, they wish to avoid manual labour task which is not engineering and soft-skills related. EAC has set a minimum of 8 weeks of industrial training for engineering students (EAC, 2017).

In terms of assessments, there is no problem in rubric forms and logbook. Industrial visits from lecturers are very important and cannot be neglected. Action from a university that dismisses the industrial visit will affect the communication link or relationship between universities and industries. In the issue of budget constraints for industrial visits, the high cost that occurred for the industrial visit will affect the supervisors' assessment (Khairiyah et al., 2018). One of the industrial training coordinators said that the industrial visit is significant to make sure the assessment and supervision quality in the industry. Moreover, industrial visits could ensure that the faculties maintain their relationship with the industry to make sure their subjects, syllabus, and curriculum are still valid and relevant to the changes that happened in the industry (Noordin, 2014). The linkage between university and industry is very important for innovation and commercialization project (Schiller, 2006; Vaaland & Ishengoma, 2016). Right supervision is important to make sure students get appropriate knowledge during industrial training.

Based on the findings above, most of the industrial training coordinators claimed the learning outcomes are achieved, and all the students passed the industrial training. But recently, there are still complaints from the employers about the capability of engineering graduates, especially in non-technical skills.

6. Conclusion

Conclusively, there are some similarities and differences between universities and industries on factors that are affecting non-technical skills development during the training. The difference can be seen a lot in the training/task given to the students and the training duration. The gap existed can be reduced by strengthening the linkage between universities and industries which can easily be done through industrial training. Thus, students could get valuable experience during industrial training as it can be the best platform for students to learn and enhance their non-technical skills. Although the industrial revolution changes, most of the non-technical skills needed by the industries remain the same. It is proven by comparing the interview data with the metadata analysis done by the researcher. With some enhancement such as computing skills, the engineering graduates should equip themselves with all the skills needed by the new industry.

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References

Ayob, A., Osman, S. A., Omar, M. Z., Jamaluddin, N., Kofli, N. T., & Johar, S. (2013). Industrial Training as Gateway to Engineering Career: Experience Sharing. *Procedia - Social and Behavioral Sciences*, *102*(Ifee 2012), 48–54. https://doi.org/10.1016/j.sbspro.2013.10.712

Azmi, A. N., Noordin, M. K., Kamin, Y., & Nasir, A. N. (2018). FACTORS IN NON-TECHNICAL SKILLS DEVELOPMENT AMONG ENGINEERING STUDENTS : AN EMPLOYERS ' PERSPECTIVE. *The Turkish Online Journal of Design, Art and Communication*, *September*(September), 918–926.

Basit, T. N. (2003). Manual or electronic? The role of coding in qualitative data analysis. *Educational Research*, *45*(2), 143–154. https://doi.org/10.1080/0013188032000133548

Baygin, M., Yetis, H., Karakose, M., & Akin, E. (2016). An effect analysis of industry 4.0 to higher education. *2016 15th International Conference on Information Technology Based Higher Education and Training (ITHET)*, 1–4. https://doi.org/10.1109/ITHET.2016.7760744

Benešová, A., & Tupa, J. (2017). Requirements for Education and Qualification of People in Industry 4.0. *Procedia Manufacturing*, *11*(June), 2195–2202. https://doi.org/10.1016/j.promfg.2017.07.366

Bhurtun, C., Jahmeerbacus, I., Oolun, K., & Feliachi, A. (1999). Short-term practical training for electrical engineering undergraduates. *IEEE Transactions on Education*, *42*(2), 109–113. https://doi.org/10.1109/13.762938

Carnevale, B. A. P. (2013). 21st Century Competencies for College and Career Readiness, 5–9.

Collins, K. M. T., Onwuegbuzie, A. J., & Jiao, Q. G. (2007). A Mixed Methods Investigation of Mixed Methods Sampling Designs in Social and Health Science Research. *Journal of Mixed Methods Research*. https://doi.org/10.1177/1558689807299526

Harkins, A. M., Rüßmann, M., Lorenz, M., Gerbert, P., Waldner, M., Justus, J., … Marwala, T. (2016). Requirements for Education and Qualification of People in Industry 4.0. *Procedia CIRP*, *11*(April), 2195–2202. https://doi.org/10.1016/j.promfg.2017.07.366

Hecklau, F., Galeitzke, M., Flachs, S., & Kohl, H. (2016). Holistic Approach for Human Resource Management in Industry 4.0. *Procedia CIRP*, *54*, 1–6. https://doi.org/10.1016/j.procir.2016.05.102

Husain, M. Y., Rasul, M. S., Mustapha, R., Malik, S. A., Amnah, R., & Rauf, A. (2013). Jurnal Teknologi Full paper Tahap Kemahiran Employability Pelajar Kejuruteraan dari Perspektif, *1*, 31–39.

Jamil, N. A., Shariff, S. M., & Abu, Z. (2013). Students' Practicum Performance of Industrial Internship Program. *Procedia - Social and Behavioral Sciences*, *90*, 513–521. https://doi.org/10.1016/j.sbspro.2013.07.121

Khairiyah, M. Y., et. al. (2018). Scenario Research on Industrial Training/Practicum in Malaysian HIgher Learning Institutions. Higher Education Leadership Academy (AKEPT), Ministry of Higher Education Malaysia.

Kumar, R. (2011). *RESEARCH METHODOLOGY a step-by-step guide for beginners*. Sage Publisher.

Laguador, J. (2013). Engineering Students' Academic and on-the-Job Training Performance Appraisal Analysis. *International Journal of E-Education, e-Business, e-Management and e-Learning*, *3*(4), 4–8. https://doi.org/10.7763/IJEEEE.2013.V3.245

Lasi, H., Fettke, P., Kemper, H.-G., Feld, T., & Hoffmann, M. (2014). Industrie 4.0. *Wirtschaftsinformatik*, *56*(4), 261–264. https://doi.org/10.1007/s11576-014-0424-4

Lee, J., Bagheri, B., & Kao, H. A. (2015). A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems. *Manufacturing Letters*, *3*, 18–23. https://doi.org/10.1016/j.mfglet.2014.12.001

Lee, J., Kao, H. A., & Yang, S. (2014). Service innovation and smart analytics for Industry 4.0 and big data environment. *Procedia CIRP*, *16*, 3–8. https://doi.org/10.1016/j.procir.2014.02.001

Mahmud, M. I., Ahmad, J., Marzuki, W., & Ahmad, W. (2016). Modul Kesediaan Kerjaya Berdasarkan Teori Cognitive Processing (CIP), (3), 59–75.

Malhi, R. S. (2008). The Hard Truth about Graduate Employability and Soft Skills. *The Hard Truth about Gradute*

Employability and Soft Skills, *448*(December 2008), 1–20.

Nelles, J., Kuz, S., Mertens, A., & Schlick, C. M. (2016). Human-centered design of assistance systems for production planning and control: The role of the human in Industry 4.0. *2016 IEEE International Conference on Industrial Technology (ICIT)*, 2099–2104. https://doi.org/10.1109/ICIT.2016.7475093

Ogilvie, C., & Homan, G. (2012). Everybody wins? Using the workplace as an arena for learning. *Higher Education, Skills and Work-Based Learning*, *2*(2), 102–120. https://doi.org/10.1108/20423891211224595

Osman, S. A., Khoiry, M. A., Rahman, N. A., Rahni, A. A. A., Mansor, M. R. A., Nordin, D., & Johar, S. (2016). The effectiveness of industrial training from the perspective of students of the civil and structure engineering department. *Journal of Engineering Science and Technology*, *11*(Special Issue onpendidikankejuruteraandanalambina), 1–12.

Phang, F. A., Yusof, K. M., Saat, M. M., & Yusof, N. M. (2014). Perceptions of engineering students on industrial training in Malaysia, (JULY), 1–6. https://doi.org/10.5339/qproc.2014.wcee2013.20

Renganathan, S., Ambri, Z., Abdul, B., & Li, C. S. (2013). Students ' perception of industrial internship programme. https://doi.org/10.1108/00400911211210288

Richert, A., Shehadeh, M., Plumanns, L., Schuster, K., & Jeschke, S. (2016). Educating Engineers for Industry 4 . 0 : Virtual Worlds and Human-Robot-Teams Empirical Studies towards a new educational age. *Ieee*, (April), 142–149.

Rodzalan, S. A., & Saat, M. M. (2012). The Effects of Industrial Training on Students' Generic Skills Development. *Procedia - Social and Behavioral Sciences*, *56*, 357–368. https://doi.org/10.1016/j.sbspro.2012.09.664

Schiller, D. (2006). The potential to upgrade the Thai innovation system by university-industry linkages. *Asian Journal of Technology Innovation*, *14*(2), 67–91. https://doi.org/10.1080/19761597.2006.9668619

Suhairom, N. (2015). Competencies framework for culinary profession in Malaysian hotel sector. Ph. D Thesis. Universiti Teknologi Malaysia.Vaaland, T. I., & Ishengoma, E. (2016). University-industry linkages in developing countries: perceived effect on innovation. *Education + Training*, *58*(9), 1014–1040. https://doi.org/10.1108/ET-07-2015-0067

Zaharim, A., Yusoff, Y. M., Omar, M. Z., & Basri, H. (2010). Employability Skills Framework for Engineering Graduate in Malaysia. *8th WSEAS International Conference on Education and Educational Technology*, 264–272. https://doi.org/10.1109/EDUCON.2010.5492478