Preparing Indonesian Civil Engineering Graduates for the world of work

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Abstract

This study investigates numerous competencies expected from civil engineering graduates based on employers' perspectives in Indonesia to provide an understanding of employers' requirements related to knowledge, skills, and personal traits. Using the employers of civil engineering graduates as the study population, this study adopted both qualitative and quantitative approaches to data collection and analysis, following exploratory sequential mixed method design. The results, developed from a factor analysis, showed that the underlying skills, knowledge, and general traits that can give competitive advantages for graduates include 10 elements. The most significant components consist of interpersonal management skills, personality traits and entrepreneurial and business skills. As the first two factors, categorized as soft skills associated with traits and character, were the most important, the implication is that employers tend to prioritize building strong characters, even when recruiting or selecting employees with limited technical skills normally obtained during university studies. Other competencies expected of Indonesian Civil Engineering graduates discussed in the paper include digital skills, as well as core knowledge of civil engineering such as design and geotechnics skills. The findings of this study will benefit universities seeking to enhance their graduates'

employability as well as the students that are hoping to be ahead of their games. It also provides insights to civil engineering employers who may want to understand the key skills and competencies in demand by other employers of civil engineering graduates in Indonesia.

Keywords: Civil Engineering, graduates, competency, world of work

Introduction

The construction industry has been among the most flourishing of all industrial sectors, and it has gained a great deal of scholarly attention due to its economic and social complexity (Li *et al*., 2019). The construction industry contributes significantly to providing society with well-designed buildings necessary for modern life and numerous varieties of infrastructure, including roads, bridges, airports, and water supply. The industry's growth trends continue to rise rapidly in terms of economic development, acting as an engine of economic growth and contributing around 6% of Gross Domestic Product (GDP) in Indonesia (Soemardi and Pribadi, 2012). Moreover, the industry generates a substantial amount of employment, which is approximately 7% of the total labour force globally (ILO, 2018). On the other hand, human capital, over the years, has become a significant issue for human resource management in the construction industry (Yankov and Kleiner, 2001). Despite absorbing a great number of unskilled, semi-skilled, and skilled labors, there continues in Indonesia to be a shortage of skilled and qualified employees in construction (Kog, 2019), as in many other nations across the globe (Rahim *et al*., 2016).

The construction sector offers a wide variety of job opportunities for civil engineering graduates. According to Bhuruk *et al*. (2018), students tend to choose careers in the construction industry

because of high rates of unemployment in many other sectors of the economy. This is essentially because civil engineering has been one of the more respected professions, as infrastructure is necessary for a robust and prosperous national economic development. According to the U.S. Bureau of Labour Statistics (BLS) in 2019, civil engineers are those who actively involved in specific job tasks such as designing, building, supervising, constructing and maintaining infrastructure projects both publicly and privately. Carrying out these sets of tasks requires a wide range of competencies and skill sets, including those needed to prevent structural collapse, always worrisome due to possible injury, loss of life, and disruption to numerous activities (Chan *et al*., 2018; Essien and Ajayi, 2017). It is therefore important that civil engineering graduates are well prepared for challenging tasks associated with providing critical infrastructure in a way to ensure safety. With the increasing demand for civil engineering positions in the Indonesian Construction industry, qualified engineers with appropriate competency set are in high demand.

According to the Indonesian Central Statistics Agency (2018), the number of construction workers in Indonesia accounted for about 8.3 million people, of which only 20% are classified as construction experts. The number of skilled workers already possessing a Certificate of Expertise Competency from the National Construction Services Development Institute was only 17% of the total number of construction workers, indicating that more and more certified workers must be trained to possess the required competencies.

“Competencies” refer to the knowledge, skills and activities necessary for effective performance of a given task, with several studies confirming the positive relationship between adequate task and contextual competencies and achievement of projects and organisational goals (Ajayi *et al*., 2016; Ryan *et al*., 2009). In most universities, courses in civil engineering have been designed to

enhance knowledge, focusing more on theoretical competencies such as mathematics, basic engineering science, and environmental subjects, rather than on hands-on skills. Due to the prerequisites of competitive competencies and skills as perceived by employers, civil engineering graduates are challenged to have more applied knowledge and specific training related to different job roles. A study carried out in India by Bhuruk *et al*. (2018), suggests that the various job-specific roles of civil engineers cover engineering analysis, cost estimating, design, planning, site inspection, and reporting, among others, with additional expectations for fresh graduates to show the ability to analyse and interpret data based on particular circumstances. Consequently, civil engineering graduates are required to develop professional skills and competencies based on standard specification. A previous study by Arciszewski (2016), argued that there exists a civil engineering crisis in terms of leadership and creativity, indicating the importance of a balance of both quantitative and qualitative knowledge. With studies and real-life experience suggesting that engineering graduates are facing competency issues when dealing with jobs in a real work (Male *et al*., 2010), there is a need to improve the applied competency and practical skills of fresh graduates so that they are prepared for the world of work based on employers' preferences.

In line with the need to tackle knowledge gaps and the lack of essential skills required of civil engineering graduates, some studies have attempted to investigate the competencies needed for effective performance the construction industry. For instance, LaFave (2015) explored how intercultural competencies could be taught to civil engineering students. Zhang *et al*. (2018) suggest strategies for enhancing civil engineering and Management students' competencies in BIM, while Jainudin *et al* (2015) looked into ways in which industrial training could help enhance their competencies. Koch (2015) also mentioned that it is important to link students with role

models in the industry to build students' awareness of the competencies necessary in the profession. While these sets of studies offer insights into how different measures could help to build graduates' competencies, their focuses were not to identify the actual competencies that civil engineering graduates require. In fact, it is open to debate as to whether the suggested competencies such as expertise in BIM, as suggested by Zhang *et al*. (2018), are valued by employers of graduate civil engineers in Indonesia.

This paucity of studies about the specific competencies needed by Civil Engineering graduates is noteworthy, given the report of civil engineering students' lack of awareness and understanding about skills and aptitudes required on the job market for each job-specific role (Bhuruk *et al*., 2018). While it is largely true that having a good grade would be sufficient to secure a graduate role, some employers often demand something more than university grades. For instance, Koch (2015) suggests that, among the reasons many job seekers are not absorbed into the job market are that they do not possess relevant competencies matching the needs of the industry, the lack of certainty of remuneration, and the absence of workforce career continuity.

While academic institutions have their ways of setting the competency levels expected of their graduates and tailor teaching activities to inculcate those competencies in the students, academic experience often fails to provide the right skillsets for graduates (Zaheer *et al*., 2020). Owusu-Manu *et al*. (2014) suggest that inadequate collaboration between universities, employers and professional accreditation bodies is to blame. This is especially the case as most construction companies have set their own criteria for employment assessment, which are harmonized with the companies' expectations when recruiting civil engineering graduates. As such, understanding competencies expected of graduates from the employers' perspectives is

important for universities that want to enhance their graduates' employability as well as for students that aim at being competitive in the job market (Zaheer *et al*., 2020)

As a way of providing both academic institutions and students with an understanding of employers' requirements in terms of graduates' skills, traits and competencies, this study seeks to understand the competencies expected from civil engineering students in the profession. Taking into account employers' viewpoints, the study investigates the underlying skills, knowledge and general traits that can give competitive advantages to graduates when they apply for jobs, as well as those that could enhance their job performance once they are in their workplaces. To provide the theoretical background for the study, the next section of the paper reviews extant literature treating the concepts of competency-based training as well as specific competencies for civil engineering roles. The findings of this study will benefit universities seeking to enhance their graduates' employability as well as hoping to be competitive on the job market. It also provides insights to civil engineering employers who may want to understand the key skills and competencies in demand by other employers of civil engineering graduates in Indonesia.

Literature review

Competency-based Framework

Research on competency-based framework (CBF) within the construction sectors has been continuously emerging (Ryan *et al*., 2009; Benayoune, 2017; Dainty *et al*., 2004; Hayton and Kelley., 2006). According to Benayoune (2017), a competency-based framework is defined as "a set of selected competencies for a specific organization needed to achieve business results" and

used as a tool to evaluate/measure the work performance of an employee within the organization. CBF can be used as an indicator for several purposes, for example, recruitment and selection, promotion of an employee, development and management of employees' information (Benayoune, 2017), as well as for compensation for employees (Zingheim *et al*., 1996). Competency consists of skills and abilities gained throughout work and life experience (Spencer and Spencer, 2008). Beardwell and Holden (2001) defined competency as an individual ability to perform a job task given by an employer at the best performance expected. Commonly, competency comprises knowledge, skills and attitudes attributed as personal characteristics to perform a job effectively (Draganidis and Mentzas, 2006). Similarly, Guillen and Saris (2013) highlighted a clear relationship between competency, personality, and organizational reward within an organization.

The Concept of Competency

The World Meteorological Organization (2018) defined competency as a combination of knowledge, skill, and behaviours. WMO also divided the competency into 3 types: core knowledge, transferable skills, and technical competencies. Core knowledge is achieved through formal and on-going education as a basis for applying skills. Transferable skills cover abilities such as teamwork, communication, leadership, accountability, commitment, as well as generic skills such problem-solving, computer skills, writing and research. In addition, technical competencies cover the specific abilities necessary to accomplish a job responsibly. According to the WMO (2018), competencies define the specific job functions for successful performance but do not

necessarily indicate the level of skills anticipated which will develop through experience and professional improvement. The WMO also clarifies that competency should explain whether someone can accomplish the job to the required level of knowledge and skills. Benayoune (2017) indicated that competency assessment is required to effectively identify and manage work performance in terms of recruitment and selection process, training staffs, performance evaluation, staff promotion and career development. Additionally, the competency model can be used to determine employees' differential compensation levels (Zingheim *et al*., 1996). Siew (2014) states that competencies are closely related to recruitment and performance management.

Forms of Competency

Currently, there is great need to develop competency and employability skills for graduates in the construction industry. It is often believed that graduates are only equipped with technical competency rather than practical skills, while the employers tend to prioritize graduates with high practical ability when conducting employee recruitment selection (Yogeshwaran, 2018). Some researchers developed the competency study based on different perspectives and might be restricted to certain areas only, for instance entrepreneurial competency (Haupt and Westhuizen, 2016), leadership competency (Ahmed *et al*., 2020; Muller and Turner, 2010; Nixon *et al*., 2012), sustainability competency (Siew, 2014), digital competency (Suprun *et al*., 2019), and communication competency (Saleh *et al*., 2019). Haupt and Westhuizen (2016) argued that entrepreneurial competency is mostly required for professional civil engineers since the

universities are not believed to develop entrepreneurship skills in their students. Siew (2014) focused on sustainability competencies by defining proficiency levels for different roles in the construction sector as well as identified the gap between the actual and required proficiency levels for a given competency. Quelhas *et al*. (2019) identified the required competencies for sustainable development in engineering courses and discussed some appropriate teaching-learning methods that support the developed competencies such as problem-based learning, case-base collaborative learning, transforming learning, and solution-oriented learning. It was also found that self-knowledge as the ability to define one's distinctive place or role in the local society is the most essential aspect for the upcoming engineers. Winter and Cotton (2012) highlighted the significance of developing the abilities to deal with issues relating to economic change, climate change, and social disparity as important for undergraduate students as they build their abilities for sustainable decision-making.

Transformation from Traditional-Design Competency into Market Needs

The study of Liu *et al*. (2013) focused on the necessity of reforming the traditional design of civil engineering education into a more applicable design based on market needs. This study reported that traditional designs lack innovation, and graduates are mostly challenged by the inability to apply their practical knowledge when seeking job roles in the construction industry. The employees are expected to have the qualities that meet the needs of employers (Suprun *et al*., 2019). Therefore, the universities are expected to train students with applied knowledge, with strong focus on practical and training projects (Liu *et al*., 2013), as well as employing lecturers

with industry experience (Suprun *et al*., 2019). Helyer and Lee (2014) explored the benefits of opportunities for work experience, such as internships, in enhancing students' employability; internships enable people while still students to experience real-work projects and develop transferable skills. Cooper *et al*. (2010) mentioned that students should be actively involved in a workplace as part of the learning process, rather than merely passively observing the real work. Such involvement is intended to enhance the skills through practical experience, preparing students to apply their knowledge to their assigned roles. Collaboration between government and educational institutions is also needed to enhance the students' skills and employability as they enter a workplace (Abas and Imam, 2016).

Izwan *et al*. (2019) discussed the competencies that civil engineers should have while working in the construction industry, stating that to be competent, a civil engineer should have technical knowledge, decision making, teamwork and leadership skills. In the meantime, Saleh *et al*. (2019) highlighted the essentials of communication competency for students of civil engineering, suggesting that teamwork and the ability to give strong oral presentations were the most important competencies to develop for supporting students' future careers. However, their study was specifically designed using only communication factors, rather than identifying different types of competencies, and relied solely on civil engineering students' perspectives, which may not reflect the views of employers. Another study by Yepes *et al*. (2017) focused mainly on the critical thinking competency as among the analytical skills that graduates should have in their professional lives. Suprun *et al*. (2019) explored digital skills for civil engineering graduates and highlighted the necessity of using digital technologies. This study employed surveys of both students and industry professionals' perspectives and considered the aspect of the digital literacy

developed at the university to meet the future market demands. The study also found that there was a shortfall in digital skills among graduate engineers. Therefore, it is necessary to improve curricula to overcome gaps both at the industry level and the university level. In the meantime, Jainudin *et al*. (2015) suggested conducting industrial training courses for civil engineering diploma students to enhance their competency for industrial work.

National Vocational Qualification (NVQs) Level 7 nationally recognized and designed for Construction Senior Management in the UK is basically a competency-based qualifications that requires a number of hours for learners to pass the qualification. The potential job role expected from taking this qualification is construction supervisor or construction manager. This qualification comprises mandatory and optional units to complete 144 credits overall. The mandatory units consist of the ability to manage teams in construction, ability to lead and contribute in meetings, etc (Pearson, 2010).

Enhancing Employability

Clarke (2008) discussed employability at the individual and organizational levels by providing applied strategies for enhancing employability for career path and job security. Aparicio *et al*. (2019) used technical posters to develop competences in civil engineering study, focusing on teamwork and leadership, effective communication, and comprehension skills. They show that competences can be in forms of visual communication, oral communication, and ability to extract relevant information. Male *et al*. (2011) studied generic competencies for all disciplines of engineering graduates in Australia by listing all competencies required and concluded that

technical competencies are not enough for graduates to succeed professionally. The study stressed that generic competencies such as communication, teamwork, problem solving and so on were perceived to be the most important factors. Similarly, many studies also have been conducted in US and Europe regarding engineers' competencies followed by their accreditation boards such as Accreditation Board for Engineering Technology (ABET) and European Network for Accreditation of Engineering Education (ENAEE). ABET is one of the accreditation program standards that offers more flexible criteria and allows civil engineering education and professional organizations to reform their educational systems into more flexible, diverse, and innovative processes (Sack *et al*., 1999).

Competence Certification

Sack *et al*. (1999) also emphasized a roadmap for change in the civil engineering education system by envisioning the needs for partnerships among many stakeholders, such as educators, practitioners, psychologists, and industry experts, so that graduates have a holistic understanding of the total system of civil engineering. In Indonesia, the Indonesian Accreditation Board for Engineering Education (IABEE), which is a part of the Indonesian Engineers Association (PII), aims to foster a culture of quality in the management of higher education in engineering and computing. IABEE is recognized by the Ministry of Research, Technology and Higher Education as the body which is responsible for the international accreditation of a study program that provides academic bachelor's degrees in engineering and computing. According to ACPECC (2012), Indonesian civil engineers should have a competence certification accredited by the

Construction Services Development Board (CSBD), and earned by attending continuous professional development (CPD) at specified profession associations to gain professional expertise.

According to Liu *et al*. (2013), curriculum development and teaching content in the university should be based on practical application and training projects, in order to reinforce students' hands-on abilities and improve their wide-ranging ability to reform the higher education systems. Based on the study of Suprun *et al*. (2019), there is a gap in the skills gained by students in universities as shown by their ability to adopt digital skills. The universities are not on the same page with the industry in terms of genuine platform used in the university. This study also stated that the university has the responsibility to bridge the gap by enhancing the curriculum with more pertinent skills and engaging engineering programs and technology required by the industry as well as commissioning more lectures from industry experts. Due to unprecedented challenges in the construction industry market, the civil engineering graduates are no longer retained in enduring professional positions, but more generally are employed for fixed term projects such that their employment will terminate when the projects are completed (Sack *et al*., 1999). Therefore, Suprun *et al*. (2019) mentioned the university is in charge of providing students with theoretical knowledge and base-level skills to prepare alumni working in the industry. Moreover, the university should also convey the real-world experience to enable graduates' transition into working in the industry level. Therefore, it is important to develop a competency framework that will benefit the universities and industry as the producer and user of graduates.

Methodology

To understand the competencies and skills in demand by employers of Civil Engineering graduates in Indonesia, this study adopted both qualitative and quantitative approaches to data collection and analysis, using exploratory sequential mixed method design as described by Creswell (2014).

Qualitative Data Collection and Analysis

Due to the paucity of similar studies on the competencies expected of Civil Engineering graduates in Indonesia, a descriptive interpretive qualitative study was carried out to understand employers' views about the competencies most important for their employees to possess. This approach is considered suitable as Van Manen (2016) posits that an inadequately explored concept could be adequately understood using a qualitative approach. As a result, interviews were carried out with employers of Civil Engineers to explore the skillsets and competencies that they consider when recruiting new Civil Engineering graduates. Using purposive sampling as a means of selecting the six interviewees, all of whom have employed civil engineering graduates, this approach ensures that information-rich participants were selected for the study (Merriam, 1998). The six participants were considered adequate for the study, as Polkinghorne (1989) suggests that five to 25 participants are expected to participate in qualitative studies. With each of the interviews lasting between 50 and 75 minutes, the participants explained the key skills and competencies that they consider when seeking to employ Civil Engineering graduates as well as those that offer a competitive advantage for their potential employees.

To gain insights from the data and establish the competencies that interviewees emphasized, the interview voice data, recorded with participants' permission, were transcribed into a written statement. The data was analysed using content driven thematic analysis, which is suitable for establishing both implicit and explicit statements emerging from the written data (Braun and Clarke, 2006). The data was coded through three categories of elements, including code/keywords, discussion and skills/competencies, in addition to information about each of the six interviewees. Table 1 shows the identified competencies that emerged from the six interviews.

To enhance the robustness of the factors established from qualitative data analysis, relevant competencies expected of graduate engineers and similar professionals within the construction industry were reviewed in extant literature focussing on both Asia and other parts of the world. In addition to the identified competencies, academic curricula were analysed to establish the competencies and skills that are academic institutions consider to be important for graduates of Civil Engineering. Table 1 shows the list of all factors established from qualitative data collection as well as the review of extant literature. All the identified factors were then combined and rephrased to fit the rating scale, with duplicate measures eliminated from the list as suggested by Field (2013).

Table 1: Summary of qualitative findings for the competencies required

Quantitative Data Collection

As it allows researchers to reach out to large number of participants in a timely and cost-effective manner (Walliman, 2019), a questionnaire was selected as a means of data collection for the study. The questionnaire used for this study consists of two main sections, including the participants' demographic information and the established set of competencies that were put on five-point Likert scale, where 1 represents "strongly disagree" and 5 represents "strongly agree." The Likert scale ensures that the average responses from individual participants and questions can be summarised (Nunnally and Bernstein, 2007). The questionnaire was administered online using Google Form, a free online platform for questionnaire administration that facilitates its sharing through links and emails to prospective participants. The platform also facilitates aggregation of questionnaire responses into an Excel sheet for easy export into SPSS, an advanced statistical analysis tool for analysis (Zaheer *et al*., 2020).

In line with research ethical standards, no identifying information was collected from the participants. Similarly, the first part of the questionnaire contained the background and consent information, which indicated that progression to the subsequent sections served as an informed consent. Other two sections of the questionnaire contained the participants' information, as summarised in Table 2, and the list of competencies identified through interviews and review of extant literature.

Before administering the questionnaire to a larger audience, a pilot study was carried out to evaluate the construct, content, and predictive validity through a small sample of research participants as suggested by Field (2013). Apart from rephrasing of the questionnaire, which was administered in English based on feedback from the pilot test, the efficacy of the internal construct was analysed and validated using cross tab analysis and frequency test.

In line with Couper's (2000) list-based sample of high-coverage populations, a probability-based survey using a list-based sampling frame was used via the web. The link to the questionnaire was shared using LinkedIn messages and other professional-facing platforms, targeting the employers of civil engineering graduates. 500 professionals were approached through direct invitations, out of which 313 responded after a series of reminders, representing about 63% response rate. Table 2 shows the distribution of the 313 respondents that completed the questionnaires used for statistical analysis.

Table 2: Demography of the Respondents

Quantitative Data Analysis

To achieve the aim and objectives of the study, the questionnaires were analyzed using Reliability Analysis and Factor Analysis.

Quantitative Data Screening and Reliability Analysis

Visual data screening and calculation of standard deviation confirmed that the questionnaires were adequately completed by the respondents and that there was no unengaged respondent. As a result, the 313 responses were used for further analysis. According to Yockey (2018) and Field (2013), it is important that the Cronbach Alpha coefficient is calculated to evaluate the internal consistency and reliability of criteria on a questionnaire. This will ensure that variables that are not contributing to internal consistency or unrelated to the underlying latent factors are removed from further analysis. With the Cronbach Alpha ranging from 0 to 1, a value above 0.8 suggests an excellent consistency, values above 0.7 are suitable and a Cronbach Alpha value

below 0.7 suggests an inadequate internal consistency of the variables (Nunnally and Bernstein, 2007).

The result of reliability analysis returned a value of 0.983 for the variables, suggesting an excellent internal consistency of the variables. In addition to this, Field (2013) suggests that once a good level of internal consistency is established, it is also important that "*Cronbach Alpha if item deleted"* is estimated for each of the items to confirm whether all of them are contributing to the internal consistency of the variables. Through this test, any item that has its *Cronbach Alpha if item deleted* value above the Cronbach alpha value of 0.983 is not contributing to the overall reliability and should be removed from further analysis. As a result, one variable, "F7 - Having an integrity (being trustworthy)" which has its *Cronbach Alpha if item deleted* coefficient as 0.984 was removed from further analysis.

Exploratory Factor Analysis

To establish the underlying competencies expected of civil engineering graduates in Indonesia, a factor analysis was carried out. This is because factor analysis, as a dimension reduction technique, allows replacement of many variables – which are 73 in this instance – with a few unobserved factors that can explain all the variables (Ajayi *et al*., 2017). The statistical analysis approach is suitable as it helps in grouping the observed variables to establish the underlying competencies that are in demand by Indonesian Civil Engineers' employers.

According to Tabachnick and Fidell (2001), Kaiser–Meyer–Olkin (KMO) and Bartlett's test of Sphericity are used to test the suitability of data for factor analysis. A KMO value above 0.6, from

its range of 0 to 1, and a Bartlett's test of Sphericity coefficient below 0.05, are considered to be adequate (Tabachnick and Fidell, 2011). Using SPSS V26, the analysis returned a KMO value of 0.962 and Bartlett's test of Sphericity coefficient value of 0.0001, indicating the excellent suitability of the data for factor analysis.

As suggested by Hair *et al*. (2014), factor extraction and rotation were carried out using factor extraction and rotation, respectively, retaining an eigen value greater than one. This resulted into 10 factor rotation, with a total variance of 68.738%, suggesting that 10 key skillsets and competencies are expected of Indonesian Civil Engineering graduates in the professions. Using the variables that contribute to the factors, the latent factors were labelled with their Eigen values and percentage of variance taken as their measures of significance. This implies that Civil Engineering graduates that are willing to be ahead of the competition and universities that are aiming to enhance their graduate employability should focus on the following 10 core competencies and skillsets:

- COMP 1: Interpersonal management skills
- COMP 2: Personality traits
- COMP 3: Entrepreneurial and business skills
- COMP 4: Knowledge of digital technology
- COMP 5: Team Playing
- COMP 6: Technical civil engineering skill
- COMP 7: Geotechnical knowledge
- COMP 8: Communication skills

- COMP 9: Client orientation skills
- COMP 10: Mentally strong and positive attitudes

Table 3 presents the results of the factor analysis, showing the variables and their factor loading, underlying latent factors, as well as the Eigen Value and percentage of Variance. As shown in the Table 3, each of the 10 factor components achieve a Cronbach Alpha above the required threshold of 0.7.

Table 3: Component Labelling and Its Associated Criteria

The Underlying Competencies of Market-Ready Civil Engineering Graduates

Based on the findings from the factor analysis, this section discusses the underlying competencies that are expected of civil engineering graduates in the world of work.

Interpersonal Management Skills

The first component named as "interpersonal management skills" had a total variance of 16.225%. This component comprised 13 variables related to character-based measures, suggesting that employers of civil engineering graduates in Indonesia value personality traits over what could be termed task competencies. This aligns with Motowildo's task-contextual competencies, which suggests that it is the contextual activities, motivation and personality traits that will effectively drive one's ability to perform job tasks effectively (Motowildo *et al*. 1997). In

addition, the Iceberg model, according to Spencer and Spencer (2008), is another job competency model that can explain this preference for interpersonal management skills over generic task competency. The model suggests that while about 20% of skills needed for job performance are physical, hidden features such as traits, self-concepts, and motive-based competencies account for the rest 80%.

Similar findings from Zaheer *et al*. (2020) showed personal management skills to be the most in demand feature by the employers. Due to lack of practical skills that graduates have during their studies in universities, the employers tend to mainly focus on personal traits and personal responsibility when recruiting and selecting their employees. It is believed that the technical competency could be processed gradually during employment (Trinder, 2008), while personality traits will inform employers about a candidate's dedication to learning and working in a team. In fact, interpersonal management skills could also be elaborated through training and development (T&D), as it is argued that T&D as the most effective way to change business cultures and improve competitive advantages (Hunt & Baruch, 2003). This necessitates that employers also enhance interpersonal management skills through training programs within their organizations in order to improve productivity and work performance. Since interpersonal management skill is a comprehensive competency, graduates should equip themselves with examples of applicable personal characteristics to position themselves for competitive advantage.

Personality Traits

The second component group was named ‘personality traits’ and had a total variance of 8.830%. This component had 5 variables related to personality traits, such as being self-motivated and trusted. In an increasingly dynamic job environment, it is becoming clearer that employees are the best assets into which a company should invest, as such investment significantly enhances job performance and employees’ productivity (Athota *et al*., 2020). In line with Zaheer *et al*. (2020), this study found that employers value personal characteristics that provide a comfortable work environment to increase job productivity. Such personality traits include self-motivation, being loyal and able to build trust, as well as having respectful attitudes towards people. Since a workplace is usually occupied by different people with diverse personalities, it is necessary for graduates to manage their attitudes and behaviors to cultivate comfortable interactions among individuals, and to develop stronger relationships, which finally result in achieving corporate goals. Recognizing personality traits is important for identifying many of the strengths and weaknesses that contribute to a society’s success. As a result, universities could better prepare their graduates for the world of work by tailoring coursework in a way that will facilitate interaction among and development of socially beneficial attitudes towards their colleagues and others.

Entrepreneurial and Business Skills

The third component based on the factor analysis was entitled ‘entrepreneurial and business skills,’ and had a total variance of 8.799%. The extracted factors consist of 4 variables related to entrepreneurial and business competencies. The suggestion here is that employers expect new

graduates to possess entrepreneurial skills necessary for interpreting the construction industry's changing economic demands and business needs, and that will contribute to professional success (Morris *et al*., 2013). There is an increasing number of graduates who ultimately become entrepreneurs instead of job-hunters, even given the shortage of entrepreneurship education in the universities. This turn away from job hunting may indicate that graduates are not fully prepared for the world of work practices (Morris *et al*., 2013). Thus there are opportunities for graduates with business skills to be self-employed, by starting a corporate venture or a new firm (Dickson *et al*., 2008). The success of such a venture relies in part on the graduates' entrepreneurial ability to harmonize diverse business tasks, such as developing new products or services that can generate incomes and benefits for the company (Haupt and Westhuizen, 2016).

Academic institutions could help in preparing their graduates for professional life by ensuring that entrepreneurial skills are included in both teaching and assessment. Essential skills and competencies include creative and innovative thinking, commercial awareness, influencing skills and being results-oriented, among others. While some universities in developing nations have started integrating entrepreneurship skills such as business research, business planning and actual business set up in their teaching at both undergraduate and postgraduate level (Duran and Valle, 2018; Ferreira *et al*., 2017), more is expected from academic institutions in Indonesia. For instance, coursework and assessment could involve the writing of business plans, market research, investigation of how new products and services could be developed within civil engineering businesses and projects, and other business-oriented provisions. Such curricular innovations will not only enhance graduates' employability skills, as employers are open to new ideas and sources of income, but will also increase the number of self-employed graduates.

Knowledge of Digital Technology

Component 4, labelled 'Knowledge of digital technology,' had a total variance of 8.215% and consists of 10 factors associated mostly with digital technology skills such as data digitalization, Building Information Modeling (BIM) and proficiency in the use of such tools as AutoCAD. BIM has been adopted in construction areas throughout their life-cycle phases to share data and information flow to all stakeholders involved, enabling easy communication and information dissemination (Azhar, 2011). This indicates the necessity for graduates to be familiar with and accustomed to using digital technology, as rapid development of digital technology within the construction industries is currently inevitable. It is also evident that digital technologies have replaced the outdated practices of using paper-based systems with a more advanced technology that helps streamline processes and inefficiencies in construction projects (Suprun *et al*., 2019). Therefore, graduates are expected to have the ability to use digital technology to improve their productivity and to manage the huge flow of information from various sources. Alexander *et al*. (2019) also highlighted the need for learning basic computer programming as part of digital literacy in early civil engineering education to prepare for future employment conditions. This becomes particularly important, as the employers look up to the technology-savvy youths and fresh graduates in their drive to enhance digitalization of their businesses.

Team Playing

Based on the factor analysis, component 5, which was named “team playing,” had a total variance of 6.232%. It comprised 6 variables related to the ability to work with others as a team. This suggests that employers value graduates who can exhibit team working skills, since such skills are essential to improving productivity and work performance, which in turn help to achieve organizational goals (Tabassi *et al*., 2011). The team is considered to be the backbone of an organization, for teams often offer better solutions to a company’s problems than do individuals working on their own (Tabassi *et al*., 2011). All team members should agree to their company’s objectives, and should contribute to those objectives based on their own ideas, abilities and responsibilities. It is also clear that effective teamwork plays a crucial role in contributing to the success of every business’s construction projects. Team playing can be done by supporting a team’s decision, reinforcing team spirit, promoting cooperation, and avoiding conflicts, among others. Consequently, universities could enhance their graduates’ employability by ensuring opportunities for practicing teamwork among their students, usually in forms of group assignments.

Technical Civil Engineering Skills

The sixth component, composed of four variables, had a total variance of 5.646%. This component was labelled ‘technical civil engineering skills,’ because they are associated with basic and fundamental civil engineering knowledge such as the ability to understand engineering principles as well as formulate engineering problems. Essentially, this competency category could be termed technical skills, which Zaheer *et al*. (2020) believed to be the primary skills that

universities teach and examine in their students. As a technical subject, civil engineering graduates are expected to be proficient in the technical knowledge of civil engineering, such as engineering design and principles, which are threshold concepts upon which other skills and competencies will be built. For instance, the knowledge of digital technology and effective team playing could not be attained without the fundamental knowledge of civil engineering and engineering design that are covered by this competency category. The graduates are also expected to be able to design and supervise construction projects. Consequently, employers value graduates who have the technical knowledge needed to solve complex engineering problems at the workplace. Technical skills are also crucial to graduates in terms of fulfilling their responsibilities as engineers to achieve sustainable projects.

Geotechnical Knowledge

Component 7, labelled as 'geotechnical knowledge,' had a total variance of 4.825%, suggesting that employers demand graduates have a strong understanding of geo-technics and foundation skills. As construction projects are often faced with unprecedented challenges associated with soil works, graduates should understand on how to design and calculate foundation structures (Das and Sivakugan, 2016). When planning infrastructure, geotechnical knowledge is essential for performing mathematical calculations and investigating slope stability and load capacity. Moreover, graduates are also required to have the ability to analyze field tests arising from soil investigations and develop prediction models based on the real site conditions. Graduates should possess basic knowledge of geotechnics as part of the technical knowledge of civil engineering.

Communication Skills

Effective communication is an essential competency recognized as the backbone of effective job performance (Alias *et al*., 2013). Component 8, labelled 'communication skills,' had a total variance of 4.590% and comprised 4 variables associated with communication proficiency. Studies have suggested that one of the competency deficiencies in engineering graduates is in their communication skills (Male *et al*., 2015; Donnell *et al*., 2011), which this study found as essential to their employability and job performance. This suggests that employers prefer that graduates have good communication skills, enabling them to interact with a wide range of professionals with different backgrounds, experiences, and cultures (Saleh *et al*., 2019). The ability to communicate effectively will help graduates to deliver their ideas both spoken and written as well as to build the network and relationships among professionals within the construction industry. Effective communication skills can significantly influence graduates' employability and careers in the industry. There is a need to develop communication skills, which also cover foreign language skills for engineers who work in an increasingly globalized/international context. It is undeniable that most graduates lack foreign language communication skills primarily when it comes to international industry demands (Riemer, 2007). Consequently, communication skills can be seen to be career enhancers, enabling graduates to manage, control, plan and lead organizational activities (Bambacas and Patrickson, 2008).

Client Orientation Skills

Component 9, 'client orientation skills,' had a total variance of 3.240% and comprised 3 variables dealing with client orientation. In the construction and engineering industry as well as other project-based organisations, client satisfaction is essential to procuring additional projects and business continuity (Aluko *et al*., 2021). This is especially important as past clients' experience will become an important criterion in future tendering. As a result, this study suggests that employers require graduates to provide excellent service to customers and respond to what the customers want or need, implying that such services will effectively facilitate repeat patronage and competitive advantage in future tendering. Through this competency, graduates are committed to provide satisfactory service as well as able to resolve clients' complaints. It is also vital to maintain long-term relationships with clients for the benefits of a company.

Mental Strength and Positive Attitudes

The last component, labeled "mental strength and positive attitudes," had a total variance of 2.138%". This recommends that employers expected graduates to be able to deal with stress and disturbance during their work. Due to demanding workloads, graduates are required to have healthy minds to avoid possible problems with mental strength or endurance (Ajayi *et al*., 2019). Regular exercise might be important to improve mental health issues so that the graduates remain well motivated and more relaxed while working (Deslandes *et al*., 2009). To be mentally strong and have positive vibes are essential to improve work performance and job efficiency. Efforts could be made to reduce those work-related stress, such as realistic schedule planing that

fits with actual workloads, clearing workspaces, and possessing time management skills (Zaheer *et al*., 2020).

Conclusion

This study explores numerous competencies expected from civil engineering graduates in the profession based on employers' perspectives in Indonesia, in order to provide an understanding of employers' requirements related to knowledge, skills, and personal traits. A sequential exploratory mixed method was applied using interview and questionnaires for data collection. In addition, reliability analysis and exploratory factor analysis were adopted for data analysis.

The results showed that the underlying skills, knowledge, and general traits that can give competitive advantages for graduates as they enter the profession consisted of 10-factors components developed from factor analysis. The most significant components were interpersonal management skills, personality traits and entrepreneurial and business skills. As the first two factors, categorized as soft skills associated with traits and characters, were ranked as most important, it becomes clear that employers tend to prioritize personal character over practical skills, when recruiting or selecting their employees, even to the extent of preferring candidates with strong soft skills but limited technical skills and lack of practical experience. This idea was supported further by the fact that technical civil engineering skills were ranked as only sixth in importance, perhaps since these skills can be developed through professional experience and field work at different job functions with the right contextual competencies. Based on employers' points of view, there exists a need for graduates to focus more on developing soft

skills/transferable skills while studying at universities, although weaknesses from lack of practical skills can be compensated for by excellent personal management skills and personality traits. Having flexible attitudes will create comfortable work environments able to improve productivity contributing to the achievement of organizational goals.

While developing personal management skills is vital, based on employers' perspectives, civil engineering graduates are also expected to develop their entrepreneurial and business skills, since these skills were the third most significant component. Since the construction business also seek to enhance its profitability, marketing knowledge and skills in developing products and services are required. Moreover, due to limited job vacancies in the construction industry, employers expect graduates to have the ability to start their own business or at least contribute to the development of new business directions for their employer, notwithstanding the shortage of entrepreneurship education offered by universities. It is currently evident that there is an increasing number of graduates who ultimately become entrepreneurs in place of job-hunters.

Although academic institutions have set their competency levels based on the competency standards and have focused on technical knowledge and skills instead of transferrable skills, it is important for universities to increase personal management skills and cultivate beneficial character traits in their curricula. Developing character can be started at early stages of education and continued during higher education. This study suggests that technical skills are not sufficient for providing university graduates the best preparation for employment and effective job performance, and argues that personal qualities must also be enhanced by both graduates and academic institutions. This is especially true since personal management skills can complement hard skills gained at the universities.

This study focused on gathering employers' views about civil engineering graduates' competencies. Further study can be pursued based on graduates' standpoints, and could also be elaborated on specific competencies relevant to different job tasks within civil engineering work areas. Further study could also be done by comparing the teaching provision given in the university and industry requirements.

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Table 1: Summary of qualitative findings for the competencies required

Competencies identified from interviews and literature review	**Interview Sources**						**Others from Literature**
	1	**2**	**3**	**4**	**5**	**6**	
1. Understanding fundamental/basic engineering knowledge	x	x	x		x		Bhuruk *et al*. (2018)
2. Having good personality	x	x	x	x	x	x	
3. Having a motivation at work: self-motivated	x		x				Bhuruk *et al*. (2018)
4. Leadership ability: ability to handle people	x	x					Bhuruk *et al*. (2018)
5. Ability to work in a team	x	x		x	x		Bhuruk *et al*. (2018)
6. Ability to identify, formulate and solve engineering problems	x	x	x				Dziekoński (2017), Bhuruk *et al*. (2018)
7. Possessing integrity	x		x	x	x		
8. Ability to plan, organization management	x						
9. Being honest and loyal	x		x	x	x		
10. Having good attitude	x	x	x	x	x	x	
11. Ability to build trust	x		x				
12. Ability to collaborate	x						Ahn *et al*. (2012)
13. Ability to communicate	x	x	x		x	x	Bhuruk *et al*. (2018)
14. Ability to deliver results	x						
15. Ability to take initiative	x						Bhuruk *et al*. (2018)
16. Having functional knowledge and skills	x						
17. Ability to provide solution to others: solution orientation	x				x		Ahn *et al*. (2012)
18. Ability to make decisions	x						
19. Having knowledge in [of?] organization	x	x		x			
20. Familiar with data driven and data digitalization		x			x		Ahn *et al*. (2012)
21. Digital literacy: ability to adopt technology and be aware of computational technology		x			x		Ahn *et al*. (2012)
22. Understanding project management and construction management		x		x		x	
23. Ability in civil engineering design		x					Bhuruk *et al*. (2018)
24. Supported by moral ethics		x	x				Ahn *et al*. (2012)
25. Having a strong work ethic			x				Ahn *et al*. (2012)
26. Ability to convince people			x				
27. Having marketing knowledge			x				
28. Understanding about soil mechanics		x	x				
29. Understanding engineering principles		x	x				
30. Must do everything to his or her utmost ability, always give his or her best from engineering point of view			x				
31. Being responsible at work			x				
32. Willing to work hard			x				
33. Must care for the public and the environment more than the one paying him or her.			x				
34. Must put public safety before personal benefit.			x				Ahn *et al*. (2012)
35. Knowledge about BIM				x		x	
36. Knowledge about safety and health in construction		x		x	x	x	Ahn *et al*. (2012)
37. Knowledge about contract FIDIC and understanding contract requirement		x		x		x	
38. Being professional and excellent				x	x		
39. Ability to understand and speak English : TOEFL and TOEIC				x			
40. Know about construction, EPC, business plan				x			
41. Having knowledge of structure, design and method		x		x			

42. Familiar with using computers, at least MS Office			x	x			
43. Having digital mindset				x	x		
44. Supporting knowledge such as digital technology such as BIM	x			x	x	x	
45. Mastering some software such as AutoCAD				x	x	x	
46. Ability to coach and mentor				x			
47. Mastering knowledge about geotechnics and foundations?		x	x		x		
48. Ability to write, listen and speak					x		Bhuruk *et al*. (2018)
49. Ability to speak to clients conveniently: presentation skills					x		
50. Ability to satisfy customer to achieve customer satisfaction					x		
51. Ability to convince customer during product presentation					x		
52. Being disciplined and precise	x	x			x		Bhuruk *et al*. (2018)
53. Ability to interpret and analyse data			x		x		
54. Ability to make a report					x		
55. Ability to calculate structural analysis, cost estimates, construction contracts, and construction management		x				x	
56. Ability to read drawings				x		x	
57. Having management skill and environmental skills						x	
58. Ability to understand new technology such as elevated work in construction						x	
59. Ability to finish tasks within required time frame							Dziekoński (2017)
60. Ability to take risks							Dziekoński (2017)
61. Having ambition at work							Dziekoński (2017)
62. Being creative							Dziekoński (2017)
63. Being flexible and adaptable							Dziekoński (2017), Bhuruk *et al*. (2018)
64. Having personal commitment							Dziekoński (2017)
65. Having a vision							Dziekoński (2017)
66. Ability to organize work for subordinates							Dziekoński (2017)
67. Being intellectual							Dziekoński (2017)
68. Being assertive							Dziekoński (2017)
69. Being self-confident							Dziekoński (2017)
70. Having empathy							Dziekoński (2017) Bhuruk *et al*. (2018)
71. Ability to deal with stress and disturbance							Dziekoński (2017), Haupt and Westhuizen (2016)
72. Ease of establishing contacts							Dziekoński (2017)
73. Ability to formulate goals							Dziekoński (2017)
74. Ability to motivate team members							Dziekoński (2017)
75. Ability to resolve conflicts							Dziekoński (2017)
76. Ability to negotiate							Dziekoński (2017)
77. Ability to manage the scope, time and cost of the projects							Dziekoński (2017)
78. Ready to work under pressure and deliver results							Bhuruk *et al*. (2018)
79. Willingness to learn							Bhuruk *et al*. (2018)
80. Stress tolerance							Bhuruk *et al*. (2018)
81. Having entrepreneurial skills							Haupt and Westhuizen (2016)
82. Ability to develop new products and services: value creation							Haupt and Westhuizen (2016)
83. Having opportunity recognition skills: ability to perceive changed conditions							Haupt and Westhuizen (2016)

Table 2: Demography of the Respondents

	Sample size	% of Respondents
Age Range of the Respondents		
Below 30 years	79	25.2
30-35 years	58	18.5
36-40 years	34	10.9
41-45 years	68	21.7
Over 45 years	74	23.6
Years of Experience		
Below 5 years	92	29.4
5-10 years	70	22.4
11-15 years	46	14.7
16-20 years	44	14.1
Over 20 years	61	19.5
TOTAL	**313**	**100**
Types of Organization		
Consultant company	62	19.8
Project Management Firm	15	4.8
Main contractor	71	22.7
Private Client	15	4.8
Public Client	74	23.6
Others	76	24.3
TOTAL	**313**	**100**
Size of Organization		
Fewer than 20 employees	54	28.4
21 to 100 employees	30	9.6
101 to 500 employees	65	20.8
501 to 1,000 employees	75	24.0
1,001 or more employees	54	17.3
TOTAL	**313**	**100**

Table 3: Component Labelling and Its Associated Criteria

NO.	**Extracted and Rotated Components**	**Eigen Value**	**%of Variance**	**Factor loading**	**Cronbach Alpha**
COMP 1	**Interpersonal management skills**	11.682	16.225		**0.94**
F26	Being responsible at work			.569	
F27	Willing to work hard			.524	
F45	Being disciplined and precise			.534	
F53	Ability to finish tasks within the required time			.565	
F54	Ability to take risks			.613	
F55	Being creative			.659	
F56	Being flexible and adaptable			.529	

F57	Having personal commitment			.594	
F58	Having a vision			.613	
F61	Being self-confident			.633	
F62	Having empathy			.584	
F68	Ability to negotiate			.604	
F71	Willingness to learn			.644	
COMP 2	**Personality traits**	6.358	8.830		**0.81**
F2	Having a good personality			.622	
F3	Being self-motivated at work			.555	
F8	Being loyal			.590	
F9	Having good attitude towards people			.672	
F10	Ability to build trust			.520	
COMP 3	**Entrepreneurial and business skills**	6.335	8.799		**0.88**
F22	Having marketing knowledge			.652	
F34	Ability to write a business plan			.570	
F72	Having entrepreneurial skills			.689	
F73	Ability to develop new products and services: value creation			.588	
COMP 4	**Knowledge of digital technology**	5.915	8.215		**0.91**
F15	Having knowledge about the organization			.513	
F16	Familiar with data driven and data digitalization			.717	
F17	Digital literacy: ability to adopt technology and being aware of technology			.550	
F30	Knowledge of Building Information Modelling (BIM)			.523	
F35	Having knowledge of structural design			.610	
F37	Knowledge of digital technology			.553	
F38	Mastering of some software such as Autocad			.707	
F49	Knowledge of cost estimation			.600	
F50	Ability to read drawings			.725	
F52	Ability to easily understand new technology such as elevated work in construction			.551	
COMP 5	**Team Playing**	4.487	6.232		**0.85**
F4	Leadership ability: ability to handle/lead people			.545	
F5	Ability to work in a team – team playing			.530	
F11	Ability to collaborate with people			.727	
F51	Having management skills			.550	
F59	Ability to organize work for subordinates			.643	
F60	Being assertive			.553	
COMP 6	**Technical civil engineering skill**	4.065	5.646		**0.86**
F1	Having fundamental/basic engineering knowledge			.641	
F6	Ability to identify, formulate and solve engineering problems			.646	
F19	Proficiency in civil engineering design			.515	
F24	Understanding engineering principles			.695	
COMP 7	**Geotechnical knowledge**	3.474	4.825		**0.90**
F23	A good understanding of soil mechanics			.655	
F40	Good knowledge of geotechnics and foundation			.626	
F48	Ability to carry out structural calculation			.541	
COMP 8	**Communication skills**	3.304	4.590		**0.82**
F12	Ability to communicate effectively.			.545	

F33	Understanding and ability to speak English: TOEFL and TOEIC			.631	
F41	Good writing, listening and speaking skills			.644	
F42	Ability to speak to clients conveniently: presentation			.548	
COMP 9	**Client orientation skills**	2.333	3.240		**0.83**
F43	Ability to satisfy customer - driving customer satisfaction			.568	
F44	Ability to convince customer during product presentation			.588	
F64	Ease of establishing contacts			.543	
COMP 10	**Mentally strong and positive vibes**	1.539	2.138		**0.76**
F63	Ability to deal with stress and disturbance			.511	
F70	Readiness to work under pressure and deliver results			.664	