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Research on the Items of Importance and Satisfaction for Employability in the Korean Information Communication Technology Sector

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Abstract: This study discusses the employability of the workforce in relation to information communication technology. There is a difference in understanding in terms of items of importance/satisfaction during/after employment processes when considering organizations related to the information technology workforce. An empirical analysis of Korean employability based on literature from Asia was conducted. It indicated that differences in the perception of the 12 items comprising importance and satisfaction related to employability could potentially lead to job mismatch. We acquired an adequate sample of 296 respondents, consisting of various organizational employees. The sample was balanced in terms of gender and large or small/medium organizations. After establishing the rank of preferences among items, a difference analysis between/among groups through demographic variables was conducted. As a result, the need for additional disciplines or courses, the arrangement of preferred rank, and methods for enhancing skills from university or education/practice institutes for "interpersonal or team-working skills" and to "communicate effectively" with a higher rank among the general skills of importance/satisfaction were derived. Therefore, technology did not replace human personalities, communication skills, and human attributes such as human cooperation. This study can help address labor shortages and support sustainable employment in organizations, even if an empirical test is rare compared to descriptive statistical analyses.

Keywords: employability; importance item; satisfaction item; information communication technology; general skills; technical skills

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1. Introduction

The fourth industrial revolution (4IR) [1] and digital transformation (DT) [2,3] have been frequently discussed terms used since 2016 to analyze the influence of information technology (IT) or information communication technology (ICT) on employment. Most discussions involve unimaginable change and significant ripple effects in the future because of innovative technologies, automation, and their effect on human labor or job positions due to the development and consolidation of ICT and advancements in artificial intelligence, robotic technology, and so forth [4–6]. The adoption of new technology, such as AI, causes skill shortages and skill mismatches among individuals in firms [7]. Carbonero et al. argued that robots reduced global employment in the relevant sectors by five percent between 2005 and 2014 [8]. Depending on the degree of technological development, the impact on the labor market is different. Webb measured the effects of AI exposure on occupational groups with various skills, arguing, "Whereas low-skill occupations are most exposed to robots, and middle-skill occupations are most exposed to software, it is high-skill occupations that are most exposed to artificial intelligence." [9].

Under conditions of deepening youth unemployment, especially in Korea, the demand side of labor has further complicated the process of acquiring a suitable workforce. Therefore, this study discusses the employability of ICT-related human resources (a major graduate or workforce through the practice of an academy or education institution) in a situation characterized by a stagnant number of quality jobs and the problem of deepened youth unemployment over the last decade. Previous studies [10–12] indicated a difference in the understanding between the items considered necessary by an organization for ICT staffing (most being engineers) and satisfaction items during the employment process or after employment by an organization.

Employment is based on the balance between the demand and supply of labor [13]. Employers and workers benefit from the bargain created through an improved job match [14]. Employment is a relationship between two parties regulating paid labor services. Usually, based on a contract, the employer, a corporation, a not-for-profit organization, a cooperative, or any other entity pays the employee in return for executing the assigned work [15]. Renewed emphasis on employability assumes a more significant role for markets to operate in skills and competence development. It implies a switch in focus from a demand-side approach to a supply-side approach in labor market policy [16].

Differences in perception regarding the items comprising the degree of importance and satisfaction related to employability might be why job mismatches occur. Based on this possibility, this study intends to analyze the factors considered by the education or practice of institutions from a supply side perspective toward human resources and directions for improvement while deeply interrogating differences in perception. This might resolve skill mismatching considering the ICT service perspective and accompanying job mismatches throughout the process and results of the analysis.

This study addresses whether there is a difference among the items of the degree of importance or satisfaction depending on the size of the enterprise, i.e. large business, small and medium business (SMB), or gender based on Asian studies. The findings of this research can help address labor shortages and support sustainable employment in organizations. Therefore, ranked items of the degree of importance/satisfaction require a sustainable response in terms of education from the supply side of labor.

The remainder of this study consists of the following: Section 2 analyzes previous research, including automation and job (calling) problems, employability concepts, and research backgrounds related to employability. Section 3 presents a questionnaire survey conducted for incumbents of ICT-related businesses and governmental agencies according to the research methodology. Section 4 discusses the results of an empirical employability analysis based on a contrived questionnaire, followed by a discussion of the findings, suggestions, and research limitations in Sections 5 and 6.

2. Research Background

2.1. Automation and Job Problem

The 4IR and DT have been the predominant discussion points in the industrial sector, academic area, and governmental scope [17,18]. Automation and job problems have been discussed amid these processes, and several alternatives to these problems have been presented [19,20]. The main discussions include threats from robots to human job positions [4,5] and the possibility of replacing low wage/skill or simple jobs with automation. Researchers have focused on the possibility of changing tasks, and enhancing efficiency by reducing the number of jobs within organizations, reducing costs as essential indicators, and wage and education levels.

There is a controversial discussion regarding the correlation between technology–jobs and technology–tasks with regard to relationships between technology and employment. The 4IR has caused large-scale discussions regarding changes to employment structure due to technological innovation (computerization). There are some assumptions regarding the effects of technological innovation on employment. Computerization has led to a 47% decrease in the total US occupational employment with routine tasks [21]. This is associated

with declining relative industrial demands for routine manual and cognitive tasks and an increased relative demand for non-routine cognitive tasks [22]. Frey and Osborne [21] assume that technology automates whole occupations rather than single-job tasks. This might lead to an overestimation of job automation [23].

Latham and Humberd [24] noted that the previous studies and public discourse on automation did not consider risk level according to job type. They posited that a threat level for each automated job depends on two factors: what value is created by the job and how to provide this value. These factors relate to two questions: (1) Can the job's core competence be substituted easily (the degree of threat to core competence)? (2) How many changes are there in the delivery method of the value of a job (the degree of threat to value type)? They coded 50 job types according to each one's value type and the competence utilized during the process. They presented a framework to determine the extent of the automation threat to each job. The study indicated four progressive directions for jobs: disrupted, displaced, deconstructed, and durable. They found that the value of jobs is the best predictor of job changes among various factors. For instance, the odds of a plumber losing their job are lower than those of a lawyer losing theirs, and this result is different from prior predictions [4,5]. The researchers stated that the acquisition of new technology or lifelong (continuing) education for all people because of the possibility of job threat owing to automation was not recommended [24].

Another prediction is that automation affects job positions depending on method [19,20]. However, Latham and Humberd [24] focused on jobs' "value creation" function and presented another interpretation of the factors that provoke change. Their research can contribute by responding to unpredictable changes in workforce demands irrespective of laborers' industry/job types, and we must pay attention to what type of workers can switch to other paths over time.

Reportedly, this is the first study that has used ranks of importance and satisfaction items in relation to ICT personnel's skills based on the perception of previous studies. Considering these items' changeable possibilities in the future, we intended to compare the analysis results of Korean samples with those of various Asian countries' research.

2.2. Employability Concept

It is difficult to define "employability" explicitly. If an ability is essential, competence suitable for employment can be justified. If a worker's virtue is considered necessary, employment suitability is possible. If used as an index/indicator, it can be expressed as the degree of employment suitability. All definitions of employability come down to an individual's (perceived) ability to obtain and maintain employment throughout their career [25]. This study defines employability as the "ability to be employed". Employability results from interactions that are related to employment, which are carried out comprehensively by the user's requirement condition and supplier's qualifications. Although the definition of employability has been discussed since 1990, various researchers or institutions have provided different definitions.

The human resources development concept dictionary of the Korean Society for Learning and Performance (KSLP) defines employability as the possibility of being employed. The KSLP defined and explained employability as follows [26]: "The possibility or potential to be employed through practice and development. As the personnel supplied by the market are more than those needed by a business or public institution, unemployment has become a social issue. Therefore, not only individuals but also those at a national level are interested in the potential employability of competent personnel. In addition, during 1980–1990, employability was transferred from a temporary worker to a regular worker under businesses' structural downsizing environment. Individual employability emerged as an important issue. Factors that increase an individual's employability include a personal qualification (including knowledge, skills, attitude), the ability to market the self, to express the self, and to utilize personal qualification suitably".

The Confederation of British Industry [27] defines employability as "A set of attributes, skills, and knowledge that all labor market participants should possess to ensure they can be effective in the workplace–to the benefit of themselves, their employer, and the wider economy." This definition entails several composite abilities, such as self-management, teamwork, the perception of the business and customer, problem-solving, communication, repair, and the ability to utilize IT.

Hillage and Pollard [28] defined employability as "having the competency to get the first job in life, the competency to preserve the job, and the competency to find a new job as needed." Individuals' assets, denoted by K (knowledge), S (skills), and A (attitudes), include the way individuals utilize these assets and how efficiently, how they express them to employers, and crucially the context for this in work for their employers to see. Hillage and Pollard defined employability as de facto equated with gaining and retaining fulfilling work.

Fugate et al. [29] added the new direction of "pro-active adaptability" to employability, including career identity, personal adaptability, and social and human capital. An asset can be classified as a "baseline asset" (essential personal attribute and fundamental skill of trust), "intermediate asset" (general or core skill including job-specific skills, communication, problem-solving ability, and core personal attributes of initiative and motivation), and "high-level asset" (skill to help support an organization's productivity such as teamwork, self-management, and commercial perception). Each asset's importance differs depending on the person or group according to their relationship with the labor market [30].

Although the literature presents various definitions of employability, the core concept is related to the capacity of individuals (including students) to obtain a job. Most explicit and implicit definitions constitute a part or many parts of core elaborate or cross concepts [31]. This concept incorporates a type of job, timing, recruitment attributes, further learning, and employment-related skills (sometimes specified as a critical skill). Even if an advanced education system accepts a measurement of employability, it is vital to evaluate its impact. Various factors can reasonably contribute to employability irrespective of the opportunities provided for learners in a university's curriculum. Harvey [30] presented nine factors such as the type of higher education institution, academic (learning) type (the problem considering part-time undergraduates), students' place and mobility, academic subject, former job experience, age, ethnic group, gender, and social class. Considering these factors, there is explicit contrary evidence for assuming employers' recruitment is rational. This study intends to use Harvey's definition of employability [30].

It is not easy to find a proxy variable to investigate the causality of a social phenomenon, such as the measurement of employability, because a job seeker's simple attributes do not determine employment. A job provider's requirements are determined organically according to multidimensional criteria under changing employment conditions according to the state of a period or economic environment.

Harvey [30] defined employability and presented its measurement. We have analyzed this concept, and our measurement of employability based on the outcome was developed and evaluated. Our study posits that the outcome approach leads to employability being understood as an institutional achievement rather than as an ability to achieve employment for each student. The operational definition presents the concept of employability–development opportunity's implicit "magic bullet".

A job seeker can either find a job (employment) after graduation or select a higher level of school or a practical institution's practice to acquire enhanced competency. Employability is attained as a development opportunity by a higher level of school, and employment after graduation is transferred to a complex process required by the demand side (employer). It is described as an alternative and more complex model; however, the model's application possibility is reversed by recruiters' irrational activities for graduates. This renders any employability indicator based on the proportion of graduates obtaining a job ineffective.

Even if job seekers have competitiveness in software engineering, they need further abilities relating to team tasks to maintain their competitiveness in the labor market. Tech-

nical communication is among those abilities because team tasks are experienced the most in the workplace. In practice, technical laborers are involved in discussion/communication at a proportion of approximately 30% and in conducting team tasks more than 50% of the time. If they have technical ability, then technical communication ability and leadership are the factors that distinguish them from others [32].

2.3. Previous Research Related to Employability

Marks and Huzzard [16] discussed the context and nature of employability in the Scottish ICT sector. They examined employees' experiences in four Scottish technology firms, explored the roles of both entry-level and on-the-job employability, and contrasted the employability requirements of employers with the employability needs of employees. They concluded that there was a considerable gap between policy-level rhetoric on employability and day-to-day work practices, as there was limited progress in technology and skills in the ICT sector [16]. Andrews and Higson analyzed the graduate and employer perspectives on graduate employability in four European countries (UK, Austria, Slovenia, and Romania) [31]. The Australian government's initiative to enhance graduate employability shed light on the relationships between university language programs, state policy, and local communities. In October 2020, the Australian Parliament passed legislation known as the Job-Ready Graduates Package, and one of the aims of the legislation was to produce "job-ready" graduates who met the needs of employers and the future workforce in response to the economic imperatives brought about by the COVID-19 pandemic [33].

Kim et al. [34] derived the result of future skill forecasting (study of national skills outlook) utilizing the job's fundamental ability (Table 1). This result was extracted using the Delphi survey and quantitative forecasting methods to predict the future. We can refer to the essential fundamental abilities required in the service industry from the research.

Table 1. Degree of the future importance of the manufacturing and service industry.

Category	Fundamental Job Ability	Degree of Future Importance	Category	Fundamental Job Ability	Degree of Future Importance
Manufacturing	Problem-solving	62.1	Service	Problem-solving	60.2
	Community ethics	59.7		Community ethics	57.2
	Technology (application)	58.0		Technology (application)	49.5
	Technology (understanding)	54.3		Technology (understanding)	48.5
	Teamwork	50.1		Teamwork	48.5

Source: Description from Kim et al. [34].

The common requisite generic abilities required in both manufacturing and service were presented as problem solving, community ethics, and teamwork. Specifically, the right people in the future labor market can be described as workers with ethical consciousness that are capable of problem solving based on collaboration. Owing to the demand for more such requisite skills in the future, a generic skill involving the capability to learn and cooperate, rather than a specific skill is preferred [27].

Harvey [30] explored an alternative approach based on an audit of employability development in the system and described a methodological risk. Harvey [30] stated that the employability audit is an indicator of the process and when/how this process can be improved rather than a simple output measurement. The audit process provided feedback regarding institutions in Wales, which promoted enhancements and provided an indicator for enhancement/improvement as a goal. It has a significance that an output measurement of the employment rate cannot bring about.

Employability evaluation needs to focus on internal improvement rather than ranking institutions (universities). A list of achievements of the employment rate does not provide

any guidelines for employment improvement. Benchmarking based on comparing institutions can mislead and be counterproductive. The evaluation of employability distinctly needs to focus on improvement. In addition, such an evaluation can be conducted with internal and longitudinal benchmarking by comparing and evaluating the results over time (employment of graduates) of input and process (an effort to develop employability opportunities) [35].

Zaharim et al.'s [11] study provided a background of employers' interests and focused on a potential engineer's employability when affected by a significant increase in unemployment among Malaysian engineering graduates. The study intended to answer the following questions: (1) What workplace skills and abilities are required? (2) How do the government and higher education overcome these requests? Zaharim et al. [11] investigated the engineering skills needed for new engineers in four countries: Malaysia, Japan, Singapore, and Hong Kong. Additionally, the study presented a list comprising requisite skills and compared similarities and differences. Zaharim et al. [11] concluded that engineering graduates should acquire and maintain generic skills such as communication, problem-solving, and interpersonal skills. The employers of the four countries agreed that excellent communication skills were more important than problem-solving abilities and interpersonal skills. The abovementioned skills are more critical than most hard skills. Moreover, IT, lifetime learning, and self-management skills were considered. Table 2 shows the skills required for a new engineer to be employed and successful in a job. In Hong Kong, possessing English and Chinese skills is considered essential; therefore, it differs from other countries. It can be comprehended as a phenomenon related to regional/economic characteristics of an intermediate/transit trade.

Table 2. Employability skill of engineering manpower ordered by employers in Malaysia, Japan, Singapore, and Hong Kong.

No.	Malaysia	Japan	Singapore	Hong Kong
1	Communication effectively	Communication skills	Workplace literacy and numeracy	Work attitude
2	Competent in application and practice	Problem-solving skills	Information communication technology	Interpersonal Skills
3	Interpersonal or team working skills	Goal-setting skills	Problem solving and Decision making	Analytical and problem-solving skills
4	Engineering problem-solving and decision-making skills	Personal presentation skills	Initiative and enterprise	English language proficiency
5	Apply knowledge of science and engineering principles	Visioning skills	Communication and relationship management	Numerical competency
6	Competent in a specific engineering discipline	IT and computer skills	Lifelong learning	Information technology literacy
7	Understand professional, social, and ethical responsibilities	Leadership skills	Global mindset	Management skills
8	Lifelong learning	Self-assessment skills	Self-management	Chinese language proficiency
9	Engineering system approach		Workplace-related life skills	
10	Knowledge of contemporary issues		Health and workplace safety	

Source: Re-composition based on Zaharim et al. [11].

Saad et al. [10] used a 13-item scale to measure engineering employability skills via a questionnaire. The study was based on a survey of employers, related to students of engineering and ICT in Malaysia. It explored employers' perceptions regarding requisite employability skills for technology-related students and the student's degree of satisfaction with their employability. Among the required skills for students, problem solving, ability to handle tools, and presentation skills were perceived as more essential for employees. The study presented the rank of importance or satisfaction given based on each item's average and standard deviation. Saad et al.'s [10] study provides a limited explanation because there needs to be a gap analysis of the degree of importance and satisfaction. In the next section, we present a further investigation, including a gap analysis after the comparison with the results of questionnaire research.

3. Empirical Analysis for Employees Related to ICT

3.1. Research Summary

Based on the previous literature's research results [10], this study sorted 12 items based on their degree of importance. One duplicate or vague thing ("having competency in theoretical and research engineering/ICT" and "the ability to acquire and apply knowledge of engineering/ICT fundamentals" are difficult to segregate, so the former was excluded from this study's survey) was excluded from Saad et al.'s [10] 13 items, and the selected items were complemented and demystified. Considering a modern organizational characteristic, that is, not only employers, but also organizational employees, participated in a job interview or affected recruiting in part for both ICT-related employers and employees were regarded as subjects of a questionnaire survey.

The survey consisted of ranking the items by importance after taking a sample of the people working for ICT-related organizations. Additionally, the degree of satisfaction of the subjects included similar questions to those regarding the degree of importance. For degree of satisfaction, ranking a priority about the degree of satisfaction/readiness for the applicants or people employed for the respondents' organizations was requested. The primary demographic information included gender, age, academic career, type of organization, work experience (length of service), position (rank) in an organization, and email address. The items of the degree of importance/satisfaction were classified with general and technical skills, and the two skills comprised six items separately.

Respondents to the survey were requested to rank the two degrees, of importance and satisfaction. We conducted a pre-test with 17 samples gathered from 23 to 29 November 2019. There were no insincere or unsuitable responses; therefore, the main test was executed, including the 17 samples. For the main test, samples from the employees of IT service businesses, R&D organizations, ICT-related SMBs, educational institutions, people of businesses participating in a focus group interview, and university-related employees were collected from 1 to 7 December 2019. A total of 34 samples were gathered. This study collected another set of 245 samples of the main test through a professional questionnaire survey institution to acquire various respondents' answers on 3 January 2020 before the COVID-19 pandemic in Korea. The primary test used a sample of 296 respondents and analysis to derive a valid result.

3.2. Measurement Tool and Research Method

After deriving the concept of employability and its measurement items drawn from the literature review, this study investigated the skills considered essential by organizational employees among ICT/engineering-related items (skills). Moreover, it explored the items that lead to the satisfaction of the applicants or employees of the respondents' organizations via a ranking system, aimed at understanding whether there is a gap regarding the degree of importance/satisfaction and whether there is a difference in subjects' responses based on business size (large businesses/SMBs) or gender. Finally, research analysis to quantitatively understand the causes of the ICT service industry's skills mismatching was conducted.

The questionnaire consisted of 31 items, including 12 on the degree of importance, 12 on the degree of satisfaction, and seven on demographic and basic information. An offline/email questionnaire was used for the pre-test measurements. The survey respondents were requested to rank answers based on degree of importance/satisfaction.

Table 3 shows the detailed items of the degree of importance/satisfaction. The items are categorized into general and technical skills, with six under each category. Concretely, the general skills are "communicate effectively," "interpersonal or team-working skills," "understand professional, social, and ethical responsibilities," "entrepreneurial skills," "lifelong learning," and "knowledge of contemporary issues." The technical skills are "competent in application and practice," "engineering problem-solving and decision-making skills," "apply knowledge of science and engineering principles," "competent in a specific engineering discipline," "engineering system approach," and "data/experiment ability."

Table 3. Questionnaire items of the degree of importance/satisfaction.

No.	Employability Skill	Description	Skill Category
1	Communicate effectively	The ability to present ideas confidently and effectively through aural, oral, and written modes, not only with engineers but also with the community at large	General skill
2	Competent in application and practice	The ability to use techniques, skills, and modern engineering/ICT tools	Technical skill
3	Interpersonal or team-working skills	The ability to function effectively as an individual and in a group with the capacity to be a leader or manager as well as an influential team member	General skill
4	Engineering problem-solving and decision-making skills	The ability to undertake problem identification, apply to problem-solving, and formulations and solutions	Technical skill
5	Understand professional, social, and ethical responsibilities	The ability to understand the social, cultural, global, and environmental responsibilities of a professional engineer, and commitment to professional and ethical responsibilities	General skill
6	Apply knowledge of science and engineering principles	The ability to acquire and apply knowledge of engineering fundamentals	Technical skill
7	Entrepreneurial skills	Having essential entrepreneurial leadership or skill in operating a business	General skill
8	Competent in a specific engineering discipline	The ability to acquire in-depth technical competence in a specific engineering discipline	Technical skill
9	Lifelong learning	The ability to recognize the need to undertake lifelong learning and possess/acquire the capacity to do so	General skill
10	Engineering system approach	The ability to utilize a systems approach to design and evaluate operational performance	Technical skill
11	Knowledge of contemporary issues	The ability to continue learning independently to acquire new knowledge, skills, and technologies. (currently, information, communication, and computing technologies are essential in the knowledge-based era.)	General skill
12	Data/experiment ability	The ability to design and conduct experiments as well as to analyze and interpret data	Technical skill

The questionnaire required each respondent to rank the items after considering a table separately for the degree of importance/satisfaction.

The general and technical skills can be questioned for each category; however, this method creates a bias regarding the respondent's opinion about items in terms of importance or satisfaction. Therefore, the items were presented to respondents by integrating with a whole table after randomization. The gathered data from the questionnaire were

organized with the Excel program, and statistical analysis was executed with the IBM SPSS Ver. 24.0 package [36].

4. Results

4.1. Demographic Attributes of Respondents

A sample of 296 respondents effectively answered from the first to the final item of the degree of importance and satisfaction. There were 180 more "male" samples (60.8%) than "female" samples. In terms of age, more subjects answered "Thirties" (119, 40.2%) than "Forties" (85, 28.7%). In terms of academic career, a majority of subjects answered "bachelor" (192, 64.9%). The subjects who answered "SMB" numbered 107 (36.1%), which is slightly more than those who replied "large business" of 95 (32.1%) in the employed organization. In work experience, 107 replied "below 5 years" (36.1%), and "more than 5 years~below 10 years" were 78 (26.4%). In terms of rank, 69 answered "deputy department head/department head" (23.3%), which is slightly more than each "assistant manager" at 50 (19.9%) and the "section chief (manager)" at 58 (19.6%). Work experience refers to the period a person has been employed in an organization; therefore, the lifelong work experience of subjects is generally longer. Table 4 presents the result of the primary demographic information.

4.2. Main Analysis Content

Spearman's rank correlation coefficient values were obtained for each pair for 12 items of the degree of importance and degree of satisfaction [37,38]. For example, a two-tailed test was executed to observe whether the values correlated with the response value of "interpersonal or team-working skills" for importance and the value of the same item in satisfaction. The values were measured with an ordinal scale; therefore, correlation analysis was analyzed with Spearman's rank correlation coefficient criteria for the 12 pairs [37,38]. Each coefficient value of the pair had a high correlation relationship statistically, considering the p-value criteria. Each pair of number 2 and number 10 had a correlation relationship under a 1% significance level ($p < 0.01$). The other 10 pairs had a very high correlation relationship, under a 0.1% significance level ($p < 0.001$). Table 5 presents the detailed analysis result of the correlation.

The degree of importance or satisfaction (construct) of the 12 items had a Cronbach alpha value over 0.9. A construct with Cronbach's α value of 0.700 or higher is reliable [37,39]. Therefore, internal consistent reliability was acquired. The correlation analysis results in Table 5 demonstrates the items' validity even if this study did not use the Likert scale.

Difference analyses between groups for the six demographic variables were conducted with an independent sample t-test (for gender) or ANOVA (for the other five variables), even if the respondent's values were measured via an ordinal scale [37]. ANOVA was carried out because each age group, academic career, employed organization, work experience, and rank (position) comprised over three groups. Each variable's difference analysis between groups was developed for degree of importance/satisfaction. The difference analyses were conducted because they had scope for interpretation on an interval scale and considered allocating an interval from the first to the twelfth rank [37,38].

First, the three items of "understand professional, social and ethical responsibilities" ($F = 1.859$, $t = 3.459$, $p < 0.01$), "apply knowledge of science and engineering principles" ($F = 2.350$, $t = -2.514$, $p < 0.05$), and "engineering system approach" ($F = 0.043$, $t = -2.181$, $p < 0.05$) in the degree of importance by gender showed a significant difference between the two groups. Meanwhile, the item of "engineering system approach" ($F = 0.128$, $t = -2.922$, $p < 0.01$) in the degree of satisfaction by gender showed a significant difference between the two groups. The "engineering system approach" item by gender, in particular, had a significant difference between the two groups in both the degree of importance and satisfaction.

Table 4. Primary demographic results.

Category		Frequency (Person)	Proportion (%)	Category		Frequency (Person)	Proportion (%)
Gender	Male	180	60.8	Work experience (Length of service)	Below 5 years	107	36.1
	Female	116	39.2		5 years~below 10 years	78	26.4
Age	The twenties	62	20.9		10 years~below 15 years	55	18.6
	The thirties	119	40.2		15 years~below 20 years	24	8.1
	The forties	85	28.7		20 years~below 25 years	18	6.1
	The fifties	28	9.5		25 years~below 30 years	9	3.0
	Sixties	2	0.7		30 years~below 35 years	2	0.7
Academic career	High school diploma	13	4.4		Non-response	3	1.0
	College diploma	19	6.4	Rank (Position)	Worker	46	15.5
	Bachelor	192	64.9		Assistant Manager	59	19.9
	Attending graduate school	9	3.0		Section Chief (Manager)	58	19.6
	Master/Doctor	63	21.3		Deputy Department head/Department head	69	23.3
Employed organization	Civilian research institute	14	4.7		Executive	9	3.0
	Large business	95	32.1		CEO	4	1.4
	SMB	107	36.1		Etc.	4	1.4
	Government agencies	39	13.2		Researcher	13	4.4
	Government-funded/ government-affiliated institute	41	13.9		Senior fellow	8	2.7
					Senior researcher	5	1.7
					Research commissioner	0	-
					Public servants	21	7.1

Table 5. Analysis result of co-relationship for the degree of importance/satisfaction of employability skill.

No.	Employability Skill	Correlation Coefficient (Spearman Value)	Significance Level (p-Value)	Correlation Relationship (Yes or No)
1	Communicate effectively	0.276	0.000 ***	Yes
2	Competent in application and practice	0.157	0.007 **	Yes
3	Interpersonal or team-working skills	0.353	0.000 ***	Yes
4	Engineering problem-solving and decision-making skills	0.260	0.000 ***	Yes
5	Understand professional, social, and ethical responsibilities	0.332	0.000 ***	Yes
6	Apply knowledge of science and engineering principles	0.279	0.000 ***	Yes
7	Entrepreneurial skills	0.577	0.000 ***	Yes
8	Competent in a specific engineering discipline	0.221	0.000 ***	Yes
9	Lifelong learning	0.394	0.000 ***	Yes
10	Engineering system approach	0.184	0.001 **	Yes
11	Knowledge of contemporary issues	0.228	0.000 ***	Yes
12	Data/experiment ability	0.212	0.000 ***	Yes

** $p < 0.01$, *** $p < 0.001$.

The items in the degree of importance of age did not show a significant difference between the two groups ($p > 0.05$). "Data/experiment ability" (F = 3.762, $p < 0.01$) in the degree of satisfaction of age showed a significant difference between the two groups. According to Bonferroni post hoc analysis, there was a significant difference ($p < 0.05$) in the item between subjects in their 20 s and 30 s and 20 s and 40 s [37].

Items for the degree of importance in the academic career did not show a significant difference between the two groups ($p > 0.05$). "Interpersonal or team-working skills" among the items of the degree of satisfaction in the academic career showed a significant difference (F = 2.562, $p < 0.05$). Bonferroni posthoc analysis indicated a significant difference (t = 2.338, $p < 0.05$) in items between the college diploma group and the master's/doctorate group [37]. In addition, "competent in specific engineering discipline" among the categories for the degree of satisfaction in the academic career showed a significant difference (F = 2.793, $p < 0.05$). Bonferroni post hoc analysis showed a significant difference (t = 1.198, $p < 0.05$) in the item between the bachelor's group and the master's/doctorate group [37].

Furthermore, ANOVA was conducted regarding the degree of importance/satisfaction based on the employing organization, work experience, and rank (position). However, none of the items indicated a significant difference statistically between these two groups ($p > 0.05$).

We can see the respondents' average and standard deviation for the degree of importance/satisfaction regarding 12 items of employability in Tables 6 and 7. It is possible to identify the rank via the mean (average) values because the class presents the mean of an interval scale. When the average is less, a higher rank can be seen.

Table 6. The perception result of the degree of importance regarding employability skills (n = 296).

No.	Employability Skill	Mean	Standard Deviation (SD)	Rank
1	Communicate effectively	5.32	3.183	**2**
2	Competent in application and practice	5.65	3.228	**3**
3	Interpersonal or team-working skills	4.83	3.338	**1**
4	Engineering problem-solving and decision-making skills	5.94	3.101	6
5	Understand professional, social, and ethical responsibilities	6.39	3.588	7
6	Apply knowledge of science and engineering principles	6.97	3.196	8
7	Entrepreneurial skills	8.64	3.342	12
8	Competent in a specific engineering discipline	7.09	3.298	9
9	Lifelong learning	8.21	3.382	11
10	Engineering system approach	7.32	2.954	10
11	Knowledge of contemporary issues	5.84	3.364	**5**
12	Data/experiment ability	5.79	3.252	**4**

The higher ranks from first to fifth were expressed with bold values.

Table 7. The perception result of the degree of satisfaction regarding employability skill (n = 296).

No.	Employability Skill	Mean	Standard Deviation (SD)	Rank
1	Communicate effectively	5.17	3.309	**2**
2	Competent in application and practice	5.85	3.269	**3**
3	Interpersonal or team-working skills	5.06	3.381	**1**
4	Engineering problem-solving and decision-making skills	6.10	3.240	**5**
5	Understand professional, social, and ethical responsibilities	6.43	3.501	8
6	Apply knowledge of science and engineering principles	6.43	3.157	7
7	Entrepreneurial skills	8.94	3.275	12
8	Competent in a specific engineering discipline	6.79	3.273	9
9	Lifelong learning	7.97	3.404	11
10	Engineering system approach	6.92	3.178	10
11	Knowledge of contemporary issues	6.31	3.179	6
12	Data/experiment ability	6.06	3.340	**4**

The higher ranks from first to fifth were expressed with bold values.

The five highest-ranked items when evaluating the degree of importance were "interpersonal or team-working skills, communicate effectively, competent in application and practice, data/experiment ability, and knowledge of contemporary issues". The five highest-ranked items when evaluating the degree of satisfaction include "interpersonal or team-working skills, communicate effectively, competent in application and practice, data/experiment ability, and engineering problem-solving and decision-making skills".

The top four items were the same in the degree of importance/satisfaction. The fifth highest, "knowledge of contemporary issues," went down to the sixth rank of the degree of importance in evaluating the degree of satisfaction. By contrast, when assessing the degree

of satisfaction, "engineering problem-solving and decision-making skills" was ranked fifth. However, it was sixth in degree of importance; therefore, there was a slight gap.

The first and second highest ranked items in the evaluation of the degree of importance/satisfaction, namely, "interpersonal or team-working skills" and "communication effectively," are general skills, and the third and fourth items, namely, "competent in application and practice" and "data/experiment ability", are technical skills. This result is related to previous research which indicates that a general skill is a requisite skill in the future rather than a specific skill [34].

The fifth highest item in terms of degree of importance, "knowledge of contemporary issues", is a general skill, and the fifth-ranked category in the degree of satisfaction, "engineering problem-solving and decision-making skills", is a technical skill. In the meantime, the top six ranks in the degree of importance/satisfaction are occupied by three general skills and three technical skills. The seventh through ninth ranks among the lower levels of the seventh through twelfth ranks includes two technical skills and one general skill. This mainly has the characteristic of having the opposite result in the seventh rank and eighth rank when evaluating the degree of importance/satisfaction. Among the remnants of the tenth through twelfth ranks, including two general skills and one technical skill, a characteristic has the same levels as the items in evaluating the degree of importance/satisfaction. The analysis result of perception gaps by employees regarding the degree of importance/satisfaction for employability skills is described in Table 8.

Table 8. The comparison of perception gaps regarding the degree of importance/satisfaction for employability skills.

No.	Employability Skill	Importance Rank	Satisfaction Rank	Rank Gap
1	Communicate effectively	2	2	0
2	Competent in application and practice	3	3	0
3	Interpersonal or team-working skills	1	1	0
4	Engineering problem-solving and decision-making skills	6	5	**1**
5	Understand professional, social, and ethical responsibilities	7	8	**−1**
6	Apply knowledge of science and engineering principles	8	7	**1**
7	Entrepreneurial skills	12	12	0
8	Competent in a specific engineering discipline	9	9	0
9	Lifelong learning	11	11	0
10	Engineering system approach	10	10	0
11	Knowledge of contemporary issues	5	6	**−1**
12	Data/experiment ability	4	4	0

The rank gap having over 1 or −1 was expressed with a bold value.

The eight items of the degree of importance/satisfaction have no gap, but four items with a gap are "engineering problem-solving and decision-making skills," "understand professional, social and ethical responsibilities," "apply knowledge of science and engineering principles," and "knowledge of contemporary issues." However, these four items' gaps are negligible (±1).

Saad et al.'s study [10] did not present a gap analysis. We conducted an additional gap analysis based on their result. Therefore, the items with higher ranks in the degree of satisfaction compared to those of the degree of importance are "lifelong learning," "knowledge of contemporary issues," "understand professional, social and ethical responsibilities," and "interpersonal or team-working skills." In contrast, the items with lower ranks in the

degree of satisfaction compared to those of the degree of importance are "competent in application and practice," "data/experiment ability," "engineering problem-solving and decision-making skills," and "communicate effectively". Among the 13 items of Saad et al.'s study [10], the items showed a rank gap of 12, and most had a large gap. In particular, the items with lower ranks in the degree of satisfaction compared to those for the degree of importance included three technical skills and one general skill. The findings indicate that the labor supply side (e.g., universities and professional educational institutes) needs to consider these items in their curricula.

Conversely, this study targeting Korean respondents had only 4 items with a gap among 12 items. However, each gap between the degree of importance/satisfaction was negligible (± 1); therefore, the rank gaps of items evaluating the degree of importance/satisfaction of employability compared to the four countries [10] were not large.

This study's first through fourth ranks and those of Saad et al.'s study [10] are similar. However, it shows a noticeable rank gap in that Koran ICT-related employees set a high value on general skills (the first and second ranks, which were "interpersonal or team-working skills" and "communicate effectively", respectively, in this study) above technical skills (the first and second ranks of "engineering problem-solving and decision-making skills and competent in application and practice" in Saad et al.'s study [10]). Moreover, there is another difference. Namely, the highest 3 items of Saad et al.'s study [10] in the rank of the degree of importance without the second rank of "interpersonal or team-working skills" went down below the fifth rank in the degree of satisfaction. This result differed in that the first through fourth ranks of the degree of importance were maintained as the same ranks of the degree of satisfaction in the Korean samples.

This study analyzed whether there is an employee perception difference between large businesses and SMBs in the degree of importance/satisfaction of employability. Table 9 presents the detailed ranks.

Both large business samples (10 items with a gap) and SMB samples (6 items with a gap) had many items that expressed a gap in rank between the degree of importance and satisfaction compared to the total samples' analysis (4 items with a gap). Specifically, the large business samples expressed rank differences in 10 of 12 items. The items "Apply knowledge of science and engineering principles" and "data/experiment ability" had a three-point gap between degree of importance and satisfaction. The item "Apply knowledge of science and engineering principles" had a low rank, being tenth in order of degree of importance; however, large businesses were relatively satisfied, placing seventh in the order of degree of satisfaction. However, "data/experiment ability" showed a high rank, being third in the order of degree of importance but ranked sixth in degree of satisfaction. Therefore, large businesses' satisfaction level was low for the personnel employed or to be employed. This suggests the need to review the issues regarding the result of labor provision. The "knowledge of contemporary issues" item had a slightly higher degree of satisfaction (having a two-point gap) than degree of importance.

In the case of SMB samples, the "competent in specific engineering discipline" item was ranked as being of low importance (ninth rank). Still, it showed a relatively high rank in terms of satisfaction (sixth rank). "Understand professional, social and ethical responsibilities" and "knowledge of contemporary issues" items showed lower satisfaction levels than degree of importance (with a two-point gap). It also needs to look over education-related curricula regarding labor provision.

In addition, "competent in application and practice" ranked second in degree of importance in SMBs but sixth in large businesses. Thus, there was a large difference. In the degree of satisfaction, SMBs ranked third, but the large businesses represented the fifth rank; therefore, there was also a difference. Large businesses perceived it as less important compared to SMBs for employees to have "the ability to use techniques, skills and modern engineering/ICT tools" of this item's definition (explanation). Compared to SMBs, large businesses are well-equipped systemically for this kind of competence education; therefore,

it is possible to strengthen competence in large enterprises by retraining employees and applying other methods.

Table 9. The comparison of perception differences by employees of large businesses and SMBs for the degree of importance/satisfaction of employability skills.

No.	Employability Skill	Large Business			SMB		
		Importance Rank	Satisfaction Rank	Rank Gap	Importance Rank	Satisfaction Rank	Rank Gap
1	Communicate effectively	2	1	**1**	3	2	**1**
2	Competent in application and practice	6	5	**1**	2	3	**−1**
3	Interpersonal or team-working skills	1	2	**−1**	1	1	0
4	Engineering problem-solving and decision-making skills	4	3	**1**	5	5	0
5	Understand professional, social, and ethical responsibilities	7	8	**−1**	7	9	**−2**
6	Apply knowledge of science and engineering principles	10	7	**3**	8	7	**1**
7	Entrepreneurial skills	12	12	0	12	12	0
8	Competent in a specific engineering discipline	9	10	**−1**	9	6	**3**
9	Lifelong learning	11	11	0	11	11	0
10	Engineering system approach	8	9	**−1**	10	10	0
11	Knowledge of contemporary issues	5	3	**2**	6	8	**−2**
12	Data/experiment ability	3	6	**−3**	4	4	0

The rank gap having over 1 or −1 was expressed with a bold value.

This study comparatively analyzed employees' perceptions between males and females in the degree of importance/satisfaction of employability in the survey. Table 10 presents the detailed ranks.

Both female subjects (nine items with a gap) and male subjects (six items with a gap) had many items expressing a gap in rank between degree of importance and satisfaction compared to the total samples' analysis (four items with a gap). In the female samples, the "understand professional, social, and ethical responsibilities" item had a four-point gap between the degree of importance and satisfaction. This item was ranked fourth in degree of importance by females; however, they rated it relatively low, in eighth place, for degree of satisfaction. The item has a three-point gap between the female and male subjects. However, males ranked the item lower, in ninth place, for the degree of importance but in the sixth for degree of satisfaction. Therefore, an education/practice program on the

supply side of labor is required to improve satisfaction levels from the demand side of labor (female) for this item.

Table 10. The comparison of perception differences by both male and female employees for the degree of importance/satisfaction of employability skills.

No.	Employability Skill	Male			Female		
		Importance Rank	Satisfaction Rank	Rank Gap	Importance Rank	Satisfaction Rank	Rank Gap
1	Communicate effectively	2	2	0	2	1	**1**
2	Competent in application and practice	4	3	**1**	6	3	**3**
3	Interpersonal or team-working skills	1	1	0	1	2	**−1**
4	Engineering problem-solving and decision-making skills	3	4	**−1**	7	6	**1**
5	Understand professional, social, and ethical responsibilities	9	6	**3**	4	8	**−4**
6	Apply knowledge of science and engineering principles	7	7	0	9	7	**2**
7	Entrepreneurial skills	12	12	0	12	12	0
8	Competent in a specific engineering discipline	8	10	**−2**	8	9	**−1**
9	Lifelong learning	11	11	0	11	11	0
10	Engineering system approach	10	8	**2**	10	10	0
11	Knowledge of contemporary issues	6	9	**−3**	5	4	**1**
12	Data/experiment ability	5	5	0	3	5	**−2**

The rank gap having over 1 or −1 was expressed with a bold value.

In the female samples, there was a rank gap of three points in the satisfaction level of the third rank compared to the sixth in the importance of the "competent in application and practice" item. The "Apply knowledge of science and engineering principles" and "data/experiment ability" items showed a rank gap of two points. The "Apply knowledge of science and engineering principles" item showed a low degree of importance but presented a higher satisfaction level, where it was place seventh.

However, "data/experiment ability" occupied the third rank in degree of importance but the fifth rank in satisfaction. This result indicated that businesses' satisfaction level was low for this item. The competency enhancement of the workforce for this item was required because the ability to analyze and interpret data in the big data era was considered essential. It signifies the need to examine this point on the labor supply side (university or

professional education institute). It needs to exert further education competency for the item with a low satisfaction level.

In addition, the "knowledge of contemporary issues" item showed a slightly higher satisfaction level than the importance level (gap = 2). The item with a high satisfaction level is needed to maintain a relatively persistent education level.

Among the male samples, the "knowledge of contemporary issues" item showed a slightly high importance level (sixth rank), but the satisfaction level was low (ninth rank). This result presents a high difference from the female samples. The "Engineering system approach" showed the two points gap and had a relatively higher satisfaction level (eighth rank) than the importance (tenth rank).

Furthermore, the "engineering problem-solving and decision-making skills" item occupied the third rank in the degree of importance in the case of the male subjects but the seventh rank in the female subjects; thus, they were different from this item. It appears that the female subjects perceived this as a less critical item relative to "the ability to undertake problem identification, apply problem-solving, formulations and solutions" of this item's definition (description) (Table 3). The "Competent in application and practice' item occupied the fourth rank in the degree of importance in the case of the male subjects but the sixth rank according to the female subjects; therefore, they were different from this item. In the degree of satisfaction, the "engineering problem-solving and decision-making skills" item occupied the fourth rank in the case of the male sample. Still, it showed the sixth rank in the female sample, indicating a difference.

Additionally, the "knowledge of contemporary issues" item (gap = −3) and the "competent in specific engineering discipline" item (gap = −2) in the male subjects showed a low satisfaction level compared to the importance level. The "data/experiment ability" item in the female subjects presented a low satisfaction level rather than the degree of importance (gap = −2).

5. Discussion

This study was conducted with a balanced sample of 296 respondents of large business and SMB employees. An analysis of the degree of importance/satisfaction was implemented empirically, and difference analyses between/among groups through demographic variables were conducted. Therefore, this study has research significance, considering that previous analyses were performed with items (indicators) for the degree of importance/satisfaction under insufficient empirical analysis except for descriptive analysis.

This study discusses employability in the ICT-related workforce under the gridlock of high-quality jobs during the last decade. Employability is a composite process of matching individual personality and the labor demand side's requirements. Concretely, it is the process of matching various factors, including unique personality, task appropriateness, the propriety of holding technology, and so forth [27–29].

Labor shortages, such as the aging population, can be addressed by applying technology and improving women's participation in the labor force. By adopting technological change, new economies require more women's skills and employability. The World Economic Forum's 2023 report highlighted that most companies would prioritize women (79%) [40].

It heeded the previous research (e.g., [10,11]) regarding a difference in understanding between the items considered important by organizations for ICT-related human resources and satisfaction items by organizations during the employment process or after employment. The depth of knowledge acquired via an empirical analysis could be explored, considering that the gap cause of perception/rank for the items comprising the degree of importance/satisfaction might partly cause job mismatching.

The analysis result of this study was similar to the results of Malaysian target research [10] or an Asian-zone target study [11] but exhibited differences in the details of its contents. The difference between this study of Korean-based respondents from the above comparison items and Asian target-based research implies the need for a priority

arrangement of curriculum composition and an additional setup or expansion of disciplines enhancing general communication skills and teamwork skills in universities or education/practice institutions in the future [11]. This study has a few rank differences (gaps) between the degree of importance and satisfaction compared to the previous research [10,11]. Superficially, education was seen as a priority for a supply of suitable quality staffing to be obtained. However, it needs persistent interest regarding the phenomenon and lasting response in education because of the differences in items according to gender or situations of SMBs/large businesses which came to light.

This research conducted a cross-sectional analysis of the specific time base for employability. It has the limitation of having relative differences in the analysis results when considering the flow of employment, which fluctuates according to the time elapsed or a fast-changing technology.

6. Conclusions

Differences in perception regarding the items comprising the degree of importance and satisfaction related to employability might be the reason behind job mismatch. Considering the research results, job mismatching problems can be addressed according to the mismatched skills in the ICT service sector's perspective. The general skills are the two items, "interpersonal or team-working skill" and "communicate effectively," having the highest rank in the degree of importance/satisfaction. Therefore, it asserts an important influence on the curriculum and consideration of the item in the labor supply (education) side. Technology does not replace human personalities, such as human team-working and communication skills, and human attributes, such as human cooperation. It induces an improvement in strengthening social characteristics in the education system and enhances individual competency.

This study has managerial contributions: (1) the point of conducting a comparison analysis of Asian countries or other countries' research results with items used in the degree of importance/satisfaction, and (2) presenting a consideration factor of labor demand and supply in a multinational business of ICT personnel. This study's results could aid in job searching in Asian countries and enhance employability in multinational businesses.

In the future, it could become the basis of further analysis to consider the evaluation result for the degree of importance/satisfaction of employability. The analysis could actually improve job mismatching problems or find a referable item in the educational sector. In the future, if research of a longitudinal study including a during/post-COVID-19 period is conducted, it might derive a rich comparison analysis result or a policy suggestion.

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