

ICT-Associated Engineering Discipline Preferences of Filipinos with Emphasis on Gender and Socio-Economic Factors

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Analyses of studies and surveys reveals prevalent patterns in the selection of engineering discipline intended to be pursued by Filipino students. Given that preference is subjective in nature, appropriate studies, tools, and methodologies were utilized in order to quantify the results. This paper also featured several factors supporting the results of preferences of the respondents. Specifically, preferences of male respondents are civil engineering (CE), mechanical engineering (ME), and electrical engineering (EE). These three disciplines significantly have male to female ratio both relative and absolute numbers. On the other hand, engineering disciplines like electronics engineering (ECE), and computer engineering (CPE) have nearly balanced male to female ratio although the number of males still dominates the number of females. Moreover, there are some areas where responses of females are greater than males and they prefer either chemical engineering (ChE) or industrial engineering (IE) but this is relative rather than absolute number. The instrument of evaluation was tailor fit in the manner that it would fulfill the Harmonized Gender and Development Agenda (HGDG). The HGDG has provisions of obtaining five percent (5%) of funds of each government office whether it belongs to Local Government Unit (LGU), National Government Agency (NGA), or State Universities and Colleges (SUCs). Furthermore, this paper revealed reasons why such results occur more than the conventional stereotypes that engineering profession is dominated by males.

Keywords: ASEAN, Gender and Development, engineering, information and communications technology (ICT).

INTRODUCTION

The engineering profession is one of the most dignified professions in the whole world. Considering the intricacies and challenges, people still pursue engineering careers. This paper exhibited aspects of the variance in gender representation across different engineering specializations in which such preferences of specific engineering disciplines have an association with gender. While the scope of this paper was in the Philippines, engineering itself is a profession involving universal science i.e. application of first principles of science. Being an applied universal science, principles and theories involved therein is unaffected by

socio-cultural norms of every country. However, this paper focused on how respondents answered the instrument of evaluation and came to conclusions. To set the scope and limitation of this study, Table 1 indicates engineering disciplines in the Philippines together with its Accredited Integrated Professional Organizations (AIPOs).

Data came from the Philippine Technological Council (PTC), the umbrella organization of various engineering AIPOs in the Philippines. PTC is also the country register of the Philippines mobilizing Filipino ASEAN and APEC engineers. The former is for Association of Southeast Asian Nations while the latter stands for Asia-Pacific Economic Cooperation in which the Philippines (officially, Republic of the Philippines) is a member since 1967 and 1989 respectively. Being conferred either an ASEAN engineer or APEC engineer in the Philippines is considered an Advanced Level Engineer (ALE) and permits the conferee to practice in respective member countries or economies (in the case of APEC).

Table 1 Engineering Disciplines in the Philippines ^{[1][2]}

Engineering Disciplines	Name of AIPO
Electronics Engineering (ECE)	Institute of Electronics Engineers of the Philippines (IECEP)
Geodetic Engineering (GE)	Geodetic Engineers of the Philippines (GEP)
Mechanical Engineer (ME)	Philippine Society of Mechanical Engineers (PSME)
Metallurgical Engineer	Society of Metallurgical Engineers of the Philippines (SMEP)
Mining Engineer	Philippine Society of Mining Engineers (PSEM)
Naval Architect / Marine Engineer	Society of Naval Architects and Marine Engineers (SONAME)
Sanitary Engineer	Philippine Society of Sanitary Engineers (PSSE)
Industrial Engineer (IE)	Philippine Institute of Industrial Engineers (PIIE)
Aeronautical Engineer	Society of Aerospace Engineers of the Philippines
Agricultural Engineer	Philippine Society of Agricultural Engineers (PSAE)
Civil Engineer (CE)	Philippine Institute of Civil Engineers (PICE)
Chemical Engineer (ChE)	Philippine Institute of Chemical Engineers (PICHE)
Electrical Engineer (EE)	Institute of Integrated Electrical Engineers (IIEE)

Reiterating Table 1, industrial engineering (IE) is included in the list of engineering disciplines under the Philippine Technological Council (PTC), but not regulated by the Philippine Government. IE has its own Philippine Institute of Industrial Engineers (PIIE) that gives certification examinations such as Certified Industrial Engineer (CIE) and Professional Industrial Engineer (PIE). The following are engineering disciplines in the Philippines regulated by the government through its respective Statutes (Republic Acts).

Table 2 Engineering Disciplines Together With Its Respective Statutes

Engineering Disciplines	Statute
Electronics Engineering (ECE)	Republic Act No. 9292
Geodetic Engineering (GE)	Republic Act No. 8560
Mechanical Engineer (ME)	Republic Act No. 8495
Metallurgical Engineer	Republic Act No. 10688
Mining Engineer	Republic Act No. 4274 as amended by Republic Act. No. 5677
Naval Architect / Marine Engineer (Marine Engineering is included in the Naval Architecture)	Republic Act No. 4565
Sanitary Engineer	Republic Act No. 1364
Aeronautical Engineer	Presidential Decree No. 1570
Agricultural Engineer	Republic Act No. 10915

Civil Engineer (CE)	Republic Act No. 544 as amended by Republic Act No. 1582
Chemical Engineer (ChE)	Republic Act No. 9297
Electrical Engineer (EE)	Republic Act No. 7920

Referring to Table 2, only the Electronics Engineering (ECE) profession has the legal basis to practice Information and Communications Technology (ICT). This was based from its statute, Republic Act No. 9292 and its section 5 states:

“The scope and nature of practice of Electronics Engineer shall embrace and consist of any work or activity relating to the application of engineering sciences and/or principles to the investigation, analysis, synthesis, planning, design, specification, research and development, provision, procurement, marketing and sales, manufacture and production, construction and installation, tests/measurements/control, operation, repair, servicing, technical support and maintenance of electronic components, devices, products, apparatus, instruments, equipment, systems, networks, operations and processes in the fields of electronics, including communications and/or telecommunications, information and communications technology (ICT), computers and their networking and hardware/firmware/software development and applications, broadcast/broadcasting, cable and wireless television, consumer and industrial electronics, electro-optics/photonics/opto-electronics, electro-magnetics, avionics, aerospace, navigational and military applications, medical electronics, robotics, cybernetics, biometrics and all other related and convergent fields; it also includes the administration, management, supervision and regulatory aspects of such works and activities; similarly included are those teaching and training activities which develop the ability to use electronic engineering fundamentals and related advanced knowledge in electronics engineering, including lecturing and teaching of technical and professional subjects given in the electronics engineering and electronics technician curriculum, and licensure examinations.”

Even the statute named Republic Act No. 10844 (RA 10844) known as “DICT Law of 2015” did not even mention the scope of practice of ICT. RA 10844 is concerned with the structure of the agency itself DICT or “Department of Information and Communications Technology” than delineating scope of practice of ICT. RA 10844 indeed validated RA 9292 because of its provision that at least one of the Assistant Secretaries of DICT shall be a licensed Professional Electronics Engineer (PECE) ^[3]. PECE is an Advanced Level Engineer of ECE that requires minimum of seven (7) years of practice as ECE ^[4].

Table 3 Comparisons of RA 5734 and RA 9292

	RA 5734	RA 9292
Name of Profession	Electronics and Communications Engineering (ECE)	Electronics Engineering (ECE)
Categories of Practice	One (Electronics and Communications Engineer or ECE)	Three (Professional Electronics Engineer or PECE, Electronics Engineer or ECE, and Electronics Technician or ECT)
Board Exam Scope (for ECE)	Mathematics, Electronics Engineering, and Communications Engineering	Mathematics, General Engineering and Applied Sciences, Electronics Engineering, Electronics Systems Technologies
Effectivity	Repealed by RA 9292	Still in effect

The Electronics Engineering (ECE) is different from Electrical Engineering (EE) under the Professional Regulation Commission (PRC) while both professions are recognized by the Philippine Technological Council (PTC) and accepted both in ASEAN and APEC Engineer Register ^[5]. On the other hand, there are still engineering programs neither included in the list of Professional Regulation Commission (PRC) nor Philippine Technological Council (PTC). These include the following but not limited to: computer engineering, manufacturing engineering, and mechatronics engineering. However, enrollment population of these disciplines are considered low relative to other engineering disciplines as manifested by government report as well as survey from the respondents.

Methods

Appropriate survey procedure was conducted especially in consideration of Data Privacy Law popularly known as Republic Act No. 10173 (RA 10173). The data privacy agreement was written both in English and Filipino (the National Language of the Philippines). The survey ran from August 2022 to August 2023. Online survey was preferred due to covid-19 risks. The pandemic emergency was only lifted on July 2023.

Data Privacy Agreement

“By responding YES, I give consent to collect my information pursuant to RA 10173 or the Data Privacy Act of 2012 (Sa aking pagsagot ng OO, aking pinapahintulutan na kalapin ang aking mga impormasyon alinsunod sa RA 10173 o Data Privacy Act of 2012)”

Residence

There are seventeen regions in the Philippines where respondents will have to answer. The residence refers to “permanent residence”

Selection of Preferred Engineering Discipline

Respondents had to select only one engineering discipline. If their preference is not included in the choices, they may choose “others” and let them manually input the engineering discipline they want. If they choose ECE, they will be looped to manual entering answer why they chose ECE and will be asked “Sex Designated at Birth” whether Female or Male. If they did not choose ECE, they will proceed in further questions (Section D onwards)

Preference Questions

- D.1 Rate the factor with 5 being the highest (Strongly AGREE) down to 1 being the lowest (Strongly DISAGREE) : The discipline I chose is the engineering major I really INTENDED to enroll
- D.2 Rate the factor with 5 being the highest (Strongly AGREE) down to 1 being the lowest (Strongly DISAGREE) : The discipline I chose has VAST OPPORTUNITIES IN MARKET/COMPANIES/INDUSTRY
- D.3 Rate the factor with 5 being the highest (Strongly AGREE) down to 1 being the lowest (Strongly DISAGREE) : THIS IS THE ONLY DISCIPLINE/MAJOR I KNOW VERY WELL since I applied in College/University
- D.4 Rate the factor with 5 being the highest (Strongly AGREE) down to 1 being the lowest (Strongly DISAGREE) : The school offering the engineering discipline/major

I pursue is within my locality and/or less than 50 km from my residence (THE SCHOOL IS NEAR TO YOUR HOUSE)

- D.4 Rate the factor with 5 being the highest (Strongly AGREE) down to 1 being the lowest (Strongly DISAGREE) : The engineering discipline/major I chose is the only course campaigned/advertised during our High School
- D5 I am aware/familiar of Electronics Engineering (ECE) profession (Answer whether YES or NO)
- D.6 Rate the factor with 5 being the highest (Strongly AGREE) down to 1 being the lowest (Strongly DISAGREE): "Engineering is an equal opportunity profession. It does not discriminate against identity such as but not limited to: religion, sex, and gender identity, ”
- D.7 Sex designated at birth (Female / Male only)
- D.8 Rate the factor with 5 being the highest (Strongly AGREE) down to 1 being the lowest (Strongly DISAGREE) : Field works in general (regardless of engineering disciplines), are disadvantageous to female engineers as lodging (hotel expenses) might be considered as additional expenses to the company as compared with male counterparts which can even sleep over inside the service vehicle and/or transport terminals (A financial issue of companies)
- D.9 Rate the factor with 5 being the highest (Strongly AGREE) down to 1 being the lowest (Strongly DISAGREE) : Office works / laboratory works are equal opportunity for male and female engineers
- D.10 Are you willing to shift to Electronics Engineering (ECE) program should time and circumstances permit? (e.g. shifting, taking ECE as new course after graduation).

The hypothesis in this paper was female respondents would likely to choose engineering disciplines which involves less field works due to socio-economic as well as “gender stereotype reasons”. While gender stereotype issues were subjective, this paper quantified in order to analyze and later address gender equality in engineering profession.

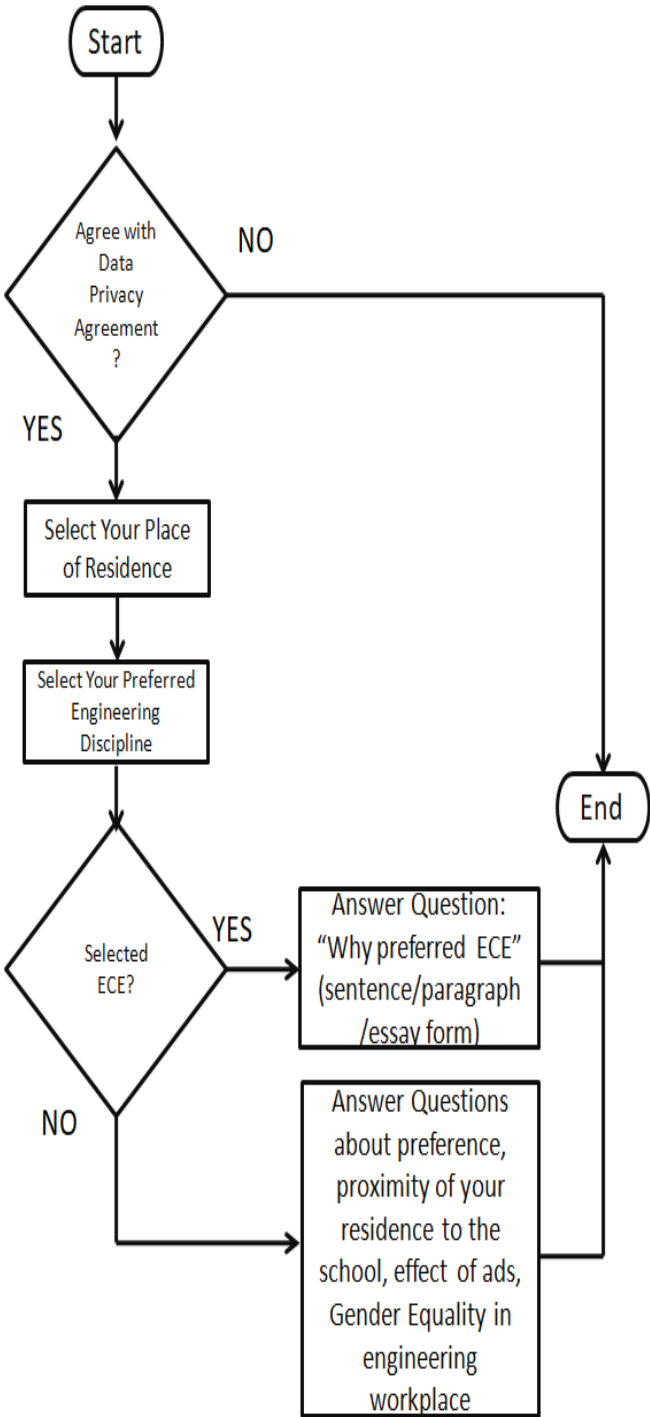


Figure 1 Flowchart of the Instrument of Evaluation

Discussions

There were five hundred fifty-seven (557) respondents in which four hundred forty-seven (474) preferred disciplines other than ECE (only eighty three respondents preferred). Those 474 respondents have a significant representation in this paper as they will respond based on the factors of intention, demand in the industry, proximity in residence, affected by advertisement, and gender stereotypes. Those 83 respondents have clustered common responses such as higher salary when pursued ICT careers, less field work preference of male over female counterpart, and lesser people who take ECE.

Figure 2 indicates that Region IV-A has the highest number of respondents (and also has the region with the largest population), followed by the National Capital Region (NCR) and Region III. These results resemble the Philippine population distribution ^{[7][8]}.

Figure 3 indicates the engineering discipline preferences of respondents with civil engineering (CE) as the most preferred comprising 33.4% of respondents. CE is popular in the Philippines and promising due to “Build, Build, Build” slogan by the government, depicting many project opportunities.

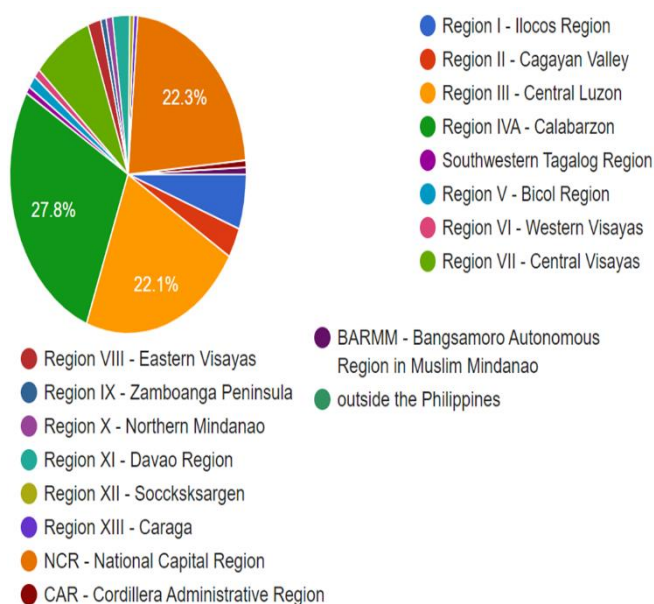


Figure 2 Regional Distributions of Respondents

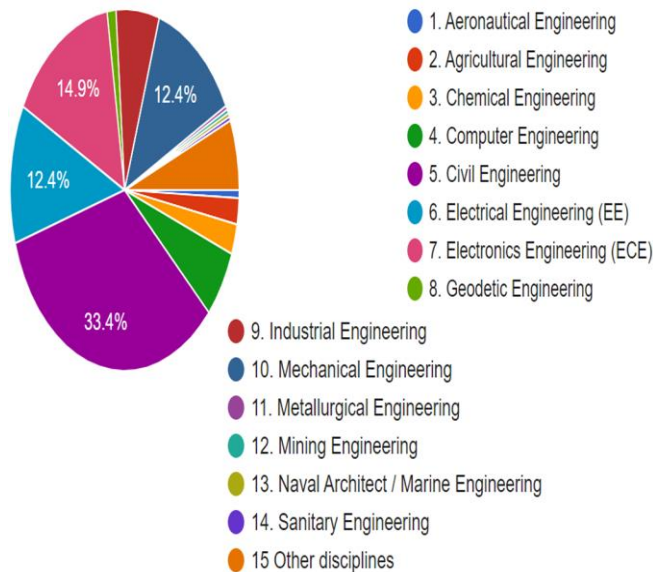


Figure 3 Engineering Discipline Preferences of Respondents

Despite of the popularity of CE however, it is one of the engineering disciplines with low female to male ratio. The survey revealed that there were 50 females and 130 males preferred CE (female to male ratio approximately 0.38). Reiterating the popularity and opportunities of CE career, this has challenges in addressing equal opportunities for women. The gender gap is much wider in ME discipline because there were only 10 females and 59 males preferred ME (female to male ratio approximately 0.17).

On the other hand, ECE have 38 females and 45 males responded (female to male ratio approximately 0.84). It was noted that ECE comprised of 14.9% of the respondents. By inferences, CE and ME and even EE has low female-to-male ratio while ECE has nearly 1 (gender balanced). This paper presented the preference of respondents and determined factors affecting their preference in their respective chosen disciplines.

Summarizing responses from the survey, Question 1 (Q1) asked whether respondents really intended the engineering discipline of their choice without any external influences,. Question 2 (Q2) asked whether respondents selected their choices as dictated by economic demands. Question 3 (Q3) asked whether respondents their choice is the only discipline they know (prevalent to those who selected CE as their preferred discipline). Question 4 (Q4) asked whether they chose their preference because of the proximity of the school to their residence. Question 5 (Q5) asked whether they chose their preference because it was advertised during their high school. Question 6 (Q6) asked whether engineering is an equal opportunity career and does neither discriminate nor favor specific gender. Question 7 (Q7) asked whether field works scenarios are disadvantageous for women. Question 8 (Q8) asked whether office/laboratory works has equal opportunities for women and men. Figure 3 indicated responses.

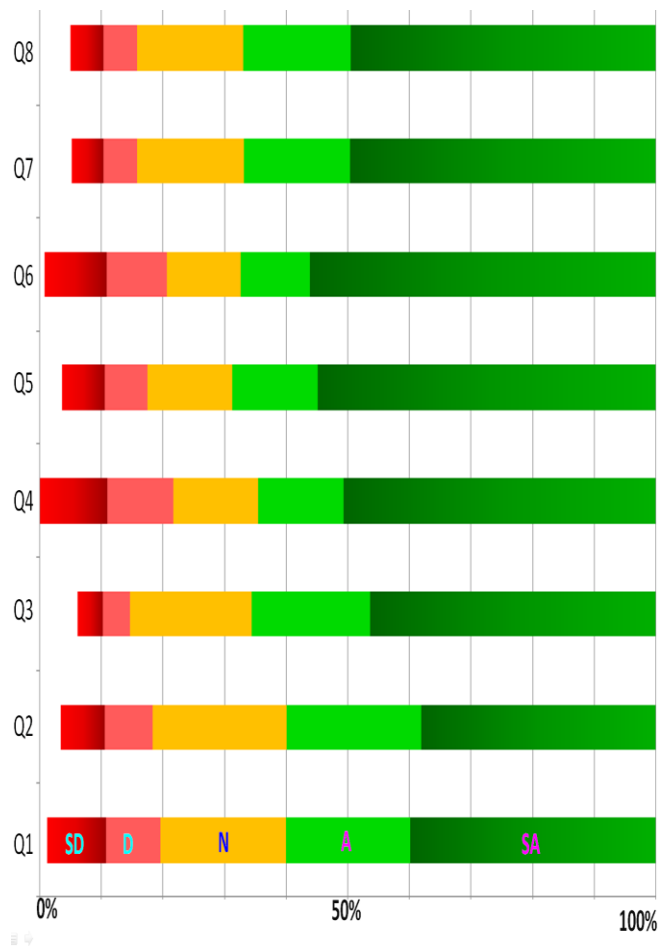


Figure 4 Likert Representation of Responses

Dark red and light red blocks represented strongly disagree (SD) and disagree (D) responses respectively. Amber blocks represented neutral (N) responses while light green and dark green blocks represented agree (A) and strongly agree (SA) responses respectively. Likert representation is typically used when using five-point scale surveys like this whereas descriptive statistics is less common ^[7]. However, it seemed necessary to determine whether the survey in this paper is a normal distribution and what is the margin of error of 474 respondents from a population. As a rule of thumb, 400 respondents from a population will give a margin of error of five percent (5%) ^[8]. While the ideal value of skewness and kurtosis should be zero to be considered normal distribution, values of skewness between -3 and $+3$, and kurtosis values of -10 to $+10$ might be acceptable under some conditions ^[9]. Descriptive statistics of responses to each questions (Q1 to Q8) have kurtosis range of -0.8 to $+0.3$ while skewness ranging from -1.2 to -0.7 which might be considered under the normal distribution.

Salient points of this survey consist of various facets that encompass socio-economic aspects not only in the Philippines but in global community.

First, CE population dominates not only the preference of Filipino students but as well as official rosters such as ASEAN Engineering Register (AER) ^[10]. Likewise, civil engineers in AER has also low female-to-male ratio (less than 1 or even less than 0.5). On the other hand, AER indicates that the number of Filipinos registered is 26%. Considering that there are ten ASEAN Member States, the benchmark would be 1060 given that there are 10600 registered members from 10 ASEAN Member States. Therefore, the Philippines is above the benchmark in AER which same with the report in IECEPISTLE 2022 ^[11].

Second, IT-BPM industry in the Philippines has high revenues before, during and even after pandemic. Likewise, even before pandemic of 2020, Telecommuting Law was enacted in 2018 to address various situations of IT-BPM workers. Moreover, working mothers benefit from these schemes ^{[12] [15]}. Most clients of IT-BPM industries in the Philippines are abroad while some are located in the Philippines.

Third, despite that ECE has the legal basis of practicing profession involving ICT, there are misconceptions that ICT and IT (a BSIT program in the Philippines) are the same. ICT was defined both by RA 9292 and RA 10844 as the totality of data transmission, reception, and / or processing of data and/or information through electronic means ^[13].

Fourth, respondents who chose ECE in the survey explicitly stated that they prefer higher salaries in ICT companies in which ECE is fit for the job. Other common answers are lesser fieldwork and the opportunity to work remotely. These responses were common from female respondents. Socio-economic challenges faced by female engineers (even other workers) are the preference of companies to hire male counterparts to avoid legal financial obligations such as maternity leave. Despite several campaigns as well as laws implementing equal opportunity employment and gender equality, these socio-economic discriminations are difficult to eliminate. Aside from issues of potential maternity leaves, fieldwork needs little accommodation expenses for male engineers compared with female counterparts., since ECE involves several ICT opportunities, female engineering aspirants preferred ECE. In the case of computer engineering (CPE), it has no government regulation over its practice of profession (statute) and is less preferred by the respondents. As for ICT-enabled industries, there are companies or work opportunities for non-ECes. In addition, there are freelancers, digital nomads, and workers from everywhere (WFE). Table 4 delineates ICT Enabled Sectors and ICT Sectors as defined in RA 10844.

Table 4 Selected Examples of ICT-ES and ICT-S Based from RA 10844

ICT Enabled Sectors (ICT-ES)	ICT Sectors (ICT-S)
HR Tasks	Telecommunications
Finance	Broadcasting
Education Sectors EXCEPT to those having Technical Disciplines such as Engineering	Programming / Networking / Computer Hardware and Software
Freelancers / WFE	Cybersecurity

Conclusions

Utmost care in processing and presenting of data were considered in order to avoid biases such as Hawthorne effect and bandwagon effect. It is the right of an individual to choose career freely. This paper studied socio-economic factors affecting individuals both female

and male in the engineering workplace. ICT careers are promising especially in adhering Gender and Development Agenda (GAD)^{[16][17]}. It was recommended to address misconceptions and to promote the ECE profession to help the country and the global community. Relative numbers of ECEs are low compared with other disciplines such as CE being the popular engineering discipline together with ME and EE and these three disciplines (ME, EE, and CE) have larger gender imbalance as compared with ECE.

While the BSIT program is out of the scope of this research, the Philippine Institute for Development Studies (PIDS) states that the Philippines is facing an oversupply of IT graduates and a Science-Technology-Engineering-Mathematics (STEM) shortage^[14]. This report might support that there was a misconception that ICT and IT are the same as Filipinos chose IT instead of ECE. BSECE and BSIT are separate undergraduate programs in the Philippines dealing with computers and technology. Information dissemination about ECE may mitigate the oversupply of IT graduates and increase the workforce in ICT Sectors (ICT-S) instead of saturating ICT Enabled Sectors (ICT-ES).

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