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# Graduates Tracer Study: Tracking, Profiling and Evaluating Employable Skills and Competencies among Information Technology Graduates using Decision Tree Algorithm

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### ABSTRACT

Human resources are one of the vital assets for the success of every organization. In similar manner, in universities, each student's performance in every schools determines the sustenance or depletion of the institution's competitive edge towards its competitors. Hence this tracer studies was conducted to determine the present personal and professional profile as well as the IT skills and competencies possessed by the Information Technology (IT) graduates in the Philippines to evaluate the relevance and quality of the programs the universities offered and to prescribe the IT skills and competencies that are sought-after by the labor industries nowadays in the IT field.

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### Introduction

The terms unemployment, job tenure or security and skills mismatch are the buzzwords that were usually heard among graduates who are seeking employment. Those three buzzwords are indeed the enigma that needs to be addressed according to the former Department of Labor and Employment (DOLE) secretary. Because of these labor phenomena issues, the labor department in the Philippines are conducting career counseling and advocacy especially those graduates who wishes to join the government force. According to the former labor secretary, finishing a degree is not enough. These job seekers who wishes to join government service should possess "Civil Service Eligibility" plus the skills both hard (job-related skills) and soft (behavior and attitude towards work) that are needed to get employed for a position. Further, the former labor secretary lamented that other job seekers lacks relevant job experience, others have attitude and behavioral problems, others lack in critical, creative thinking and problem solving-skills and others have poor communication skills. To summarize, the soft skill gap is more obvious among newly graduates than to those who have experience landing a job already. This is the hiring difficulty that they encounter that is also the same difficulty that is being faced by industries. Moreover, she lamented that this is also the findings that she read from several surveys about employment. Thus the demand for an effective education and appropriate training system, and receptive to the needs of employers and industries and in making their graduates easily employable and absorbed in the labor market is a must. From the information gathered by the department from the department's PhilJob-net website, private job ads board, job fairs and professional organizations state that the standard or prescribed factors for employment include "integrity, adequacy in communication skills, customer orientation in terms of a mind-set that can facilitate compliance, and capacity to solve problems given the frontline nature of the

functions" [1]. Another action made by DOLE to address job and skills mismatch in the country was tying up with LinkedIn, a popular networking site that is employment-oriented. The purpose of this act is to connect the right employment skills with the right opportunities. Because of this partnership, LinkedIn issued a Philippine Skills Report that prescribe the top skills of about four million Filipinos who are subscribers of this networking site to help the labor sector in identifying applicants that fit to their specified employing standards. This endeavor will enable these labor sector to achieve what they aim for in an employee and also for those job applicants to find the right job that match to their skills and abilities [2]. Further, LinkedIn reported the following most hired occupations which are: (a) Sales Professional, Software Developer, Customer Service Specialist, Marketing Specialist, Operations Manager, Recruiter, IT Support Specialist, Human Resources Professional, IT Consultant and Accountant. One of the concerns in the 2<sup>nd</sup> State of the Nation Address of Former President Benigno Simeon Aquino III is on addressing the Filipino workers job-skill mismatch problem and improvement in the access to decent and productive employment and making sure that there is enough supply of the needed skills. He instructed the concerned government agencies to device convergent programs to address the said issues and these programs are on: (a) reviewing education and training curriculum; (b) developing the Philippine Qualifications Framework; (c) implementing Career Guidance Advocacy Programs and (d) optimizing the Phi-JobNet and strengthening Labor Market Information [3].

In response to this advocacy, the higher educational institutions are compelled to track the progress of their students not just from entrance to graduation but also until they get employed and how they sustain their employment.

Assessing the achievements made by the students after graduation into the world of work and further studies are

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relevant to the needs of labor market otherwise significant adjustments and systematic improvements are made especially that the curricular programs nowadays need to be responsive to globalization and fast-speed economic and technological transformations in the society. Graduate's employability is also an indicator of effectiveness in the application of internal quality systems in the organization. Quality assurance and accreditations becomes a policy priority among universities not just in the country but also in the international settings since they are confronted with rankings and classifications such as State University and Colleges (SUC) Leveling, Normative Financing, Typology and Institutional Sustainability Assessment [4]. In fact this is one of the objectives of CHED Strategic Plan for 2011 to 2016 which states that "because of the formation of high-level human resource, and generation, adaptation, and transfer of knowledge and technology for national development and global competitiveness there is a need to upgrade the quality of higher educations, programs and systems in the country towards achieving international standards; broaden access to quality higher education of those who seek it; and efficiently and effectively manage the higher education system ensuring transparency and integrity in it" [4].

A way to track graduates is through the tracer studies conducted by every higher educational institution purposely to evaluate the relevance and quality of the programs offered to the actual needs of the labor industries. Tracer study according to Jaca is a tactic employed by tertiary schools to track and account the achievements of their graduates after graduation especially after they landed a job [5]. Schomburg had cited several advantages of conducting tracer studies which are (a) revisiting of curriculum; (b) assessment of the relevance of the program offered; (c) contribution to the accreditation process and (d) to inform the stakeholders about the school's performance [6]. He also mentioned that the following are the usual questions asked to conduct tracer studies: (a) What happens to graduates after they leave the school premises? (b) Were they able to get employment? (c) Do they use the skills and competencies they acquired from the school? and (d) Is their skills and competencies suited to the demands in the labor market? Likewise a tracer study that was conducted by Menez (2014) tried to find out whether there could still job mismatch, underemployment and promotion issues among graduates in Master's program particularly in Master of Business Administration in one of the colleges in the country [7]. Her study's result showed that graduates of the said master's program have no issues on job mismatch, underemployment and promotion. Business administration expertise gained from schooling has contributed to their professional advancement and contentment in their jobs [5].

This notion have prompted the researcher to embark on a research that traces the whereabouts of the Bachelor of Science in Information Technology graduates at the Catanduanes State University, Philippines for the past five (5) years and determine the sough-after IT skills and competencies in the IT industries based from the responses elicited from the graduates so that program and curricular adjustments would be made to sustain the marketability of these graduates. Likewise, the result of the study would serve as inputs for tertiary schools in the country as well as policy makers to formulate regulations towards the improvement of the educational process as well as budgetary aspects especially for the IT infrastructure so that IT graduates could easily earn IT skills and competencies with the aid of the IT tools and equipment.

### **Related Works**

Several reviews had been made about the related literatures and studies that have bearing and below are some: Employability means possessing skills that makes the graduates commercially viable in the industries. These skills are necessary for acquiring, preserving and being productive and thriving in a job. These skills also refer to the ability of the employees to easily adjust in their working environment and coworkers, to troubleshoot and solve problem, make critical decisions and move along easily to the ladders of success [8]. Further, employability means that the workers need to be adaptable in their working environments and actions and should be prepared to shift jobs and fields if there are better chances. Generic and technical skills are necessary so that workers would be able to cope with: (a) increasingly complex work practices; (b) greater job flexibility and rotation; (c) increased interaction with consumers; (d) reduced supervision and lastly (e) team working [9]. The following are the top ten employability skills needed by companies in the United Kingdom, these are: (a) communication and interpersonal skills; (b) problem solving skills; (c) being initiative and self-motivated; (d) working under pressures and deadlines; (e) organizational skills; (f) team work; (g) ability to learn and adapt; (h) numeracy; (i) valuing diversity and difference and (j) negotiation skills [10]. Likewise, the soft skills needed to get employed are: (a) communication and interpersonal skills (written and verbal); (b) team working; (c) problem solving; (d) initiative and self-motivation; (e) planning and organizational skills; (f) drive; (g) numeracy; (h) ability to learn and adapt; (i) time Management.

Gurvinder and Sharan's (2008) study identified the perceptions of employers about the employability skills needed in the job market in Malaysia versus the graduate's perception of the employability skills they possessed. The results of this study revealed that employers preferred to hire graduates from public universities. Both the employers and graduates have agreed on the rankings on the priority skills needed to get employed. The results of this study also suggested that younger employers tend to be more favorable to graduates' employability skills. The higher the job position of the employer within the organization, the higher were the expectations of graduates [11].

The study of Etshim (2017) identifies the factors affecting collaboration between higher education and the labor market in Kinshasa, Democratic Republic of Congo. The finding of this study revealed that the existing curriculum and policies have inadequacies that do not provide new graduates with sufficient skills to become productive in the labor market. The result of this study further proposes the need for collaboration between higher education institutions and employers in order to design effective curricula and build up an educational environment that truly benefit current students and their future employers [12].

Application of data mining technique to determine employability of graduates was also reviewed in this study. Jantawan, and Tsai's (2013) study construct a Graduate's Employability Model using a data mining classification algorithm. The study's data were obtained from a tracer study conducted through a web-based survey of Ministry of Higher Education, Malaysia (MOHE) for the year 2009. The classification experiment was performed using various Bayes algorithms to determine whether a graduate has been employed, remains unemployed or in an undetermined situation. The performance of Bayes algorithms were also compared against a number of tree-based algorithms.

Information Gain is also used to rank the attributes and the results showed that top three attributes that have direct impact on employability are the job sector, job status and reason for not working. Results showed that J48, a variant of decision-tree algorithm performed with highest accuracy, which is 92.3% as compared to the average of 91.3% from the other Bayes algorithms. This leads to the conclusion that a tree-based classifier is more suitable for the tracer data due to the information gain strategy [13].

Jantan, Hamdan, and Othman's, (2010) study embarked on human talent prediction using classification and prediction data mining algorithm. Decision tree classifier was used in this study. By using this technique, the pattern of talent performance had been identified through the classification process. In that case, the hidden and valuable knowledge discovered in the related databases were summarized in the decision tree structure. In this study, they used decision tree C4.5 classification algorithm to generate the classification rules for human talent performance records. Finally, the generated rules were evaluated using the unseen data in order to estimate the accuracy of the prediction result. [14]

The studies related to employability and the studies with application of data mining techniques inspired the researcher to embark on the use of decision tree algorithm to determine and prescribe the employable IT skills and competencies for IT graduates in the subject university.

### Methodology

This research was developed to seek answers for the following questions: (1) What is the profile of the IT Graduates in terms of: (a) age; (b) sex and (c) marital status? (2) What are the employment data attributes of graduates of Information Technology (IT) program from a certain government subsidized university 2010 to 2016 in terms of (a) Employment Type; (b) Job Title, (c) Type of Organization; (d) Job Status; (e) Nature of Industry they are engaged in, and (e) IT Job Category? (3) What are the employable IT skills and competencies of IT graduates? (4) What are the prescribed IT skills and competencies for IT graduates?

This research employed the descriptive-survey method through utilizing questionnaire in gathering data and information relative to graduate's personal and professional attributes. Likewise, data analytics was employed in this research to assess the employable IT skills and competencies of the IT graduates. The population of this study was all of the IT graduates from 2010 to 2016. An online survey questionnaire was posted in the social network accounts of all the graduates with contact to the institution. However, only 155 graduates responded to the questionnaire posted online. The sources of data in this investigation therefore were the responses of the 155 IT graduates. The research instrument is composed of the following parts: (1) Personal Profile of IT Graduates; (2) Employment Data; (3) Employable IT Skills and Competencies Possessed by the Graduates and (4) IT Graduates Suggestions for Improving their Employability. The investigation made use of frequency count, weighted mean and data mining algorithm to interpret the data. The responses of the respondents were tallied and extracted and served as input for data analysis. SPSS version 20 was utilized in this study in doing frequency count, computing for weighted mean. Data analysis was done through Rapidminer version 8.1 using Decision Tree Algorithm.

The classification algorithm was utilized in this manner: (1) data pre-processing (replacing missing values); (2) setting variable role; (3) developing a model; and (3) prescription as to the employable IT Skills and Competencies of the IT

Graduates. The personal and professional employment attributes of the graduates were analyzed using SPSS version 20 software. Data analysis and interpretation was conducted to model out the common IT skills for of IT graduates using Decision Tree Algorithm.

### Results and Discussion

#### Personal Profile of IT Graduates

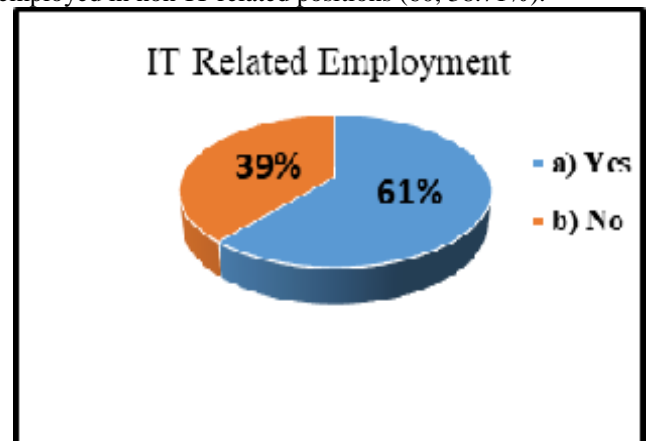
The first problem that needs answer for this study is about the personal profile of the graduates in terms of age, sex and marital status. Table 1 below shows the profile of the graduates. From Table 1 the arithmetic mean for age is 24.70 years old. To answer the first problem posed, the profile of IT Graduates is that there were more graduates whose age ranges from 20 to 24, there were more male than female respondents and mostly are single.

**Table 1. Personal Profile of IT Graduates.**

Profile Variable	Frequency	Percent
Age		
a)20-24	85	54.84%
b) 25-29	57	36.77%
c)30-34	13	8.39%
<b>Total</b>	<b>155</b>	<b>100.00%</b>
Sex		
c) Male	91	58.71%
d)Female	64	41.29%
<b>Total</b>	<b>155</b>	<b>100.00%</b>
Marital Status		
a)Single	125	80.65%
b)Married	30	19.35%
c)Widow/(er)	0	0.00%
d)Separated	0	0.00%
<b>Total</b>	<b>155</b>	<b>100.00%</b>

#### Employment Attributes of IT Graduates

The second problem posed in the study queries about the employment attributes of the graduates in terms of IT Related Employment, Employment Type, Type of Organization, Job Status, IT Job Category and Nature of Industry. Employment attributes of the graduates were presented through the different graphs below. Figure 1 shows the employment attribute of the IT graduates in terms of whether their present job is IT related or not. From the graph, it could be seen that majority of the IT graduate's present job is IT related (95, 61.29%) and 60 from among the 155 IT graduates were employed in non-IT related positions (60, 38.71%).



**Figure 1. Employment Attribute in terms of IT Related Employment or Not.**

Figure 2 shows the employment attribute of the IT graduates in terms of employment type. Most of the IT graduates were employed locally (126, 81.29%) while 17 or 10.97% were employed in foreign countries and 12 or 7.74% have opted to be self-employed

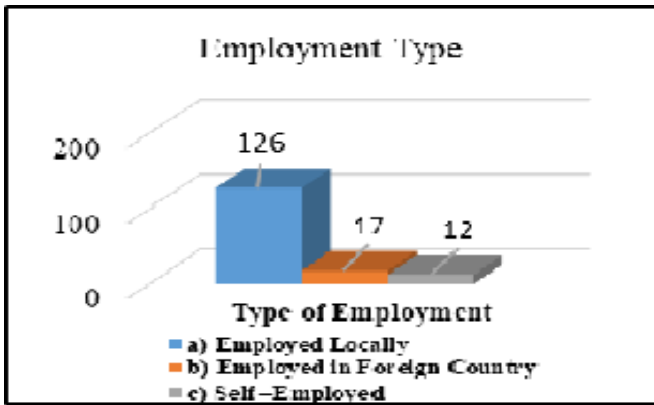


Figure 2. Employment Attribute in terms of Employment Type.

For the employment attribute on the type of organization the IT graduates are working with, it could be gleaned in Figure 3 that they were working at the private sector as could be evidenced by the responses of 107 ( 69.03%), 42 or 21.10% belong to the government sectors and 6 or 3.87% were working in non-government offices.

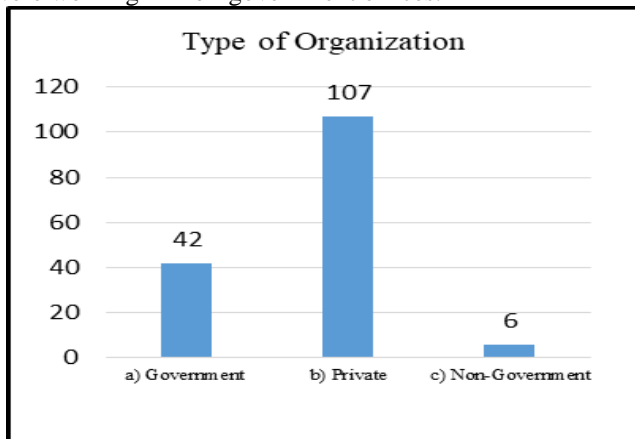


Figure 3. Employment Attribute in terms of Type of Organization.

In terms of Job status, Figure 4 below shows that most of the graduates were occupying permanent position in the organization where they belong (95, 61.29%) and the least of them were working on part-time basis (2,.29%)

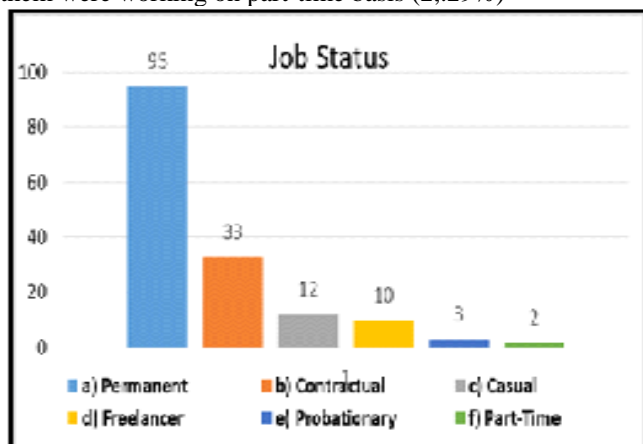


Figure 4. Employment Attribute in terms of Job Status.

For the IT Job Category Employment Attribute, Figure 5 displays the category where the present employment of the IT graduates belong. In this study, their IT jobs were categorized into fourteen (14). Most of the positions occupied by the IT graduates belong to either database or network administrator (60, 38.71%) or the least were those employed and consultant Technical Support (1, 0.65%).

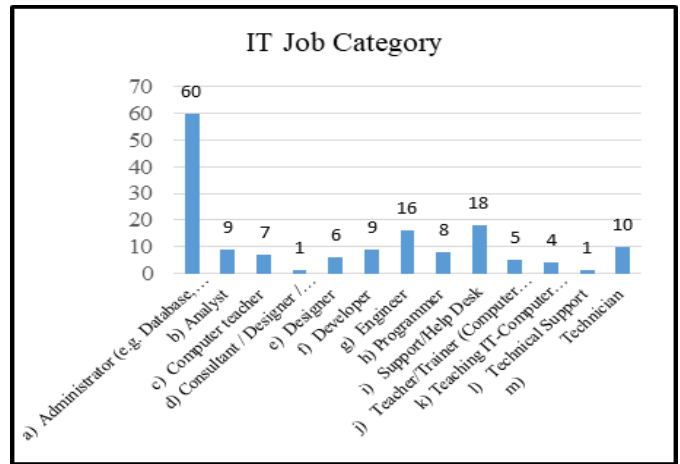


Figure 5. Employment Attribute in terms of IT Job Category.

Figure 6 shows the nature of industry where these IT graduates belong. Most of the IT graduate's job belonged to IT-Hardware as evidenced by the responses of 34 (21.00%), followed by those working in Government Services (19, 12.00%), followed by those working in Banking or Financial Services (16, 10.00%).

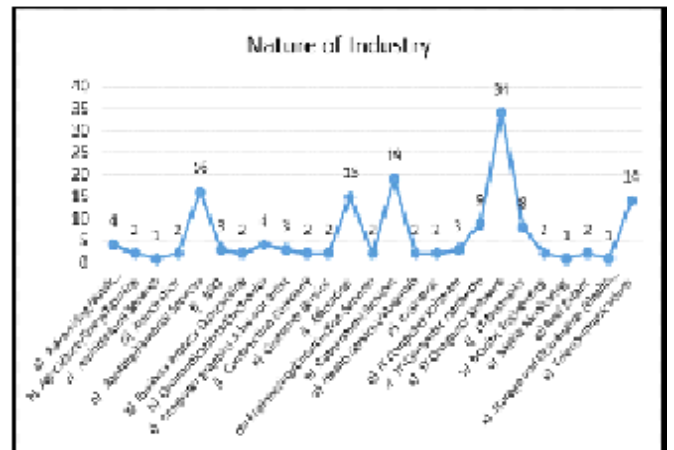


Figure 6. Employment Attribute in terms of Nature of Industry.

Employable IT Skills and Competencies Possessed by IT Graduates

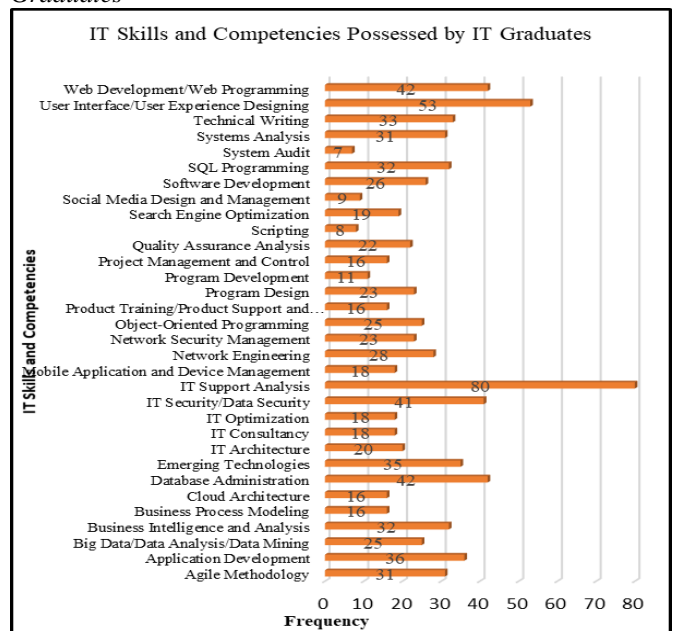


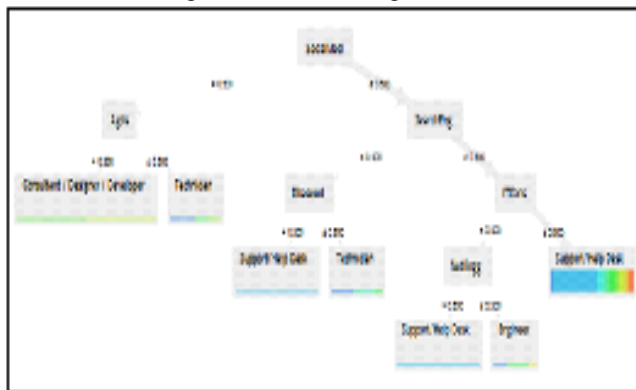
Figure 7. IT Skills and Competencies Possessed by IT Graduates.



The third question posed in the present study seeks to answer about the employable IT skills and competencies possessed by these graduates. It can be gleaned from the graph that IT graduates skills are focused on IT Support Analysis (80, 51.61%) followed by User Interface/User Experience Designing (53, 34.19%), Database Administration(42, 27.10%), Business Intelligence and Analysis and Web Development next on Emerging Technologies, Big Data/Data Analysis/Data Mining and Application Development (36, 23.22%), next is on Technical Writing (33, 21.29%, ) this is followed by Agile Methodology, Systems Analysis and SQL Programming (31, 20.00%), next is on Network Security Management and IT Consultancy (28, 18.06%), and the least is on Scripting (8, 5.16%). This implies that the IT graduates possessed the necessary skills that are marketable in the IT fields not just in the country but also in foreign lands.

*Prescribed Employable IT Skills and Competencies Possessed by IT Graduates*

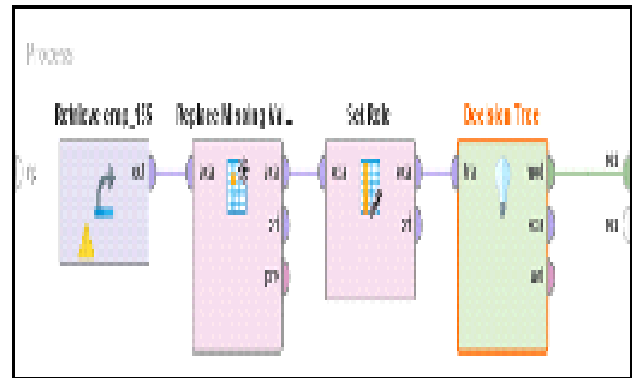
The fourth question posed in this study is on the prescribed employable IT skills and competencies of the graduates. With Rapidminer Studio version 8.1, three steps were undertaken, namely: (1) data pre-processing (replacing missing values); (2) setting variable role; (3) developing a model; and (3) prescription as to the employable IT Skills and Competencies of the IT Graduates. Figure 8 shows the employable IT skills and competencies of IT graduates that resulted from using Decision Tree Algorithm.



**Figure 8. Prescribed IT Skills and Competencies.**

Figure 8 could further be explained using Table 2 below:

The dataset that was developed in this study was a table composed of 33 columns for the different IT skills specified in the study and the category of the IT graduate’s jobs. Matrix of this data was presented using Microsoft Excel. The next step was building a classifier wherein a model was developed using predictive modeling algorithm in Rapidminer Studio. This study utilized Decision Tree Algorithm of which the process is shown on Figure 9.



**Figure 9. Building a Decision Tree Model to Prescribe the Employable IT Skills and Competencies for IT Graduates. Conclusion**

Tracer studies conducted by tertiary schools would enable collaboration between colleges and universities with business and industries not just in the country but also in foreign lands to improve education and employment of graduates. Likewise, acquiring the right person for the right job would enable to transform the organization’s aspirations into reality. This study therefore has implications for IT students, IT graduates, educational, labor and legislative bodies of the government.

For the IT students and IT graduates, they would be made aware of what human capital (both soft and hard skills) to invest in to make themselves marketable in IT industries. For the higher educational institutions, internal quality and program assessment should be made to ensure that the needs of the labor market are sustained and their graduates are employable. Significant impact on the IT industries would be observed through the result of this research since they could

**Table 2. Prescribed it skills and competencies for each job category.**

IT Job Category	Prescribed IT Skills and Competencies
Administrator	Agile Methodology, Application Development, Big Data/Data Analysis/Data Mining, Database Administration, IT Security/Data Security, IT Support Analysis, Object-Oriented Programming, Network Security Management, SQL Programming, Systems Analysis, Web Development/Web Programming
Analyst	Agile Methodology, Application Development, Big Data/Data Analysis/Data Mining, Database Administration, IT Security/Data Security, IT Support Analysis, Quality Assurance Analysis, Product Training/Product Support
Chief Executive Officer	Agile Methodology, Business Intelligence, Cloud Architecture, Product Training/Product Support, Web Development/Web Programming
Consultant	Big Data/Data Analysis/Data Mining
Designer	Program Design, User Interface/User Experience Designing
Developer	Agile Methodology, Application Development, Business Process Modelling, Cloud Architecture, Database Administration, IT Architecture, Mobile Application and Device Management, Object-Oriented Programming, Program Development, SQL Programming, Systems Analysis, User Interface/User Experience Designing, Web Development/Web Programming.
Engineer	Cloud Architecture, IT Architecture, IT Consultancy, IT Optimization, IT Security, Network Engineering, Network Security Management
Programmer	Agile Methodology, Application Development, Mobile Application and Device Management, Object-Oriented Programming, Program Design, Program Development, Scripting, SQL Programming, Systems Analysis, User Interface/User Experience Designing, Web Development/Web Programming
Support/Help Desk	Big Data/Data Analysis/Data Mining, Business Intelligence, Database Administration, Emerging Technologies, IT Consultancy, IT Optimization, IT Security, IT Support, Mobile Application and Device Management, Product Training/Product Support, Search Engine Optimization, SQL Programming, Systems Analysis, Technical Writing
Technician	Emerging Technologies, , IT Consultancy, IT Security/Data Security, Mobile Application and Device Management, Program Design, Search Engine Optimization, Social Media Design and Management, User Interface/User Experience Designing

prescribe the right IT skills for the right IT job, hence they could employ the right person for the right job and ensure the productivity and commitment of the hired personnel to the organization. Awareness of the needs of both educational and labor sectors could enable the legislative body of the government to formulate regulations, policies and laws to make educational and labor reforms and budgetary adjustments towards the betterment of educational and labor systems in the country.

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