The Geospatial Job Placement Model Using Decision Tree Based on Mobile Application in Indonesia

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Abstract—The development of the geospatial industry is increasing, hence the quality of geospatial information supplies and various technologies and workforce competencies are needed. At present, geospatial and labour in the field of geographic information system have a variety of features in the midst of global, regional and international competition. Therefore, the government will continue to improve competitiveness and workforce in this field through appropriate policies, regulations and training. The geospatial industry requires workers who are reliable and competent in their fields. The research objective is to create a decision model of GIS job positions that are in accordance with the needs of the geospatial industries. The decision tree model is used in the analysis based on pre-requisite of each GIS Job Position. The results of the study indicate that not all of respondent fulfil the pre-requisite of job positions, but approximately 95.4% is matching. The benefits of this model make self-evaluation for every geospatial workforce to get certificate of competency, especially in GIS fields.

Keywords: competency, job competitiveness, decision tree, profile matching, Geospatial workforce

I. INTRODUCTION

Geospatial workforce are faces various problems and challenges in Indonesia, where both quantity and quality are not sufficient. Policies and regulations of the Indonesian government to encourage the growth of the Geospatial Information (IG) Industry are now considered adequate, especially with the issuance of IG Law No. 4 of 2011. Equity apart from socio-demographic dimension is also geographical-financial. And sustainability in addition to paying attention to aspects of the availability of natural resources also environmental impacts [1]. At present geospatial data and information systems are utilized to increase its prosperity [2].

Indonesia has business potential and is relatively very attractive in promising geospatial technology. This condition is due to exceptional spatial and visual usability. When viewed from the vast territory of Indonesia, there are still many areas that have not been mapped in detail [3]. Geospatial technology describes the use of a number of different high-tech systems and tools that obtain, analyse, manage, store, or visualize various types of location-based data [4]. At present, the use of geospatial technology has been developed by experts and the public in various fields, for example in the fields of archaeology, demography, economics, disaster management, transportation, and so on. Urban and regional planning is an activity that has adopted national, regional and local GIS applications throughout the world in different contexts [5]. The growth of the geospatial industry in China in 2006, which included surveying, mapping, remote sensing, photogrammetry, geographic information systems and car navigation, has generated a turnover of more than 40 billion Yuan or around $ 5.3 million. The geospatial industry in China also includes more than 10,000 companies and institutions with at least 300,000 people working in this industry [6]. If this number experiences a 25-year cycle, 2,000 people will occupy the post every year. But this is still divided into various levels, such as graduates of SMK, D1, D3, D4 / S1, and S2 / S3.

The condition of geospatial human resources in Indonesia, both related to the quantity and quality, has not been sufficient to date. The total human resources needed for geospatial information are 50,000 people. This amount will certainly increase again if it has entered the ASEAN-China global market [7].

Related to the geospatial Industry in Indonesia, there are still various obstacles to being able to grow as an independent industry, among them due to the weak competitiveness of the geospatial industry. The needs to be raised as a national issue because it is considered quite worrying, especially when facing the MEA or the upcoming free market era. Global competition in international markets requires strengthening in terms of: acceptance and guidance of geospatial human resources, capital, regulation and licensing, expansion of Scope of services, technological innovation, global networking, and future trends in geospatial application trends, geospatial industry marketing and quality assurance [8]. The ability to apply or use a set of related knowledge, skills and abilities needed to successfully perform an 'important job function' or task in a defined work setting.

Competency models that integrate technical aspects, business skills, analytical, and interpersonal skills are needed for geospatial market development, as well as models to describe the types of workers needed in the geospatial information technology industry, increase employee recruitment and selection, manage employee performance, design geospatial information technology training and education programs [9]. Based on this in advance and with the increasingly urgent need for geospatial resources, it is necessary to develop a real time and easily available geospatial resource data processing facility, it is necessary to formulate to define the level of human resource competency. [10]

At the international level there are geospatial companies like Digital Globe that provide high-resolution maps for the latest geospatial solutions that help decision makers. Based on the development of these demands, various jobs that have arisen in the geospatial technology industry require the development of an integrated competency model in an application. This approach is needed to prepare entry-level workers with basic skills to ensure career success, such as job descriptions created by Digital Globe, including: (1) GIS Remote Sensing, (2) GIS Cartographer, (3) GIS Mapping, (4) Geomatics, (5) GIS Photogrammetry, (6) Geospatial, (7) GIS Digitizer, (8) GIS Technicians, (9) GIS Managers, and (10) GIS Specialists. [11]　　　Scheme of KKNI IG 2017, there are contains seven field categories of geospatial work, e.g (1) Terrestrial Survey, (2) Photogrammetry, (3) Hydrographic Field, (4) Cartography Field, (5) Remote Sensing, (6) Geographic Information System (GIS), and (7) Regional Survey Area. This research focus on GIS job position, where the model was developed. The objectives of the research is to create a decision model of GIS job positions that are in accordance with the needs of the geospatial industries using decision tree. The model is to be implemented in mobile application, namely GeoJob.

II. METHOD

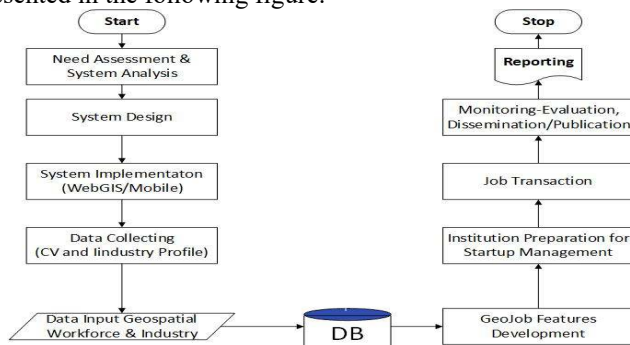In general, the stages of system development are presented in the following figure:

Figure 1. The Stage of research

A. Data Collection

Data collection activities were carried out by visiting the Geospatial Association of Industry and Certification/Training Institutions in the geospatial field (such as LSP MAPIN) and the Professional Association of Geospatial, as well as by holding a Focus Group Discussion (FGD). Secondary data and primary data are the main data used. The secondary and primary data include: (1) Secondary data, in the form of study literature, national and inernational / world industrial development statistics (sourced from journals, reports and websites), national and international geospatial industry profile data (derived from comparative studies), regulatory and regulatory data, etc, (2) Primary Data, in the form of primary geospatial human resources (curriculum vitae) data and agency/industry.

B. UML

Unified Modelling Language (UML) is a general-purpose visual modelling language is used to define, visualize, build, and document software system artefacts. It captures the decision and understanding of the system to be built. This is used to understand, design, explore, configure, maintain, and control information about such systems. It is intended for use with all development methods, lifecycle stages, application domains, and media. The model is intended to unify past experiences about modelling techniques and incorporate the best software practices today into a standardized approach [12].

C. Decision Tree

Decision tree is one method of solving problem decisions by representing knowledge in the form of trees. A tree has a conditional node that indicates the truth of an expression or attribute. The conditional node provides several possible values, which can be a boolean value (True or False), or several alternative values that an attribute might have.

III. RESULTS AND DISCUSSION

A. Logical Expression

Table of logical expression is prepared based on pre-requisite of each GIS possible job (refers to Scheme of KKNI IG 2017) as shown Table 1.

TABLE 1. LOGICAL EXPRESSION OF EACH POSSIBLE JOB

Variables	Logical Expression
OPERATOR -EOP_1	GIS Operator Assistant with work experience in the GIS field for 2 years effective, or
EOP_2	D2 graduate in GIS, or
EOP_3	D2 Geospatial Information graduates with work experience in the field of GIS at least 1 year effective, or
EOP_4	D1 graduate in GIS with work experience in GIS at least 2 years effective, or
EOP_5	D1 Geospatial Information graduate with at least 2 years effective work experience and has a GIS training certificate, or
EOP_6	Someone who has a certificate of training related competency units and work experience according to related units for at least 6 years effective, or
EOP_7	A self-taught person who has experience working in the field of GIS at least 8 years effective.
TECHNICIAN -ETK_1	GIS operator with at least 2 years work experience, or
ETK_2	D3 graduate in SIG, or
ETK_3	D3 graduate in Geospatial Information field with work experience in GIS at least 1 year, or
ETK_4	D2 graduate in GIS with work experience in GIS at least 2 years, or
ETK_5	D2 graduate in Geospatial Information with minimum 3 years work experience in the field of GIS, or
ETK_6	Someone who has a certificate of training in related competency units and work experience according to the related unit for at least 8 years.
ANALYST -ETA_1	S1 graduate in Geodesy / Geomatics / Geography, or
ETA_2	S1 graduate in Geosciences with 2 years work experience in the field of Geographic Information Systems
ETA_3	S1 graduate in Geosciences and S2 in Geographic Information Systems

Variables		Logical Expression
SUPERVISOR EAM$_1$	-	Level 6 Qualification Geospatial Information Field with work experience in GIS at least 5 years and has IG level 7 training certificates, or Graduates of S1 and S2 in Geodesy / Geomatics
EAM$_2$		/ Geography / Remote Sensing with work experience in the field of GIS at least 2 years, or Graduated from Geodesy / Geomatics /
EAM$_3$		Geography with minimum 5 years work experience in GIS
EXPERT -EAH$_1$		Level 7 Qualification Geospatial Information Field with work experience in the IG Field at least 2 years and has IG level 8 training certificates, or Graduates of S1 and S2 Geodesy / Geomatics /
EAH$_2$		Geography in the field of Geographic Information Systems with work experience in the field of Geographic Information Systems at least 2 years, or

Variables	Logical Expression
EAH$_3$	Graduates of S1, S2 and S3 Geodesy / Geomatics / Geography in the field of Geographic Information Systems with work experience in the field of Geographic Information Systems at least 1 year

B. Decision table

The decision table is made based on logical expression, were used symbol of expression (table 2)

TABLE 2. DECISION TABLE OF PRE-REQUISITE GEOSPATIAL JOB POSITION

Job Position	Education											C	W						T
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11		W1	W2	W3	W5	W6	W8	
Operator	Y	Y	Y	Y	Y							Y	Y	Y			Y	Y	Y
Technician	Y			Y		Y	Y					Y	Y	Y	Y				Y
Analyst								Y	Y		Y	Y		Y	Y	Y	Y	Y	
Supervisor								Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y
Expert								Y	Y		Y	Y	Y	Y					Y

Remark:

E: Education Background	E7: D3-GIS	E910: Combine E9 and E10	W6: WE- 6 years
E1:Non Geospatial Education	E8: S1-Geoscience	W: Working Experience (WE)	W8: WE- 8 years
E2: D1-Geoscience	E9: S1-Geomatics/Geodetics/Geographic	W1: WE- 1 year	T: GIS Training
E3: D1-GIS	E10: S2-Geoscience	W2: WE- 2 years	T7: GIS Training Level 7
E4: D2-Geoscience	E11: S3-Geoscience	W3: WE- 3 years	T8: GIS Training Level 8
E5: D2-GIS	E810: Combine E8 and E10	W5: WE- 5 years	C: Certificate of Competency
E6: D3-Geoscience			

Table 3 shows that each job position have so many pre-requisite in education background, competency, working experience and training. Symbol E1 is to express the non-geospatial education or multidiscipline. They can joint in the geospatial area with several pre-requisite, term and condition.

C. Decision tree

The decision tree is made regarding the decision table as next step of the research (Figure 2)
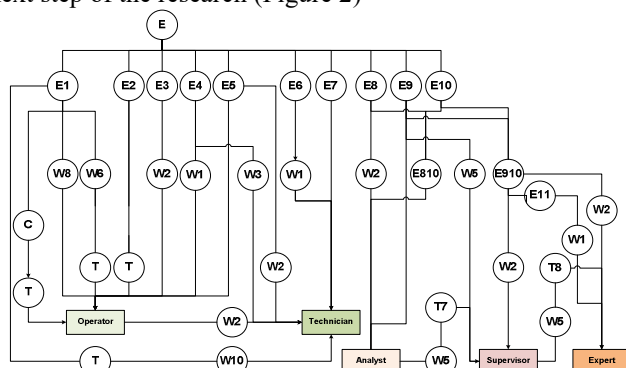

Figure 2. Decision tree of Geospatial Job Position

Figure 2 shows that the decision tree start from the education and then competency, working experience and training respectively. The flow will then be used as a reference in formulating every possible job.

D. Model Formulation

Model formulation for each possible job is made based on the decision tree.

GIS Operator:
$$D1=E1•C•W2+E5+E4•W1+E3•W2+E2•T+E1•W6•T+E1•W10 \quad (1)$$

GIS Technician:
$$D2=D1•W2+E1•T•W10+E4•W3+E5•W2+E6•W1+E7 \quad (2)$$

GIS Analyst:
$$D3=E8•W2+E9+E8•E10 \quad (3)$$

GIS Supervisor:
$$D4=D3•W5•T7+E9•W5+E9•E10•W2 \quad (4)$$

GIS Expert:
$$D5=D4•W5•T8+E9•E10•E11•W1+E9•E10•W2 \quad (5)$$

The equation above shows that each possible job has different requirements so that based on the experience of each workforce, the system can help provide appropriate position decisions.

E. Model Implementation

Model formulation is to be implemented using real data of geospatial workforce, where the number of respondent 130 persons. In the reality, it is possible one persons has many possible job (table 3).

TABLE 3. NUMBER OF GEOSPATIAL WORKFORCE COMPETENT IN GIS AREA

Description	Geospatial Job Position					
	Operator	Technician	Analyst	Supervisor	Expert	Not Match
Number of Match Job Position (persons)	19	23	90	2	3	6
% (based on Number of Respondent)	14.6	17.7	69.2	1.5	2.3	4.6

The percentage of matching with pre-requisite approximately 95.4% of respondent. Means that the model can identifying portfolio every geospatial workforce. The results shown in figure 3
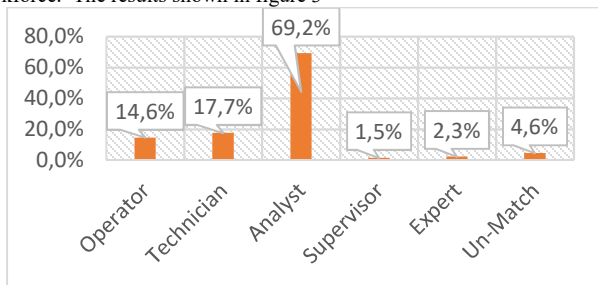

Figure 3. Visualization of workforce competency in GIS Area

Figure 3 shows the competency of respondent in geospatial area, where most of them dominant as GIS Analyst (69.2%), GIS Technician (17.7%), GIS Operator (14.6%), and a few of Expert and Supervisor position. Means that only 4.6% Un-match with pre-requisite.

F. Mobile Application

Attribute design of GeoJob application has been developed, where the analysis of the design of the application system with various actors involved, each of which has its attributes. The Entity Relationship Diagram (ERD) of GeoJob application is shown figure 4.
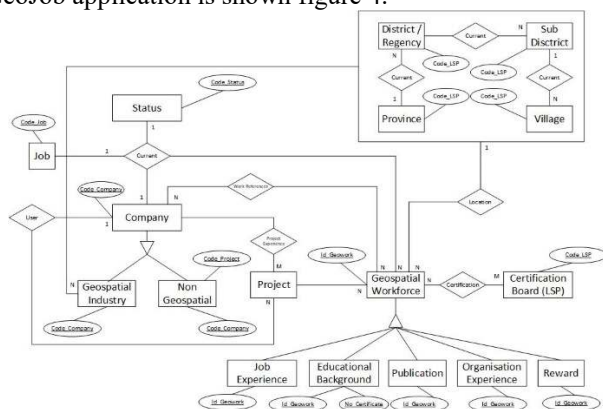

Figure 4. ERD of GeoJob Application

Figure 4 shows that linkages between tables can be explained by looking at the nature of the relationships presented in the ERD. The Storyboard of application design shows in Figure 5 below

Figure 5 Story Board of Mobile Application

In general, the GeoJob application is shown in Figure 5, where information is related to one another. Furthermore, the development of features has also been carried out in accordance with the designs that have been made.

IV. CONCLUSION

Decision Tree based on the Formal and Non Formal Education is very important to decide the Level of Geospatial Competency. Based on the analysis the percentage of match job position approximately 95.4%. Design and implementation of the Mobile Based Model of GIS Job Position is needed to improve the performance both geospatial company and Geospatial Workforce.

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