Detection of Relevant Career Track for Information System Undergraduates Using Profile Matching

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Abstract. We are facing the industrial revolution era 4.0 today. The issue of information technology, disruption technology and employment is very urgent. Data from the Indonesian Ministry of Research and Technology and from the Indonesian Ministry of Manpower in 2017 show that Indonesian workers who work not in accordance with their majors are above 50%. The number of jobs relevant graduates are an important value for Information System study program during the assessment by the National Accreditation Agency for Higher Education. So that needs a system to help students for detecting, identifying, and directing them to relevant career track using Decision Support System approach. Profile Matching method implemented with determining of 17 alternatives (career track) and 18 criteria (competencies: core=60%, elective=40%) based on IS 2010 curriculum. Whereas weight of each criterion associated with alternatives is stated in 3 variants (significant coverage, some coverage, not required). The highest rank shows that those career track is the most relevant to the student's criteria (competencies). The other uses of those rank is also able to help students in determining their thesis topic.

Keywords: Profile Matching, Information System, Career Track, IS 2010 Curriculum

1. Introduction. We are facing an era of the industrial revolution 4.0. Issues of Information Technology, technological disruption and employment are very urgent. Comparison of job vacancies availability with the number of active workers is out of balanced. Impact of this condition is the increasing of unemployment rates in several developing countries including Indonesia. Another problem is the mismatch between the areas of interest / competence of graduates from the past with the current occupation. The General Director of Resources of Science-Technology and Higher Education, Indonesian Ministry of Research, Technology, and Higher Education in 2017 stated that "only 45% of engineers graduated work relevant with their majors" [1]. Meanwhile, the Indonesian Minister of Manpower in 2017 stated that "63% of Indonesian workers work not accordance with their majors" [2]. From these data it can be concluded that the level of linearity between the competencies of study programs graduates and occupational fields is relatively low (under 50%).

At present, the Indonesian higher education curriculum is also implementing OBE (Outcome Based Education) where the learning process places more emphasis on LO (Learning Outcome) and the achievement of students' competencies when they graduate. In addition, the number of graduates who are linear with occupation is also an important point during the study program assessment by the National Accreditation Agency for Higher Education (BAN-PT).
From the above background, its need a consultation infrastructure for students as prospective graduates so that they can be directed to the occupations which relevant with their competencies / skills using Decision Support System (DSS) approach. This research using scope of the Information Systems (IS) study program.

2. Literature Review

Literature review includes a review of DSS, profile matching methods, IS 2010 Curriculum, and some previous research related to academic DSS, such as: selecting of courses, sub-majors selection, and even determining of thesis topics.

2.1 Decision Support System and Profile Matching method.

Decision Support System (DSS) is an interactive computer-based system that helps decision makers utilize data and models to solve a problem [3]. Profile matching method is a method that is often used as a mechanism in decision making by assuming that there is an ideal level of predictor variables that must be met by the subjects studied, rather than the minimum level that must be met or passed. In the profile matching process, it is broadly a process of comparing the actual data value of a profile to be assessed with the expected profile value, so that the competency differences (also called gaps) can be known, the smaller the gap produced, the greater the value weights [4][5][6].

2.2 IS 2010 Curriculum

The IS 2010 Curriculum is a curriculum guide for undergraduate Information Systems around the world. The IS 2010 curriculum was formulated by the Association of Computing Machinery (ACM) and the Association for Information System (AIS) [7]. Although released since 2010, this guide is still considered relevant to the current conditions of academic-career growth. So that this curriculum is still referred by several Information Systems study programs throughout the world including Indonesia. In fact, the Association for Information Systems in Indonesia (AISINDO) as a representation of the Information Systems study program association in Indonesia, also refers to IS 2010 Curriculum [8].

2.3 Previous Related Research

Fiarni et al [9] have developed a DSS to select sub-majors of information systems (A: Infrastructure management, B: Business Intelligence, C: E-Business) using a decision tree algorithm. Sudarma et al [10] have developed DSS to choose courses in higher education using the ELECTRE method, with 8 alternatives (courses) and 8 criteria (value of report card). Daniati [11] has developed a DSS to determine thesis topic using a combination of K-Mean and SAW methods, with 5 alternatives (group of topics) and 5 criteria (clusters). Sunarti [12] using profile matching method for employees recruitment. Pandit [13] has proposed a model of DSS for research topic (appropriate with undergraduates) selection.

3. Research Methodology

Refer to the Waterfall methodology [14][15], figure 1 shows the sequence of this research methodology, starts from : 1) first stage, analyzing the problems that occur and determining the scope. 2) second stage, observation of various literatures to answer the problem of discrepancy between IS graduates' competencies and career tracks or occupations. 3) The third stage, is the determination of
one method that is considered the most relevant compared to other DSS methods. 4) The fourth stage, is the determination of criteria (competencies) and alternatives (career track) based on the IS 2010 Curriculum document. 5) Fifth stage, implements the formula of the selected DSS method in the previous stage into tools or programming languages + databases. 6) Sixth stage, the DSS simulation is carried out by inserting some real academic data samples from student respondents. 7) The final stage, conclusion statement based on observations of DSS output data.

4. Results and Discussion

The implementation of the research methodology consists of realization of: determining the Profile Matching method as a DSS formula, determining the criteria and alternatives, simulating the profile matching method with several sample of academic data from the respondents, and discussing the results of the DSS output.

4.1 Choosing the Profile Matching method

The reason for choosing this Profile Matching method over other DSS methods is because this method has advantages in terms of measuring the "similarity" between the alternative criteria values and the expected profile criteria values. While in other methods (for example: SAW, WP, AHP), the chosen alternative is determined and ranked based on the "weighting" factor for each of the existing criteria. Therefore, the profile matching method was chosen and considered more suitable for this case.

4.2 Determination of Criteria and Alternatives

Determination of criteria and alternatives is based on IS 2010 Curriculum document as a guideline. In the IS 2010 Curriculum document, relationship between 18 criteria (competencies) and 17 alternatives (career track) is shown in Figure 2. The criteria (competencies) are grouped into 7 core competencies and 11 elective competencies.

![Figure 2. IS 2010 Curriculum model (courses competency VS career track)](image-url)
As seen in Figure 2, the criteria (competency) are shown in the vertical column, where members of the core courses criteria = \{"foundation of IS", "enterprise architecture", ..., "IT Project management"\}, and members of the elective courses criteria = \{"application development", "business process management", ..., "social informatics"\}. Meanwhile, the alternative (career tracks) are shown in horizontal row, where members of alternative = \{"A: Application Developer", "B: Business Analyst", ..., "Q: Web Content Manager"\}.

### 4.3 Profile Matching simulation with sample data

As a preliminary simulation, it is assumed that there is one student who will be tested and detected which career track is relevant to his competence. Figure 3 shows that the left hand side (light blue column) is a re-depiction of the previous figure 2. The key of "significant coverage", "some coverage" and "not required" are sequentially changed to value = 2, 1 and 0. The "profile" column in figure 3 is suppose that the student's competency scores (from c1 to c18) are worth 1 for all, or in other words the competence is "some coverage" for all criteria/competency. Furthermore, on the right side of the table, "GAP" column shows the difference / distance between the "profile" columns to each “A-Q” column on the left side of table.

| A  | B  | C  | D  | E  | F  | G  | H  | I  | J  | K  | L  | M  | N  | O  | P  | Q  | R  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 2 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 |
| 2 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | -1 | -1 | -1 | -1 | -1 | -1 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | -1 | -1 | -1 | -1 | -1 | -1 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Figure 3. Profile matching simulation – phase I**

| GAP | Meaning | Value |
|-----|---------|-------|
| 0   | No GAP (Competence as required) | 3     |
| 1   | Individual competence is 1 level excess | 2.5   |
| -1  | Individual competencies lack 1 level | 2     |
| 2   | Individual competence is 2 level excess | 1.5   |
| -2  | Individual competencies lack 2 level | 1     |

By using the reference in table 1, the GAP value from figure 3 is then transformed to the value as shown in figure 4. In the core competency gets a 60% percentage because it is considered that this competency is more important and fundamental than the elective competency which only gets a percentage of 40%. At the TOTAL row values are obtained from the formula: average (c1 → c7) * 60% + average (c8 → c18) * 40%. Finally, in the RANK row the determination of rank #1 (top) is for the owner of the highest TOTAL value, followed by ranking #2, #3,… and so on. The alternative
(career track) which ranks #1, #2 and #3 is the top-3 alternatives that are recommended by profile matching, because they are considered the most appropriate for the user's profile competency.

Figure 4. Profile matching simulation – phase II

4.4 Discussion

Alternatives that get ranking 1, 2 and 3 are the recommendations of final results from DSS in supporting the decisions of student users in determining career tracks that are relevant to their competencies. In Table 2 shows the results of the calculation of profile matching from 5 sample data of IS Student of UPN "Veteran" East Java, Indonesia. Each rank is occupied by 1 type of career track as seen in students with numbers 2 to 5 (Rezcio to Dimas). In other case, it can be 1 level rank is occupied by many career tracks, this is because they have same total value. As in student #1 (M. Purwanto), rank #1 is occupied by : N (Network Administrator) or J (IT Asset Manager), rank #2 is occupied by : M (IT Security and Risk Manager), and rank #3 is occupied by : D (database administrator) or F (e-business manager) or H (Information Auditing and Compliance Specialist).

Table 2. Career track ranks results using profile matching

| IS student respondent @ UPN Veteran, East Java, Indonesia | Career track ranked by DSS using profile matching |
|----------------------------------------------------------|--------------------------------------------------|
| No | Student ID | Name | Rank #1 | Rank #2 | Rank #3 |
|----|------------|------|---------|---------|---------|
| 1  | 15xxxxx058 | M. Purwanto | N / J | M | D / F / H |
| 2  | 15xxxxx059 | Rezcio M.I | M | D | N |
| 3  | 15xxxxx019 | Himas A | F | K | E |
| 4  | 15xxxxx011 | M. Agung | F | G | L |
| 5  | 15xxxxx045 | Dimas A.P | B | K | F |

5. Conclusion

All 18 criteria (competencies) and 17 alternatives (career track) based on IS 2010 Curriculum have been successfully implemented into DSS using Profile Matching method. From the experiment of 5 sampling data from IS student in UPN Veteran East Java Indonesia showed that each student had successfully identified the top-3 ranks where each rank was occupied by 1-to-Many career tracks.
Besides to being able to detect, identify and support the decision to choose a career track, this Profile Matching DSS also has the opportunity to be used to support students' decisions in choosing areas of interest or prospective thesis topics. So that linearity of competencies - areas of interest - thesis topics - and career tracks can be achieved.

Currently, the competency filling mechanism is still qualitative in scale ("0", "1", or "2"). In further research, the competency filling mechanism can be more quantitative and measurable, such as using real subjects value ("A", "A-", "B +", "B", "B-", "C", "D", "E") combined with likert scale.

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