Design of Expert System for Hard Skill Competencies-Based Employee's Performance Evaluation

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Abstract

The quality of human resources is one of the important factors to maintain the sustainability of a company, therefore it is essential for the company to evaluate performance of its employees. With the recent rapid development of computer technology, especially in the field of artificial intelligence, many problems can now be effectively addressed with the help of computer. The purpose of this research is to design an expert system for hard skill competencies-based employee performance evaluation. The system is expected to be able to give accurate recommendations on decision making process of several human resources' issues such as recruitment, training, transfer, and promotion in the filling plant division. This research uses descriptive analysis, prototyping, gap analysis and Analytical Network Process (ANP) to build a system which will function like an expert in evaluating the performance of employees. This system contains knowledge domain in 7 position levels of SMART's filling plant employees. Critical factors of this system are mastery of basic work health and safety, ability on operating filling plant machines, ability on machine maintenance and mastery in quality management system. Results of the system test show that the proposed expert system had been running well in accordance with the rules in the decision table and had been considered to be able to meet human expert representation.

Keywords: *ANP, expert system, gap analysis, performance evaluation*

1. INTRODUCTION

High quality human resources are employees with balanced required soft and hard skills. To achieve it, a company needs to perform continuous improvement and evaluation on employee's performance (Meilani, 2008 ; Casey, 2005). The evaluation should be carried out on an objective criterion and basis. This study is performed based on condition on filling plant division of PT. SMART, Tbk which uses subjective method in promoting and evaluating performance of its employees. This subjectivity may leads to delay and inaccurate decision in allocating a staff in particular position. For this reason, there is an urgent requirement for the company to have a quick, systematic and accurate evaluation system. With the recent development of computer and IT, this requirement can be effectively answered by employing an expert system.

In addressing the afore-mentioned issue, the proposed expert system will use gap analysis and Analytic Network Process (ANP) to ensure objectivity and accuracy of the employee performance evaluation. In the early stage, prototype of the system will be developed to work mainly on hard skill aspects of the employee. The purpose of this study, therefore, was to build a system which is able to overcome the employee evaluation problem by giving recommendation to the management of PT. SMART, Tbk in making decision on several human resource issues, such as recruitment, training, mutation and promotion in filling plant division.

2. METHOD

The development of the system was carried out in several stages as follows: (i) exploring and collecting system's knowledge source through observation, interview and literature study (ii) knowledge acquisition into forms of expert knowledge and formal

knowledge (iii) representing the knowledge in the form of 'IF-THEN' (iv) developing inferential machine with forward chaining methods (v) transferring the acquired expertise into machine language with PHP, Apache and MySQL and (vi) system testing through verification, validation and user interface tests. Verification test will be performed to analyze the logical sequence of the system while it runs and to verify it with the decision table. In addition, validation test is carried out to ensure the appropriateness of the system behavior with expert knowledge. Methodology on designing the proposed system is depicted in Figure 1.

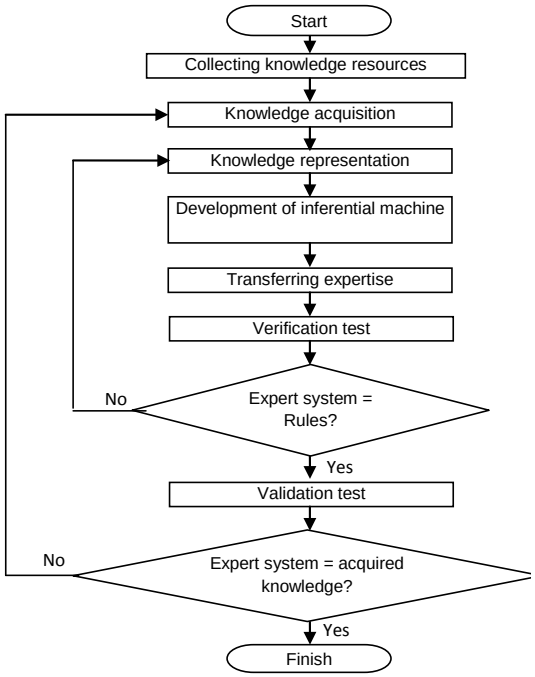

Figure 1. Methodology in designing the expert system for employee performance

2. RESULTS AND DISCUSSION

2.1Employee Performance Evaluation System

Current evaluation system implemented in the company uses soft skill competences which consist of following criterion: creativity, cooperative, ease of adaptation, motivation, thoroughness, discipline, communication ability, problem solving ability, computer literacy and ability to work under pressure. In general, current evaluation is divided into two parts which are short-term and long-term evaluation. The short-term one is done on weekly basis and focuses on how to tackle problems in investigated period and to plan activities in the next period. Furthermore, long-term evaluation is performed annually. The evaluation is intended to assess the performance of each employee in the investigated period.

The proposed hard skill based evaluation system is expected to enrich the current system so that objective evaluation result can be achieved. In detail, this system operates by comparing the existing and standard competence level for each position within division. Hard skill competences considered in this study are arranged based on Standard Operating Procedure (SOP) in filling plant division of PT. SMART, Tbk, which are (1) mastery of basic work health and safety (2) ability on operating filling plant machines (3) ability on machine maintenance and (4) mastery in quality management system. Each competence is decomposed into criterions as detailed in Table 1.

Table 1. Competence and its criterions

No	Competence	Criterion
1	Mastery on basic work health and safety (K3)	- Implement principles of work health and safety - Indicate causes of work accident - Wear work safety equipment - Possess certificate of SMK3
2	Ability on operating filling plant machines (OM)	- Able to operate the machine - Aware of machine failure symptoms - Certification and experiences on machine handling - Effectiveness and efficiency in task completion - Machine setting
3	Ability on machine maintenance (MF)	- Maintain the machine - Repair the machine - Understanding of filling plant machine components - Arrange report on planning, maintenance and repairing the machine
4	Mastery in quality management system (MM)	- Aware of mistakes in filling process and understand each oil product direction - Understand the criterion in product defect - Understand HACCP criterion - Understand the reporting system - Participation in HACCP training

2.2 Design of Expert System

2.2.1 Knowledge Source

Knowledge and expertise to be embedded in the system are collected from two kinds of sources, documented and non-documented ones. Formal knowledge from documented sources is gathered from general work guidance and Standard Operating Procedure in filling plant division. The latter source is non-documented one which involves personnel in filling plant division, which are manager and head of filling plant production. This selection on sources was made on experience and work duration basis.

2.2.2 Knowledge Representation

Presenting the collected knowledge from sources involves four stages of development; they are drawing the knowledge domain block diagram to emphasize the boundary of the investigated problem (Kusumadewi, 2003), sketching decision target diagram to illustrate the diagnosis direction, outlining dependency diagram with forward chaining method and creating decision table. The final goal of this step is to get a decision table which will be used to determine the value of each criterion as well as to propose recommendation according to the established rules. Dependency diagram and sample of decision tables are illustrated in Figure 2 and Table 2 as follows.

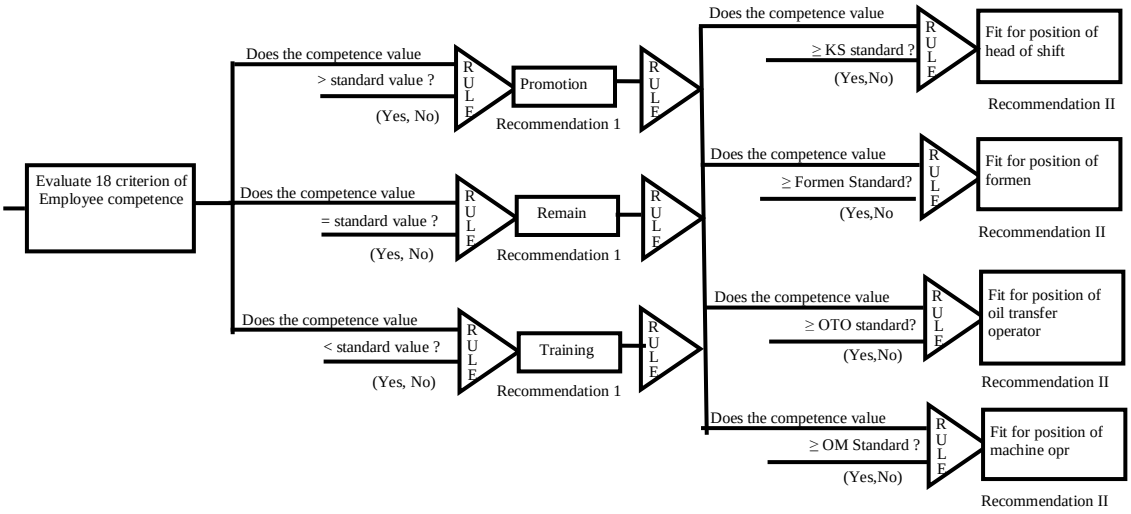

Figure 2. Dependency diagram

Table 2. Sample of decision table

No.	Parameter	Answer		
		If		Then
		Yes	No	
A	4,20 < prioritized competence value ≤ 5,00	√		Go to 1 and Save RA
			√	Go to B
B	3,40 < prioritized competence value ≤ 4,20	√		Go to 1 and Save RB
			√	Go to C
C	2,60 < prioritized competence value ≤ 3,40	√		Go to 1 and Save RC
			√	Go to D
1.	Head of Shift	√		Go to 1A
			√	Go to 2
2.	Formen	√		Go to 2A
			√	Go to 3
3.	Transfer Oil Operator	√		Go to 3A
			√	Go to 4
4.	Machine Operator	√		Go to 4A
			√	Go to 5
5.	Admin Operator	√		Go to 5A
			√	Go to 6
6.	Product Hand-over Operator	√		Go to 6A
			√	Go to 7
6A.	Competence value > standard competence of product hand-over operator	√		Go to 6B and Save R1
			√	Go to 6C
6B.	Competence value >= standard competence of admin operator	√		Save R8
			√	Save R9

Note: RA, RB, RC, D, 6C refer to complete recommendations and actions mentioned in system's database

2.2.3 Inferential Machine

This expert system was developed with forward chaining method. The development of inferential machine was conducted by transferring rules in decision table into machine language in the form of IF-THEN. It means that each respond in the table will be implemented as rule in this system. Each respond displayed in the decision table represents a fact, of which the system will trace accordingly to match it with the available rule and then execute it and give recommendation as the part of THEN.

Facts which are used in the table are drawn from the results of gap and ANP analysis. Gap analysis describes the difference between competencies of an employee and those required to occupy a particular position (Muchsam, 2011). The latter analysis uses weighted competency criterion from ANP analysis (Hidayat, 2009). Example of these analysis results are depicted in Table 3 and 4.

Table 3. Example of gap analysis

Name	K3				OM					MF					MM				Description
	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	Employee Competence
Ridwan	3	3	3	2	4	3	2	3	3	3	3	3	3	3	3	4	3	3	
Position	K3				OM					MF					MM				**Description**
	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	Competence required for position
OFD	2	3	3	2	2	2	2	3	2	3	2	2	3	2	3	3	2	2	
Name	K3				OM					MF					MM				**Description**
	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	Gap
Ridwan	1	0	0	0	2	1	0	0	1	0	1	1	0	1	0	1	1	1	

Table 4. Result of ANP analysis

No.	Competence	Weight	Criterion	Weight
1	Mastery on basic work health and safety (K3)	0,167	- Implementing principles of work health and safety - Indicating causes of work accident - Wearing work safety equipment - Possessing certificate of SMK3	0,000 0,061 0,106 0,000
2	Ability on operating filling plant machines (OM)	0,315	- Able to operate the machine - Aware of machine failure symptoms - Certification and experiences on machine handling - Effectiveness and efficiency in task completion - Machine setting	0,075 0,162 0,016 0,000 0,062
3	Ability on machine maintenance (MF)	0,136	- Maintaining the machine - Repairing the machine - Understanding of filling plant machine components - Arrange report on planning, maintenance and repairing the machine	0,020 0,068 0,006 0,042
4	Mastery in quality management system (MM)	0,382	- Aware of mistakes in filling process and understand each oil product direction - Understanding the criterion in product defect - Understanding HACCP criterion - Understanding the reporting system - Participation in HACCP training	0,178 0,089 0,115 0,000 0,000
			Total	**1,00**

2.2.4 Transfer of Expertise

This stage is carried out by putting IF-THEN rules into the knowledge-base of expert system development tool. Development tools deployed in this study are PHP as the server programming language, Apache as the web server and MySQL for database provider. The output of this stage is a prototype of expert system for employee performance evaluation,

which was developed in Indonesian language. Being designed as prototype allows the system to be further developed and improved according to the future changes and needs. This prototype consists of several web pages including homepage, consultation page, admin page, HRD page, help page and contact us page. Screen shots of pages in the developed prototype are depicted in Figure 3.

Figure 3. Evaluation in process and recommendation pages

2.2.5 System Testing

Each system is needed to be tested to ensure that it works correctly an the rule.d follows the established rule. The proposed expert system is tested in three aspects, they are verification test, validation test and user interface assessment. The first test is conducted by accessing web pages and running the system with various inputs. This test involves an expert from laboratory of computation and system analysis. The result shows that the system behaves correctly according to the given input which makes it pass this test.

Validation test was conducted by comparing recommendations produced by the system with those suggested by the expert, in this case is the representative of HRD staff in filling plant division of PT. SMART, Tbk. Test results demonstrated that recommendation given by the system is identical as expert recommendation. It means that the system is capable of representing and replacing real-world expert in evaluating employees' performance.

The last test was carried out in purpose of examining the usability of this system. This test involves respondents who are asked to use the system and then give their opinion in a designed questionnaire. Five criterions are investigated in this test to conclude how usable the system is. The criterions as well as their level (on scale of 1-5) based on users' evaluation are as follows: available features (3.9), suitability with the needs (3.9), ease of use (4.1), clarity of information (3.6) and interactivity (3.4). Based on those results, it can be believed that the system has good performance in term of its usability.

CONCLUSION

The expert system for employee performance evaluation is developed to provide a quick, easy an objective evaluation. The system is build based on 4 competencies: mastery of basic work health and safety, ability on operating filling plant machines, ability on machine maintenance and mastery in quality management system It uses gap and ANP analysis to give valuable accurate recommendation for promoting and allocating a staff in a particular position. The system has performed well in three types of test which allowing it to represent real expert in giving recommendation on human resources issues.

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