Designing a Smart Prediction Model for Influence of the Infrastructure Completeness on Work Satisfaction

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Abstract: Based on Indonesian data, 47.1% of hospital permanent employees were found to be dissatisfied at work. Dissatisfaction can be caused by several factors such as internal, external or a combination of both. The external factors that highly suspected to cause work dissatisfaction were incomplete infrastructure facilities. The purpose of this study was to design a prediction model of the influence of the infrastructure completeness on work satisfaction from a population of 230 respondents with 70 samples (by stratified random sampling). Statistically, questionnaire data were analyzed using univariate, bivariate with chi-square tests, and multivariate with multiple logistic regression at a 95% confidence level ($\alpha = 0.05$). Based on statistical test values, the prediction model was built using the Adaptive Neuro-Fuzzy Inference System (ANFIS) method. Of the six variables tested, found three variables (i.e., workspace, furniture / furniture, office equipment) that significantly influence the works satisfaction, $p < 0.05$. The workspace variable was the most dominant which has an opportunity of 10.494 times higher to be satisfied with a poor workspace. Accuracy results of 98.7% towards the design of predictive models was achieved.

1 INTRODUCTION

The hospital is a labor-intensive organization with diverse employee resource backgrounds (Supriyanto & Ernawati, 2015). Human resources at the hospital are divided into 3 (three) groups, namely professional, managerial and workforce. The professional group is tasked with trying to cure treated patients (Soeroso, 2016). All categories of human resources in the hospital will have different job satisfaction.

Job satisfaction is a form of employee perception that is reflected in attitudes and focused on behavior towards work. According to Kreitner & Kinicki (2016), job satisfaction is a positive feeling about one's work that is the result of an evaluation of its characteristics.

Job satisfaction as a very important factor of productivity and quality of work, especially in health workers (Dragana, Arandjelovic, Maja, & Stanković, 2018). Research conducted by Jaiswal et al. (2015) in India found that the average hospital employee job satisfaction index was in the same range, but was found to be highest for nurses (68%), followed by doctors (66%), support staff (63%) and technicians (62%). Research Dragana et al. (2018) in Sweden that

most employees think that their work is interesting and stimulating, so they work enthusiastically. More than 50% of health workers surveyed stated that they were not satisfied at work. Research at the Jakarta Hajj Hospital by Sulistyarini (2018) found that 47.1% of the hospital's permanent employees were dissatisfied with work. Prayoga, Lailiyah, & Sari's (2017) research at the Blambangan District General Hospital in Banyuwangi Regency states that all hospital staff have a level of satisfaction in the satisfied category.

Many ways you can do to measure someone's job satisfaction. Researchers at Cornell University developed the Smith, Kendall, & Hulin (1969) approach called Job Descriptive Index (JDI) to assess job satisfaction with several work dimensions, namely work, salary, promotion, infrastructure facilities, supervision, and colleagues. In terms of job satisfaction, Gilmer (1966) in As'ad (2018) mentions the factors that influence job satisfaction are opportunities for advancement, job security, salary, company and management, intrinsic and work factors, working conditions, social aspects of work , communication and facilities.

The completeness of work facilities and facilities will encourage the emergence of effective and

efficient work results and encourage quality improvement in line with existing work standards. Work facilities provided by the company must be adjusted to the needs of the organization, so that the work done by employees can run effectively (Hasibuan, 2016; Turnip et al, 2020; Wijaya et al, 2019).

In this study, a preliminary survey was conducted by interviewing 20 Hospital employees about satisfaction with the completeness of facilities and infrastructure in supporting work, as many as 13 people said that they were satisfied with the infrastructure used and 7 people said they were not satisfied. Dissatisfaction is caused because according to respondents there are some infrastructure facilities that are incomplete when they work so that it interferes with the work implementation. Equipment that is felt by the employee is lacking such as ventilators, special beds, and others. The incomplete infrastructure is also caused by old age such as photocopiers, and others. Infrastructure such as narrow parking, medical committee rooms and a less ergonomic Central Sterile Supply Department (CSSD / sterilization) cause employees to be less satisfied. Design model to predict the influence of the infrastructure completeness on work satisfaction from a population of 230 respondents with 70 samples (by stratified random sampling) is performed.

2 METHOD

This type of research is a quantitative analytic study with a cross sectional study design. The study was conducted at the Stella Maris Hospital in Medan in December 2019. The study population was all permanent employees in the Hospital about 230 people, and samples were obtained as many as 70 respondents. Univariate data analysis, bivariate using chi-square test, and multivariate using multiple logistic regression tests with a confidence level of 95% ($\alpha = 0.05$).

Adaptive Neuro Fuzzy Interference System (ANFIS) is an algorithm that combines fuzzy systems with artificial neural networks (Wijaya & Suhartono, 2012; Turnip et al, 2018). The basis of the integration is the advantages and disadvantages of each system. ANFIS was first introduced by Jang in 1993 (Jang, 1993). Neural networks recognize patterns and adapt patterns to environmental changes, while fuzzy logic combines human knowledge and seeks conclusions to make a decision. The main advantage of artificial neural networks is that they can recognize the system

through a learning process to improve adaptive parameters. The weakness of this system is the complexity of the structure. While the fuzzy system has a concept similar to the concept of human thinking. The combination of the two will complement each other's strengths and weaknesses (Kusumandari et al, 2018; Turnip et al, 2018).

Fuzzy inference system used is a first order Tagaki-Sugeno-Kang (TSK) fuzzy inference system with consideration of simplicity and computational ease. The basis for rules with two fuzzy if-then rules as below.

$$If \ x_1 \ is \ A_1 \ and \ x_2 \ is \ B_1 \ Then \ y_1$$
$$= c_{11} \ x_1 + c_{12} \ x_2 + c_{10}$$
$$f \ x_1 \ is \ A_2 \ and \ x_2 \ is \ B_1 \ Then \ y_1$$
$$= c_{11} \ x_1 + c_{12} \ x_2 + c_{10}$$

where x_1 and x_2 are inputs and A_1, A_2, B_1, B_2 are degrees of membership with predetermined fuzzy rules. Whereas $c_{11} \ x_1 + c_{12} \ x_2 + c_{10}$ and $c_{11} \ x_1 + c_{22} \ x_2 + c_{20}$ are linear parameters. ANFIS architecture can be seen in the Figure 1. From the Figure1, it can be seen that there are 5 layers or 5 layers in ANFIS architecture. The neurons in the first layer are called adaptive to the parameters of an activation function. The output is in the form of a new degree of membership that is formed from existing inputs, namely μA_1, μA_2, μB_1, μB_2. The membership function used in this study was trimf.
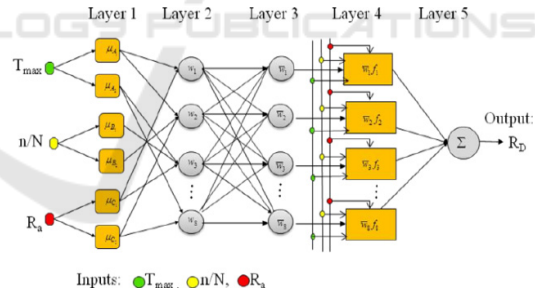

Figure 1: ANFIS diagram with 5 layers.

The neurons in the second layer are fixed neurons and use the And operator. The output is the product of the degree of membership in layer 1 as

$$w_1 = \mu A_1 . \mu B_1$$

where w_1 is an α predicate or fixed neuron. Each node output states the firing strength of each fuzzy rule. This function can be expanded if the premise section has more than two fuzzy sets. The number of vertices in this layer shows how many rules are formed. The neuron in the third layer is formed from the calculation of the ratio of α predicates or fixed

neurons from the i-th rule to the sum of all α predicates. This output is often referred to as normalized firing strength.

$$\overline{w_i} = \frac{w_i}{w_1 + w_2 + \dots + w_n}$$

If more than two rules are formed, the function can be expanded by dividing w_i by the total number of w for all rules. On the third layer, the resulting output becomes adaptive neurons. There are new parameters called consequent parameters ($c_{i1} x_1 + c_{i2} x_2 + c_{10}$). This parameter is affected by the α predicate. In this last layer there is only one output node which is the output or the result of all the calculations that have been done above.

$$\sum_i \overline{w_i} . f_i = \frac{\sum w_i . f_i}{\sum w_i}$$

where $\sum_i \overline{w_i} . f_i$ is y as an output system.

3 RESULTS AND DISCUSSIONS

Characteristics of respondents which most of them were aged <32 years by 54.3%, a small proportion aged> 32 years 45.7%. Based on gender, the majority of respondents were 74.3% female. Based on education, the majority of respondents had a diploma education of 55.7%, the remaining are undergraduate and master degree about 1.4%. Based on the length of work, the majority of respondents worked> 5 years about 64.3% and <5 years about 35.7%.

Based on the results of bivariate analysis, all independent variables were significantly related to employee job satisfaction (p = 0.016), work space (p = 0.009), lighting (p = 0.043), furniture / furniture (p = 0.001), communication tools (p = 0.027), office supplies (p = 0.005), and air fresheners (p = 0.030). Full Chi-Square statistical test results can be seen in Table 1.

The results of multivariate analysis with multiple logistic regression tests showed that as many as 7 variables as a candidate model, obtained as many as 3 variables that affect job satisfaction of hospital employees, namely workspace, furniture / office furniture and office equipment.

The most influential variable in this study is the workspace variable which has a value of Exp (B) / OR = 10.494 meaning that employees who declare a good hospital workspace, have the opportunity to feel

satisfied by 10.4 times higher than employees who declare workspace less well.

Table 1: Relationship of Each Independent and Dependent Variable.

Variables	Job Satisfaction		p-value
	Satisfied	Less satisfied	
Building: Good Less	45 7	10 8	0,016
Workspace: Good Less	47 5	11 7	0,009
Lighting : Good Less	48 4	13 5	0,043
Furniture: Good Less	42 10	6 12	0,001
Communication tool: Good Less	47 5	12 6	0,027
Office supplies: Good Less	46 6	10 8	0,005
Air Freshener: Good Less	46 6	11 7	0,030

Table 3: Multiple Logistic Regression Test Results.

Variables	B	Sig.	Exp(B)	95%CI for Exp(B)
Workspace Furniture Office supplies Constant	2,351 2,160 2,076 -9,641	0,006 0,003 0,009 0,000	10,494 8,671 7,970	1,965-56,051 2,103-35,757 1,665-38,148

3.1 Workspace Effects

The results showed that there was an influence of workspace on job satisfaction of hospital employees. Employees who stated that the hospital workspace was good, had the opportunity to feel satisfied by 10.494 times higher than employees who stated the workspace was not good.

Job satisfaction is one factor that is able to improve the performance of an employee so it needs attention. Low conditions of job satisfaction can cause employees to get bored with their tasks so that sooner or later it is not reliable. Equipment or

infrastructure is very supportive in the work to facilitate and expedite work, especially work space.

The results of this study prove that the completeness of workspace infrastructure facilities affects employee job satisfaction. Employees who state that the work space is complete and in good condition tend to feel satisfied at work. The management realizes that employee participation must be considered because employees as human resources play the most important and potential role for hospital success. Completeness of infrastructure related to work space in the form of area, cleanliness, comfort and layout of photos or paintings.

With the completeness of the furniture provided, the employee will feel satisfied at work. Biasana satisfaction refers to the pleasure and love of his work. In addition, employees also demonstrate discipline by complying with predetermined rules and demonstrate work performance both individually and in groups.

3.2 Furniture Effects

It was found that there is influence of furniture on employee job satisfaction in hospitals. Staff who stated that the hospital furniture was good, had a 8.6 times higher chance of being satisfied compared to those who did not.

The results of this study prove that furniture has a significant effect on employee job satisfaction. Employees who state that furniture is complete and in good condition tend to feel satisfied compared to incomplete ones. The completeness and availability of furniture in the employee's office is related to the arrangement of the location of furniture which is well organized and neat, ergonomic chairs and tables, cupboards to store adequate files, furniture conditions that have long been replaced. All of that is to support employee work and increase job satisfaction.

3.3 Office Supplies Effects

Based on the results of the study showed that there is an influence of office equipment on job satisfaction of hospital employees. Employees who state good hospital office equipment have a 7.9 percent higher chance of being satisfied compared to less good ones.

It was found that the completeness of the office affects employee job satisfaction. Employees who state that complete office equipment tends to feel satisfied at work. The work environment can support work improvement, the office was more attentive and is able to provide office equipment to support the convenience of employees at work. The availability of office equipment needed by employees will

improve and accelerate work to work more effectively and efficiently.

3.4 Smart Model with ANFIS

Data processing starts from entering data, designing input and output forms, trying out training data, and continuing with testing the training data. Next, the model adjusted the range of values and shapes of the input pyramid. 40% of the total data is used as training data and the rest is used as test data. Figure 2 (a) shows the selected training data. Inputs, outputs, and rules on anfis are set using Grid Partition. Member Functions (MF) serves as a reference for the distance value from the input that will categorize the level of assessment of the respondent. In this experiment, 3 MF to provide 3 categories of assessment based on the value of the respondents were used. For the output itself, a constant value is used to increase the accuracy of the data to be processed. In the end some rules that are related to each other will be formed by themselves.

The accuracy of the modeling results is improved by using a hybrid method. The use of hyrid is a combination of backpropagation and least-squares regression which aims to adjust the FIS parameters. Error tolerance is given a value of 0 which indicates that training will stop when the amount of training is reached. The value of the epochs is given 10 which indicates the data will be given 10 repetitions in order to get maximum accuracy. Figure 2 (b) shows the results of testing toward the training data. The results on the data (blue dot) show that the test and training data are coincidental (red dot) which indicate the high level of modeling accuracy. It shows the data that we present with our target of fulfilling what we want.

Figure 3 is a form of rule structure that has been composed of various numbers in the data. The data consists of 7 inputs in the form of Building, work space, lighting, furniture, communication tools, office supplies, and air fresheners and 1 output in the form of employee job satisfaction. The rules formed are interconnected with all input and possibilities formed to produce output.

As explained in the previous Grid Partition, the model will be formed as shown in Figure 3. Consists of three pyramids that indicate the level of respondents' assessment to be processed. Consists of less, medium, and good, each of which represents the category for the number obtained from the respondent's satisfaction value. The distance value used is 1 - 5. The use of this trimf model is very suitable for this data because the accuracy obtained is quite good.

The process in Figure 3 is useful for determining the level of satisfaction of employees based on the results or the total number of questions from respondents. Consists of 7 entries, each based on a total of scores in one rating category. After the data is tried and matched with the initial training data, then the data is compared between the data from the questionnaire and the data from the data that we have designed. This is to prove whether anfis accuracy system is qualified to be used. Figure 4 is the displayed of developed rules. Finally, the accuracy of 97,6% of smart predictive model was obtained.
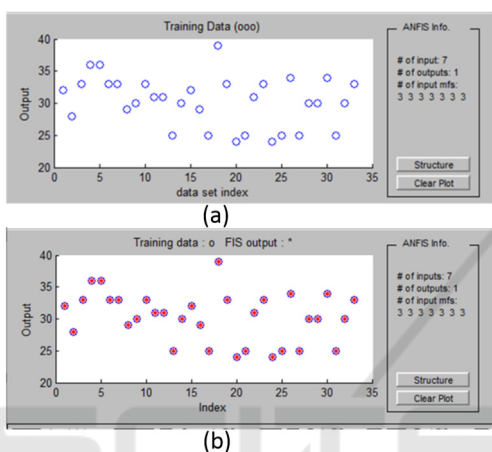

(a)

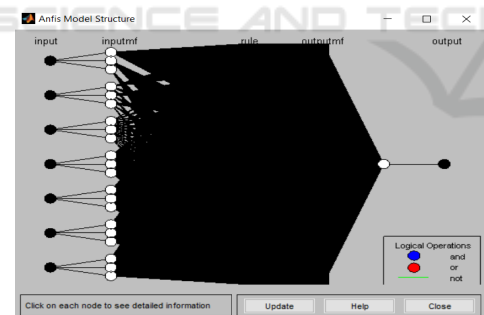

(b)

Figure 2: Training vs Testing data.

Figure 3: The design smart model for job satisfaction.

Figure 4: Rules viewer for parameter adjusting.

4 CONCLUSIONS

Workspace, furniture, office equipment affect employee job satisfaction while building variables, lighting, communication tools, air fresheners do not affect job satisfaction. The most influential variable in this study is the workspace variable which has an Exp (B) / OR value of 10.494, which means that employees who declare a good hospital workspace, have the opportunity to feel satisfied by 10.494 times higher than the less good. Smart prediction model for influence of the infrastructure completeness on work satisfaction with 97.6% accuracy is achieved. The high level of accuracy indicates that the obtained model can be used by management to predict the job satifaction without repetition measurement data.

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