SERVICES IMPROVEMENT WITH TRIZ AND TOPSIS METHOD

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ABSTRACT

One of the first laboratories was established at Atma Jaya Catholic University (UNIKA Atma Jaya) is laboratory of industry statistics in 1999, which along with the opening of the industrial engineering department at UNIKA Atma Jaya Jakarta. As the laboratory was first established, it is only fitting many shortcomings and weaknesses compared to newer laboratory. According to the table Recapitulation Sheets Evaluation of Activities in the laboratory, then the problem in the statistical laboratory can be concluded with the provisions of problems associated with the service and the number is more than 40% of the total students

To fix the problems that arise, we need a tool that can reduce the incidence of problems in the laboratory industry statistics. Tools that are used to identify the problem in this research is TRIZ (Teorija Rezhenija Izobretatelskish Zadach). This method was first discovered by a Russian named Genrich Altshuller in 1946 to fix a problem in the field of product, so that it can provide an innovative alternative solution to every problem. However, recent TRIZ method has been applied to various other disciplines such as social, political, services, biology, and others. The result of the TRIZ method is an alternative solution that should be re-elected. In this study, researchers used TOPSIS method as a tool to select the best innovative solutions.

Based on the TRIZ method, we got innovative solutions to eight types of problems that exist in the laboratory industry statistics. Each problem has more than one alternative solution, so that the TOPSIS method can be selected alternative that comes closest to an ideal solution to be applied in the laboratory industry statistics. Alternative solutions can be applied today is the alternative to overcome the problem of lack of guidance presentation, difficulty of question presentation, the size of the writing on the board that is too small, and many computers are broken. With the Mann-Whitney test, it is known that the average value of 2009-2010 semesters is not equal to the average value of the odd semester of 2010-2011, even the average value of the odd semester of 2010-2011 that has been applying the new method is lower than the previous semester. This happens because some factors beyond the application of the method itself. For many alternative problem that damaged the computer, made students group consisting of two people per group and three computers, where two computer as a backup for each group.

Key words: *TRIZ, TOPSIS, innovative alternatives, Mann-Whitney*

1. INTRODUCTION

Atma Jaya Catholic University is one private university in Jakarta, which is recognized nationally. Atma Jaya was built in 1960, now Atma Jaya Catholic University has seventeen courses that are accredited. One of the newly established departments is majoring in industrial engineering in 1999. To improve the quality of its graduates, Atma Jaya University can perform an upgrade from the various segments that exist, and one of them is quality improvement in industrial engineering laboratory. Graduation requirement that students pass all required laboratory with the ever minimum value of C can be used as a filter to improve the quality of its graduates.

One of the first laboratories was established is laboratory industry statistics in 1999, which along with the opening of the industrial engineering department at Atma Jaya Jakarta. As the laboratory was first established, it is only fitting many shortcomings and weaknesses compared to newer laboratory. The shortcomings are the facilities that have been aged parents,

teaching techniques that are not appropriate, the lack of facilities that support teaching, and others.

To improve the quality of industrial engineering graduate of Atma Jaya, then one of them is to improve the quality of the laboratory that was one graduate student. Improving the quality of the laboratory is by finding and repairing problems in the laboratory industry statistics. The principal problem is how to improve laboratory services in the industry statistics that could improve the quality of its graduates.

For this study is not too broad in scope, then given the necessary restrictions, namely:

1. Recapitulation questionnaire based on historical data of the questionnaire data practicum semester industrial statistics 2009-2010
2. Student satisfaction based on laboratory facilities and the quality of teachers during the practicum took place
3. Comparison of quality of graduate laboratory industry statistics based on the presentation of research between 2009/2010 semester by semester odd 2010-2011

2. RESEARCH METHODOLOGY

Preparation of research done to find out and get a general picture about the state of industrial statistics laboratory at the University of Atma Jaya, which is where the general picture can be identified problem. By knowing the problem exists, then made the formulation of the problem and the problem definition, and goals to be achieved by the researchers. The last stage of preparation of this research is to study literature on all supporters of the theory related to research.

Complete data were taken from questionnaires ISO "Evaluation of the Implementation of Activity Sheet Form In the Laboratory". Recapitulated the number of questionnaires is 92 pieces, according to industry statistics the population throughout researcher semester 2009/2010. From the results of these questionnaires, could got grievances felt by researcher during the practicum takes place in one semester.

Data processing is a process of processing data that has been collected previously in the hope that the results obtained in accordance with the original purpose of the study, and carried out systematically according to the methods required. Data processing consists of several stages, namely:

1. Identify the problem
2. Definition of problem
3. Determining tools
4. Solution problem
5. Evaluate solutions
6. Application solutions

When the solution obtained by TOPSIS method can be applied, then the researcher will do the application directly to one to two meetings in the laboratory. But sometimes there are solutions that can not be applied if the cost associated with such a large renovation of laboratories, purchase of computers, changing the layout of desks and blackboards, and so forth.

3. RESULTS AND DISCUSSION

Data was collected using a questionnaire ISO Atma Jaya with the title Activity Evaluation Sheet Form In FR-UAJ-09-14/RO Laboratory. The questionnaire is made by the ISO Team Atma Jaya Jakarta for the purpose of ISO certification, especially ISO Faculty of Engineering, Atma Jaya. Questionnaires with FR-UAJ-09-14/RO code, is used by all engineering laboratory at Atma Jaya Jakarta, so that the contents of the questionnaire can be justified by the Atma Jaya itself.

At this stage of data processing, done some testing to get the desired results in accordance with the purpose, in the early stages, is used TRIZ Tools to find the problem and seek solutions of the problems encountered. The next phase is to evaluate the solutions obtained by the elimination method using TOPSIS method of decision analysis.

Based Anatsari (1990), limits the emergence of problems in a human service to the field of services is 40% of the population, then the

problem in the statistical laboratory can be concluded with the provisions of problems associated with the service and the number is more than 40% of the total researcher, then there are 15 problem that appears associated with service in the statistic laboratory

At this stage of problem definition, formulation of the problem is (problem formulation) with a diagram that shows a causal relationship between problems that arise from the 15 types of problems in the laboratory industry statistics. Here's one picture formulation of the problem to the problem of lack of lab equipment

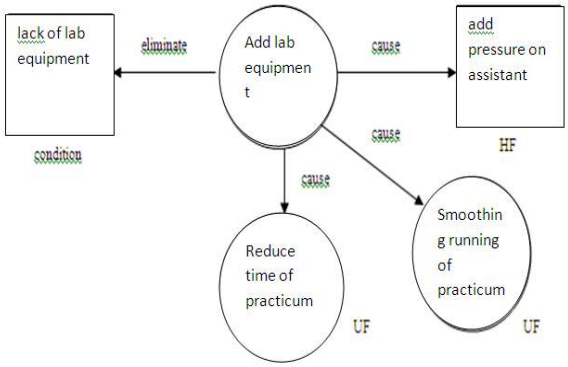

Figure 1. Problem Formulation

Based on the above picture, then it could be a sentence - a sentence which states the existence of contradictions relationship problems this stage is called with a problem statement. The relationship of this problem is defined on solutions that produce harmful function (HF), and not done on the useful function (UF). Examples for this problem are: to increase the number of lab equipment used, it will increase pressure on the assistant on duty to care for and maintain all equipments used by each lab progress

Phase contradiction tools is an important stage and the overall influence of TRIZ tools. At this stage the researcher should be able to share problems-problems that exist under the category of problems according to the rules of TRIZ tools itself. Based on the information that researchers can get directly from Prof. Chai. K. H, grouping in a parameter problem is really subjective, in accordance with their respective ideas of researchers who use them.

Examples of tools contradiction to the above problems are as follows

Table 1. Contradiction tools

No.	Problem	39 Parameters		Brief Reasons
1	number of lab equipment is less	FTC	Volume stationary object	number of lab equipment that is not moving
		UR	Stress or pressure	pressure to maintain lab equipment

Results from these tools contradiction table will be included in the TRIZ contradiction table to determine the appropriate number of principles to the problem. On the problem of lack of lab equipment, with the feature to change and undisired results, the obtained value of the solution number 24 and 35 of 40 principles. So both of numbers is an appropriate alternative solution to overcome the problem of lack of lab equipment.

After the researchers to group problems in 39 parameters, and known alternative solutions relating to the problem, then the next stage of innovation is developing a selected from 40 Principles. Here's an innovative solution to the problem of lack of lab equipment with solution number 24 and 35 at 40 Principles:

1. Does not add practical tool, but researcher bring the tools for experimental purposes alone from home, so the lab does not provide practical tools. Thus assistants do not have the responsibility to care for and maintain lab equipment (solution number 24)
2. Adding a practical tool but change the previous system, which focuses responsibility for all equipment at the lab assistant, became a shared responsibility between researcher and assistants. So researcher also have the responsibility to care for and maintain all lab equipment is used. (solution number 35)
3. Adding some kind of practical tools are easy to maintain, and change the use of lab equipment into fewer types. Such as adding rubber balls for data retrieval, and replace the use of the card (because the card is more easily damaged, such as stuck together, torn, hit the water, etc.) (solution number 35)
4. Not practical but add a device using practical tools that are not in physical

form, so it is not required by the process of care and custody assistants and researcher. Retrieving data using the program on the computer, so that adequate treatment is a computer maintenance course (solution number 35)

Based on the TRIZ method, has been the result of alternative solutions for each problem, where every problem could result in some solutions. However, it should be the selection of the best alternative solutions to be applied, so used TOPSIS.

In the TOPSIS method, required attributes that are used for comparison are determined subjectively by the decision makers, in this case, the decision maker is a laboratory assistant and head of the laboratory. The attributes used in each problem differs according to the needs of each related problems. In the selection and assessment of attributes, researchers have been discussing with statistical laboratory assistant in the field on 25 October 2010 to 3 November 2010.

Here are the results of the calculation of weighting the attributes using entropy method on the problem of lack of lab equipment. The attributes used are cost, liability, storage needs, and length of preparation.

Table 2. TOPSIS Matrix

	Biaya(Rp) (Y1)	Luas (cm^2) (Y2)	Waktu (hari) (Y3)	Tanggung jawab (Y4)
Alternatif 1 (a1)	1	1	1	1
Alternatif 2 (a2)	1.719.000	2725,8	1	4
Alternatif 3 (a3)	1.660.000	2428,8	1	3
Alternatif 4 (a4)	3.500.000	1	90	2
Σ	6.879.001	5155,6	93	10

Table 3. TOPSIS Matrix Result

	a1	a2	a3	a4
S_i^*	0,070	0,010	0,007	0,111
S_i^-	0,131	0,019	0,021	0,089
$S_i^* + S_i^-$	0,201	0,029	0,028	0,200
C_i^*	0,652	0,664	0,739	0,443

Based on the above calculation with TOPSIS method, the alternative selected is the alternative with the largest value of Ci *, due to higher conversion is done better, it means that the greatest value is the best. For the problem of lack of lab equipment, alternative solutions are selected from the above TOPSIS method is alternative 3, which adds some kind of practical tools are easy to maintain, and change the use of lab equipment into fewer types. Such as adding rubber balls for data retrieval, and replace the use of the card (because the card is more easily damaged, such as stuck together, torn, hit the water, etc.). Selected alternative is not the best alternative, because there are still shortcomings also compared other alternatives, but the alternative selected is the closest alternative to the ideal solution.

TOPSIS calculations performed for each problem, so that each and every problem has a solution that most nearly ideal for application.

Table 4. Solutions Elected

No.	Problem	Solutions Elected
1	The number of practical tools that are less	add some kind of practical tools are easy to maintain, and change the use of lab equipment into fewer types. Such as adding rubber balls for data retrieval, and replace the use of the card (because the card is more easily damaged, such as stuck together, torn, hit the water, etc.)
2	Test time (various tests), which is not long enough	extended testing time but the assistant should be more concerned with cheating researcher's places like pencil cases, calculators, rulers, mobile phones, etc.
3	Problem test (various tests) are too difficult	change the assessment system during the test, where a matter is difficult to get a greater weight than a simple matter, so that each test is a matter of easy and difficult problem
4	Guidance making presentations	guidance does not always have the assistant, but could also on researcher other friends who have passed the laboratory statistics, so researcher will be more discussion with their friends rather than ask directly to the assistant
5	Problem presentations test are too difficult	presentation of questions is not watered down but the value obtained when the researcher is able to answer properly higher, whereas when it is not able to answer remained no value as well (changes in the assessment system, rather than because)
6	The writing on the blackboard is less clear (size & shape)	size of the writing on the blackboard not be enlarged at any time, but only in some modules that require a little explanation on the board, while in some modules that require a lot of information, text sizes remain small, so that no information was not conveyed to the researcher
7	AC in lab is not cool enough	AC cooled but the researcher is given additional duties, questions, revisions to the report, and others to reduce idle time in the lab waiting for her friends to experiment
8	Too many breakdown computer	divide into groups of researcher use of computers, so that not every group of researcher to get a computer for data processing, not every person

There are various obstacles that hinder the application implemented, so there are only a few solutions that can be implemented today to analyze the results. Constraints caused by

the lab has been running for more than half, and it is impossible to change the matter, systems, or other things in the middle of practice. When the data processing was completed, statistical lab industry has entered the eighth module, namely Decision Analysis module, which in this module does not use practical tools such as balls, cards, or scales

For applications solutions to the problem presentation counseling research and questions, the results were compared with the value of the previous semester research presentations. Of the two populations, it is known that the data is not normal distribution for both populations, so the Mann Whitney test was used to compare both the average value.

Mann Whitney test was performed with Minitab software 15, with the following results:

Mann-Whitney Test and CI: genap 2009/2010, ganjil 2010/2011

	N	Median
genap 2009/2010	96	70.00
ganjil 2010/2011	32	62.50

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Point estimate for ETA1-ETA2 is 8.00
95.0 Percent CI for ETA1-ETA2 is (2.00,13.00)
W = 6777.0
Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at 0.0013
The test is significant at 0.0012 (adjusted for ties)
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Conclusion: Reject H0 because the P value (0.0013) <α (0.01), so the average value of 2009-2010 semester is not equal to the average value of the odd semester of 2010-2011.

Problems that are not clearly written on the board improved by increasing the size of the writing on certain modules that do not require a lot of writing on the board. In these eight modules, decision analysis module, an assistant can apply this solution because there is little written on the board.

For many problems a computer that is damaged, do grouping per two people per shift it. Based on information from statistical assistant, it is known that in the odd semester 2010/2011 there were only 24 computers that can function well for statistical data processing (software SPSS and Minitab). So the clustering researcher done to 24 computer. Table 5 shows an example grouping done on the shift A.

Table 5. Distribution group

shift A		
Computer no.	researcher 1	researcher 2
1	Angella Olivia K	Hani Natalia
2	Albert Agung	Aurelius
3	Yudhi	Ignatius Patty R W
4	Nixon William K	Christoforus
5	Angella Olivia K	Hani Natalia
6	Albert Agung	Aurelius
8	Yudhi	Ignatius Patty R W
9	Nixon William K	Christoforus
11	Angella Olivia K	Hani Natalia
15	Albert Agung	Aurelius
16	Yudhi	Ignatius Patty R W
18	Nixon William K	Christoforus

In table 5 there are three different colors where the color indicates the use of different computer if the computer was originally damaged. So each group has three alternatives researcher computer number which can be used in the statistical laboratory for lab work in progress.

4. CONCLUSION

Based on research that has been created by researchers in previous chapters as well as goals to be achieved, then made the following conclusion:

1. To improve the quality of laboratory services in statistics during the practicum lasts, to be processed by TRIZ methods, in order to get an alternative that comes closest to the ideal solution to every problem
2. Based on the results of data processing for the application chosen solution, found only four solutions that can be directly applied
3. From the results of application of these solutions, which can be measured with certainty is the presentation of research that found between odd semester researcher semester 2010/2011 with 2009/2010. The results of the comparison value is no difference between the value researcher second semester because of various things
4. The size of the writing on the board be enlarged and clarified the eight modules

(decision analysis module), so that writing can be seen from the rear
5. Grouping researcher for the use of computers is divided to two people per group, with the reserves two additional computer per group. So each group researcher get three numbers that computers can be used if the computer is damaged
6. There are some differences between TRIZ and TRIZ in services in the fields of product, but such differences do not hamper the data processing itself TRIZ

5. SUGGESTION

Advice given by the researchers are suggestions for further research and suggestions for practical in the laboratory industry statistics Atma Jaya University.
Suggestions for the Laboratory of Industrial Statistics and Decision Support:
1. Apply improvement methods to solve problems that arise in the laboratory industry statistics
2. Perform a planned preparation for the repair of this research can be conducted and perceived benefits
3. Coordinate changes that will be conducted by a laboratory head statistics

Suggestions for further research:
1. Make 39 parameters and 40 principles are specially equipped for field service
2. More informant asked prof. Chai. K. H to get more certainty
3. TRIZ method to apply for services for other examples, so the bias prove the truth of the theory of TRIZ in service sector
4. Further clarify the problem in the function diagram

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