IMPLEMENTATION OF EXPERT SYSTEM FOR MONITORING PERFORMANCE ENGINE AND EMPLOYEES IN WEAVING UNIT USE RULE-BASED REASONING METHOD

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Abstract

The textile industry is very suitable to be developed in Indonesia because it is a intensive industry absorb labor. Increased production in the textile industry can be done by using information technology. One form of information technology in industry is by applying an expert system. This research is the development of a monitoring system AJL who have been there before. AJL monitoring systems read the status of the weaving unit then stored into the database. Status data and expert interview data is used as input of an expert system. Expert system using rule-based reasoning method that has 6 rules to determine the performance of the engine, the performance of employees and the quality of the thread. The output of the system is classification of performance that displayed in tables and graphs using a visual programming language.The research resulted a system that display the classification of performance the engine, the performance of employees and the quality of the thread so it can help menajerial on aspects of engine management and human resources. Expert system has been tested with dummy data then compared to manual calculation and the results are the same.

Keywords: textile industry, expert systems, rule-based reasoning, engine and employee performance.

I. Introduction

The textile industry is very suitable to be developed in Indonesia because it is a intensive industry absorb labor.

Increasing production in the textile industry is needed to help the Indonesian economy. Increased production in the textile industry can be done by using information technology . One form of information technology industry in the world is by applying an expert system . Expert system is a system that tried to copy the human knowledge into the computer, so the computer can solve problems like an expert (Kusumadewi , 2003) . Human expertise does not last long , can be lost due to the expert died , stopped working or transfer employment . Expert system is a software that is run by using a computer . By using expert systems , expertise can be continuously used for the computer is started . An expert in the concwarpon is influenced by several factors , while the expert system which can perform with consistent concwarpons . In addition, in certain cases can result in a more rapid concwarpon . Expert system is an expert system then the software can be customized so that it can be made the same expert system with large numbers and can work continuously.

The purpose of this research is to make the application of expert systems in the weaving unit for monitoring engine performance and employees by using rule-based reasoning in a textile company.

II. Theory framework

A. Definition of Expert System

Expert system is a computer program designed to model the problem solving like an expert (Durkin, 1994). Expert systems can also be defined as a field of computer science which utilizes intelligent computer so that it can behave like a human. Expert system that functioned as a program to mimic human experts should be able to do things that can be done by an exper (Giarrantano dan Riley, 2005). Experts are people who have capability or understand in the face of a problem. From experience, an expert on developing the capability of being make it can solve the problem with good results and efficient (Hartati and Iswanti, 2008).

B. Architecture expert system

Architecture expert system consisting of 7 the main component for as seen from figure 1. Components was : (Hartati dan Iswanti, 2008) :

a. User Interface
Expert system providing communication between system and the wearer called the interface. Interface effective and user-friendly very important that especially for users who are not skilled in an art applied to systems experts.

b. Knowledge Base
The base of knowledge contains knowledge needed to understand, formulating and resolve the matter. The base of knowledge is dynamic, can grow from time to time.

c. Inference Machine
In the form of software that contains to a methodology used to perform reasoning against bits on information in a base of knowledge and used for formulating conclusion. This part can also be said as a thinking machine because in principle to find solution of a problem.

d. Working Memory
Is the part used for storing facts acquired while the process of inference that is temporary because used to the process of inference next.

e. Database
A database is a place for acquiring data sources for machines inference it is also to accommodate solution the result of the process of inference.

f. Expert
Experts are people who have capability or expert in a particular field.

g. User
The user is users common who benefit from expert system.

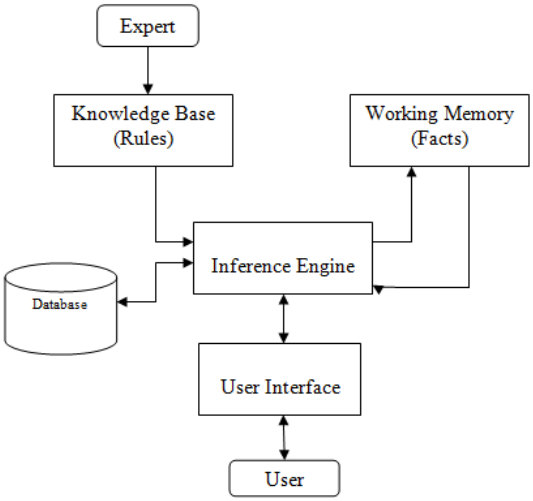

Figure 1. Architecture expert system

C. Knowledge Base

The base of knowledge contains pengetahuan-pengetahuan in solve the problem, corresponding to a given domain. There are two forms approach the base of knowledge commonly used, namely: rule-based reasoning and case-based reasoning (Kusumadewi, 2003).

D. Rule-Based Reasoning

To rule-based reasoining, knowledge was presented by the use of rules include: if-then (muhammad, 2005). This form is used when having a number of experts on a knowledge of a particular matter, and the experts can deal with the problem in a row. Besides, this form is also used when needed an explanation of the achievement of a solution. The representation of knowledge is as follows :

Rule 1:
IF The government does not consistent
THEN dollar rise
Rule 2:
IF The fuel oil prices rise,
THEN Prices of goods expensive
Rule 3:
IF The government does not consistent
AND The fuel oil prices rise,
THEN to buy dollars

E. Unit Weaving

Unit weaving very important in textiles because is a unit which used to cultivate raw material form of threads into a fabric. In production process this unit must go on because if stop will be decreasing volume of production thread. With reduced output thread while operational costs would remain causing the company loss.

The working mechanism of weaving unit is crossed threads of feed among the ranks of threads warp, so formed plait certain appropriate design woven fabric determined. The difference between the weft and warp observable from figure 2.

Figure 2. The weft thread (left) and warp thread (right)

Weaving machine used in research is ajl (water jet looms). Machine ajl 4 have lights indicator have different colors to show status of machinery, as seen from figure 3. Four a lamp shade the indicators are:

1. Green color show machine was running.
2. Blue color show machine stopped because the weft broke up.
3. Yellow color show machine stopped because the thread warp broke up.
4. Red shows machine stopped because for another.

Figure 3. Machine AJL (air jet looms)

III. Methodology

A. Research Materials

Material used in this research in the form of the results of the interviews and transaction data. Transaction data obtained from the application of monitoring system ajl in PT Primatexco Indonesia. PT Primatexco Indonesia has address in the way of Jendral Urip Sumoharjo, Village Sambong, District Batang, Central Java.

Data obtained from speakers interview that are masters / experts in the field of weaving. The speakers was supervisor and manager at the weaving in PT Primatexco Indonesia named Mr. Puji Raharjo and Mr. Faiturrahman. From the results of the interview obtained of factors determine the performance of employees and machinery. A good performance is the fulfillment the target set by the company. The value of the target adjusted by the name of an item that is produced and stored in tabular dataitem. A table dataitem can be seen on a table 1.

Table 1. Table dataitem result of monitoring system ajl

NO	NAMA ITEM	TARGET LUSI (Menit)	TARGET PAKAN (Menit)	TARGET MESIN (Permenit)
1	KK 104-1	1.5	2.5	0.2
2	KK 623-1	1	2.5	0.2
3	KK 124-1	1	2.5	0.2
4	KK 348-1	1	2.5	0.2
6	KK 347-1	1	2.5	0.2
5	KK 411-1	1	2.5	0.2
8	KK 317-1	1	2.5	0.2
7	KK 616-1	1	2.5	0.2

Transaction data obtained from the recitation status of the unit of weaving. Blok diagram system readout data contained in application monitoring system ajl as was in this figure 4.

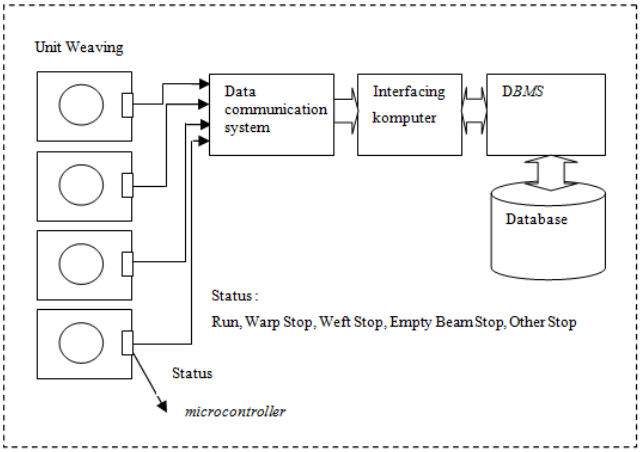

Figure 4. Data readout system diagram

As seen from figure 4 system starts from unit weaving. In the units weaving mounted mikrokontroler used for reading status consisting of run, warp stop, feed stop, empty beam stop and other stop. Of status has next coded so as to be applied to the process data communication with computers. Order next is read the code by computer through a process interface computer. After the computer interface next is the process changed another become a role model N and T through calculation against time and enumeration as seen on table 2. Next parameters is stowed to table datarecord based on engine number as seen on tables 3.

Table 2. The parameters of N and T in units of weaving

PARAMETER	DESCRIPTION	UNIT
T1	Time weft stop	Minute
T2	Time warp stop	Minute
T3	Time running	Minute
T4	Time empty *beam stop*	Minute
T5	Time *other stop*	Minute
N1	Count of weft stop	How many times events
N2	Count of warp stop	How many times events
N3	Count of running	How many times events
N4	Count of empty beam stop	How many times events
N5	Cacah of other stop	How many times events

Table 3. Table Datarecord

ID	DATENO	SHIFT	NOMOR MESIN	TANGGAL	WAKTU	DATA	TT	T1	T2	T3	T4	T5	N1	N2	N3	N4	N5
156526	20130522060100	1	JD-01	22/05/2013	11:32:52	13	331,8	7,933	17,25	302,2	0	4,383	8	8	14	0	4
156527	20130522060100	1	JA-01	22/05/2013	11:32:48	13	331,8	16,2	37,07	268,6	0	9,883	14	12	27	0	5
156528	20130522060100	1	JD-02	22/05/2013	11:32:52	11	331,8	9,05	43,08	271,2	0	8,467	14	17	30	0	4
156529	20130522060100	1	JA-02	22/05/2013	11:32:48	13	331,8	27,68	10,02	289,2	0	4,833	43	17	58	0	6
156530	20130522060100	1	JA-11	22/05/2013	11:32:44	13	331,6	8,65	15,42	280,5	0	4,633	32	54	182	0	21
156531	20130522060101	1	JD-03	22/05/2013	11:32:53	13	331,7	18,77	58,02	253,5	0	1,433	25	16	40	0	2
156532	20130522060101	1	JA-03	22/05/2013	11:32:49	13	331,7	16,43	9,717	302,4	0	3,1	25	2	29	0	1
156533	20130522060101	1	JA-12	22/05/2013	11:32:45	13	331,7	9,25	17,87	282,7	0	2,333	38	59	178	1	11
156534	20130522060101	1	JD-04	22/05/2013	11:32:53	13	331,8	16,47	14,95	296,9	0	3,55	23	4	27	0	6
156535	20130522060101	1	JA-04	22/05/2013	11:32:49	13	331,7	8,85	47,82	267,8	0	7,183	14	15	30	0	1
156536	20130522060101	1	JD-11	22/05/2013	11:32:47	13	331,7	9,417	10,4	302,4	0	9,45	12	5	18	0	7
156537	20130522060101	1	JA-13	22/05/2013	11:32:45	13	331,6	10,57	14,83	280,8	0	1,733	41	57	187	0	6
156538	20130522060101	1	JD-05	22/05/2013	11:32:54	13	331,8	6,933	0	324,9	0	0	5	0	6	0	0
156539	20130522060101	1	JA-05	22/05/2013	11:32:50	13	331,7	116,9	7,133	193,9	0	13,75	130	2	126	0	12
156540	20130522060102	1	JD-12	22/05/2013	11:32:47	13	331,7	14,27	5,183	311,7	0	0,567	17	4	22	0	2
156541	20130522060102	1	JA-14	22/05/2013	11:32:46	13	331,6	13,12	12,8	281	0	0,833	59	55	208	0	4
156542	20130522060102	1	JG-01	22/05/2013	11:32:54	13	331,7	14,97	3,767	312,8	0	0,2	14	1	15	0	1
156543	20130522060102	1	JD-06	22/05/2013	11:32:55	13	331,8	19,73	49,35	262,5	0	0,183	24	6	30	0	1
156544	20130522060102	1	JA-06	22/05/2013	11:32:50	3	331,7	11,43	71,53	242,9	0	5,9	14	15	30	0	3

B. Research Tool

Instrument used in this research is

1. Consisting of a set of computer hardware to the specifications toshiba satellite l745 prosessor's core i 5, a storage medium (harddisk), 250 the pl and memory 2 gb.
2. Software such as windows, operating system a programming language delphi and mysql to management database.

C. System Development

This research constituting development of monitoring system ajl. The system yields display status of each machine. Next status the machine calculated and stored in a database. Status machine news calculated to get efficiency machines and the production of.

System that old still oriented efficiency machines and the production of not specifically showing performance machines and employees. System development done by applying expert system using database it already is. Database then will be an expert system for to display data performance of each machines and employees. Taking process data use query employee performance and query performance machine.

D. The Design of System Using DFD

Data flow diagram is diagram of flow of data describing how the data processed by the system. The diagram context of the displayed figure 5. Entity external experts, these are expert system and user admin. Speakers was supervisor and manager at the weaving in PT Primatexco Indonesia. The result of the interview factor determining performance by employees and machinery.

Experts selected from supervisor and managers who is an employee who know how of units of weaving. Employee who experienced will know the exact value to determine the value of parameters N and T. Determination target value parameters will determine the output of a system. Entity experts will do target inputan against the machine the employees and the parameters by means of login in the system. Entity user admin do the regulation on access and the right of each entity. The user is entity ekternal entity that can obtain information about the performance of a machine employees performance the thread and monthly performance by means of login in expert system.

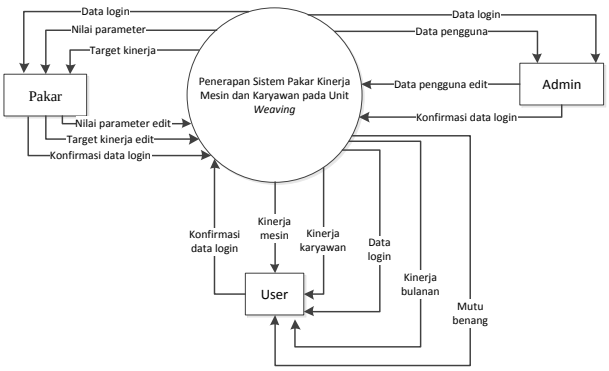

Figure 5. The context diagram

To describe the data stream of input and output, management process data storage and processes to store data indicated on figure 6. Process in the expert system consisting of 5 namely process logins, process rule-based, process

machinery, performance employee performance and quality thread, the process of showing performance monthly and processes user. Login process used to regulate user allowed use system. Data store applied to the process logins is es_ user; es_userlevel, and es_menu. Rule-based process used to store the parameters and the target in input by experts. Process performance machinery, performance employee and quality thread used to display each performance. Arrangement user done by admin by using process user. The last process is showing monthly performance is done by the user and use the data store es_kinerjahari.

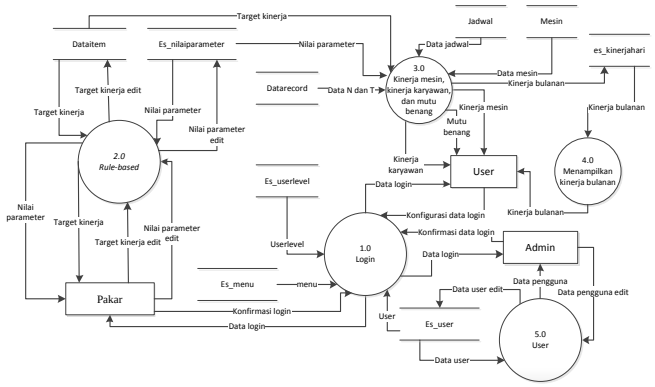

Figure 6. DFD expert system

E. Design database

Expert system is use database worn by monitoring system ajl plus some table support the new system developmen.

1. Old table consists of 4 tables that:
   dataitem, datarecord, mesin dan jadwal.
2. New table consists of 5 that es_user, es_userlevel, es_menu, es_nilaiparameter dan es_kinerjahari.

F. Design Rule-Based Reasoning

Reasoning based rules knowledge represented by using rule shaped if-then. Form here used because there are a knowledge experts at issue performance machines and employees. So experts can solve a performance problem in a sequence.

On this design the rules written in the form of statements IF [premise] THEN [conclusion]. At expert system design this premise is the value or N or T and konkuwarp is performance. Parameters N and T and stored in table datarecord. While the target filled by experts kept in table dataitem.

Based on the table datarecord and not all field used to design a experts system. Field used to design expert system T1, T2, N1, and N2 with the formula as follows :

$$T_k = \frac{T1}{N1} + \frac{T2}{N2}$$

description :
T_k : employee performance with the units are minutes
T_1 : time weft stop with a unit of minutes
T_2 : time warp stop with a unit of minutes
N_1 : count weft stop with a unit of x times
N_2 : count warp stop with a unit of x times

On a table dataitem used to design expert system is field target_feed, target_warp, and target_machine. The target is time to be protected by employees to couple thread with unit minutes.

The Target machine is broken thread index per minute.

$$W = TargetPakan + TargetWarp$$

description :
W : target index with a unit of minutes
$TargetPakan$: target weft with a unit of minutes
$TargetWarp$: target warp with unit of minutes

$$F_t = TargetMesin$$

description :
F_t : target index broken thread per minute

Untuk menghitung frekwensi putusnya benang permenit menggunakan tabel *datarecord* dengan rumus sebagai berikut :

$$F_m = (N_1+N_2)/(T_1+T_2+T_3+T_4+T_5)$$

description :
F_m index broken thread per minute
N_1 : count weft stop with a unit of x times
N_2 : count warp stop with a unit of x times
T_1 : time weft stop with a unit of minutes
T_2 : time warp stop with a unit of minutes
T_3 : time running with a unit of minutes
T_4 : time empty *beam stop* with a unit of minutes
T_5 : time *other stop* with a unit of minutes

Having acquired the value of field table datarecord and dataitem then made design rules for expert system as on a table 4.

Table 4. Rules for expert system

No.	IF	THEN
1.	$T_k > W$	Employee performance is not good
2.	$T_k \leq W$	Employee performance is good
3.	$F_m > F_t$ and Does not occur in all machine which produces an item that same and there are at least n machine	Performance machine not good or thread unsuitable for the machine
4.	$F_m \leq F_t$ and Does not occur in all machine which produces an item that same and there are at least n machine	.Engine performance is good
5.	$F_m > F_t$ and Occur in all machine which produces an item that same and there are at least n machine	The quality of thread is not good
6.	$F_m \leq F_t$ and Occur in all machine which produces an item that same and there are at least n machine	The quality of thread is good

IV. Results and Discussion

A. Research Result

Expert system research showing list performance machines, employees and the threads each classified two things are good and not good. Classification systems based on rules experts found in tabular 3. While the data processed is datarecord that is the result of weaving unit data acquisition status.

Setting the value of the percentage the number of machines and a minimal amount machine is carried on a menu of setting the value of a parameter. The value of a percentage 80 and a minimal amount machine 2 shows that as many as 80 % or more of all engines for items same it has value index many thread staak exceeding a target and the number of machine more than 2, then quality thread not good. A menu setting the parameters can be seen from figure 7.

Figure 7. A menu setting the parameters

The value of performance targets in input on the menu target performance. Performance targets consist of warp target, weft target and machine target. Performance values can change by the way add value or change the value. The example in Figure 9 when value added process then selected to target the original warp 2.5 will be 5 because it is coupled with a 2.5 rating in accordance with the target field, warp, likewise for weft and machine target.

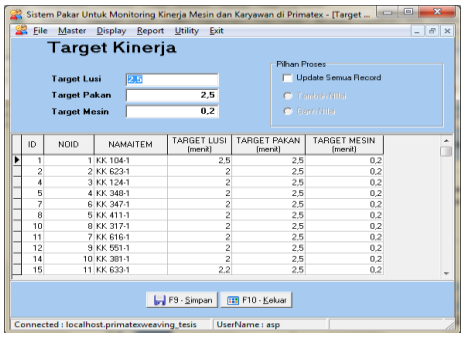

Figure 8. Menu performance targets

A menu display is the main menu of expert system it ' s because there ' s the reading process data on a ajl. The result of the reading data then to the rules of expert system then shown into the performance of the performance of a machine, which is 3 the performance of its employees and the quality of threads as seen from figure 9. Can be substituted date as the date of the other to see the performance of to be desired. Performance displayed in graphical form to ease the reading data.

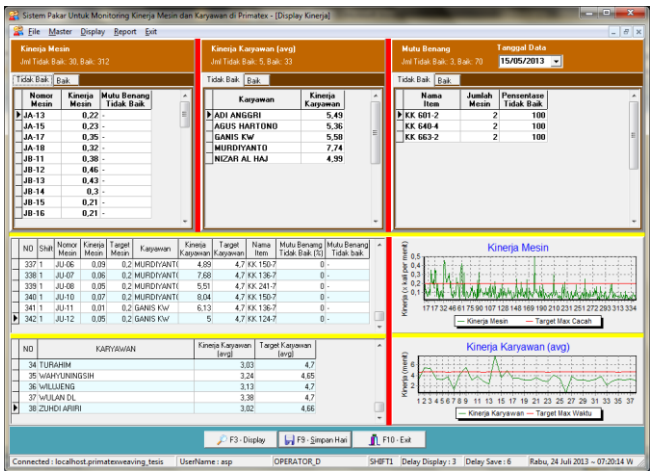

Figure 9. Menu display

a. Discussion

Monitoring performance machine and employees can done well after using expert system this. Monitoring done by means of looked at or charts performance on a menu display. Employees that possess performance not good can be known and be done supervision or development by part of human resources. Performance when declining evenly at a particular time caused from exhaustion can then be given solution in form of food small or light refreshments to improve its performance again. Otherwise employees that possess a good performance can be given incentive to promote or preserve its performance. Machine that have performance not good will soon be known and become input for managerial pengeloloan the machine.

Employee performance value obtained from the calculation of average, for an employee to handle more than 1 machine. Example employee named Siti Luhendah retrieved values performance 3.51 + 1.76 + 2.63 + 2.96 + 3.13 + 3.5 + 3.4 + 2.61 + 2.04 + 2.5 = 29.59 then that value on average then the result is 2.96, as in the table 5.

Table 5. The average value of employee performance

NO	KARYAWAN	Kinerja Karyawan (avg)	Target Karyawan (avg)
22	ROFIQ	2,98	4,7
23	SITI LUHENDAH	2,96	4,58
24	SOFYAN HAKIM	4,17	4,7
25	SOLECHA	3,37	4,7
26	SRI BADARIYAH	0,73	4,7
27	SRI WAENDAH	3,88	4,76
28	SUGIONO	3,18	4,7

Engine does not good performance was the application of rule number three expert system. While a good performance was the application rules to 4. Display after program is run as in a figure 10.

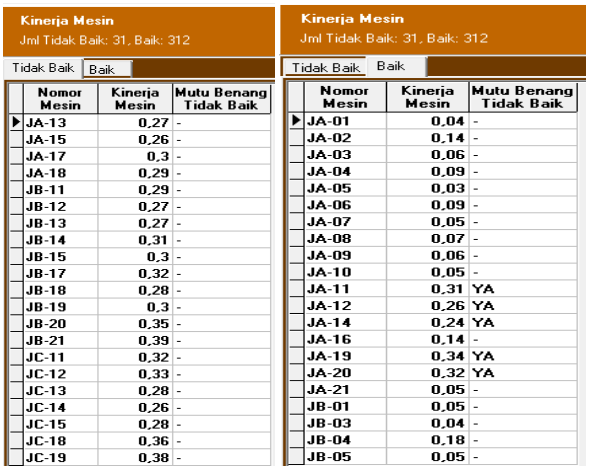

Figure 10. Engine performance is not good and good

Employee performance not good was the application rule number 1 of expert system. While employee performance good was the application rule number 2. Display program is run as in a figure 11.

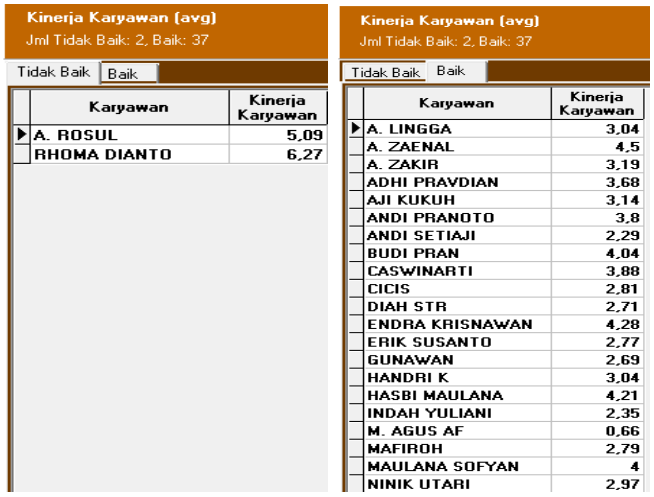

Figure 11. Employee performance is not good and good

The quality of not good thread is application of the rules of a system of experts to 5 beang good while the quality is the rule of experts to 6. A display after progam run as in a figure 12.

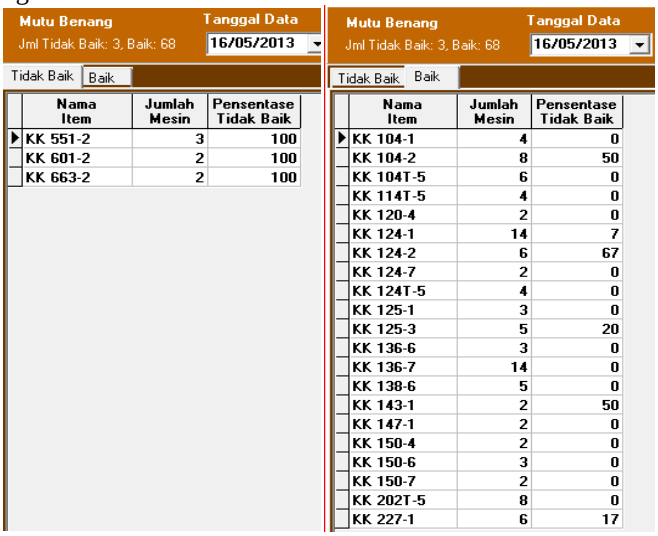

Figure 12. The quality of thread is not good and good

V. Conclusion

Research expert system for monitoring the performance of engines and employees in units of weaving several conclusion as follows:

1. Expert system for monitoring engine performance and employees using rule-based reasoning method. Testing with dummy data and real data generate data according to the calculation.
2. The system can display the engine performance, the employees performance and quality of thread.
3. System can be showing specifically engine number and the name of employees in order to help the managerial on the machine and human resources management.

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