

Expert System Detects Problems of Inkmaker Machine And Mixer With Forward Chaining

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Abstract— Industrial growth is characterized by the ability to progress in the field of production both in the type of industry, increasing the quality and volume of production activities. Machine is one of the factors of production which determines the smoothness of a production process. In order for the production process to run efficiently, a certain part of the company that is needed to support the maintenance and repair of the machine is called Maintenance Engineering. PT. Segwerk Ind is a multinational company engaged in printing inks for the packaging industry with imported raw materials such as dyes, varnish. The problem of how to maintain the condition of the machine so that it is always prime when production activities take place, Trouble machines are indeed one of the factors that can make a company go bankrupt, such as the production process is hampered, a long machine down time, so that customers will replace their suppliers because they do not want to risk business they are stunted. Therefore, for the success factor of a company's production process, it is required to have appropriate preventive and corrective maintenance activities as well as the problem of lack of competent human resources, therefore we need tools that can solve these problems. The results displayed by making expert system software show that the ink machine problem solving can be known based on the historical machine so that the downtime faced by PT. Segwerk Ind can be pressed as little as possible against machines in the ink industry such as ink printing machines.

Keywords— detecting ink engine problems; expert systems; forward chaining

I. INTRODUCTION

Industrial growth is characterized by the advancement capability in the production field in both industrial types, improvement of quality and volume of production activities. The machine is one of the production factors that determine the smoothness of a production process. For the production process to run efficiently, a certain part in the company that supports to do maintenance and repair to the machine is Maintenance Engineering. Maintenance and repair system that already exist in several companies already based Online (CMMS), so that the production operator can send a Job Order Online in case of trouble machines, then maintenance engineering will immediately take action ranging from the manufacturing to repairs/maintenance, but

this can only be done in a certain shift condition (such as morning shift).

According to (Pudji W, 2012) the journal PT. Philips Indonesia is a company engaged in the field of lighting (lighting / lamps). This company always produces maximum production results. In the Lamp Component Factory section especially in the Stem Glass department there are 3 types of machines that operate, including Tubing, Flare and Exhaust Cutting Machine (ECM) machines. The three types of machines play an important role in producing lighting components so that we need the best method to avoid frequent damage. The maintenance includes corrective maintenance, namely maintenance activities after the machine is broken and preventive

maintenance, namely machine maintenance activities to prevent damage

According to the expert system Journal (Putra Tanjung, 2017) Inverter welding machine is the development of the generation of conventional welding machines where conventional welding machines use transformers / coils with a low working frequency of 50-60Hz, so to get large currents it is necessary to enlarge the size of the transformer, so the larger the size the transformer then requires a large electrical power as well. In the inverter welding machine the power is produced through the switching process of the ferrite core transformer where the switching frequency is very high between 18khz to 100khz so the size of the transformer is very small and the power generated is large. an expert system that can analyze the symptoms of damage into a name damage decision by using the Forward Chaining method as a tracking method and the Certainty Factor method as a method for calculating the value of trust in symptoms given by a welder. Keywords: Expert System, Inverter Welding Machine, and Certainty Factor.

According to (Bangun, irawan hadi;rahman arif;darmawan, 2014) In this study using the Reliability Centered Maintenance (RCM) II method to solve the problem. Blowing machine OM is one of the important machines in the yarn production process. Blowing OM machine has the highest downtime so research will focus on the components of the Blowing OM machine. The results of data processing showed that the critical components in the Blowing OM machine based on the frequency of engine damage and total downtime were flat belt and spike lattice components. The results of the maintenance interval analysis show that the type of surface damage of uneven flat belt rubber has an optimal maintenance interval of 510 hours, flat rubber belt loose 260 hours, broken belt flat 580 hours, wood spike lattice broken 620 hours, and broken spike lattice nails 500 hours . From the calculation of the total optimal maintenance cost, the results show that the surface damage type of flat rubber flat belt is Rp. 7,973,519.82, loose rubber flat belt Rp. 11,000,673.81, broken flat belt is Rp. 14,061,553.06, spike lattice wood a fracture of Rp.19,170330.63, and a broken spike lattice nail of 30,880,512.66. Reliability Centered Maintenance (RCM) II method compared to the total previous maintenance costs there was a decrease in maintenance costs in the Blowing OM machine by 10.27%.

According to (Ahyari, 2019) the Maintenance Function is to be able to extend the economic life of existing production machines and equipment and to make sure that these production machines and equipment are always in optimal condition and ready

to use for the implementation of the production process.

According to the journal (Hidayat, 2017) In making expert systems, it is necessary to make a decision on how to make a decision making system using the Simple Additive Weighting model. such as research on decision making for scholarship acceptance.

Researchers conducted a case research at PT. Segwerk Ind is a multinational company engaged in printing ink for packaging industry with imported raw materials such as dyes, varnish, where researchers found the problem of how to maintain the condition of the machine to be always prime during production activities. For the sake of maintaining the smooth production process that will take place then the authors build an expert system with forward chaining method, so that the downtime can be suppressed as small as possible against the existing machines in the ink industry such as Mixer machine.

II. LITERATURE REVIEW

A. Expert System

According to (Yulianti, 2016) the expert system is one of the fields of artificial intelligence (AI) that seeks to adopt human knowledge to computers, combine knowledge and search data to solve problems that normally require human expertise.

B. Forward Chaining method

According to (siswanto, 2000) The Forward-Channing method is sometimes called: data-driven because the inference engine uses information specified by the user to move the entire network from 'AND' and 'OR' logic until a terminal is determined as an object. Forward channing starts from a collection of facts (data) by looking for rules that match the existing assumptions / hypotheses leading to conclusions.

C. Backward Chaining Method

According to the journal (Hidayat, Rachmat; haryanto ; sapinah, 2019) Backward Chaining Method The backward chaining method is backward tracking which starts the reasoning from the conclusion (goal), by looking for a set of hypotheses towards facts that support a set of hypotheses. Backward Chaining method is the opposite of forward chaining where it starts with a hypothesis (an object) and asks for information to convince or ignore. Backward chaining inference engines are often called: "Object-Driven / Goal-Driven". The inference engine is part of an expert system that tries to

use the information provided to find the appropriate object.

According to the journal (Akil, 2017) remembering that, backward-chaining is a form of thought that is controlled by purpose or goal. Backward-chaining is useful for answering specific questions such as "What should I do now?" and "Where are my keys?". Often, the price of the backward-chaining method is less than linear search in KB, because the process only touches on the relevant facts.

D. Unified Modeling Language(UML)

According to (rosa a.s.;Shalahuddin, 2018) defines that, "UML is a visual language for modeling and communication about a system using diagrams and supporting textures".

According to (Hidayat, 2018) system that can help improve customer service and quick responses as well as documentary evidence stored in a database. Researchers developed a web-based Customer Relationship Management (CRM) system with the waterfall model.)

According to (Dharwiyanti, 2003) unified Modeling Language is a graph-based language for visualizing, specifying, constructing and documenting from an Object-Oriented (OO) based software development system. UML is also referred to as a standard language for the development of a software that can convey how to make and shape models - models but does not convey what and when the model should be made which is one of the processes of implementing software development. Whereas UML itself consists of several diagrams, namely:

1. Use Case diagram
2. Activity diagram
3. Deployment Diagram
4. Component Diagram

E. Entity Relationship Diagram

According to (Priyadi, 2015) defines that, "Entity Relationship Diagram relations between entities, can be done using a database modeling called Entity-Relationship Diagrams (E-R Diagrams)".

The components of Entity Relationship are:

1. Entity
2. Relations
3. Attributes
4. The connecting line

F. Flowchart

According to (Hidayat, 2014) emphasized that, Flowchart is a graphical depiction of the steps and sequence of procedures of a program. Flowcharts help analysts and programmers to solve problems into

smaller segments and help analyze other alternatives in operation. Flowcharts usually facilitate the resolution of a problem, especially problems that need to be studied and evaluated further. Flowchart is a form of image / diagram that has one or two directions flow sequentially. Flowcharts are used to represent and design programs. Therefore the flowchart must be able to represent the components in the programming language)

G. Testing

According to (Ariani.Sukamto, Rosa, 2014) explained that, "Software testing is an element of a topic that has a wide scope and is often associated with verification (verification) and validation (validation) (V&V)

Testing for validation has the following approaches:

a. White-Box Testing

Test the software in terms of design and program code whether it is able to produce functions, input and output in accordance with the requirements specifications. White box testing is done by checking the logic of the program code. Making test cases can follow the testing standards of the programming standards that should be. Examples of white box testing are, for example, testing the path (by tracing) looping in programming logic. Testing of the documentation made must also be done so that the documentation made remains consistent with the software made.

III. PROPOSED METHOD

A. Expert Objects Determination

The Expert System object aims to transfer the ability (transferring expertise) of an expert or other source of expertise into a computer and then transfer it from a computer to an unskilled user (not an expert). This process includes four activities, namely:

- a. knowledge acquisition
- b. knowledge representation
- c. knowledge inference
- d. knowledge transfer

In the expert system analyzing the engine trouble there are several expert objects that are the source of the builder of this system, including:

1. Expert I, served as Maintenance Engineering Coordinator
2. Expert II, served as the Head of the Supply Chain
3. Expert III, Ir. H. Eddy Suwardi serves as Director.

The results of the Expert interview resulted in a conclusion that engine handling must be carried out as quickly as possible so that downtime can be avoided.

The following is a collection of data or facts that are asked to the user to the final conclusion in the form of suggestions or solutions from the results of consultations conducted. The expert table that will be described will present the relationship between the machine and the symptoms of the machine and the level of the problem at hand.

Table 1 Types of Machines

No	Machine Code	Machine name
1	MX	Mixer Machine
2	INK	Ink Maker Machine

Table 2 Trouble Machine

No	Trouble Code	Machine Trouble
1.	MX201	Does the machine can't running the mixer
2.	MX202	Whether the emergency sensor is off
3.	MX203	Whether the grounding has been interlock on
4.	MX204	Whether the dust collector was turned up
5.	MX205	Is the overload sensor indicator off
6.	MX206	Is sensor oil level indicator ok
7.	MX207	What is sensor limit movement on position on
8.	INK001	Does the ink formula can't drop out / ink maker not running
9.	INK002	Whether the emergency sensor is off
10.	INK003	Is the pressure switch on position on
11.	INK004	What is the supply rawmat sensor on
12.	INK005	What is a vertical pump indicator error / off
13.	INK006	Is the monitor display unconnected with the main display board

Table 3 Relationship between Machine Symptoms and Level of Problems

RULES	P201	P202	P203	P204	P205	P206	P207	P208	P209	P210	P211	P212	P213	P214	P101	P102	P103	P104	P105	P106	P107	P108	P109	P110	P111	P112	SOLUSI
RM001	X	X	X	X	X	X	X	X	X	X	X																AA
RM002	X		X						X																		AB
RM003	X		X						X																		AC
RM004	X	X		X																							AD
RM005	X	X	X		X																						AE
RM006	X	X	X	X	X		X		X																		AF
RM007	X																										AG
R1101															X												BA
R1102															X	X	X	X	X	X	X	X	X	X	X	X	BB
R1103															X	X	X	X	X	X	X	X	X	X	X	X	BC
R1104															X	X	X	X	X	X	X	X	X	X	X	X	BD
R1105															X	X	X	X	X	X	X	X	X	X	X	X	BE
R1106															X	X							X				BF
R1107															X	X						X	X				BG
R1108															X	X						X	X				BH

B. Explanation of Algorithm Table Flow

Existing Data About The Symptoms Of The Machine First Made A Rule (Rule), So That In Solving The Problem Easier To Do. Knowledge Base Or Rule Base That Is Made To Get Knowledge About The Level Of Problems That Occur With The Machine Is Written In The Form Of If-Then (IF-Then).

Rule 1

IF P201 And P203 And P205 And P207 And P209 And P211 And P213 Then AA

IF P101 And P103 And P105 And P107 And P109 And P111 Then BB

Rule 2:

IF P202 Then AG

IF P102 Then BA

Rule 3:

IF P201 And P204 And P210 Then AB

IF P101 And P104 And P109 And P111 Then BB

C. Expert System Algorithm

Here is an algorithm from the system that the author designed

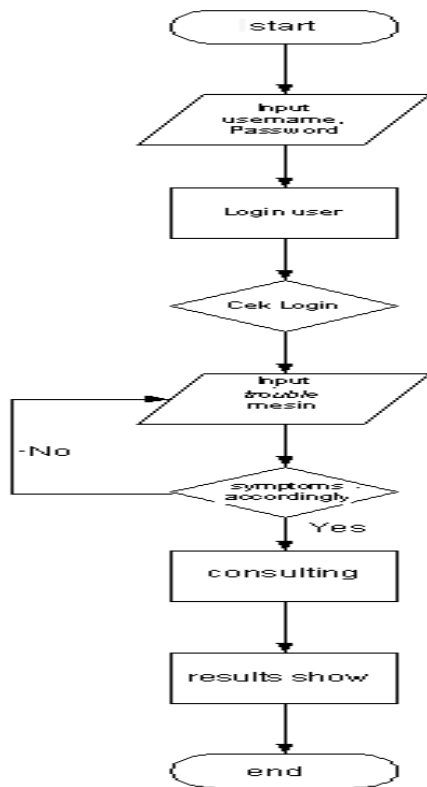


Fig .2 Expert System Algorithm

Explanation of the logic flowchart function as follows:

1. The first process is to log into the system
2. Then after the login process is successful the user will start the consultation process, in the consultation process the system will enter the symptoms of complaints experienced by the machine.
3. The system will display the answer at the consultation in accordance with the symptoms that occur on the machine.
4. The results displayed by the system are problem solving that have been used by experts in handling the problem (records based on historical machines)

D. Best first search

search rules that work based on a combination of the two previous methods. The best first search method is the combination of the depth first search method and the breadth first search method and the breadth first search method by taking advantage of both methods. At each step of the first best search process, choose nodes by applying adequate heuristic functions to each node or node that we choose by using certain rules to produce a successor. In best first search, the search is allowed to visit the lower node

and if it turns out that the higher level node has worse heuristic value

The advantage:

1. Requires a relatively small memory, because only nodes - nodes on the active path only
2. Find a solution without having to test more nodes

Disadvantage: Allows getting stuck on optima values

IV. RESULT AND DISCUSSION

Based on the problems that exist in PT Siegwerk Indonesia in detecting engine trouble, the results of the expert system software that has been made, are then tested through software testing techniques using use case diagrams, Activity diagrams, Entity Relationship Diagrams and white box testing. The following diagram

- a. Use Case Diagrams manage engine symptom

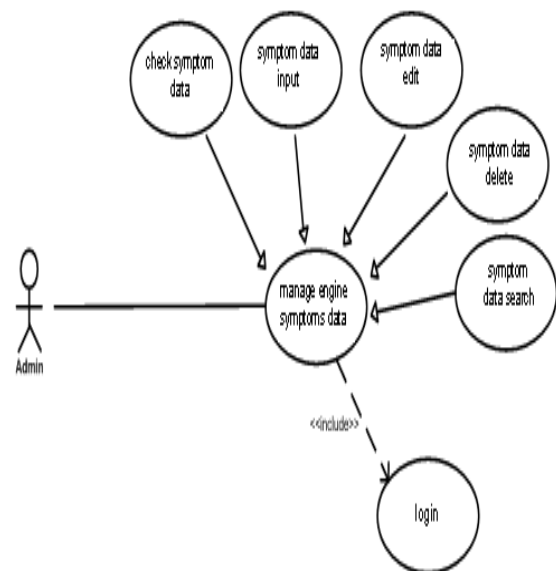


Fig 4 Use Case Diagrams manage engine symptom data

Tabel 5. Deskripsi Use Case Diagrams manage engine symptom data

Use Case Name	manage engine symptoms data
Goal	Admin can see, enter, change delete, search engine symptoms data
Pre-Condition	Admin login

Post-Condition	Data on engine symptoms can be seen, searched, added, modified and deleted
Failed end Condition	Data on engine symptoms fail to be seen, searched, added, changed and deleted
Actors	Admin
Main Flow/Basic Path	1. Enter the engine symptoms data 2. Change the engine symptom data 3. Erase data on engine symptoms 4. Looking for engine symptoms data 5 View engine symptom data

Main Flow/Basic Path	1. Input the symptoms of the machine 2. Changing the Fact Conditions Symptoms 3. Input the fact fact condition
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b. Use Case Diagrams determine the consultation solution

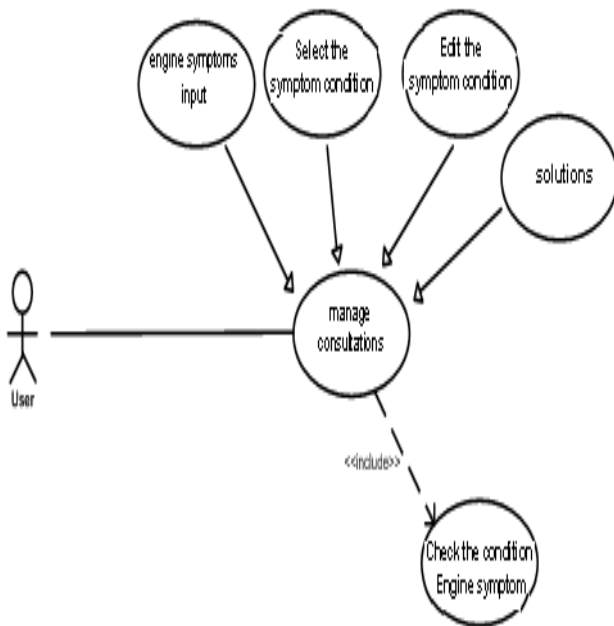


Fig 5 Use Case Diagrams determine the consultation solution

Table 6. Deskripsi Use Case Diagrams determine the consultation solution

Use Case Name	Determine the consultation solution
Goal	Determine the engine trouble solution
Pre-Condition	Admin to login
Post-Condition	Admin to login
Failed end Condition	Failed to determine a solution
Actors	admin

c. Entity Relationship Diagram

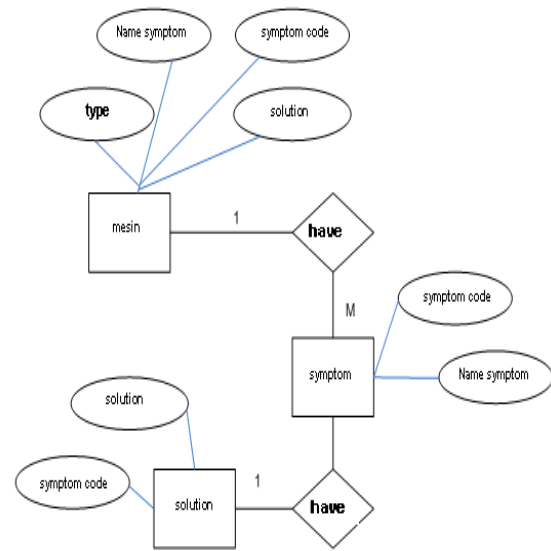


Fig 7 Entity Relationship Diagram

Table 7. Machine File Specifications

No	Elemen Data	Akronim	Tipe Data	Size	Keterangan
1	Symptom code	kodegejala	Text	6	Primary key
2	Symptom name	Namagejala	Text	100	
3	Machine type	Jenis	Text	15	
4	Solution	Solusi	Text	200	

d. White box testing

Table 8. white box testing

No.	Input Condition	Expected Result	Test Result	Conclusion
1.	Enter symptoms	Displays conditions where the rules are in accordance with the knowledge base so that it displays the results of the consultation	Showing that the provisions of the rules according to the knowledge base so that it displays the results of the consultation	Path worked on

V. CONCLUSION AND SUGGESTION

Conclusion

Based on the problems that researchers found in detecting engine trouble, it can be summarized as follows:

- a. How to maintain the condition of the machine so that it is always prime when production activities take place
- b. Trouble machining is indeed one of the factors that can make a company go bankrupt, such as the production process is hampered, the machine down time is long, so that customers will change their suppliers because they do not want to risk their business being hampered

Suggestions

Suggestions that researchers are expected to be able to further improve the results of delivery:

- a. For the success factor of a company's production process, it is required to have appropriate preventive and corrective maintenance activities as well as the problem of lack of competent human resources, therefore we need tools to solve these problems.
- b. Build expert system-based computer software, so the downtime can be pressed as little as possible against the machine
- c. It takes time for special training for the production team so that they can use this

program and also inform the symptoms of new machines outside of existing ones.

- d. Maintenance of software (software) and computer hardware (hardware) is needed so that the system is protected from damage periodically.

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