Journal of Information System Research (JOSH)
Volume 5, No. 4, Juli 2024, pp 1242−1250
ISSN 2686-228X (media online)
https://ejurnal.seminar-id.com/index.php/josh/
DOI 10.47065/josh.v5i4.5651

Web-based Machine Daily Check Application for Preventive Maintenance using Rapid Application Development

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Submitted: **21/07/2024;** Accepted: **29/07/2024;** Published: **30/07/2024**

Abstract−In a manufacturing company, preventive maintenance is one of the scheduled programs implemented to reduce the risk of damage, downtime, and repair costs, thus the production targets can be achieved optimally. So that PT. Trimitra Chitrahasta can become a reliable automotive component manufacturer and be able to compete in the Southeast Asia region in the field of Metal Stamping and Die Making. An integrated maintenance system needs to be developed to increase the achievement of the company's production targets. A web-based information system has been created to support the development of a maintenance system which includes features such as master data image, machine data, and master data person in charge, category, master data description, master data sheet, machine inspection, and daily machine reports. The development methods used are Rapid Application Development (RAD) and Unified Modeling Language (UML) to design business processes. The system implementation uses the Laravel framework PHP, HTML, and MySQL as the database. The analysis results show that the application of a web-based information system can increase the effectiveness of managing preventive machine inspections. The number of documented working days increased significantly, which indicates improved inspection discipline. The frequency of machine downtime was reduced, reducing additional costs for repairs, and mold production target achievement increased from 90% to 100%, indicating increased production efficiency.

Keywords: Preventive Maintenance; Web-Based Application; Rapid Application Development; Unified Modelling Language; Production Efficiency.

1. INTRODUCTION

The combination of all technical and administrative actions, including supervision called as maintenance. It aims to ensure that a system is in its required functioning state [1]-[3]. In detail, maintaining a system is related to several actions such as inspecting, servicing, replacing, testing, adjusting, overhauling, measuring and detecting obstacles in order to avoid any failure that would lead to interruptions in production operations [4]-[8]. Therefore, every company definitely strive for effectiveness in its maintenance to reduce the consequences of failure and extend the life of a system. One of the companies whose maintenance effectiveness we observed was PT. Trimitra Chitrahasta.

PT. Trimitra Chitrahasta is a company engaged in the manufacturing industry of metal stamping dies, jigs and equipment components that produce automotive components. This company, which was founded in 1994, has become a trusted automotive component manufacturer in the Southeast Asia region. Nowadays, the company is currently experiencing problems in preventive maintenance on machine parts, resulting in an increased risk of damage, downtime and repair costs, as well as achieving less than optimal production targets. As a consequence, there are engine performance problems based on data reporting for the last 3 months. The Makino CNC machine only accepts checks 10 out of 24 working days in a month, while the WIRECUT ALPHA C600-iC machine detects 14 out of 24 checks. this indicates inconsistency in the application of the test procedures. In this case, recommendations are needed that provide solutions to these problems.

In the previous research, the optimal maintenance policy options as well as the relationship between the maintenance and applicatoin areas explored. Reimbursement policies of components consisting of the optimizaton of time and replacement costs, the optimization inventory spare parts and system optimization improvements (repair). In this area the focus of the research is how the effectiveness of maintenance visits from the time and cost of maintenance [9]-[11]. Thereafter, a literature study which is conducted by Oktavia & Nurmalia (2022) regarding maintenance of medical devices, it was recommended that dailhy maintenance use a web-based information system because this system is equipped with features that can make the maintenance process more monitored, thereby reducing the risk of downtime or damage to medical device equipment [12], [13]. In addition, web-based information system also implemented in troubleshooting and machine maintenance at PT Akebono Brake Astra Indonesia. It made several simplifies maintenance monitoring in the production area, reduces paper usage, reduces the total amount of time to handle machine problems, increases production productivity by 7%, saves excess machine part inventory funds, and simplifies report management [14].

Afterwards, several studies developed preventive maintenance system through the stages of the waterfall method. The research results reported by Wiyono et al. (2021), machine maintenance regularity increased, breakdown incidents reduced from 10 to 2 per month with total downtime reduced from 100 hours to 20 hours [15]. Apart from that, this method also produces shorter data reporting [16], efficient planning data collection, reducing the frequency of production disruptions [17]. However, this method has disadvantages, including long

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development time, expensive costs, an unsustainable development process, iteration often creates new problems, and small mistakes can result in big problems at a later stage [18].

The daily maintenance problems experienced by PT Trimitra Chitrahasta are similar to the results of research and studies that we obtained previously, so in this research a web-based daily checking system was created in the form of an application for preventive maintenance. The development carried out in this research is Rapid Application Development (RAD) and Unified Modeling Language (UML) for business process design. The system implementation uses the Laravel PHP framework, HTML, and MySql as the database. The RAD method has the advantage of being able to overcome the problems of the waterfall method because it emphasizes rapid and iterative development. The goal is to provide accurate and real time data for better decision making in machine maintenance.

2. RESEARCH METHODOLOGY

2.1 Materials

The tools and materials used in this research are a Personal Computer (PC) with specifications (Intel® Core™ i3 CPU M370 processor @ 2.40GHz; operating system (OS) Windows 11; XAMMP 7.3 server, and Visual Studio Code as script editor), Tab Elite 8 Inch with Quadcore 1.4 GHz CPU.

2.2 Research stages

Making this daily checking application requires tools and materials that support the operation of the application. First, identifying machine data at PT Trimitra Chitrahasta is necessary to find out the technical specifications and previous maintenance history as shown in Figure 1. Next, record machine performance data such as operational time, downtime, frequency of maintenance, and repairs carried out to obtain information regarding current machine inspection and maintenance procedures, including the checklist or verification list used. Secondly, production process data is analyzed to measure production quality and efficiency. Thirdly, identify the personnel responsible for carrying out machine maintenance and operation to review the competence and experience of personnel in carrying out machine maintenance and operation tasks. After going through these three main processes, a review of the operational procedures above obtains an evaluation to determine the advantages and disadvantages of the design that has been created as in Figure 2.

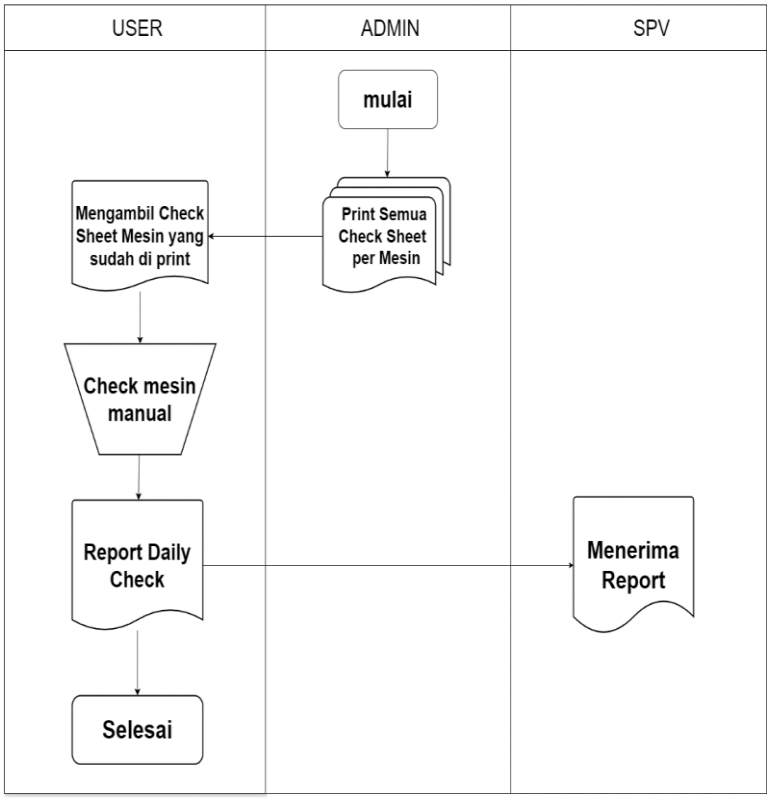

Figure 1. Normal machine check sheet flow

In Figure 2, the proposed machine inspection flow is useful as a guideline in application design. The differentiates this design from the previous system is that all data in the manual system is automated using a web-based application, starting from machine input, PIC input, machine and PIC validation, check sheets, to production reports.

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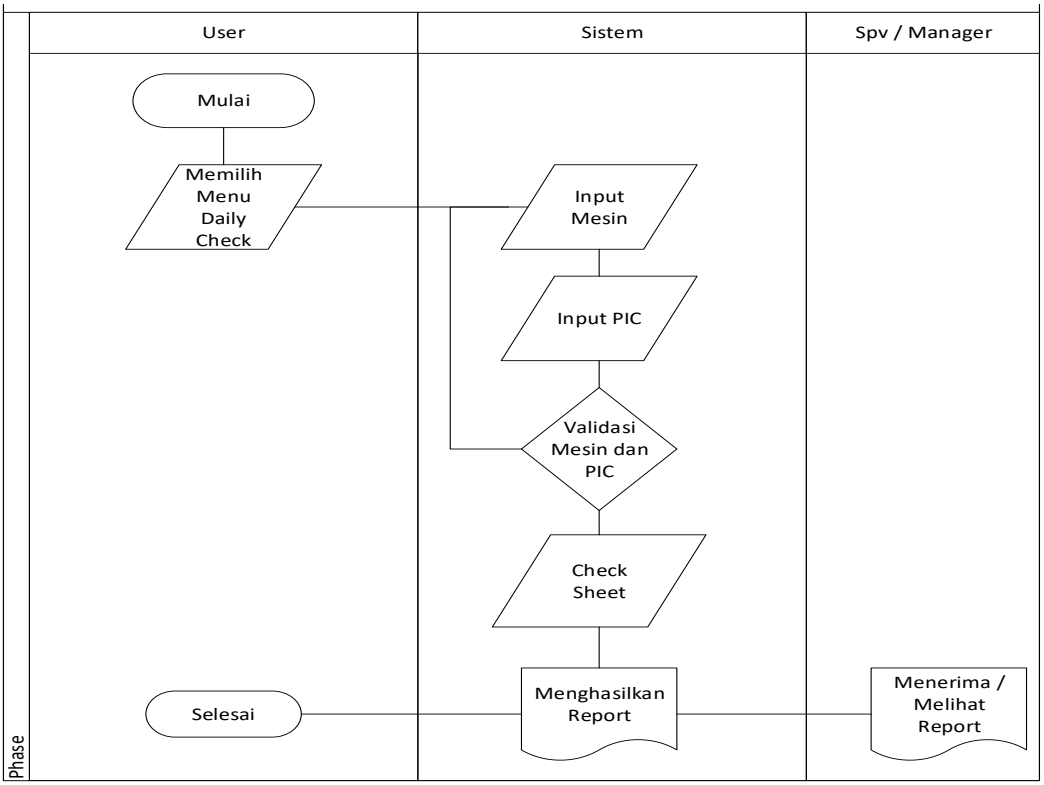

Figure 2. Flow of proposed machine check sheet

In addition, for system development, the method Rapid Application Development (RAD) is used in developing the daily machine check system. The key objectives of RAD are high quality systems, fast development and delivery and low cost [20]-[22]. The important stages in this method pay attention to several things as shown in Figure 3. First, requirements planning, namely various features to guarantee efficient and consistent machine inspections such as category master data, PIC, machine data, desc data, pointsheet data, inspection point machines, and report. Second, the design process, namely ensuring that all features are well integrated and meet user needs, such as use case diagrams, class diagrams, activity diagrams, sequence diagrams, flow diagrams, UI/UX design, and coding processes. Lastly, implement a daily machine checking system for daily checks where testing uses black box testing, namely checking system functionality without looking at the code, ensuring all features function as expected.

Figure 3. Flow of proposed machine check sheet

3. RESULT AND DISCUSSION

This system resulted seven main stages such as Machine Master Data, PIC Master Data, Category Master Data, Desc Master Data, Pointsheet Master Data, Machine Daily Check, and report.

3.1 Login Page and Dashboard Display

Figure 4.a and 4.b show website of the information system regarding the web-based Daily Check Machine starting from the login and homepage display below.

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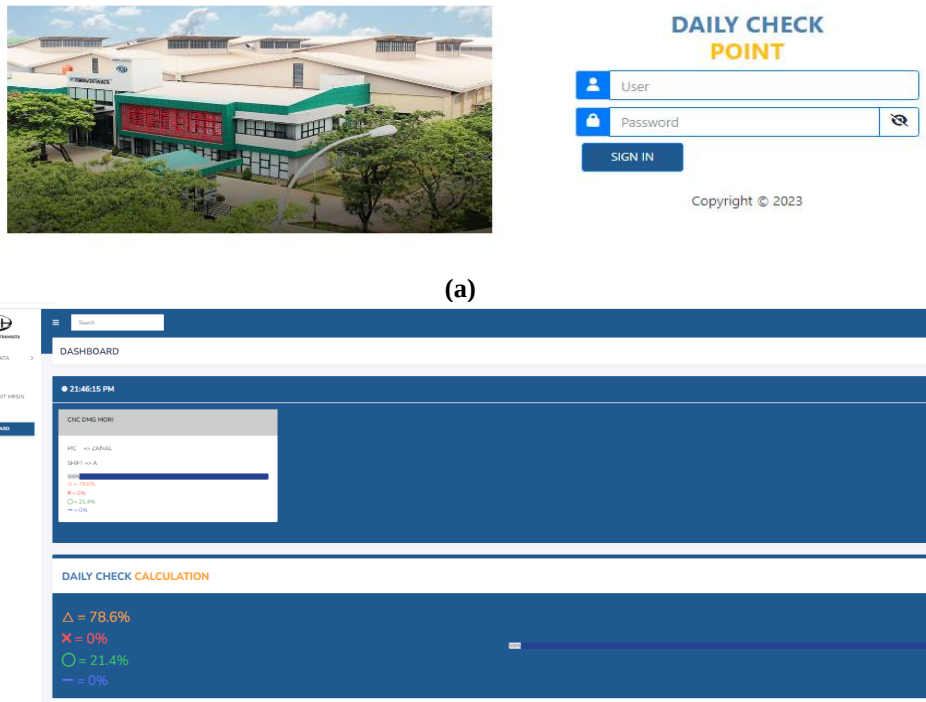

Figure 4. Login page display **(a)**, Dashboard page display **(b)**.

The login page in Figure 4.a is used by regular users and admins to manage and use the daily machine check system. Users must enter their Employee Identification Number (NIK) and password to access the system. If one or both of the information is incorrect, a message will appear telling the user to repeat the login process. After successfully logging in, the user is immediately directed to the dashboard page (as shown in Figure 4.b) to start daily checking on the machine. The dashboard produces data from all users who carry out daily checks on that day. The system automatically calculates the results of each machine inspection, categorizing the results as OK (good), ABNORMAL (abnormal), DAMAGED, or NOTHING.

3.2 Master Data Category Menu Page

The Master Data Category page is designed to display data resulting from the data creation and updating process. On this page, you can easily see the list of categories that have been created and updated in the system as shown in Figure 5.a, 5.b, 5.c, and 5.d to create, edit, and void the master data of category.

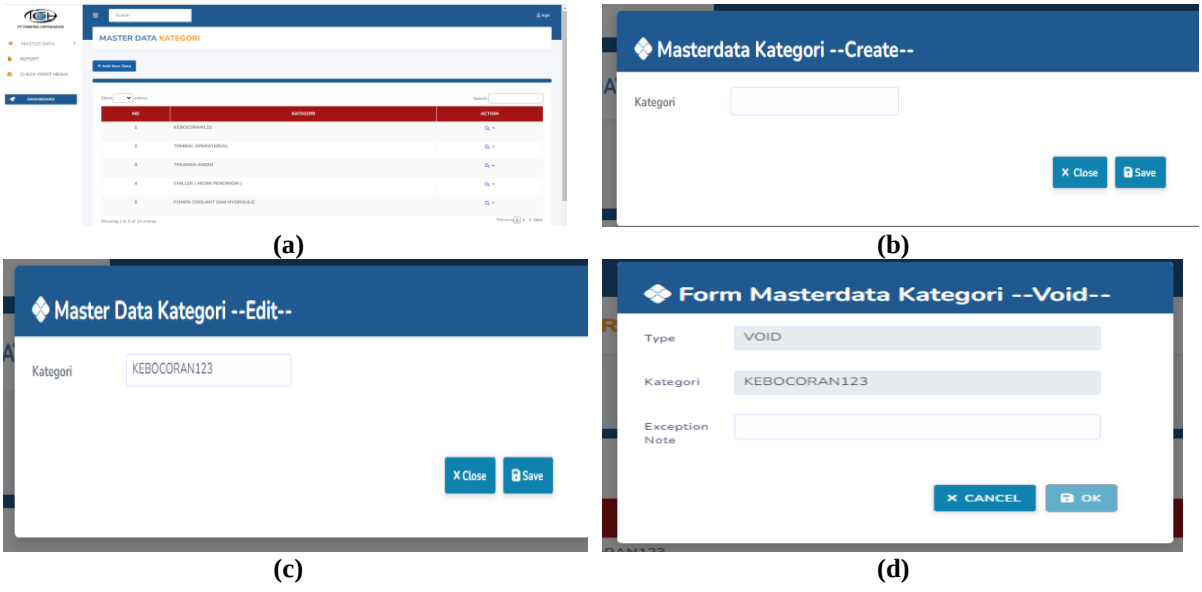

Figure 5. Category master data page **(a)**, Create master data category **(b)**, Edit master data category **(c)**, Void master data category **(d)**.

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The Category Master Data page in Figure 5.a is designed to display data results from the data creation and update processes. On this page, you can easily see the list of categories that have been created and updated in the system. To create category data and fill in category input as shown in Figure 5.b, users can access the Master Category Data menu. On this page there is an input form that allows users to add new categories to the system. Afterwards, to make edits to the category master data, open the category master data page in the application, select the category you want to update, then make the necessary changes to the existing category information form as in Figure 5.c. Then, with this void category form, users can delete category data by filling in related notes or reasons as shown in Figure 5.d.

3.3 Machine Data Master Menu Page

On this Master Machine page, users can view real-time data involving the creation, update, and cancel processes in Figure 6.a. Thereafter, go to the Machine Master page in the app, look for the Add Machine button and click it to open the add form. On the form, fill in the fields with the appropriate information. After filling is complete, press the Send button to save the data. After that, the system will provide confirmation that a new machine has been added. You can check the machine list to ensure the changes have been saved successfully.

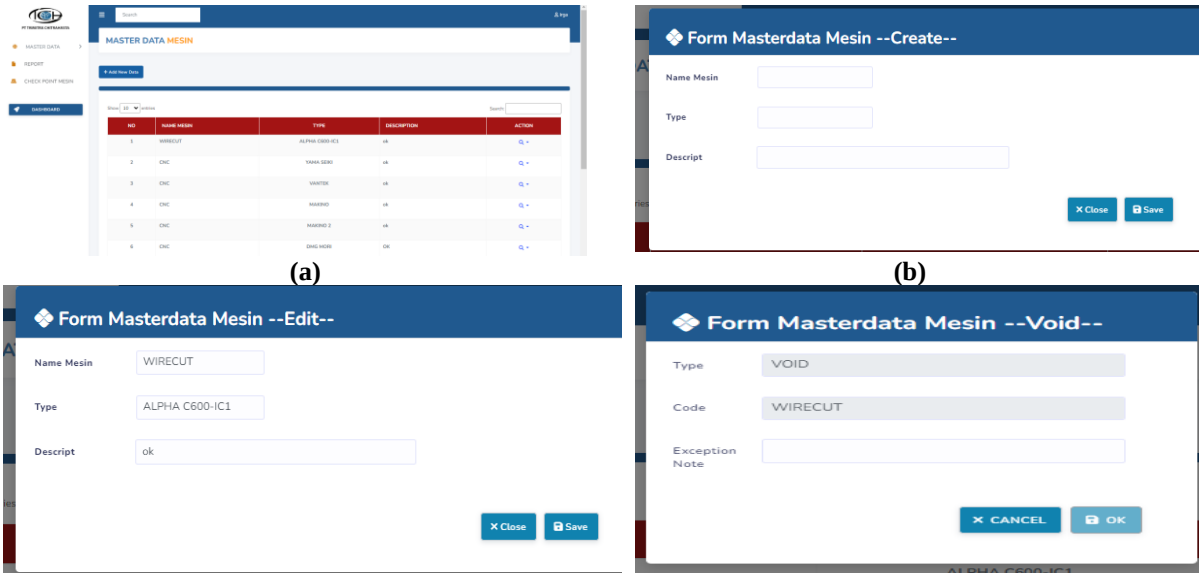
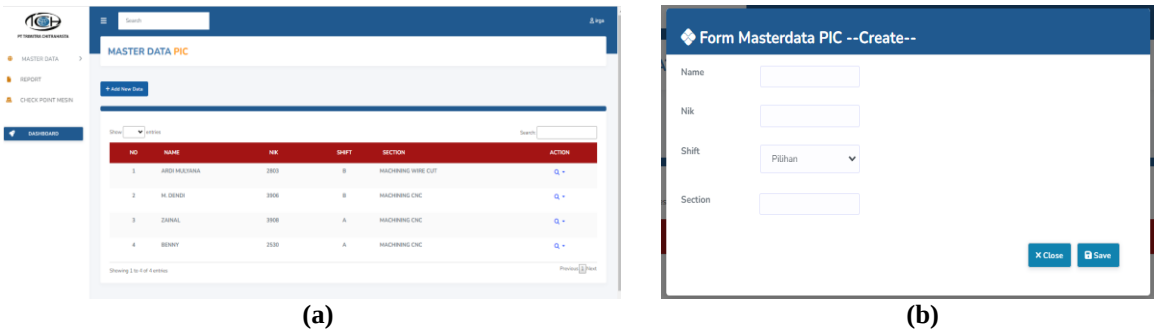


Figure 6. Machine master data page **(a)**, Create master data category **(b)**, Edit master data category **(c)**, Void master data category **(d)**.

On the edit page (in Figure 6.c), make the necessary changes, press the submit button to save. The system will confirm that the machine data has been updated. To delete machine master data, go to the Machine Master page in the app. Select the machine you want to delete, then fill in the void form with notes as shown in Figure 6.d. Click submit to confirm. The system will confirm successful cancellation.

3.4 PIC Master Data Menu Page

This section aims to propose a PIC master data that is monitored by user via several process as shown in Figure 7. On the PIC Master page there is a dashboard, users can access and monitor the results of various processes, including adding, editing and canceling PIC data. To add data to the master PIC, go to the Master PIC page in the application. Click the Add PIC button to open the addition form. Fill in the fields with the required information, then click the Send or Add PIC button to save the data. To delete the main image data, go to the Main Image page in the app. Select the images you want to delete, then fill in the blank form with notes. Click send to confirm. The system will confirm successful cancellation.



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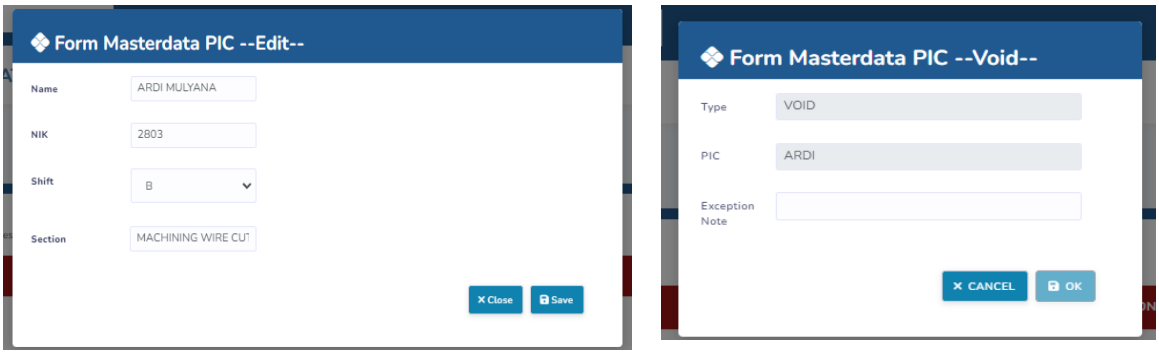
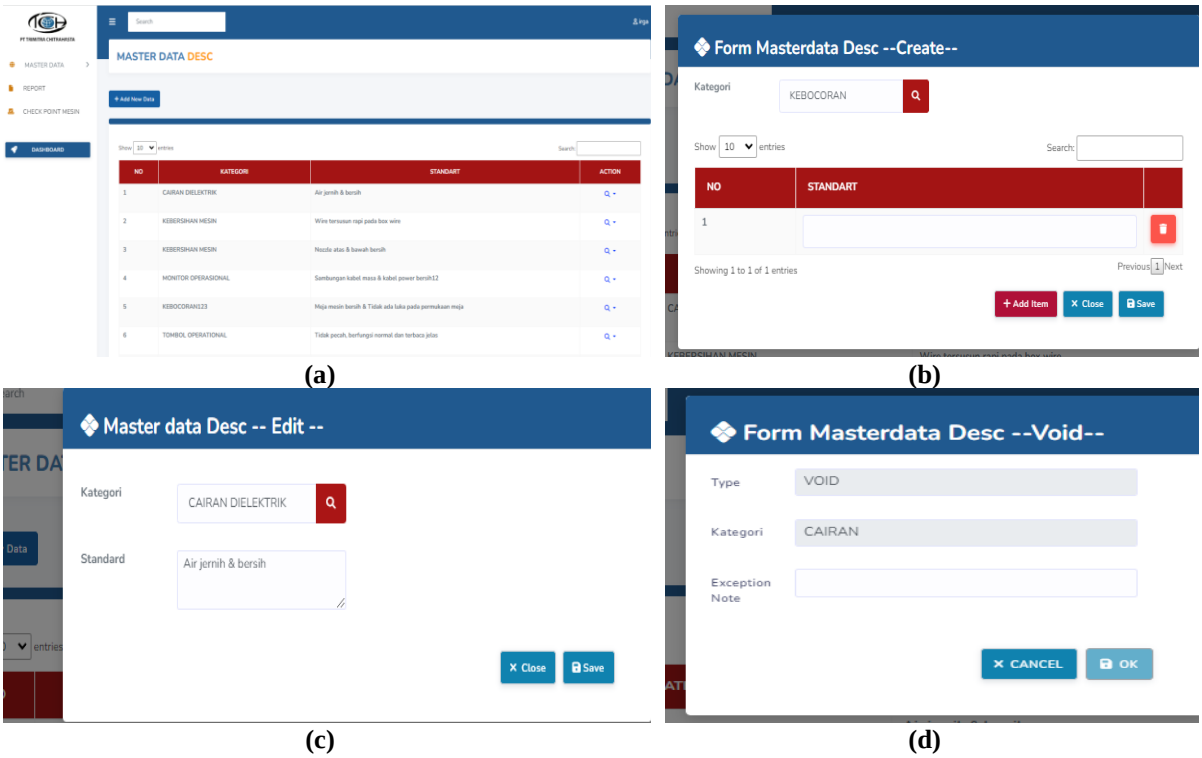


(c) **(d)**

Figure 7. PIC master data page **(a)**, Create master data category **(b)**, Edit master data category **(c)**, Void master data category **(d)**.

3.5 Master Data Desc Menu Page

The Master Data Desc page in the application that show in Figure 8 is designed to make it easier for users to see data that has been created, edited and cancelled. By accessing this page, you can monitor and manage information related to pointsheets easily.



(a) **(b)**

(c) **(d)**

Figure 8. Desc master data page **(a)**, Create master data category **(b)**, Edit master data category **(c)**, Void master data category **(d)**.

To create new data on the Master Data Desc page, open the application and select the Master Data Desc option from the main menu in Figure 8.a. On the description creation page (in Figure 4.b), select the category associated with the description you want to add. Fill in the columns provided. Make sure all required fields are filled in as required. Finally, press the Submit button to save the new description into the system. To perform data editing on the Edit Master Data Desc page, open the application and select the Master Data Desc option from the main menu as shown in Figure 8.c. Select the data you want to edit, change the required information in the edit form, and press Submit or Save Changes to save. The system will provide confirmation once successful. To delete the main image data, go to the Main Image page in the app. Select the images you want to delete (in Figure 8.d), then fill in the blank form with notes. Click send to confirm. The system will confirm successful cancellation.

3.6 Master Data Pointsheet Menu Page

The Master Data Pointsheet page we can see Figure 9. The application is designed to make it easier for users to see data that has been created, edited and canceled as shown in Figure 9. By accessing this page, you can monitor and manage information related to pointsheets easily.

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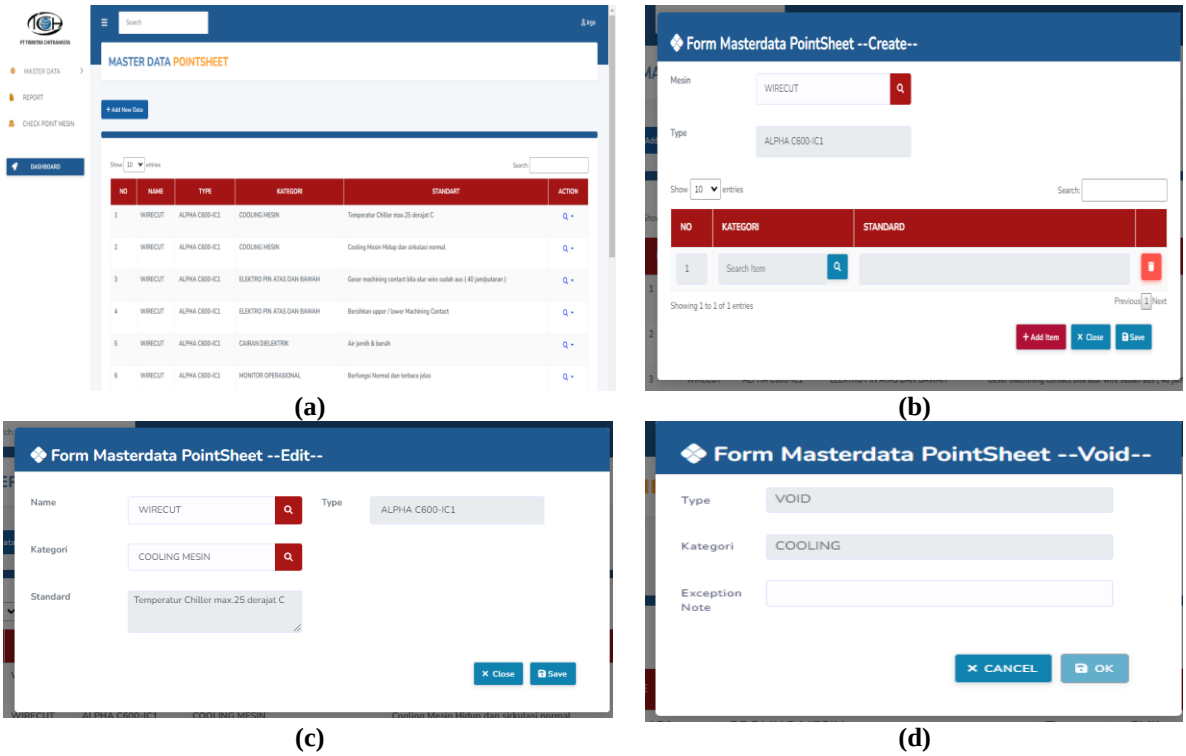
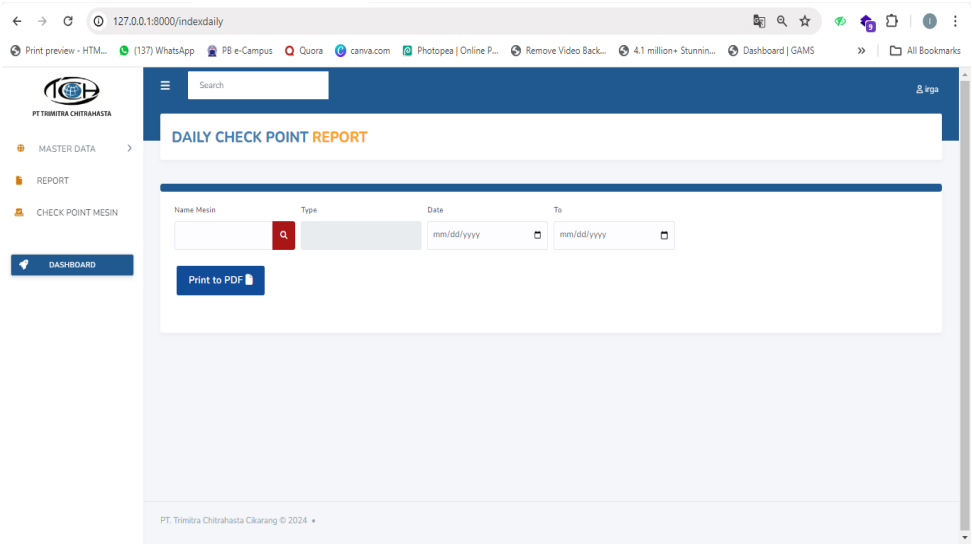


Figure 9. Pointsheet master data page **(a)**, Create master data category **(b)**, Edit master data category **(c)**, Void master data category **(d)**.

To create new data on the Master Data Poinsheet page we can see Figure 9.a, open the application and select the Master Data Poinsheet option from the main menu. On the description creation page (in Figure 9.b), select the machine associated with the description you want to add. Fill in the columns provided. Make sure all required fields are filled in as required. Finally, press the Submit button to save the new description into the system. To make edits on the Edit Master Data Poinsheet page, open the application and select the Master Data Poinsheet option. Select the pointsheet data you want to edit as shown in Figure 9.c. Then, you will be taken to an edit form where you can change the necessary information. Fill in the columns you want to edit as needed. When finished, press Send to save. To delete Poinsheet master data, go to the Master Desc page in the application. Select the Pointsheet you want to delete, then fill in the blank form with notes. Click send to confirm. The system will confirm successful cancellation as we can see in Figure 9.d.

3.7 Report Page

To retrieve report data, start by selecting the options for the desired machine. Fill in the form and until dates on the form. After that, click Export PDF. The requested data will appear in PDF view. The following is a picture of the report results.



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PT TRIMITRA CHITRAHASTA

DAILY CHECK POINT MESIN
WIRECUT AGIE CHARMILLES

DICEK	DIBUAT
Nama :	Nama : ZAINAL / M. DENDI

BULAN : MEI

NO	OPERATOR CEK POINT MESIN	STANDART	SHIFT
1	KEBERSIHAN MESIN	a. Wire tersusun rapi dan tidak lebih dari 1/2 box wire	A / B
		b. Cover / sela - sela Arm bersih	A / B
		c. Meja mesin bersih dan Tidak ada luka pada permukaan meja	A / B
		d. Sambungan kabel masa dan Kabel power bersih	A / B
		e. Lantai dan Area sekitar mesin bersih	A / B
		f. Tidak ada Chips / sisa proses yang menempel di dinding mesin	A / B
2	KEBOCORAN	a. Tidak ada kebocoran air	A / B
		b. Tidak ada kebocoran angin Tekanan angin antara 0.6 - 0.9 mpa	A / B
3	CAIRAN DIELEKTRIK	a. Pressure Filter masih kencang Minimum 0.2 mpa	A / B
		b. Fine Filter bersih Ganti Ã± 200 jam kerja	A / B
		c. Cek kadar Resin (value Ã± 2 ÂµS/cm)	A / B
4	ELEKTRO PIN ATAS DAN BAWAH	a. Bersihkan upper / lower Machining Contact	A / B
		b. Geser machining contact bila alur wire sudah aus (40 jam/putaran)	A / B
5	COOLING MESIN	a. Cooling Mesin Hidup dan sirkulasi normal	A / B
		b. Temperatur Chiller max.25 derajat C	A / B
6	MONITOR OPERASIONAL	a. Berfungsi Normal dan terbaca jelas	A / B

PIC MESIN		KODE PENGISIAN
SHIFT A	SHIFT B	
		✕ = Rusak
		△ = Abnormal
		○ = OK
		━ = Tidak Ada
ZAINAL	M. DENDI	

ILUSTRASI CEK POINT

(b)

Figure 10. Login page display **(a)**, Dashboard page display **(b)**.

3.8 Discussion

This research reveals that there is still a lack of discipline in consistently and timely machine inspections at PT. Trimitra Chitrahasta has a negative impact on the effectiveness of machine maintenance management. Data for the last three months shows that Makino CNC machines and WIRECUT ALPHA C600-iC only receive checks on a small portion of the working days they should. The impact of this lack of consistency includes increased risk of machine damage, additional repair costs, and frequent downtime which disrupts production targets.

The analysis results show that the implementation of a web-based information system can increase the effectiveness of machine inspection management. In the system testing period, there was a significant increase in the number of well-documented workdays in machine inspections. This indicates that discipline in checking machines is increasing, which in the end can reduce the risk of machine damage and downtime. The frequency of machine downtime is significantly reduced after implementing the system, thereby reducing additional costs for repairs. In addition, the achievement of the die production target increased from 90% to 100%, which shows an increase in production efficiency. The following is a comparison between before and after system implementation shown in the Table 1.

Table 1. The following is a comparison between before and after system implementation

No	Aspects	Before Implementaiton	After Implementation
1	Checking Methods	Manual	Web-based system
2	Checking Discipline	Low	High
3	Number of Documented Working Days	12/24 days	23/24 days
4	Downtime Frequency	High	Low
5	Additional Costs for Repairs	High	Low
6	Production Targets	90%	100%
7	Machine Failure Frequency	High	Low

In addition, by checking the machine regularly, damage identification becomes faster and can be handled immediately. This reduces the frequency of machine breakdowns, as problems can be identified and resolved more quickly. Data generated in real-time by the system provides better visibility into machine condition, enabling more proactive and efficient maintenance. With real-time data, companies can optimize maintenance schedules and immediately act on early indications of damage, thereby improving overall machine performance and durability.

4. CONCLUSION

Web-based machine daily check application is support for preventive maintenance because it enhance a disciplinary. The use of HTML, Javascript, and PHP framework Laravel 7 approximation helped user during daily

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check activity. The implementation of this application also improved efficiency and effectivity of machine maintenance. Based on the results, documentation of work day enhance from 12 to 23 for a month, downtime and cost are reduce. Thereafter, production targets enhance from 90% to 100%, the frequency of machine breakdowns also decreases, allowing for rapid identification and treatment. This system provides real-time data for optimization of maintenance schedules and proactive actions, increasing operational efficiency, reducing costs and increasing company productivity. This application can be recommended for all departments in the company with the added ease of access via mobile phone and increasing user satisfaction with the system and its impact on the company's workload and productivity. This application can be recommended for all departments in the company with the added ease of access via cell phone and also increases user satisfaction with the system and its impact on the company's workload and productivity.

ACKNOWLEDGMENT

Thank you to Faculty of Engineering Universitas Pelita Bangsa who have supported the implementation of this research.

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