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Designing the Digital System Using SDLC Methodology to Increase Inspection Efficiency at PT. LV

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ABSTRACT

Inspection Check Sheet (ICS) is one of the information formats that contains the result of characteristics dimension of a part as a basis for improving product quality according to PT. LV standard. On it's implementation ICS still use paper form manually. Based on result of observation from June to August 2022 founded an inaccurate data at ICS has 13 cases, with the total quantity of retained parts is 6469. There are several disadvantages if it is still done manually. First, the average time consumed for the current system process takes 2 minutes and 45 seconds. Second, found seven unnecessary repetitive activities. Third, the approval process by Quality Control Supervisor is once a week. This study aims to identify the weaknesses and the impact of a current ICS system, then improve by designing a digital ICS system using System Development Life Cycle (SDLC) methodology. The implementation of a proposed improvement in October to December 2022 resulting the time consumed of using ICS was reduced by 72,34%. Second, the number of inaccurate data and retained parts turn into no cases. Third, no more repetitive activities in data input process. Last, the approval process changes into digital using the digital ICS system.

Keyword: Inspection Check Sheet, System Development Life Cycle, Digital System, System Improvement, System Design.

ABSTRACT

Inspection Check Sheet (ICS) adalah salah satu format informasi yang berisi hasil dimensi karakteristik suatu part sebagai dasar untuk meningkatkan kualitas produk berdasarkan standar PT. LV. Dalam implementasinya ICS masih menggunakan formulir kertas secara manual. Berdasarkan hasil observasi pada bulan Juni hingga Agustus 2022 ditemukan ketidakakuratan data di ICS sebanyak 13 kasus, dengan total jumlah part yang ditahan sebanyak 6469. Ada beberapa kerugian jika proses dokumentasi ICS masih dilakukan secara manual. Pertama, rata-rata waktu yang digunakan untuk proses sistem saat ini membutuhkan waktu 2 menit 45 detik. Kedua, ditemukan tujuh aktivitas repetitif yang tidak perlu. Ketiga, proses persetujuan oleh Quality Control Supervisor seminggu sekali. Penelitian ini bertujuan untuk mengidentifikasi kelemahan dan dampak dari sistem ICS saat ini, kemudian melakukan perbaikan dengan merancang sistem ICS digital menggunakan metodologi System Development Life Cycle (SDLC). Implementasi usulan perbaikan pada bulan Oktober hingga Desember 2022 menghasilkan waktu penggunaan ICS berkurang sebesar 72,34%. Kedua, jumlah data yang tidak akurat dan bagian yang tertahan berubah menjadi tidak ada kasus. Ketiga, tidak ada lagi aktivitas berulang dalam proses input data. Terakhir, proses persetujuan berubah menjadi digital dengan menggunakan sistem ICS digital.

Keyword: Inspection Check Sheet, System Development Life Cycle, Digital System, System Improvement, System Design.

1. Introduction

PT. LV is a manufacturing company focusing on precision plastic injection molding and electronic assembly. PT. LV was established in 1994 and already had customers from several domestic and foreign companies. The company has two factories in the Cibitung Plant and the EJIP (East Jakarta Industrial Park) Plant, to support the production process. The Cibitung Plant produces small-sized printer supporting parts, and the EJIP Plant focuses on produce the large-sized printer parts, such as printer housing and printer cover, until assembly services. The company is led by a presidential director for both factories, assisted by eight managers. The eight managers are Operation Manager, Human Resource Development Manager, Finance Manager, Accounting Manager, Marketing Manager, Purchasing Manager, and Quality Control & Production Planning Control Manager.

One of PT. LV manual systems is the Inspection Check Sheet (ICS). ICS is a format of information that contains the results of characteristics of the dimensions of a part as a basis for improving product quality to comply with the company standards (PT. LV, 2010). Quality Control is a division under the Quality Control & Production Planning Control Manager focusing on using the system. To fill out the ICS form, Quality Control requires data from the inspection process of a part dimension as a data source. The data needed are the date, part name, part code, measurement result, and others. The ICS is made by the Inspector and approved by the Quality Control Supervisor. The data input process is done manually by the Inspector. The Inspector inputs some data by looking at the results of the part inspection from the computer screen and then written into the ICS form. The total data that needs to be input into the ICS form is a minimum of 14 part information data input plus an average of 22 data resulting from the dimension check character, so a total of 36 data. Meanwhile, one part can consist of one to two ICS forms, depending on how complicated the dimensional checking character of a part is. Many data input processes is many writing processes, which makes the possibility of writing errors more significant.

Once there is inaccurate data on the ICS form, it affects some aspects. Based on the results of observations from June to August 2023. There is an indication of wrong decision-making regarding the inaccurate results of checking the dimensions of a part which causes the part to be detained. In this period, the number of inaccurate data at the ICS was 13 cases, with the quantity of retained parts being 6496. In addition, there are several disadvantages if the data input still manual. First, manual writing takes a long time. Second, there are unnecessary repetitive activities. Third, the approval process is carried out once a week by the Quality Control Supervisor. This study aims to design a digital system using System Development Life Cycle (SDLC) methodology. SDLC is an analytical method for designing the best gradual approach developed following user cycles and activities (Kendall & Kendall, 2013). According to Rosenblatt (2013), there are five stages in designing information systems using the SDLC methodology: system planning, analysis, design, implementation, and system security & support. The design of this system uses Microsoft Excel as the main tool. Thus, improvement will result in the digital ICS, which can be more efficient.

2. Methods

This section will describe the theoretical steps or methodology of this research, start from initial observation, problem identification, literature study, data collection, data analysis, then come up with conclusion and recommendation. Each phase will have distinct aims and ways of achieving the objective. It will be shown in **Figure 1**.

2.1 Initial Observation

The current system or manual inspection check sheet system are observed. In the first step, Inspector gets sample parts and part information sheets from the production leader, including as part name, part code, machine number, and others. The Inspector carries out the process of inspecting the character dimensions of the part. When finished, the Inspector writes down the inspection result data one by one from the computer screen into the inspection check sheet form. Then the inspection check sheet is achieved into Bantex to be used by the relevant division, namely the production department. After one week, on Wednesday, the Quality Control Supervisor will approve all inspection check sheets. Then put it back into Bantex. After making observations, problems can be identified to determine what improvements must be made.

2.2 Problem Identification

To determine the suitable research objectives, problem identification is constructed. The problem that needed to solve in this research is related to one of manual system of inspection check sheet at PT. LV. The Quality Control department is who fully in charge to manage this inspection check sheet system. In its implementation is at PT. LV EJIP plant, this inspection check sheet is not efficient. Due to, the process still done manually. Some of process resulting inaccuracies data of inspection check sheet system, especially in input the characteristics dimension of a part. To understand more problem clearly, the details of current system should be known. The current system is analyzed to identify the weaknesses in making a suitable improvement.

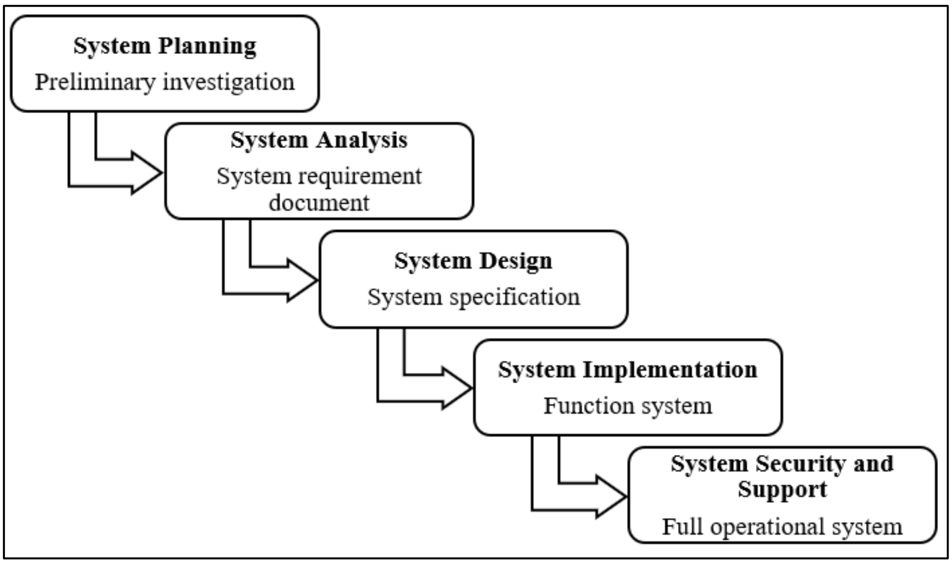
This research aims to reduce inaccurate data on the inspection check sheet and increase the efficiency of using inspection check sheets digitally. After done with identify the problem and objectives, then the scope and assumptions will determine. In this research, the scope is the research is only conducted in the Quality Control department of PT. LV EJIP Plant. The data are taken two times: the first from June to August 2022 and the second from October to December 2022. The assumption is that all information should be input into the proposed system, especially for all characteristic dimensions of parts that are unsimilar.

2.3 Literature Study

In this research, the literature study describes the theoretical and methodological approached based on the related problems. This can help find a solution that fits the problem to be identified. The literature study of this research originates from company files, books, journals, and company websites. Literature study in this research is:

- Information system which explains the collection, processes and distributes the data.
- System analysis which explains the situation and specifies what improvements on the new system should be accomplished to identify the purposes of the research.
- System design which explains how the system works based on user requirements.
- System development life cycle methodology explains an analysis using a structured phase to plan, analyze, design, implement, and support information systems.

In this research the methodology used is system development life cycle (SDLC). SDLC is an analytical method for designing the best gradual approach developed following user cycles and activities (Kendall & Kendall, 2013). According to Rosenblatt (2013), SDLC is an analysis that uses a structured phase of system planning, system analysis, system design, system implementation, and system security and support.



(Source: Rosenblatt, 2013, p.23)
Figure 1. Five Development Phase of SDLC Methodology

In making the manual inspection check sheet become a digital system. This chapter will explain five phases in using the system development life cycle methodology such as: system planning, system analysis, system design, system implementation, and system support & security. However, this research scope is just until the system implementation phase. **Figure 1** shows the development phase of the SDLC.

2.3.1 System Planning

The system planning phase identifies system requirements for consideration in creating a new system or making improvements. In its stages, it focuses on problems in current system to determine the needs of the information system that will be developed. Then used to make plans for the development of information systems. This phase also calls preliminary investigation used to perform and evaluate the system problem. This phase is crucial because the outcome will affect the entire development phase (Rosenblatt, 2013). Usually, this activity will show the opportunities for system problems and why the system needs to develop within the organization to determine the proposed system scope, which is the critical step in this phase (Valacich & George, 2016).

2.3.2 System Analysis

According to Dennis et al. (2012), the system analysis phase will investigate the current system, identify the improvement, find opportunities, and develop the concept for a new system. Furthermore, the researcher knows who will use it, what it will do, and where it will be used. In developing the system, gathering information regarding the current and proposed system is necessary for developing the system. According to Rosenblatt (2013) to understand the system, interviews are conducted to make the system requirement document: business or document process diagram, use case analysis, data flow diagram, and data dictionary. The list of system requirement documents which are:

- Business or Document Process Diagram
- Use Case Analysis
- Data Flow Diagram
- Data Dictionary

2.3.3 System Design

According to Rahmadini (2019), system design has three techniques: conceptual, logical, and physical. This technique aims to analyze the structure and relationship between external entities. The steps start with creating a conceptual model that can be achieved using an entity relationship diagram. Then, create a physical data model. After that, the user interface will be described using a system including input and output design.

2.3.4 System Implementation

The system implementation phase produces new system procedures for development, testing, and system documentation. This phase will focus on how the system runs smoothly and converts input data into useful information (Dennis et al., 2012). Several aspects must be considered in supporting system implementation, namely visual basic for application programming. Visual Basic for Applications is a programming language developed by Microsoft. In short, VBA is a tool used for developing the programs on Microsoft software, including Microsoft Excel. Then, this VBA coding will be a part of system documentation. After developing the proposed system. User manual are made, the user manual provides step-by-step instructions to help the user comprehend the digital ICS system smoothly. The user manual will contain both images and writing with several explanations in it will help the user easily understand how to use the digital ICS system. Last, the implementation result will be analyzed then comparing of the current and proposed system.

2.4 Data Collection

Data was collected from direct observation in the Quality Control department of PT. LV, especially in the measurement room area. The data are gathered two times. First, from June to August 2022, the data collected for this research is the current system or manual inspection check sheet data. Second from October to December 2022, the data collected for this research is the data after implementing the digital inspection check sheets system. The data collected helps researchers analyze company problems and improve the design of digital inspection check sheets. The data collected is as follows:

- Approximate total inaccurate data of the inspection check sheet.
- The average time consumed of the inspection check sheet for each process.

2.5 Data Analysis

After collecting the required data, the research will focus on data analysis. This study uses the system development life cycle methodology as a method of analysis to obtain the best improvement. The step of analysis is:

- Analyze the current system of inspection check sheet by doing observation and interviews to make the document flowchart for identifying the weaknesses of the current system.
- Identify the user requirements as guidance to create the digital inspection check sheet system from the current system document flowchart analysis.
- Create a use case analysis, data flow diagram, entity relationship diagram, and physical data model to depict the user interface design.
- Designing the digital inspection check sheet system's user interface, input, and output design.
- Implement the digital inspection check sheet system and compare the current and proposed systems, then identify whether the proposed system successfully achieves the research objective.

2.6 Conclusion and Recommendation

The last step of this research is to summarize all the results from the objective. After the conclusions are presented, the recommendations from this research will be given. These recommendations can be used for new research related to this topic.

3. Result and Discussion

3.1 System Planning

System planning or preliminary investigation is the first phase in designing a digital system. Based on the result of observation from June to August 2022. Was found 13 cases of inaccurate data of the current ICS system that caused the part to be detained. The total part being retained is 6496, as shown in **Table 1**.

Table 1. Total Retained Parts Caused by Inaccurate Data

Month	Inaccurate Data/Month	Quantity of Retained Part
June	4	1760
July	4	1340
August	5	3396
Total	**13**	**6496**
Average	**4**	**2165**

Table 2. Time Consumed of a Current ICS System

N Observation	Search ICS Form on Bantex	Fill out Part Information	Fill out Character Dimension Result	Achieves ICS Form to Bantex
1	00:00:10	00:01:01	00:01:07	00:00:15
...	...	...	...	...
51	00:00:11	00:00:47	00:02:04	00:00:19
Total	00:09:27	00:44:23	01:11:32	00:14:28
Grand Total	02:19:50			
Average	00:02:45			

Besides that, there are several disadvantages if the current data input ICS system is still manual. First, based on the 51 observations of time consumed in current data input, the ICS process takes a long time. The observation resulting in the total time consumed is 2 hours and 9 minutes with the total average time of one document ICS, which is 2 minutes and 45 seconds. The summary time consumed is shown in **Table 2**. Second, seven unnecessary repetitive data input was found, as shown in **Table 3**. Third, the approval process by the quality control supervisor once a week.

Table 3. List of Seven Repetitive Data Input of Current ICS System

No	Daily Check List App & Dimensi Form	Inspection Check Sheet Form
1	Machine No	Machine No
2	Part Name	PROD NAME
3	Part Code	PROD CODE
4	Inspect By	PIC (IPQC INSP)
5	Judgement	Judgement
6	Problem	Notes:
7	Date	Date

3.2 System Analysis

The second phase is system analysis. The result of analysis of the current ICS system shown in **Figure 2.** After the proposed system flowchart constructed, the next step is analyzing the system flowchart by using use case analysis as shown in **Figure 3**. The use case analysis will briefly explain the activities carried out to produce an output or input of a system to an external user that triggered an event. There are two external users, which are inspector and quality control supervisor. As the primary user, the inspector initiates an event by providing input to the system, and the quality control supervisor, as the secondary user, responds to the event by analyzing the data provided by the inspector.

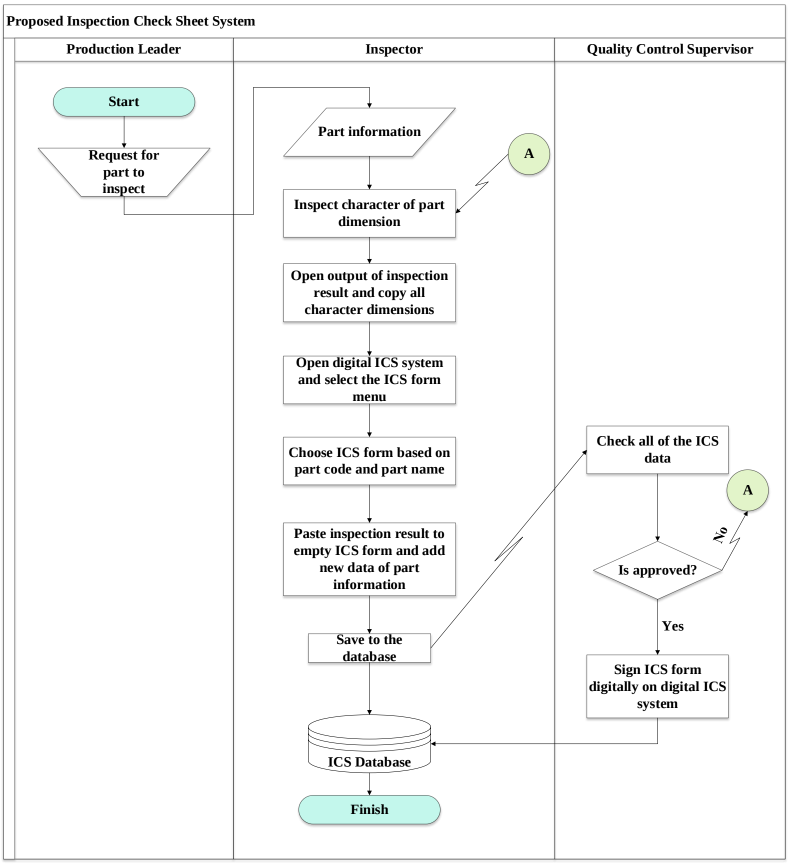


Figure 2. System Flowchart of Proposed Digital ICS System

A further step is to construct a data flow diagram (DFD) followed by a data dictionary description dictionary of data flow, data store, process, and entities. The DFD is started by constructing a context diagram of the digital ICS system, explaining the relationship between the system and all entities, as shown in **Figure 4.** Then, the DFD level 0 will be constructed to explode and present more detail of the context diagram. The DFD level 0 is shown in **Figure 5,** which explains more detail about the relation of entire entities to subsystems inside, including with data store. The relation also shows the data flow. Last, **Figure 6, 7,** and **8** explain the child diagram, which explodes a DFD level 0 process after completing the DFD of digital ICS system, including a data description dictionary of data flow, data store, process, and entities.

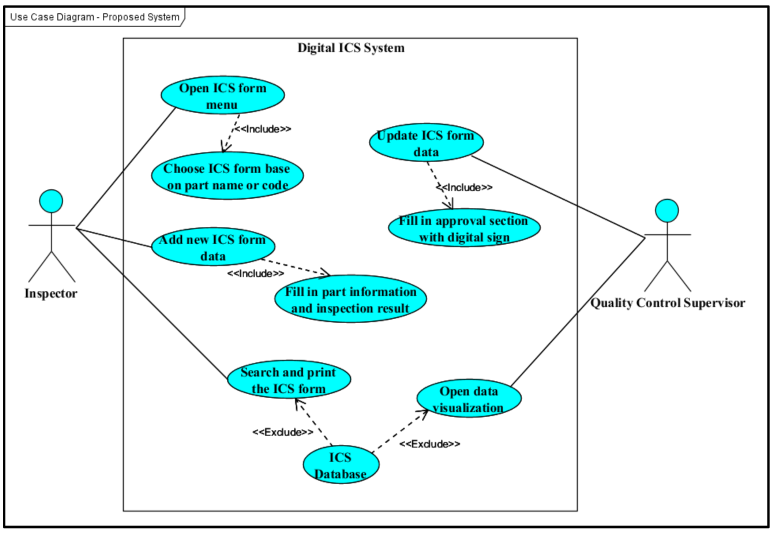


Figure 3. Use Case Diagram of Digital ICS System

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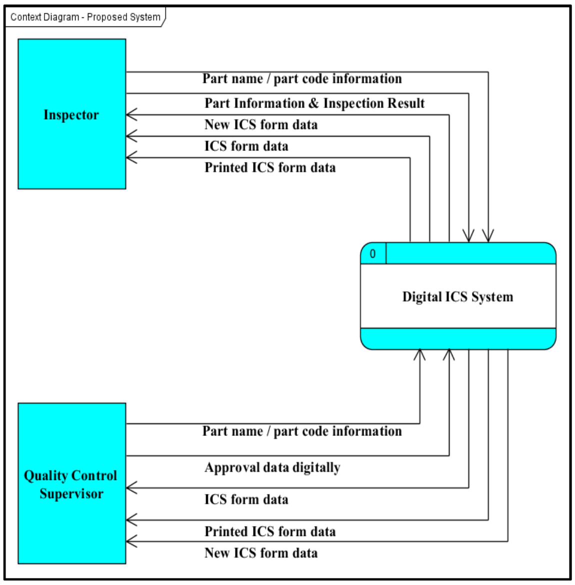

Figure 4. Context Diagram of Digital ICS System

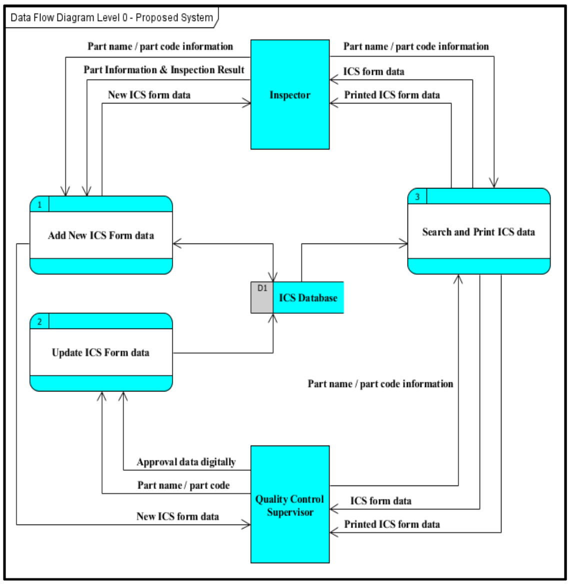

Figure 5. DFD Level 0 of Digital ICS System

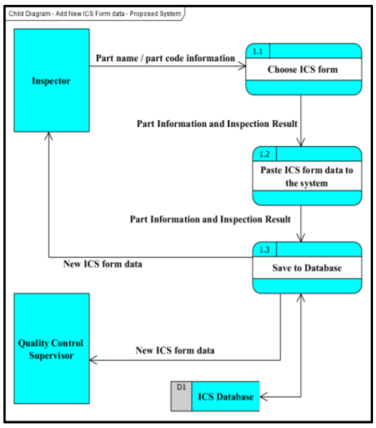

Figure 6. Child Diagram of "Add New ICS Form Data"

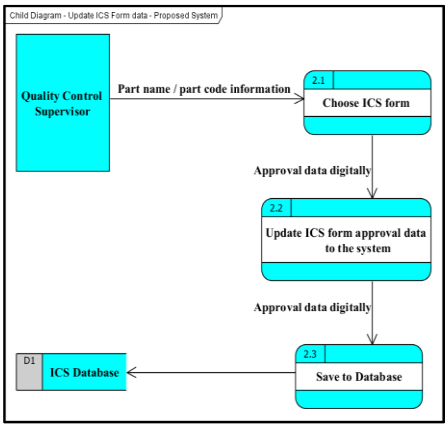

Figure 7. Child Diagram of "Update ICS Form Data"

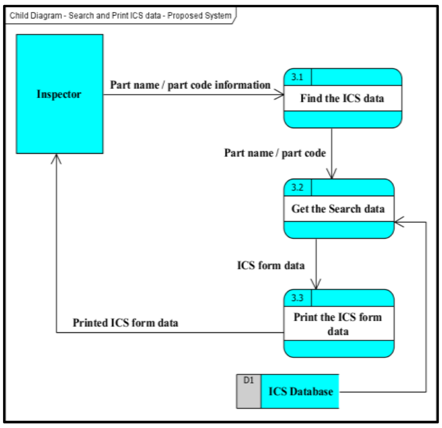

Figure 8. Child Diagram of "Search and Print ICS Data"

3.3 System Design

The third phase is system design. Start by creating the entity relationship diagram to know the relationship between entities of data. **Figure 9** shows the entity relationship diagram of the digital ICS system. A further step is creating a physical data model of a digital ICS system database; the entities in it has same as entity relationship diagram. The difference is having a central database of ICS database to centralize data between inspector and supervisor quality control entities. **Figure 10** shows the physical data model of the digital ICS system.

After creating the database, the user interface is designed to provide clear communication between the system and the user. From the input user interface for input design, **Figure 11, Figure 12, Figure 13, and Figure 14** shows a user interface design. **Figure 11** shows the main menu of the digital ICS system. **Figure 12** shows sub-menu-1 or ICS form menu. **Figure 13** shows input data of the digital ICS form and User form part information. **Figure 14** shows sub-menu-2 or the update ICS form menu.

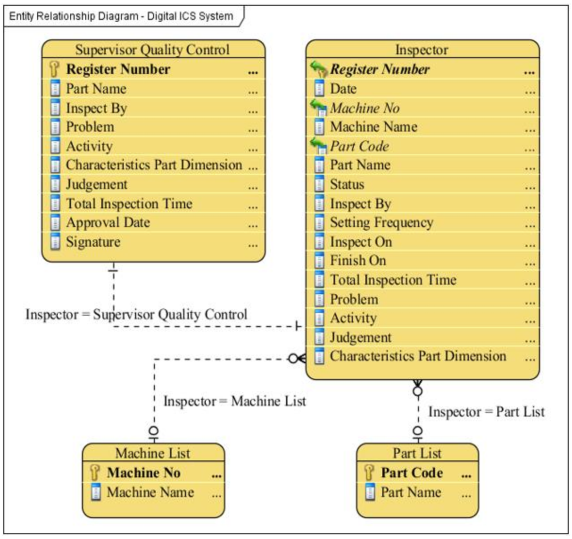

Figure 9. Entity Relationship Diagram of ICS System

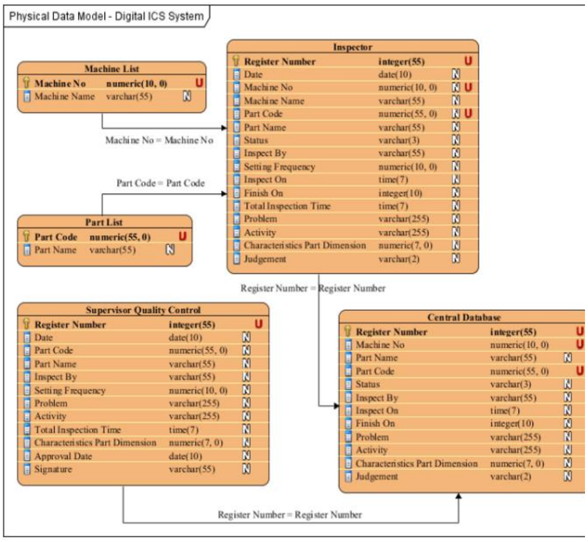

Figure 10. Physical Data Model of ICS System

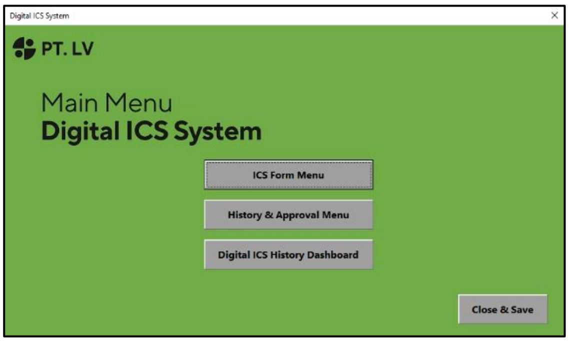

Figure 11. Main Menu of Digital ICS System

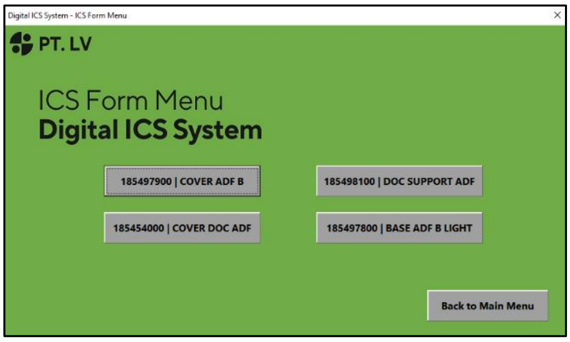

Figure 12. Sub-menu-1 or ICS Form Menu

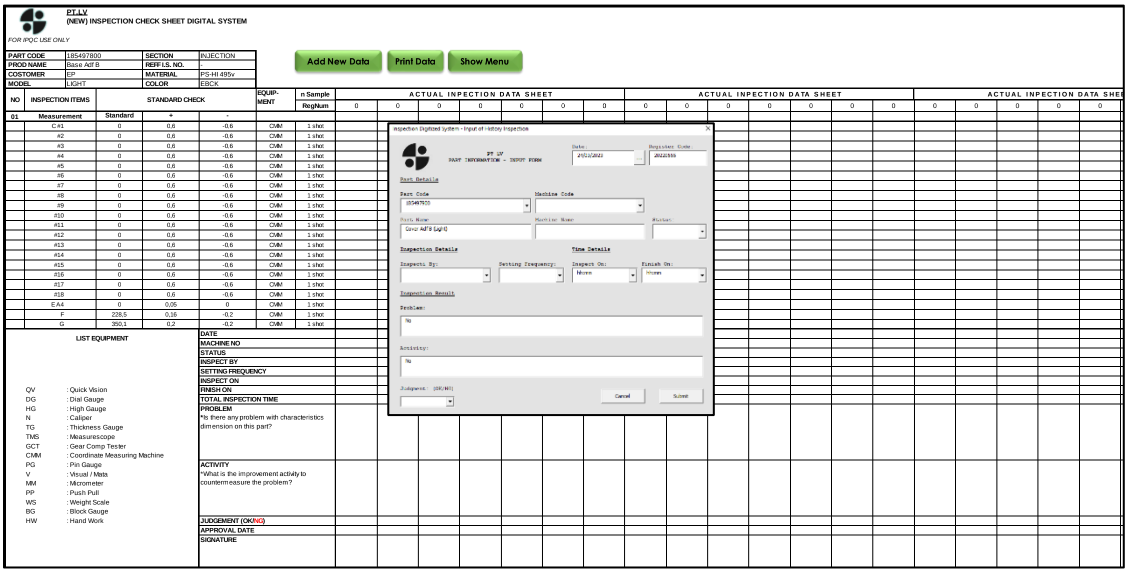

Figure 13. Input Data of Digital ICS Form and Userform Part Information

Figure 14. Sub-menu-2 or Update ICS Form Menu

Furthermore, the output design is shown in **Figure 15 and Figure 16. Figure 15** shows the output design of a user forms part information. While **Figure 16** shows a data visualization of digital ICS dashboard. The data visualization consists of information: part list of problems, inspector rate, top list of problems, NG rate by production status, monthly trend NG rate, and daily trend NG rate.

No	Register Code	Date	Machine No	Machine Name	Part Code	Part Name	Status	Setting Frequency	Inspect By	Time Inspection

Finish Inspection	Total Inspection Time	Problem	Activity	Judgment	Approval Date	Signature by Supevisor

Figure 15. Output Design of a Userform Part Information

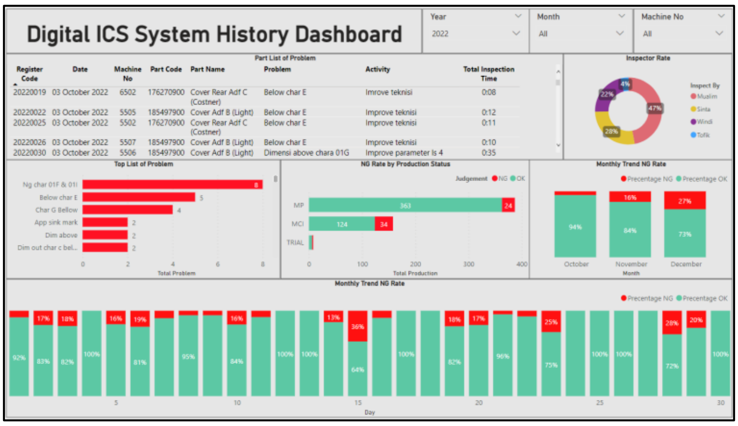

Figure 16. Data Visualization of Digital ICS Dashboard

3.4 System Implementation

The last phase is system implementation, in implementation to develop the analysis and design of the digital ICS system is using a Visual Basic for Application programming language by Microsoft Excel. Then, the user manual of a digital ICS system is created. The user manual provides step-by-step instructions with some images to help the user comprehend the digital ICS system smoothly.

Finally, the proposed system has been implemented. Based on the observation from October to December 2022, implementing the digital ICS system has several impacts. First, the inaccurate data has reduced from 13 cases to 0 cases. **Figure 17** shows the graph of the comparison of total inaccurate data between the current and proposed system. Second, the total time consumed by the proposed system was reduced by 72,34% from the current system. **Figure 18** compares the current and proposed system's total time consumed—the approval done digitally.

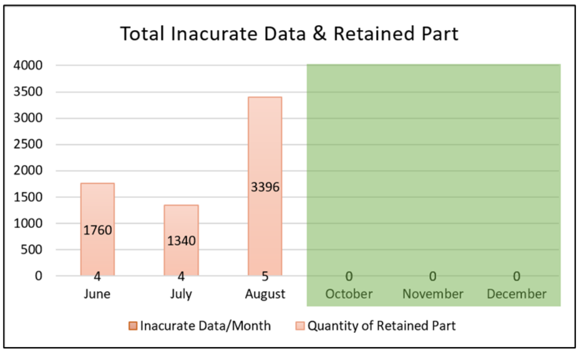

Figure 17. Comparison Total Inaccurate Data and Retained Part

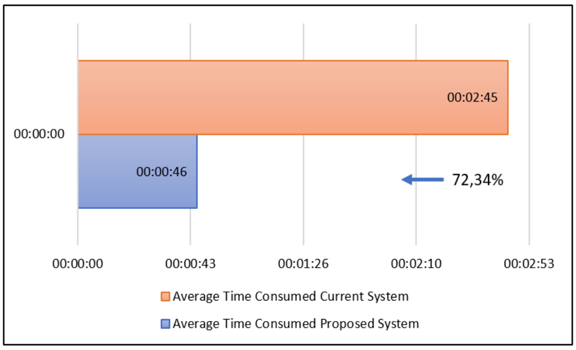

Figure 18. Total Time Consumed Between Current and Proposed System

Then, compare the new digital ICS system to the previous one—the comparison between the document and system flowchart, which can be seen in **Figure 17**. As seen on the figure, the proposed system process has significantly changed because there is no longer a manual input, especially by writing. All the proposed system becomes digital, and the process of filling characteristics dimensions is just copy-pasted from the inspection result output. The quality control supervisor will do the approval process digitally using a digital ICS system.

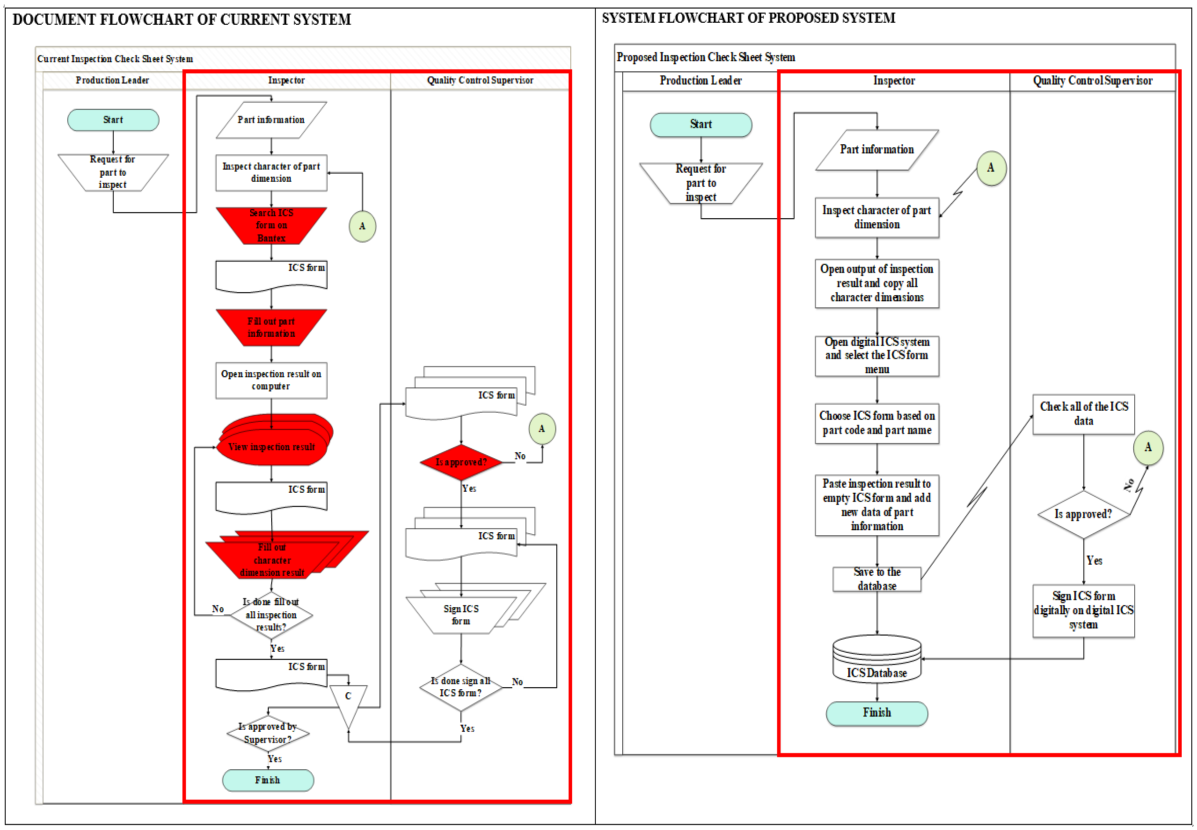

Figure 17. Comparison of Current Document and Proposed System Flowchart

4. Conclusion

This research concludes that the current system of inspection check sheet in PT. LV is still done manually. It caused inaccurate data input of characteristic dimensions of a part that affected part to be detained. Based on the observation from June to August 2022, found 13 cases of inaccurate data caused by the manual system, with the total retained part is 6496. Besides that, the average time consumed takes 2 minutes and 45 seconds for one data input process of a current system. That has seven repetitive data input activities. Last, the approval process takes once a week or every Wednesday. After identifying the current system's weaknesses, the weaknesses are improved by designing a digital ICS system using system development methodology. The implementation of the digital ICS system starts from October to December 2022. In its implementation, it successfully reduced the number of inaccurate data and retained part significantly to become 0 cases. Then, the impact of designing a digital ICS system is determined by comparing the current and proposed system. First, the average time consumed reduces by 72.34% from 2 minutes 45 seconds become 46 seconds only. Second, there is no more repetitive data input activities. Last, an approval process is done digitally using the digital ICS system.

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