Inform : Jurnal Ilmiah Bidang Teknologi Informasi dan Komunikasi
Vol.9 No.1 January 2024, P-ISSN : 2502-3470, E-ISSN : 2581-0367

Developing a Business Intelligence Dashboard of Liquid Material at a Toy Manufacturing Company using a System Development Life Cycle (SDLC) Model

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Received: 2023-08-01; Accepted: 2023-12-08; Published: 2023-12-22

Abstract— Fashion doll manufacturers place a substantial emphasis on maintaining aesthetic appeal. One of the most important aspects of preserving a fashion doll's attractive appearance is using liquids to keep the hair in place despite countless shocks and bumps during the distribution process. According to a recent observation on liquid material control at one of the largest toy manufacturing companies worldwide, the process and database had shortcomings that might be fixed by developing a business intelligence dashboard using the SDLC methodology. The SDLC approach was adopted as the improvement methodology. According to the initial observation, improvement can be made by designing a system architecture that includes input data until data visualization. The form was created in Microsoft Forms and integrated into Microsoft Excel, Microsoft Power Automate, and Microsoft Power BI. After being implemented, this enhancement successfully reduced deficiencies and waste. According to the testing findings, all the capabilities perform as the users and stakeholders desired, satisfying all user requirements. Consequently, the organization applies business intelligence to the other departmental areas to visualize the data.

Keywords— Liquid Materials; SDLC; Database; System Architecture; Business Intelligence; Dashboard.

I. INTRODUCTION

The invention of new toys is quick in the labor-intensive field of toys. In this circumstance, toy businesses must manufacture high-quality goods that appeal to the general public and their intended market. The appealing appearance of a toy is crucial since, especially for fashion doll products, the first aspect to consider when buying a toy is its appearance. Fashion doll products must be explicitly packaged to endure a lengthy export and import distribution voyage while still looking good.

A manufacturing company called *PT TMC* produces well-liked fashion dolls that are sold all over the world. Many innovative techniques have been utilized on the product being produced to maintain its excellent appearance after the distribution process. The use of liquids to retain the fashion doll's hair in place despite numerous shocks and bumps during the distribution process is crucial to maintaining a fashion doll's attractive appearance. However, the material control of liquid material in *PT TMC* needs to be standardized and has numerous shortcomings that need improvement to make the material control sustainable. So, this research aims to standardize liquid material control and improve numerous shortcomings.

By analyzing the current system's shortcomings and creating the proposed system using the System Development Life Cycle (SDLC), this study focused on upgrading the liquid material control system. The system development life cycle (SDLC) is examined, and any deficiencies are clarified [1]. SDLC for developing business intelligence avoids extremes by balancing the approach with the set of limitations for the developer to review the system [2]. Many phrases have been used to describe the objectives of this method. The main aim is to create a system that fulfills user and stakeholder needs and supports necessary activities. The system must also have certain qualities, including effectiveness, precision, compatibility, adaptability, portability, and acceptability [3].

This study used Microsoft Form, Microsoft Power Automate, Microsoft Excel, and Microsoft Power BI to support the system. Specifically, in the process of liquid materials requirement controls, this research is expected to assist in designing a liquid material management system. Furthermore, Microsoft Power BI, as one of the tools utilized, is a software released by Microsoft in 2015 that is a cloud-based data analysis tool that can be used for data analysis and modeling complex data mashups [4].

In line with the utilization of Microsoft Power BI, business intelligence is a term used to describe the technology and strategy used to collect, analyze, and integrate business information for a corporation. These advantages make corporate intelligence creation crucial, especially for dashboards. Business intelligence (BI) can also refer to processes, structures, tools, databases, applications, and frameworks for data analysis and the creation of useful information from raw data to assist business managers in making decisions [5]. In other words, business intelligence converts data into knowledge [6]. Business intelligence aids engineers in gathering data, producing reports, and making decisions. With the help of business intelligence, organizations are becoming more data-driven in their decision-making.

Meanwhile, for the approaches, there are three in the BI which depend on the goals of the development of the BI. There is a managerial approach, a technical approach, and value-

DOI : https://doi.org/10.25139/inform.v9i1.6705

added capabilities [7]. Regardless of the desired result of BI, an organization-wide adoption implies a considerable change in the organization's business processes. The deployment of BI alters management for BI as an incremental or transformative process of gradually changing the organization's reporting structure [8].

Furthermore, manufacturing companies are undoubtedly one of the foundations of economic strength in many nations. This industry's global prosperity depends on top-notch goods and production techniques. One nation's primary sources of income could come from its manufacturing sector. It is a significant business activity. The world has started to develop a strategy to sustain and expand its profit as the competition heats up and customers become more demanding [9]. BI has been proposed to make precise and wise business decisions quickly. This includes applications and analytics based on operational and analytical databases [10]. BI's applications and analytics can be a personal assistant for a real-time overview, a reference tool, and anticipation events [11].

To enable effective decision-making inside a manufacturing company, in this case, *PT TMC*collection of approaches, tools, and procedures known as business intelligence (BI) is used to gather, integrate, analyze, and present data from multiple sources or multidimensional overviews. Business intelligence will provide the integrated evaluation and analysis for the company [12]. Business intelligence refers to a broad range of tools, methods, and technologies intended to assist organizations in deriving valuable insights from their data and using this knowledge to inform decision-making. The critical components of business intelligence include consolidating data from diverse sources, analyzing large datasets, presenting data comprehensibly, employing predictive analytics with statistical models, and ensuring data quality management.

Data analysis or computational capabilities are essential for those three main components since the company and organization have massive amounts of data from their production process [13]. This fact also applies to *PT TMC*, one of the largest toy manufacturing companies. It remains unknown if larger organizations that have adopted business intelligence, like publicly traded companies, get the full rewards of the systems' potential. In other words, the firm must implement business intelligence across all its functional areas to observe its strategic impact.

Nevertheless, there are significant strategic implications for corporate intelligence [14]. Enhancing economic performance is closely linked to the favorable effects on both routine and innovative aspects of organizational performance through the strategic utilization of business intelligence. Thus, *PT TMC* can improve its financial performance by strategically employing business intelligence. Furthermore, environmental efficiency is enhanced through business intelligence, which provides data integration and analytical capabilities for delivering crucial decision-making information to stakeholders across different organizational levels. This, in turn, facilitates strategic planning, performance improvements, and the creation of competitive advantages for *PT TMC*. Additionally, the ability to make smarter choices at all organizational levels is supported by the precise and relevant data provided by business intelligence, leading to better outcomes and more informed decision-making. Ultimately, business intelligence offers a competitive edge by equipping *PT TMC* with the knowledge needed to make informed decisions, positioning the company ahead of the competition, and potentially providing a market competitive advantage.

II. Research Methodology.

The research methodology shows the steps of conducting the research. The methodology used in this research is the System Development Life Cycle (SDLC). The SDLC was chosen because it outlines the framework with many activities and tasks to be completed during the development process that is adapted to lead to the main and additional outputs of the system [15][16]. Figure 1 shows the research methodology that consists of seven stages: plan, design, development, test, implementation, maintenance, and evaluation.

A. Plan

In this stage, there are three steps: business process observation, data gathering, and identification of shortcomings. Those three steps have different objectives. Business process observation in *PT TMC* aims to describe the flow of the current liquid material control system. This data can be categorized as qualitative data, defined as non-numerical data shown in the word and non-numerical form, such as the flow of the current system. Qualitative data answers the questions of how and why [17]. Data gathering refers to the process of collecting historical data from the database. This step is conducted by performing an audit on the production floor and using available historical data. It aims to determine the user and stakeholder requirements so that future improvement will be relatable for them. To empower users to become aware of business requirements that will enable the development of a BI system that will improve the decision-making within the organization [18]. After the business process is observed and data gathered. The shortcomings of the current condition can be identified. The shortcomings relate to the wastes that can be eliminated by developing the new system.

B. Design

In this stage, the shortcomings will be converted to a technical design that will improve the material control of liquid material. The required information types and the best methods for processing them are described in an information of systems architecture [19]. System architecture serves as the big picture of the development of this system. The system's requirements from the users are crucial because it determines the system's functionality. With that, user and stakeholder requirements are expected to be satisfied by the improvement. In this instance, all users are involved in the conversation. After that, the dashboard is designed based on the user requirements. The example of user requirements is autocalculated material requirements.

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C. Development

The development stage follows the system architecture design. The development stage starts from the form of development. Microsoft Form is used because of its flexibility; the data will be stored on the organization's server. The data from the form will be stored in Microsoft Excel. Microsoft Power Automate will simplify the data structure and make a lighter database. The output is Microsoft Excel. Microsoft Excel will be the source of the dashboard. The ETL process involves extracting, transforming, and loading data into the Microsoft Power BI Tools. ETL collects data from a source, converts it to a new format compliant with business rules, and then moves it to the destination data structure [20] [21]. The dashboard is developed after the ETL process, considering user and stakeholder requirements. The key feature of the dashboard will be on the main page. An example of the key feature is filtering data based on categories.

D. Test

Test stages consist of system testing based on the user requirements. The functionality and features will be tested. If there were an error, the system could be evaluated and fixed before real users used it. Since the system development performs the ETL process, the accuracy of the calculated data is also being examined to ensure the business intelligence gives the right and precise material data. This process was performed by comparing the system developed and manual calculation results.

E. Implementation

The implementation of the system will start with brief training for the user and stakeholders. The features available in the system will be shown. This short training was conducted in a brief presentation and hands-on with 30 minutes. This stage is also related to the installation of the required software. The software required to be installed is only Microsoft Power BI for stakeholders. The form and dashboard are being published to the *PT TMC* server and will be restricted in access to revise or edit the system.

F. Maintenance

As a result of the possibility that the data input is incorrect, maintenance must be carried out. The system will be monitored and checked during the care to ensure it functions as planned. On the off chance that there is a mistake, the system will need to be corrected. There is a connection between this stage and the development stage. A dashboard section has been set aside to monitor phony data to circumvent this issue. The integrity of the data may be maintained with more ease as a result of this feature.

G. Evaluation

Evaluation refers to the satisfaction status of the users and stakeholders. This evaluation used a distributed questionnaire to identify the satisfaction level by emphasizing the question in the system's features.

III. RESULT AND DISCUSSION

A. Plan

Business process observation for liquid material control in *PT TMC* can be seen in Figure 2.

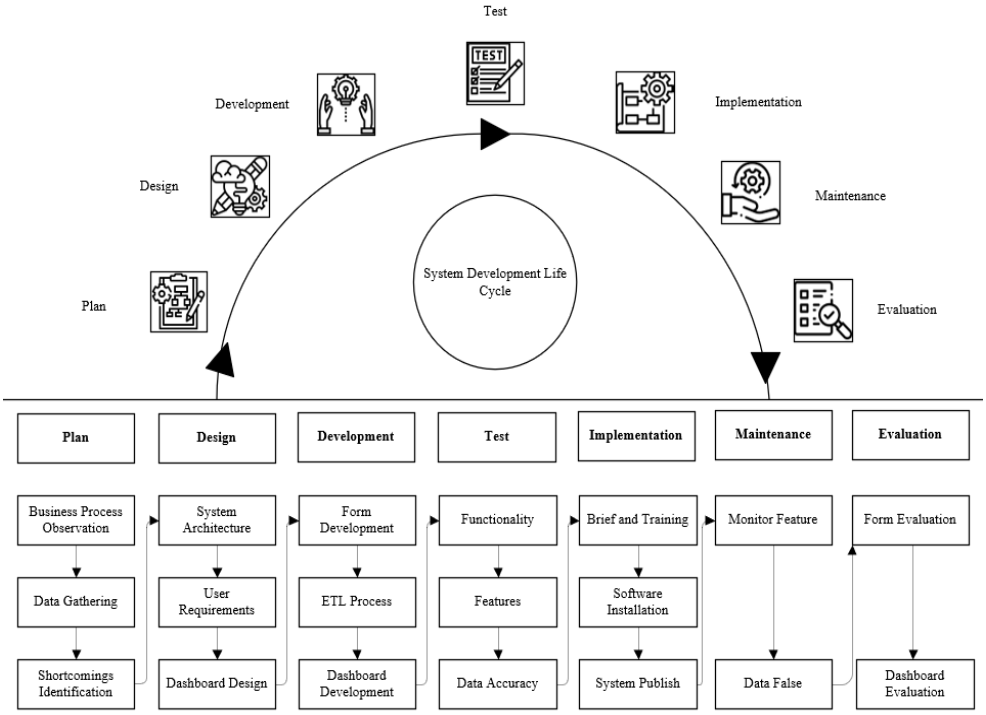

Figure 1. Research Methodology

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Figure 2 shows two user categories: grooming leaders and industrial engineers. Industrial engineers must input the liquid material requirements to the MRP system in production. The current database uses Microsoft Excel with five sheets that represent each material. This condition leads to the inefficiency of searching the data since the data in Microsoft Excel is still raw.

There are numerous ways to view data in modern times, including using Power BI. The user of Power BI can create visualizations that are both appealing and effective [20]. Power BI also allows the user to use it as an application for analytics and sharing business knowledge within cloud integration, allowing the user to data discovery and preparation [22].

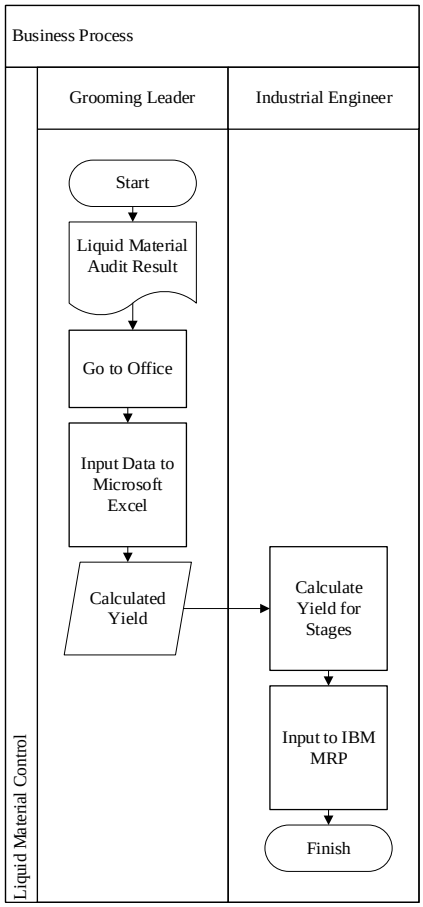

Figure 2. Current Swim Lane Diagram

Shortcomings can be analyzed based on the current flow of liquid material control. The grooming leader needs to go to the office to input the data, but this limitation can be overcome by using a form accessible anywhere via a smartphone. The current swim lane diagram indicates that the industrial engineer has to calculate the yield per stage in the existing database. However, this drawback can be addressed by developing a pre-calculated yield per stage in the business intelligence dashboard.

Data gathering from historical data can be collected from current databases that use Microsoft Excel to store the data of liquid material. Figure 3 shows the existing database of liquid material. The current database consists of 4 sheets for each type of liquid material. Four liquid materials are being used in *PT TMC* in the grooming process. These liquid materials include hair setting, aqua dest, jhonson, and weicon.

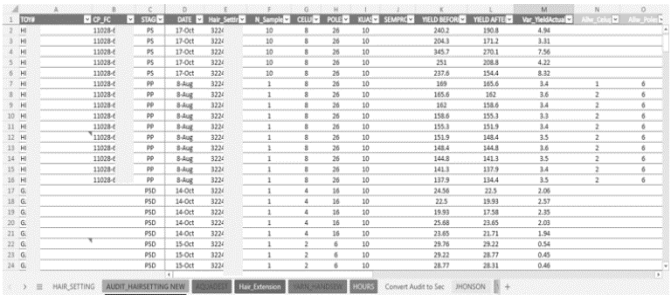

Figure 3. Current Database

The current database has several shortcomings that could become a danger in the future, such as:

a) Manual Entry: Grooming Leader needs to input the data into Microsoft Excel. Due to extensive data, the Grooming Leader risks mistyping or inputting the data into the wrong sheet or column.

b) Human Error: There are many possibilities for human error when using Microsoft as an open-access database. Inadvertence of erasing the data, miss-input, wrong formula, and manipulating the data can occur. This database will be used to produce data on the IBM MRP system; thus, it is important to overcome human error.

c) The Accuracy of Data is Low: Microsoft Excel is open to editing. The accuracy can be questioned because everyone can edit and manipulate the data. There is no guarantee that the data is the actual data.

d) No Security: The security of the data is low since Microsoft Excel is open access to edit. Everyone can edit and even delete Microsoft Excel. Then, the data will be gone.

e) Requires Time to Get the Data: When industrial engineers want to input the yield from Microsoft Excel, they must search every sheet. This condition can be categorized as a waste since the time required to search is high.

B. Design

System architecture corresponds to the fundamental concepts that specify how a system is created. In this circumstance, the system architecture describes the emerging business intelligence. The system architecture is shown in Figure 4. The audit results for the grooming leaders and assistants will be included in the grooming audit form. The web Share Point database will be used to store the data. Microsoft Power Automate will automatically process those data to simplify them before storing them in the database. The data from the database will go through an ETL process and be visualized using Microsoft Power BI's business intelligence [21] [23].

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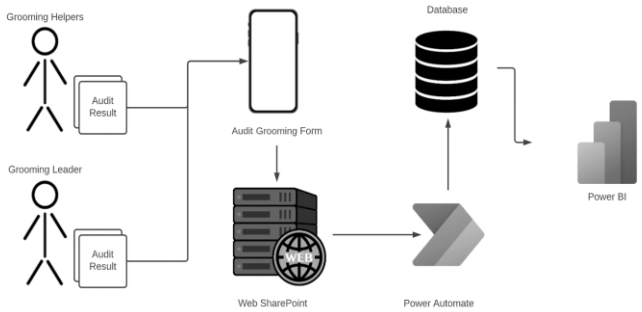

Figure 4. System Architecture

As shown in Figure 2, there are two categories of users grooming leaders and industrial engineers. Based on the discussion with those two categories of users, Table 1 shows the user requirements. The industrial engineer has seven requirements that need to be satisfied, while the grooming leader only has four requirements to be satisfied.

TABLE I
USER REQUIREMENTS

No.	Users	Requirements
1	Industrial Engineers	Filter based on Toy Number. Filter based on Count Point Flow Chart. Filter based on Piloting Stage. Filter based on Material Type. Material yield after 7% of allowances. Material yield after conversion to the unit in the MRP system. Material yield per Piloting Stage.
2	Grooming Leader	Form to input all liquid material data. Toy Identity. Yield before and after for all types of material. Auditor identity.

Based on the user requirements, some data must be available in the database and form. Table 2 shows the required data. Required data can be categorized as toy identity, audit result, and auditor identity.

TABLE II
REQUIRED DATA

Column Name	Column Name
Toy Number	Yield Before 1
Count Point of Flow Chart	Yield After 1
Audit Stage	Yield Before 2
Actual Piloting Date	Yield After 2
Audit Type	Yield Before 3
Part Number	Yield After 3
N-Sample	Yield Before 4
Brush Number	Yield After 4
Dip Frequency	Yield Before 5
Polish Frequency	Yield After 5
TH Spot	Name of Technician
Spray Frequency	Employee ID of Technician

The dashboard will consist of 5 pages, each with its objective. The first page is the dashboard to show all material yield and filters based on toy number, audit stage, and audit type. The second and third pages are the pages to show the yield of liquid material per stage so the engineer can evaluate the integrity of the audit result. The fourth page serves as a reference for the engineer for a similar toy. The fifth page has the objective of monitoring the data false.

C. Development

Microsoft Forms can be the solution to eliminate the shortcomings of inputting the audit result using a computer. Microsoft Excel allows Grooming Leaders to input the data from their mobile phone and the production floor.

Figure 5 shows the flow chart of the developed Microsoft Form. The form consists of 9 sections. The first section collects the data for toy identity and has the branches to determine which section will be the next based on material. Section 2 until Section 8 are for audit data. Section 9 is auditor identity.

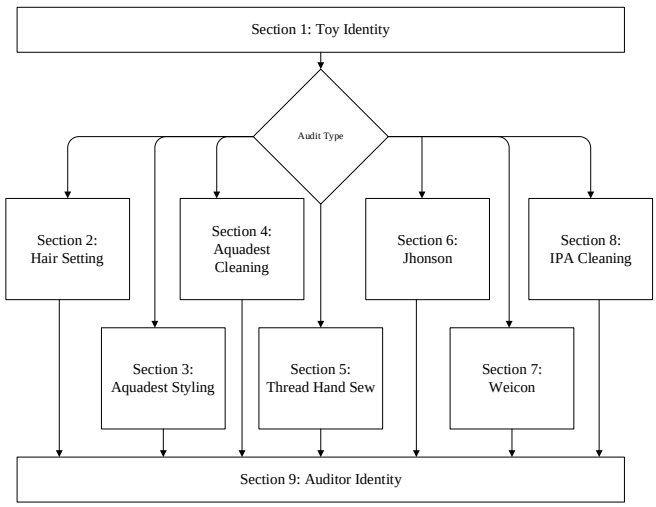

Figure 5. Form Flow

Microsoft Form is developed based on the data requirement. Microsoft Form was also designed as simple as possible to avoid misunderstanding the form. Figure 6 shows the Microsoft Form.

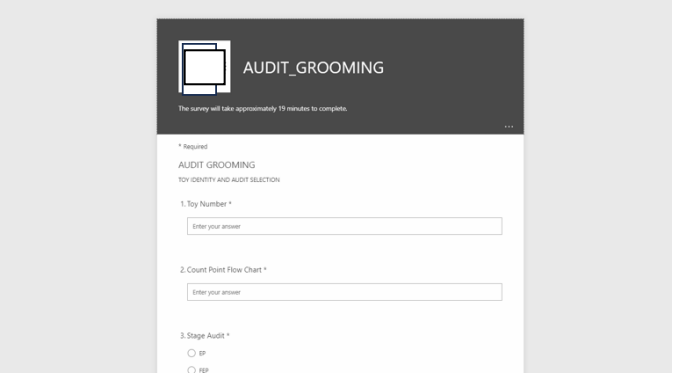

Figure 6. Microsoft Form

Microsoft Excel is used in SharePoint to store the Microsoft Forms output. The 77 columns in this Microsoft Excel

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document housed all the data based on the questions from the Microsoft Form. Multiple-column versions of Microsoft Excel are challenging to manage and monitor.

In addition, Microsoft Excel will not serve as Power BI's data source. The data structure is crucial for creating a lasting database. Numerous columns might cause the stack overflow issue, which puts the database and business intelligence dashboard in danger. The database needs to be simplified to avoid that issue. This research can simplify the Microsoft Form outcome by using Microsoft Power Automate. In addition to reducing database weight, it will prevent stack overflow issues. Microsoft Power Automate is used to simplify the data structure of Microsoft Excel. Figure 87 shows the Microsoft Power Automate steps.

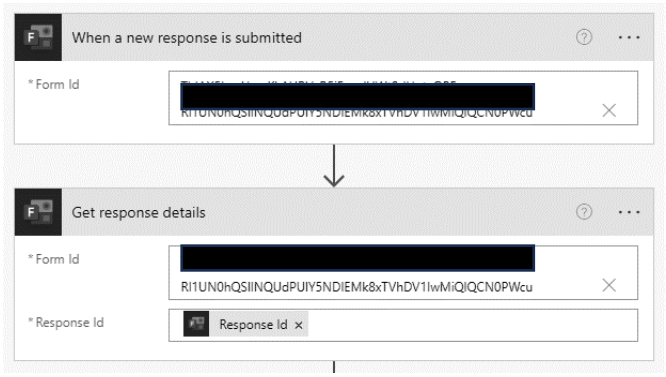

Figure 7. Microsoft Power Automate

After using Microsoft Power Automate, the new database has only 22 columns as opposed to the old database's 77 columns. There are numerous data source possibilities in Microsoft Power BI. The source is online since the database in Figure 9 is kept in SharePoint. Then, the source of the data is the website.

The navigator window opened when the data's origin was verified. The user can choose the table that will serve as the data source in the navigator pane. Power BI chose Table 1 as a source. The window displays the preview. Next, modify the data so that it may be edited by the user and supported by dashboard visualization.

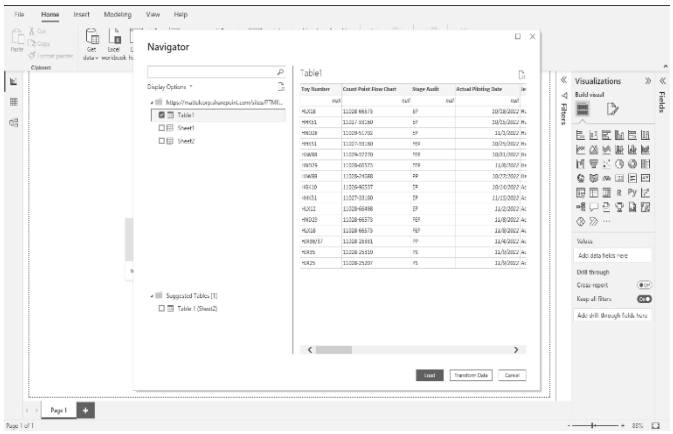

Figure 8. Extract Data

The following step of data cleaning must include data type correction. All columns' data types have been altered. Table 3 lists every type of data that is present in each column. Text, whole numbers, and decimal numbers serve as the data type in the column.

TABLE III
REQUIRED DATA

Column Name	Data Type
Toy Number	Text
Count Point of Flow Chart	Text
Audit Stage	Text
Actual Piloting Date	Date
Audit Type	Text
Part Number	Text
N-Sample	Whole Number
Brush Number	Whole Number
Dip Frequency	Whole Number
Polish Frequency	Whole Number
TH Spot	Whole Number
Spray Frequency	Whole Number
Yield Before 1	Decimal Number
Yield After 1	Decimal Number
Yield Before 2	Decimal Number
Yield After 2	Decimal Number
Yield Before 3	Decimal Number
Yield After 3	Decimal Number
Yield Before 4	Decimal Number
Yield After 4	Decimal Number
Yield Before 5	Decimal Number
Yield After 5	Decimal Number
Name of Technician	Text
Employee ID of Technician	Text

Data tables must be divided into numerous tables to organize the data structure. Dimensions are listed in the first table. A dimension table is a table that contains the data attributes that can be used to characterize the data in a fact table. Data columns in a dimension table include both additions and rarely changed columns. Examples include toy numbers, count point flow charts, audit stages, and audit types. The count point of the flow chart is the main link between the dimension table and the fact table. Due to the complexity of the data structure in this Power BI, the fact table will be divided into six tables with the addition of a final refresh table to prevent stack overflow. There are eight tables in Power BI.

The connection between the dimension table and the fact tables is depicted in a relationship diagram. The count point of the flow chart is the relationship's primary key. Since a toy

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number can include many count points in a flow chart, it cannot be the primary key. From the dimension table to a fact table, there is only one direction and nine One-to-Many relations. There are no connections to the most recent refresh table. The relationship diagram is in Figure 9.

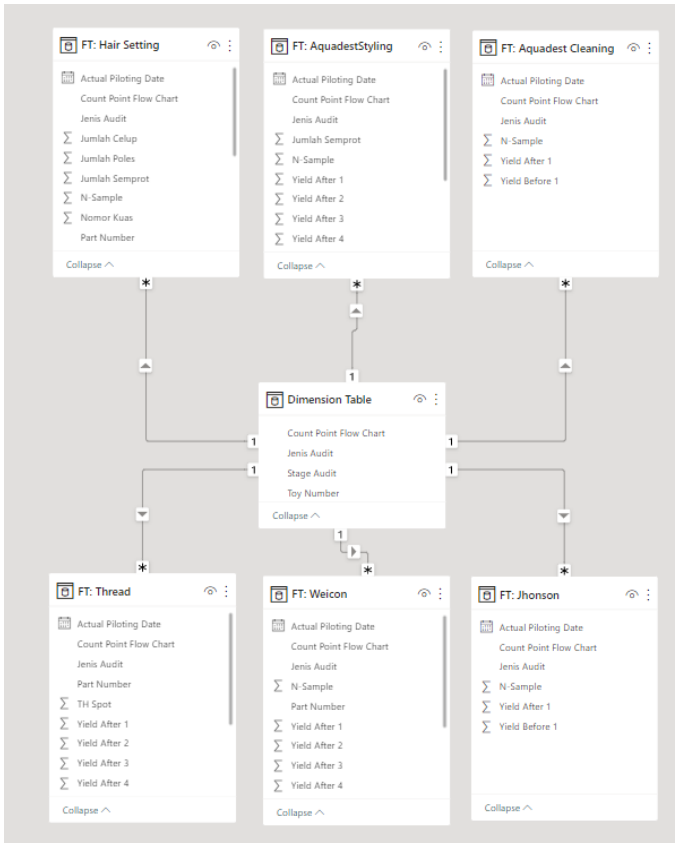

Figure 9. Relationship Diagram

Page 1 is the dashboard for all material. All essential liquid material yield can be found on this page. The page's header displays the company's logo and the dashboard's name. Additionally, there is data regarding Power BI's most recent refresh. There are three sections on this page—Figure 10 displays page 1. There is a lot of information hidden since it is confidential.

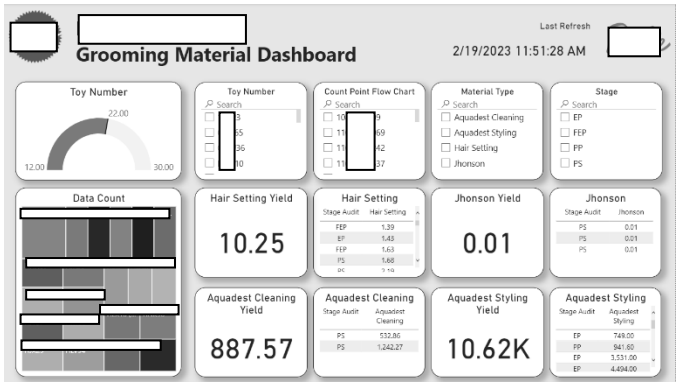

Figure 10. Dashboard

The allowances of 7% have been added to the yield of all liquid materials. The IBM MRP system has set the unit of liquid materials, and the Microsoft Power BI has converted all yield into units on IBM MRP, so the engineer needs to input the displayed yield. Depending on their needs, engineers can filter the data. To increase the amount of data displayed, engineers can filter out all of section 1 or just one toy's identification.

The filter section and stage-based yield information are on pages 2 and 3. As a filter and output for Hair Setting, Aquadest Styling, Aquadest Cleaning Jhonson, Weicon, and Thread Hand Sew, there is a toy number and count point flow chart. The grooming table per stage is depicted in Figure 11. There is a lot of information hidden since it is confidential.

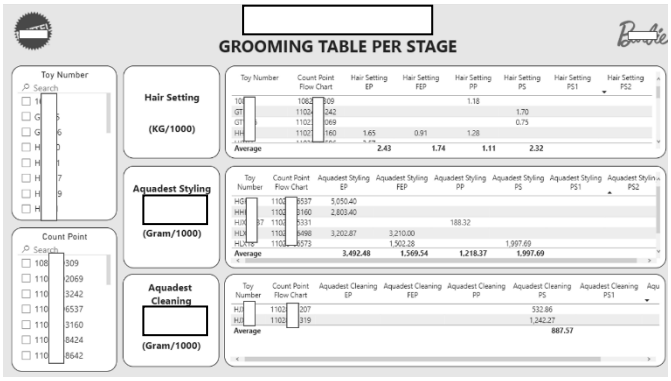

Figure 11. Per Stage

If the audit data for the desired toys were not accessible, the engineer may use the calculation on page 4 to find a reference toy with the same dip and polish amount. The data on Hair Settings will be displayed, and there are two slicers for dip and polish. The reference for dip and polish is in Figure 12. There is a lot of information hidden since it is confidential.

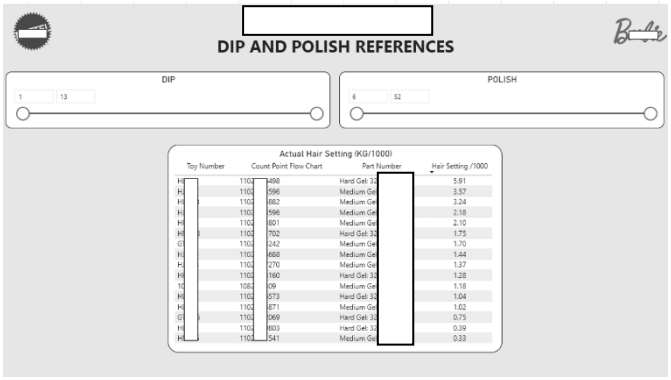

Figure 12. Reference Page

The last page is a data false detector where the engineer can evaluate the integrity of the data. If a toy number is shown on this page, it means there is data false and needs to be fixed to make the yield shown on the other pages can be used by the IBM MRP system. Figure 13 shows the page.

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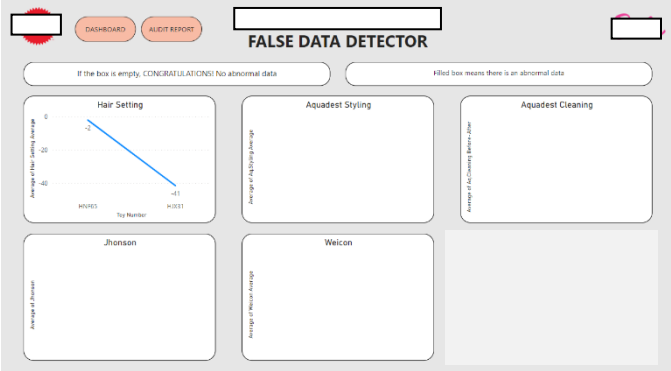

Figure 13. Data False Detector

D. Test

This stage aims to test whether the system has completely provided all the features based on user requirements. The features also need to be checked for errors. Data accuracy was inspected to ensure the calculated data on the dashboard. The test was conducted based on the user requirements. Table 4 shows the result of the test.

TABLE IV
SYSTEM TESTING

Users	Requirements	Feature	Status
Industrial Engineers	Filter based on Toy Number	Available	Work Perfectly
	Filter based on Count Point Flow Chart	Available	Work Perfectly
	Filter based on the Piloting Stage	Available	Work Perfectly
	Filter based on Material Type	Available	Work Perfectly
	Material yield after 7% of allowances	Available	Work Perfectly
	Material yield after converted to the unit in the MRP system	Available	Work Perfectly
	Material yield per Piloting Stage	Available	Work Perfectly
Grooming Leader	Form to input all liquid material data	Available	Work Perfectly
	Toy Identity	Available	Work Perfectly
	Yield before and after for all types of material	Available	Work Perfectly
	Auditor identity	Available	Work Perfectly

Based on the testing process, all of the features have been provided on the new system, and all of the features also run perfectly. The next is to inspect the data's accuracy. There were no differences Based on the data manually calculated and calculated by Microsoft Power BI. The conclusion is that the system passes the data accuracy test.

E. Implementation

The implementation started with a briefing with the users. The grooming leaders were briefed about the input process of the audit result. The industrial engineers were informed about how to use the dashboard and the objective of the pages. Then, software installation, especially for Microsoft Power BI, was performed. The Microsoft Power BI is also being published to the *PT TMC* Server.

Figure 14 shows the comparison between the old audit flow and the new audit flow. Old audit flow requires the Grooming Leader to go to the office and input through the staff's computer. The new audit flow allows grooming leaders to input the data on the production floor using their smartphones. The calculation of savings from audit flow improvement is IDR 10,064,206. The savings from using the business intelligence dashboard is IDR 6,939,247. So, the total cost savings are IDR 17,003,453 per year with an IDR 0 investment.

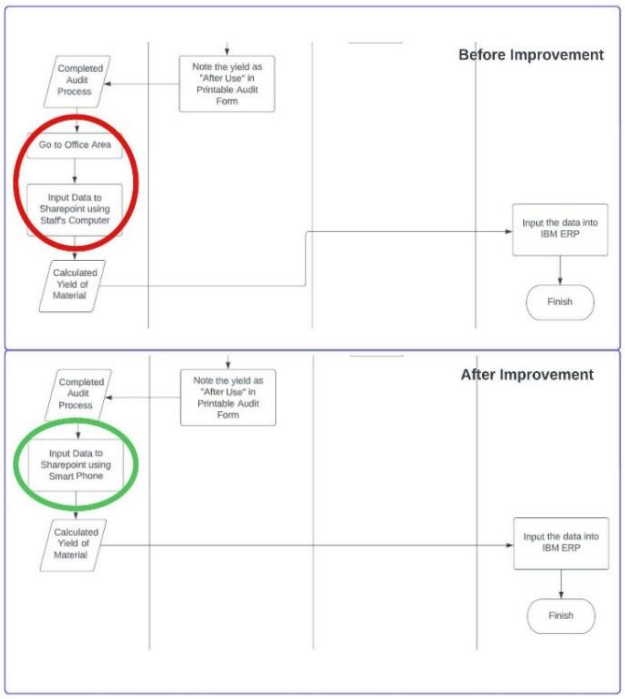

Figure 14. Flow Comparison

F. Maintenance

Before the system is published to the company's server, the system needs to be refreshed in a certain period, especially for Microsoft Power BI. This activity leads to the update of the data based on the latest data in the database. Commonly, an error occurred in the dashboard because of the complexity of the Microsoft Power BI data structure. However, the database has been simplified using Microsoft Power Automate in the system developed in this research. Within seven months, four errors occurred because the user input the wrong format in Microsoft Forms. However, this error is easy to solve.

G. Evaluation

The evaluation stage refers to the satisfaction status of the users. This evaluation was performed using a questionnaire. Table 5 shows the assessment result by the grooming leader for the form. This questionnaire emphasizes the meeting of user requirements and the system being developed.

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TABLE V
FORM EVALUATION

Question	Minimum Score	Score	Maximum Score
Which of the following words would you use to describe the new method?	Poor	Good	Excellent
How well does the form meet your needs?	Poor	Very Well	Very Well
How would you rate the value of the product for the money?	1	4	5
How easy is it to operate?	Very Hard	Very Easy	Very Easy
How much effort did you put forth to complete the form?	Very Much	Less	Very Less
Is it an improvement or something else?	Strongly Disagree	Strongly Agree	Strongly Agree
How would you rate the flow of the form?	Poor	Good	Excellent
Is the form easy to understand?	Very Hard	Very Easy	Very Easy
Does the form make your work easier?	Strongly Disagree	Strongly Agree	Strongly Agree
Is the form accessible from your phone?	No	Yes	Yes
Is the form simpler than using a computer?	Strongly Disagree	Agree	Strongly Agree
What are future features that you recommend to us?		-	

TABLE VI
DASHBOARD EVALUATION

Question	Minimum Score	Score	Maximum Score
Which of the following words would you use to describe the new method?	Poor	Excellent	Excellent
How well does the dashboard meet your needs?	Poor	Very Well	Very Well
How would you rate the value of the product for the money?	1	5	5
How easy is it to operate?	Very Hard	Very Easy	Very Easy
How much effort did you personally have to put forth to use the dashboard?	Very Much	Less	Very Less
Is it an improvement or something else?	Strongly Disagree	Strongly Agree	Strongly Agree
How would you rate the flow of the dashboard?	Poor	Excellent	Excellent
Is the dashboard easy to understand?	Very Hard	Very Easy	Very Easy
Does the dashboard make your work easier?	Strongly Disagree	Strongly Agree	Strongly Agree
Is the dashboard accessible from your phone?	No	No	Yes
Is the dashboard simpler than using Microsoft Excel?	Strongly Disagree	Strongly Agree	Strongly Agree
What are future features that you recommend to us?		-	

The first question asks about the new method applied using a form that the grooming leader finds more accessible to input the audit result. The form already met grooming leaders' needs. While using the form, the grooming leader found operating easy and agreed that the new method improved. As for future improvement, the grooming leader has no comment.

Table 6 shows the evaluation result by an industrial engineer for the dashboard. Industrial engineers also described the new method as an improvement that met their needs well. They also found the new system to be easy to understand and operate. This method also made their work easier. However, this dashboard is optimized to open on a computer, not a phone.

The industrial engineer also described the new method as an improvement that met their needs well. They also found the new system very easy to understand and operate. This method also made their work easier. However, this dashboard is optimized to open on a computer, not on the phone.

IV. CONCLUSION

The toy manufacturing company that produces fashion dolls is critical to maintaining the product's appearance. The use of liquids to retain the fashion doll's hair in place despite numerous shocks and bumps during the distribution process is one of the crucial parts of maintaining a fashion doll's attractive appearance. Based on current observations of liquid material control, there were shortcomings in the process and database that can be improved by developing Microsoft Form and a business intelligence dashboard using SDLC methodology.

The SDLC methodology becomes the framework for conducting the improvement. The system is being developed through the SDLC framework. The planning stage involves observing the business process, gathering data, and identifying shortcomings. The design stage comprises system architecture, user requirement identification, and dashboard design. The development stage consists of form development, ETL process, and dashboard development. The testing stage consists of testing for functionality, features, and data accuracy. The implementation consists of user briefing, software installation,

DOI : https://doi.org/10.25139/inform.v9i1.6705

and dashboard publishing. Maintenance focuses on monitoring and preventing data false. The evaluation stage is where a questionnaire evaluates the new system.

The form was developed in Microsoft Forms and connected to Microsoft Excel, Microsoft Power Automate, and Microsoft Power BI, as described in the system architecture. After the proposed improvement is implemented, the shortcomings are successfully eliminated. All user requirements are being met, and based on the testing stage, all features are working smoothly as users expect. The improved flow leads to the saving of labor time. The labor time saved by this material control improvement resulted in an annual savings of IDR 17,003,453 with zero investment.

ACKNOWLEDGMENT

This acknowledgment is presented to commend the individuals who have directly or indirectly supported this research. PT TMC is acknowledged for allowing researchers to conduct observations and gather historical data.

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