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DIGISAFETY: Digitalization of Safety Inventory and Inspection System for Fire Protective Equipment using AppSheet (Study at a Shipbuilding Company)

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Abstract. The shipbuilding industry is a high-risk sector for accidents, including fires. Indonesian Regulation No. 1 of 1970 mandates worker safety protections, requiring companies to provide and maintain effective fire protection equipment through regular inventory and inspections. Observations show that the fire protection equipment at the shipbuilding company includes fire extinguishers, sprinklers, and hydrant systems. However, the current manual inventory and inspection processes are inefficient, prone to human error, and result in unintegrated data. In the digital era, digital technology is essential for efficient inspections and reporting. This research aims to design an information system for integrating the inventory and inspection of fire protection equipment at the shipbuilding company. The system, developed using AppSheet and integrated with Google Sheets, features Inventory Database, Inspection Dashboard, Inspection Data, Inspection Schedule, Layout Mapping, Maintenance Data, and Standard Operational Procedure (SOP) menus. Additional functionalities include inspection reminder notifications and data download options. The system supports three user roles: Safety Foreman as executor, SHE Supervisor as admin, and SHE Assistant Manager as management. Usability testing with USE questionnaires resulted in a score of 90.3%, categorizing the system as "Highly Feasible" for use. System testing was conducted using usability testing with USE questionnaires, which resulted in a score of 90.3%, categorizing it as "Highly Feasible" for use.

Keywords: Fire Protection Equipment Management, Digital Inspection System, Shipbuilding Industry Safety

1. Introduction

The shipbuilding industry is a heavy production sector with a high likelihood of accidents, including fires, due to the materials, equipment, and processes involved [1]. Fire risks can stem from welding sparks, fuel leaks, and the accumulation of flammable materials. Fire incidents significantly impact employers, workers, society, and the environment, leading to material losses, company instability, environmental damage, and potentially fatal consequences for employees and nearby communities [2].

According to Indonesian Regulation No. 1 of 1970, workers are entitled to safety protections to ensure their well-being and enhance national productivity. The regulation mandates measures to prevent, reduce, and extinguish fires, ensuring the safety of all individuals in the workplace [3]. Therefore, the company must effectively prepare itself, including providing appropriate fire protection equipment [4]. However, to maintain effectiveness, fire protection equipment must be inventoried to ensure the company understands their location and readiness. Regular inspections are also necessary to ensure the equipment is always prepared for emergency use.

The shipbuilding company utilizes portable fire extinguishers, sprinkler systems, and a fire hydrant system as part of its fire protective equipment. Observations indicate that the inventory and inspection of fire protection equipment are not optimal. The lack of inventory complicates maintenance efforts due to insufficient guidance on the quantity, location, and condition of the equipment. The inspection process is still conducted manually by the Safety Foreman, involving paper checklists filled out during inspections, which are later summarized into Ms. Excel by the SHE Supervisor. This manual system is time-consuming and inefficient, prone to human error, and often results in inaccurate data. Additionally, the inspection results are not well-integrated due to being recorded on separate forms.

In the current digital era, the implementation of digital technology is crucial for upporting inspections and efficiently reporting inspection results [5]. This technology saves time and reduces paper use, as manual methods are no longer efficient [6]. Recognizing this need, this research aims to design an information system for the integration of inventory and inspection of fire protection equipment at The Shipbuilding Company. This information system will be developed using AppSheet, a no-code visual application development platform that can be accessed via the website or application, and can be integrated with various data sources from Google Sheets as its database [7]. The information system will be tested using the usability testing method to assess and improve functional requirements based on existing [8].

2. Methods

The development of this information system employs an object-oriented method following the Software Development Life Cycle (SDLC) with the iterative waterfall model [9], whose stages can be seen in Figure 1. This model addresses the limitations of the original waterfall method by offering faster results, requiring less time, and providing greater flexibility through dividing the project into smaller parts, allowing quick progress and valuable user feedback [10].

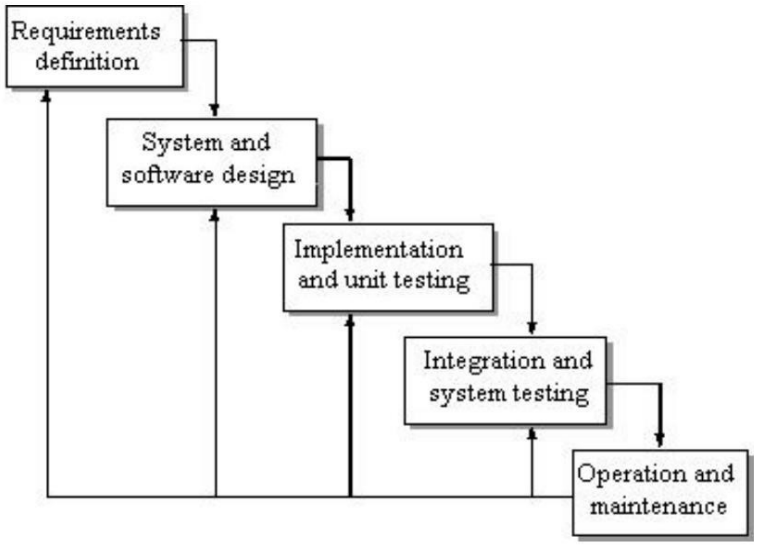

Fig. 1. Iterative Waterfall Model

The phases in the Iterative Waterfall method are as follows:

1. The Requirement Definition
   The Requirement Definition phase aims to identify user needs, the expected functions of the software, and the limitations of the software. In this phase, information is gathered through interviews, discussions, and observations.
2. The System and Software Design
   The System and Software Design phase involves designing the information system. In this phase, the design is carried out by creating Use Case Diagrams to understand the system's functions from

the user's perspective and by mapping out business processes to ensure that the system aligns with organizational workflows and objectives.

3. The Implementation and Unit Testing phase involves implementing the system design into the program. The information system to be developed uses AppSheet with database management through Google Sheets. Each unit is developed and tested for its specific functionality.
4. The Integration and System Testing
   Integration and System Testing are used to combine individual units into the complete system after each unit has been tested. Once integrated, the entire system is tested to identify any failures or errors, focusing on functional specifications. This testing is to validate the program and determine the success of the developed program [11].
5. The Operation and Maintenance
   The Operation and Maintenance involves deploying the system, providing training and support, performing regular maintenance, making updates based on feedback, and continuously monitoring and evaluating performance.

3. Result and Discussion

3.1. Analysis of Inspection Checklist

NFPA (National Fire Protection Association). Inspection of portable fire extinguishers refers to NFPA 10 Standard for Portable Fire Extinguishers [12]. Meanwhile, inspection of sprinkler and fire hydrant system refers to NFPA 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems [13]. The fire hydrant system comprises standpipe and hose systems, fire pumps, water storage tanks, also valves, valve components, and trims. Therefore, inspecting the hydrant system involves examining each component within the system.

3.2. Use Case Diagram Design

In designing this information system, a use case diagram is created to illustrate user interactions with the system and to provide a visual representation of the steps performed by users within the system. This information system has three types of users, each with their own roles and responsibilities: the Safety Foreman as the executor, the SHE Supervisor as the administrator, and the SHE Assistant Manager as the management. The Safety Foreman is responsible for inspecting fire protective equipment, the SHE Supervisor ensures that all inventory and inspection procedures are properly conducted, and the SHE Assistant Manager oversees the results of the inventory and inspections. Each user has different levels of access within this system.

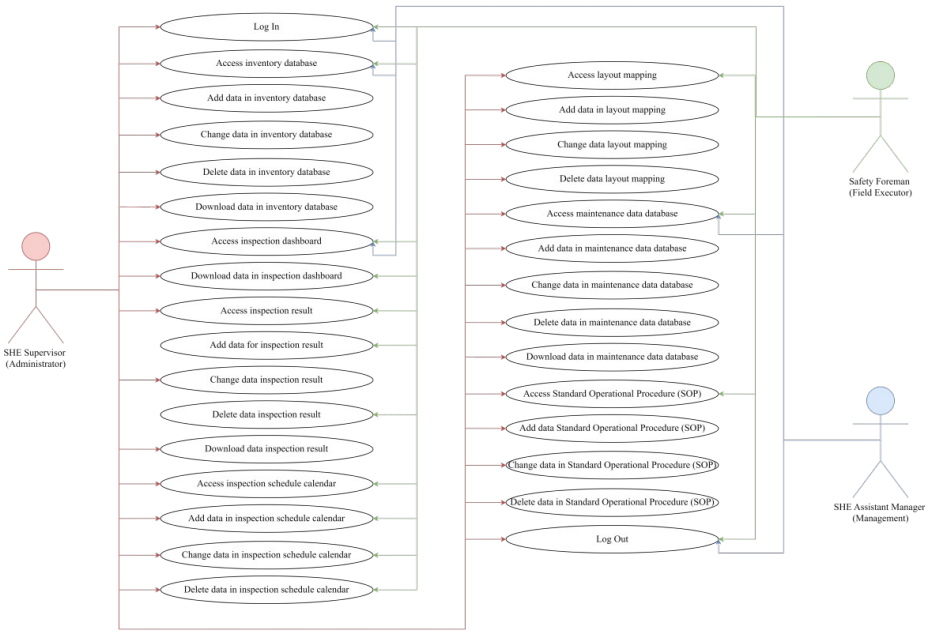

Fig. 2. Use Case Diagram

3.3. Database Design

The platform used to develop this information system is AppSheet, a platform developed by Google. AppSheet allows users to create mobile and web information systems by utilizing data from Sheets, using Google Sheet as the database. The database comprises several sheets within Google Spreadsheet, grouped according to their menu functions as follows:

1. Database Home and Submenu: Database Home manages the user login system according to their respective roles, while Database Submenu organizes the display of submenus within the Data Inspection menu.
2. Inventory Database: Used to store inventory data of all fire protective equipment. It also includes reference data to be imported into the information system to link various data tables.
3. Inspection Database: Stores inspection data categorized by fire protective equipment.
4. Inspection Dashboard Database: Stores integrated data from the Inspection Database, which will be displayed in bar charts according to the categories of fire protective equipment
5. Inspection Calendar Database: Manages data input in the Inspection Schedule menu and displays the results in calendar form.
6. Layout Mapping Database: Stores layout mapping files for each fire protective equipment that has been uploaded.
7. Maintenance Data Database: Stores data of fire protective equipment requiring maintenance based on inspection results.
8. Standard Operating Procedure (SOP) Database: Stores uploaded Standard Operating Procedure files.

3.4. Interface Design

This information system can be accessed via the website and AppSheet application, available for both iOS and Android. The system functions are identical whether accessed through the website or the app, with differences only in the display adapted to the medium used and the ease of data download.

The menus displayed in this information system depend on the user's role, as determined by the entered username and password. Upon initial access, the home page is empty, and users must log in first to load

the menus that will appear on the home page. The displayed menus are tailored to the access rights granted by the developer to each user.

1. Log In and Log Out

This page allows users to log in and log out of the information system. Users must enter the username and password provided by the developer to access the system. Each user has a unique username and password. To log out of the information system, users simply need to click the "Log Out" button.

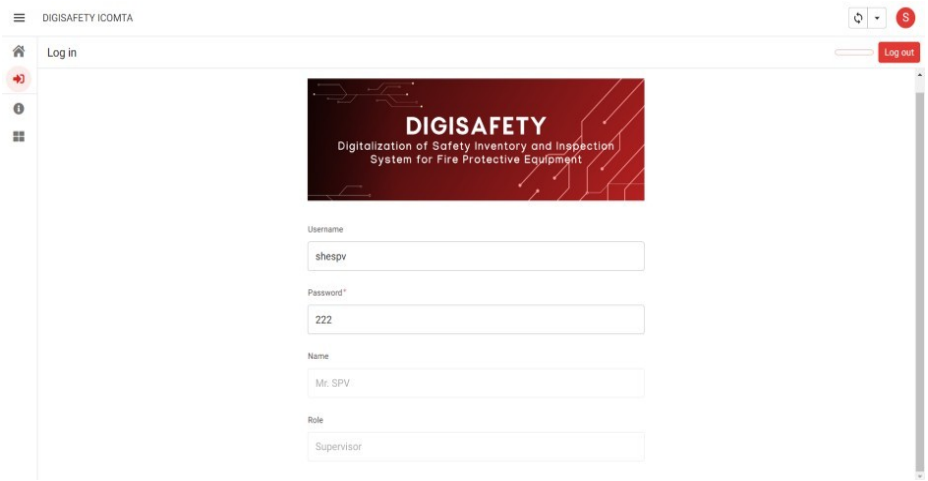

Fig. 3. Log In and Log Out Interface

2. Home Page

The home page is the initial screen displaying menus accessible to users according to the Use Case Diagram in Figure 1 after successfully logging into the information system. Each user will have different menus and access rights. Generally, the system menus include Inventory Database, Inspection Dashboard, Inspection Data, Inspection Schedule, Layout Mapping, Maintenance Data, and Standard Operating Procedures (SOP). The Safety Foreman and SHE Supervisor can access all menus, but with different interaction features. Meanwhile the SHE Assistant Manager can only access three menus: Inventory Database, Inspection Dashboard, and Maintenance Data.

3. Inventory Database Menu

The Inventory Database Menu contains data on all fire protective equipment, displayed in tables categorized by items. Clicking on an item displays details such as Code, Category, Type, Number, Specification, Area, Location, Expiration Date, Days Until Expiration, Expiration Status, and QR Code. The SHE Supervisor can add data through the Inventory Database Form. The system will automatically generate a unique code and QR Code for each piece of fire protective equipment item entered, ensuring that each item has a distinct code and QR Code.

4. Inspection Dashboard Menu

The Inspection Dashboard Menu displays six bar charts showing the inspection results for each fire protective equipment. The charts are grouped by year, and clicking on a year group will display the monthly inspection results. Clicking on a month group will show the inspection results categorized as good, need maintenance, or under maintenance. Selecting one of these inspection status categories will display a table of the corresponding inspection data, and clicking on an inspection data item will show detailed information from the Inventory Database for that item.

Fig. 4. Inspection Dashboard Menu Interface

5. Inspection Data Menu

The Inspection Data Menu presents the inspection results for fire protective equipment. The initial display of this menu consists of several submenus categorized by fire protection equipment items. Each submenu displays tables of inspection data grouped by year and month. Clicking on an inspection data item will show detailed information according to the Inventory Database.

Each submenu within the Inspection Data Menu has an Inspection Form with a checklist tailored to the category of fire protective equipment. This form is accessible only to the Safety Foreman and includes the Inspection Date, Inspection Time, QR Code Scan, inspection checklist, Remarks, Non-compliance Photos, and Notes. The Inspection Form features a QR Code scanning function for fire protective equipment items, usable only through the AppSheet application on a mobile phone. When a QR Code is scanned, the system automatically displays detailed information about the item, facilitating the inspection process for the Safety Foreman.

6. Inspection Schedule Menu

The Inspection Schedule Menu initially displays a calendar. To add data, users must fill out the Inspection Calendar Form, which includes fields for Status, Inspection Item, Start Date, End Date, Start Time, End Time, and Notes. The SHE Supervisor fills out this form to schedule inspections up to one week before they are to occur, while the Safety Foreman fills in the actual data after the inspections are completed. Scheduled data entered by the SHE Supervisor is marked in yellow, while actual data entered by the Safety Foreman is marked in green. This allows for the identification of any discrepancies between scheduled and actual inspection implementation.

Data entered into the Inspection Schedule Menu triggers pop up notifications on AppSheet application on a mobile phone to both the Safety Foreman and the SHE Supervisor. The Safety Foreman receives notifications immediately after the SHE Supervisor enters the inspection schedule data, as well as on the day before and the day of the scheduled inspection. The SHE Supervisor receives notifications immediately after the Safety Foreman enters the actual inspection data.

7. Layout Mapping Menu

The Layout Mapping Menu showcases cards, each card presenting a layout or map of the locations of fire protective equipment. To add layout mapping data, the SHE Supervisor can fill out the Layout Mapping Form by entering the file name and uploading the layout map file in jpg or png format.

8. Maintenance Data Menu

The Maintenance Data Menu shows information on fire protective equipment that are currently undergoing or have completed repairs. The menu's layout consists of a data table organized hierarchically by year,

month, and category of fire protective equipment. Clicking on a data item displays detailed information from the Inventory Database.

The Maintenance Data Form features fields for Category, Code, Request Date, Maintenance Type, Remarks, Completion Date, and Invoice. It includes a QR Code scanning function in the "Code" field, enabling the system to automatically retrieve item details and simplify data entry for the SHE Supervisor. The QR Code scanning capability is available only via the AppSheet app on mobile devices, whereas on a PC/Laptop, users can select from a list of available item codes.

9. Standard Operating Procedures (SOP) Menu

The Standard Operating Procedures (SOP) Menu is displayed in a card format, with two available cards: SOP for Management of Fire Protective Equipment, and DIGISAFETY Usage Instructions. To add SOP data, the SHE Supervisor must fill out the SOP Form by entering the file name and uploading the SOP file in pdf format.

3.5. Information System Testing using Usability Testing

After designing the information system, testing was conducted by gathering user feedback through a usability testing questionnaire to assess efficiency, effectiveness, and user satisfaction [14]. The questionnaire used was the USE Questionnaire [15], consisting of 30 questions in 4 categories: usefulness (8 questions), ease of use (11 questions), ease of learning (4 questions), and satisfaction (7 questions). The testing involved 9 users as respondents, including 1 Foreman, 3 Staff/Admin, 3 Supervisors, and 2 Assistant Managers. Respondents accessed and used the information system via the website or application according to their positions, then completed the questionnaire online using Zoho Form. The assessment was conducted using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) to assess the extent to which respondents agree or disagree with each questionnaire item [16]. The results of the respondents' questionnaires are presented in Table 1.

Table 1. Respondents' questionnaires

Question		Respondent								
		R1	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**
Usefulness	**Q1**	4	4	5	4	5	5	5	5	5
	Q2	4	4	4	4	5	5	5	5	5
	Q3	4	5	5	4	5	5	5	5	5
	Q4	4	3	3	3	5	4	5	5	4
	Q5	4	5	4	4	5	5	5	5	5
	Q6	4	5	5	4	5	5	5	5	5
	Q7	4	4	4	4	5	5	5	4	5
	Q8	4	4	4	3	5	5	4	5	4
Ease of use	**Q9**	4	5	4	4	5	5	4	5	5
	Q10	4	3	4	4	5	5	5	5	4
	Q11	4	3	4	4	5	5	4	5	5
	Q12	4	3	4	3	5	5	4	4	4
	Q13	4	4	4	3	5	4	4	4	5
	Q14	4	4	4	4	5	5	4	5	5
	Q15	4	3	5	4	5	5	3	5	3
	Q16	4	4	4	4	5	5	5	4	5
	Q17	4	4	4	4	5	5	5	5	5
	Q18	4	3	5	4	5	5	3	5	4
	Q19	4	4	4	3	5	5	5	4	5
Ease of Learning	**Q20**	5	4	5	4	5	5	5	5	5
	Q21	5	4	5	4	5	5	5	5	5
	Q22	5	5	5	4	5	5	5	5	5
	Q23	5	4	5	4	5	5	5	5	5
Satisfaction	**Q24**	4	5	4	4	5	5	5	5	5
	Q25	4	5	5	4	5	5	5	5	5
	Q26	4	4	5	4	5	5	4	5	5
	Q27	4	4	5	4	5	5	5	5	4
	Q28	4	4	5	4	5	5	5	5	5
	Q29	5	5	5	3	5	4	5	5	5
	Q30	4	5	5	4	5	5	5	5	5
Score		125	123	134	114	150	147	139	145	142
Total Score		**1219**								

Based on the assessment scores provided by respondents in Table 1, the percentage of system feasibility is calculated using the following equation:

$$ty\ percentage(\%) = \frac{\sum Respondent\ s'\ Total\ Score}{Max\ Question\ Score \times \sum Question \times \sum Respon} \quad (1)$$

$$¿\frac{1219}{5 \times 30 \times 9} \times 100\,\%$$

$$¿\frac{1219}{1350} \times 100\,\%$$

$$¿90.3\,\%$$

The equation converts the assessment scores into percentages, reflecting the system's usability level. By calculating the percentage of responses from the respondents, the extent to which the information system meets user needs can be evaluated. These evaluation results are based on the feasibility standards for information system usage as outlined in Table 2 [17].

Table 2. feasibility standards for information system

Percentage (%)	Category
<21	Very Infeasible
21-40	Infeasible
41-60	Moderately Feasible
61-80	Feasible
81-100	Highly Feasible

Based on the usability testing results, this information system received a feasibility percentage score of 90.3%. According to Table 2, which outlines the feasibility standards for information systems, this score indicates that the system is highly feasible for use. This high score reflects positive user feedback and demonstrates that the system is useful, easy to use, easy to learn, and meets user needs.

4. Conclusion

Based on the analysis and discussion in this study, the following conclusions can be drawn:

1. The design of this information system includes mapping use case diagrams, creating databases with Google Sheets, and developing interfaces with AppSheet. The system is accessible via website and application, with three user roles: Safety Foreman as the executor, SHE Supervisor as the admin, and SHE Assistant Manager as the management. Each role has access according to its function.
2. To optimize the inventory and inspection system for fire protective equipment, the system includes main menus such as Inventory Database, Inspection Dashboard, Inspection Data, Inspection Schedule, Layout Mapping, and Maintenance Data. Additionally, there are supporting menus such as Standard Operating Procedures (SOP) and extra features like inspection reminder notifications and data download capability.
3. The system was tested using a usability testing (USE Questionnaire) with 9 respondents, resulting in a feasibility percentage of 90.3%, which falls into the "Highly Feasible" category.

As a recommendation, future research could develop additional features related to inventory and inspection management. For example, a feature that allows the admin user (SHE Supervisor) to input reference data for new fire protective equipment items without the help of a developer, as well as enabling the admin user (SHE Supervisor) to add new users and manage user roles independently.

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