

The Effectiveness Of Android-Based Fire Extinguisher Inspections Using Quick Response Codes (Qr Codes) at PT Industri Jamu Dan Farmasi Sido Muncul Tbk.

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ABSTRACT

In industrial settings, one of the key measures for ensuring safety is protecting against fire hazards. Therefore, a series of efficient preventive and response measures is necessary to reduce the risk of fire. In Indonesia, one approach to addressing the threat of fire involves the use of portable fire extinguishers (APAR). This study aims to develop a Portable Fire Extinguisher (APAR) inspection system using Android-based QR code technology. The study employs an R&D approach based on the Four-D (4D) model, which consists of four stages: define, design, develop, and disseminate. Data were obtained through a feasibility test (expert users) conducted by subject matter experts as well as media and systems experts, and through pre- and post-testing. The results of the subject matter experts' review yielded a score of 82.5%, categorized as "highly feasible." The media and systems experts conducted validation and achieved a score of 85%, also categorized as "highly feasible." The trial results showed an increase in scores from 89 using the manual method to 96 with the QR code system. Therefore, the developed system is considered effective and more efficient in supporting the fire extinguisher inspection process and the management of workplace safety data.

Keywords: Fire Extinguisher, inspection, QR Code, Android, Workplace Safety.

INTRODUCTION

Occupational Safety and Health (OSH) is an organized effort to protect workers and people in the workplace from hazards and the risk of accidents that may occur while working. OSH principles are applied not only in the industrial sector but also in the community, small and medium-sized enterprises (SMEs), and laboratories, making its scope very broad and extremely important (Rizqi Ulla Amaliah et al., 2023). Industry refers to economic activities that process raw materials, semi-finished goods, and/or finished goods into products of higher value. This definition encompasses the processes of design and technical fabrication to meet industrial needs, as stipulated in the Industrial Law No. 5 of 1984. In an industrial setting, one of the key measures for ensuring safety is protecting against fire hazards. Therefore, industrial buildings must be equipped with fire protection systems that comply with regulatory standards—systems capable of preventing fires from starting,

containing the spread of fire, extinguishing fires quickly, providing safe evacuation routes for workers, and minimizing fire damage.

One type of active fire protection device, known as a fire extinguisher, can be used to prevent, combat, and manage fires. The implementation of occupational safety and health (OSH) standards is becoming increasingly important across various industries, particularly to prevent and reduce the risk of fire. Fire extinguishers must always be ready for use and inspected and maintained on a regular basis. According to NFPA 10, fire extinguishers must undergo a visual inspection every month and a more thorough inspection every year. This is in accordance with Ministry of Public Works Regulation No. 26/PRT/M/2008, which mandates periodic inspections and the documented recording of the condition of firefighting equipment (Permen PU, 2008). The purpose of this is to ensure that fire extinguishers continue to function properly in the event of a fire, as well as to prevent loss of life and significant property damage (Dewi et al., 2025).

Today, technology and information systems are advancing at a rapid pace. As technology evolves, the demand for information continues to grow, particularly for information that is valuable, truthful, accurate, timely, and relevant. Such information can help anyone resolve various issues that arise. A QR Code (Quick Response Code) is a code that can convey information quickly and also provide a rapid response (Zuhria & Hasanah, 2024). As QR Codes (Quick Response Codes) continue to evolve, more and more research is being conducted on these symbolic codes. Various studies are ongoing, aimed at increasing the amount of data that can be stored in QR Codes (Quick Response Codes), improving their resistance to damage, and much more. In Indonesia, QR codes (Quick Response codes) are not yet widely used. However, QR code (Quick Response code) apps compatible with various types of cell phones are widely available and can be downloaded for free online. Advances in information technology, particularly smartphones, offer opportunities to improve efficiency in the management of fire extinguishers. The use of a barcode system linked to a digital app facilitates the identification of each portable fire extinguisher through quick scanning. As a result, the process of analyzing inspection results becomes more efficient, accurate, and can be conducted in real time (Riwayanto & Fasya, 2023). The use of this technology not only speeds up the inspection process but also reduces the risk of human error and increases transparency in fire extinguisher reports (Paradita & Nurjati, 2025).

PT Industri Jamu dan Farmasi Sido Muncul Tbk. is a manufacturer of traditional herbal remedies and modern herbal medicines with the largest market share in Indonesia. The

company occupies an area of approximately 36 hectares and has dozens of buildings constructed with Grade I and II building materials. The use of machinery, equipment, and hazardous materials in the production process will continue to increase. In this regard, the pharmaceutical industry is highly vulnerable to fires due to the flammable chemicals it handles. Additionally, the use of electricity and heat required for production and industrial operations can also lead to fires. The inspection of portable fire extinguishers (APAR) at PT Industri Jamu dan Farmasi Sido Muncul Tbk. is currently not well-structured. This is because there are approximately 417 portable fire extinguishers scattered across various locations within the company. In addition, the inspection process takes a considerable amount of time due to the long distances involved and the use of paper-based checklists. The inspection process, which still relies on manual methods using paper forms (checklists), is prone to recording errors, delays in reporting, and makes it difficult to track historical inspection data (Suryani et al., 2025). The objective of this study is to evaluate a fire extinguisher inspection system using QR codes integrated with Google Sheets at PT Industri Jamu dan Farmasi Sido Muncul Tbk. The purpose of this study is to facilitate the rapid and accurate generation of reports, thereby assisting management in developing future strategies.

METHODS

This study employed a Research and Development (R&D) methodology by applying the Four D (4D) model developed by S. Tiagarajan in 1974, which consists of four stages: definition, design, development, and deployment. The instruments used include an expert validation sheet covering content and media aspects, as well as a Likert-scale questionnaire with a rating range of 1 to 5 (pre-test and post-test). Data analysis in this study utilized needs analysis through observation to identify problems and a feasibility test using the formula $P = \frac{\sum x}{(\sum X)} \times 100\%$. These percentage results were interpreted as qualitative data based on Akbar's (2013) feasibility scale to evaluate the product's feasibility level according to the following criteria:

Rentang Persentase	Kriteria Kelayakan
81% - 100%	Sangat Layak (Sangat Efektif)
61% - 80%	Layak (Efektif)
41% - 60%	Cukup Layak (Cukup Efektif)
<40%	Tidak Layak (Tidak Efektif)

RESULT

Problem Identification (define)

The Problem Identification stage of the 4D method in this study was conducted through direct observation in the workplace and the distribution of questionnaires to OSH inspectors and OSH supervisors. Based on the results of the questionnaire and observations regarding problem identification, it can be concluded that APAR testing at the company has been conducted routinely once a month, in accordance with the applicable Occupational Safety and Health (OSH) standard operating procedures (SOPs). In practice, OSH officers continuously perform physical inspections, such as checking the pressure on the manometer, ensuring that seals are intact, inspecting the condition of hoses, and ensuring that cylinders are clean. However, the record-keeping method, which still relies on manual, paper-based checklists, is considered inadequate. This is evident from technical challenges in the field, such as checklists that easily get dirty, wet, or damaged when exposed to rain—especially in outdoor areas. In addition to issues with data recording, the monitoring process is also frequently disrupted by difficulties accessing fire extinguisher locations, for example, due to obstructions or locked rooms during scheduled inspections. If there are technical issues—such as a drop in fire extinguisher pressure or a malfunctioning pressure gauge—the OHS officer will immediately replace the unit with an available spare fire extinguisher. However, most respondents—both OHS officers and OHS supervisors—stated that the current manual inspection method is still considered effective to somewhat ineffective, as supervisors must still perform manual rechecks to ensure the recorded data is accurate. Therefore, the respondents agreed and felt it was necessary to modernize the system immediately. All respondents wanted technological innovation in the form of a digital inspection system using an app or QR codes. The implementation of this digitalization is considered capable of replacing paper-based systems that are prone to damage, reducing human error, and tangibly improving efficiency and transparency in OSH oversight within the company.

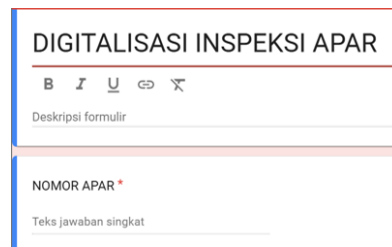
System Design (Prototype Development Phase)

1. Creating a system using Google Forms

The first step is to create a fire extinguisher checklist based on the data collected during the define phase. This process is carried out so that the fire extinguisher inspection data

can be converted into digital form. Below is a screenshot of the fire extinguisher checklist using Google Forms:

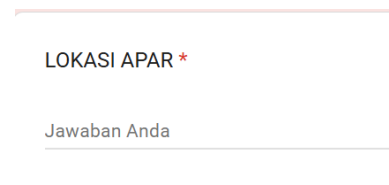
a. System home screen



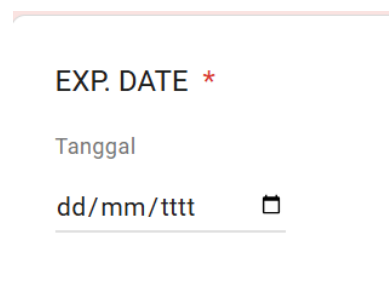
b. Fire Extinguisher Type and Capacity Screen



c. Fire Extinguisher Location Screen



d. Fire Extinguisher Expiration Date Screen



e. List of Occupational Safety and Health (K3) Inspection Officers Screen

PETUGAS *

☐ SUJIONO

☐ ARDI

☐ AGUS

☐ PUJO

☐ RIZKY

☐ Yang lain:

f. Fire Extinguisher Inspection Date Display

TGL PENGECEKAN *

Bulan, hari, tahun



g. Fire Extinguisher Details Display

KETERANGAN *

Teks jawaban panjang

2. Creating a monitoring system (Google Spreadsheet)

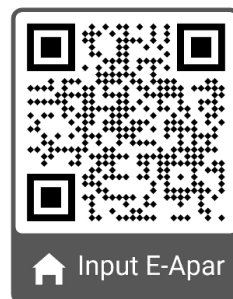
After designing the system using Google Forms, the next step is to import the responses entered in Google Forms into a Google Spreadsheet.



By enabling the “View in Spreadsheet” feature, all submitted response data will be automatically collected and displayed in tabular form.

3. Creating a QR Code

QR codes are created as an alternative method for data entry. These QR codes are generated by embedding the form link created by the respondent into the me-qr.com platform. Additionally, there are several parameters that can be customized when creating the code, such as the size, shape, and name of the barcode to be used; the size can be adjusted according to the system's requirements.



The results of the study show that an Android-based APAR inspection system utilizing QR codes has been designed as a tool to facilitate the APAR inspection process and data management within companies. This system uses QR codes located on each fire extinguisher to connect inspectors with the provided digital inspection forms. With this method, inspectors no longer need to manually fill out paper checklists; instead, they simply scan the QR code and enter the inspection data via an Android device. These results

indicate that the system design aligns with the research objective, which is to create a faster and more user-friendly inspection mechanism in the field.

System Testing (development)

1. Subject Matter Expert

The results of the subject matter expert's evaluation are shown in the following table.

a. Subject Matter Expert

Product validation by the subject matter expert was conducted to verify whether the product's content aligns with the developed curriculum. The results of the subject matter expert's evaluation are shown in the following table.

No.	Aspect	Validator					Total score	Max. score	Percentage	Criteria
		1	2	3	4	5				
1.	Compliance with inspection points	4	4	3	3	3	17	20	85%	Well worth it
2.	Clarification of Occupational Safety and Health (K3) Terminology	3	4	3	3	3	16	20	80%	appropriate
3.	Completeness Of Chechs Variables	4	4	3	3	3	17	20	85%	Well worth it
4.	Accuracy of the sequence of inspection steps	3	4	3	3	3	16	20	80%	appropriate
TOTAL							66	80	82,5%	Well worth it

The feasibility assessment by subject matter experts yielded a total score of 66 out of a maximum of 80, resulting in a feasibility percentage of 82.5% and placing it in the "highly feasible" category. This percentage indicates that the prepared material meets the expected operational standards for APAR inspections, particularly in terms of content and the structure of the inspection items.

2. Media & System

Media and system validation tests were conducted to determine the suitability of the developed system for use, with evaluations performed by five validators. The following table shows the results of the media and system expert validation tests.

No.	Aspect	Validator					Total score	Max. score	Percentage	Criteria
		1	2	3	4	5				
1.	Eassy access	3	4	3	3	4	17	20	85%	Well worth it

2.	navigational clarity	3	4	3	3	4	17	20	85%	Well worth it
3.	efficiency	3	4	3	3	4	17	20	85%	Well worth it
4.	ease of data compilation	3	4	3	3	4	17	20	85%	Well worth it
TOTAL							68	80	85%	Well worth it

The results of validation tests conducted by media and systems experts show that the system demonstrated highly satisfactory performance in every aspect of the evaluation, indicating that it is capable of managing, processing, and presenting summary reports in an accurate, integrated, and organized manner.

Effectiveness Evaluation (Disseminate)

The effectiveness evaluation phase (dissemination) in this study was conducted on a limited scale, specifically within the internal operations of the Occupational Safety and Health (GA K3) department at PT Industri Jamu dan Farmasi Sido Muncul Tbk. This dissemination was intended to gather final operational feedback before the system was fully adopted as a new standard procedure. The following are the total results of the pre-test and post-test, as well as a comparison table between the two systems.

1. Total Pre-Test (Manual Method)

No.	Statement					Total
	Speed	Easy	accuracy	Tracking	Useg	
1.	3	4	4	3	3	17
2.	5	5	5	5	3	23
3.	4	4	3	3	4	18
4.	3	3	3	4	3	16
5.	3	3	3	3	3	15
TOTAL	18	19	18	18	16	89

The results of the initial (pre-test) assessment of the implementation of manual APAR inspections showed a total score of 89 from 5 respondents. The aspect of ease ranked highest with a score of 19, indicating that officers and supervisors are generally accustomed to and familiar with traditional inspection procedures. Meanwhile, the aspects of speed, accuracy, and tracking each received the same score of 18. These results indicate that the manual method performs reasonably well, but its implementation remains limited due to physical obstacles in the field and the potential for human error in record-keeping. On the

other hand, the usability aspect received the lowest score of 16, indicating that paper-based checklist media still have limitations in terms of practicality and operational efficiency.

2. Total Post-Test (Qr Code)

No.	Statement					Total
	Speed	Eassy	accuracy	Tracking	useg	
1.	3	3	3	3	3	15
2.	5	5	5	5	5	25
3.	4	4	4	4	4	20
4.	3	3	4	4	3	17
5.	4	3	3	4	5	19
Total	19	18	19	20	20	96

After the QR code-based Apar inspection system was piloted, there was an increase in the total cumulative score to 96 from 5 respondents. The most notable improvement occurred in the areas of tracking and usability, both of which received the highest cumulative score of 20. This indicates that the use of QR code-based technology significantly enhances operational ease and the system's reliability for monitoring and tracking inspection history in real-time. In addition, the speed and accuracy aspects also improved, each scoring 19, indicating that the digital system is capable of accelerating the reporting process and reducing data errors. The ease of use aspect scored 18, suggesting that users are still in the process of adapting to the newly implemented digital interface and workflow.

3. Comparison of the Two Systems

Conventional System	System Performance Aspects	Barcode System
72%	Speed	76%
76%	Ease of use	72%
72%	Accuracy	76%
72%	Tracking	80%
64%	Usage	80%

The results show that there have been changes and improvements in overall operational performance between the conventional system and the barcode system. The greatest improvement occurred in the usability aspect, which rose from 64% in the old system to 80% in the barcode system. Similarly, the speed and accuracy aspects each improved from 72% to 76%. Overall, it can be seen that the use of a QR code-based system provides significant benefits, namely increased efficiency, accuracy, and ease in tracking fire extinguisher inspection data within the company.

DISCUSSION

Problem Identification (define)

The results of the study during the definition phase indicate that PT Industri Jamu dan Farmasi Sido Muncul Tbk. still uses manual methods to inspect portable fire extinguishers (APARs). To inspect 417 (four hundred seventeen) APAR units spread across the factory's 36-hectare area, on-site personnel carry paper-based physical checklists. Observations indicate that this manual method has significant drawbacks, particularly regarding data security and time efficiency. Another study conducted by Suryani et al. (2025) on Digital-Based Inspection of Portable Fire Extinguishers (APAR) revealed the same issue: APAR inspections are still frequently conducted manually using paper forms. Inspection processes that still rely on manual methods using physical forms (checklists) are prone to recording errors, delays in reporting, and make it difficult to track historical inspection data.

System Design (Prototype Development Phase)

The design of an Android-based fire extinguisher inspection system that utilizes QR codes in this study is intended to meet the need for a more efficient, user-friendly, and well-documented inspection method. QR codes were chosen because they can uniquely store the identity of each fire extinguisher unit, allowing each device to be directly linked to the relevant digital inspection form. In this context, QR codes serve as a bridge between the physical fire extinguishers and the digital information system used to document inspection results. A study by Hasibuan et al. (2024) demonstrated that an Android-based fire extinguisher maintenance and inspection application using QR codes was designed and tested without any functional errors, proving this method effective for improving fire extinguisher management more efficiently. This research is related to the findings of the previous study, as both utilize QR code identification to expedite the inspection data entry process.

System Testing (development)

1. Subject Matter Expert

The evaluation results by the subject matter expert indicate that the product received a total score of 66 out of 80, with an 82.5% suitability rate, placing it in the "highly suitable" category. These results show that the developed material meets user needs, including the appropriateness of inspection aspects, the completeness of inspection variables, the clarity of occupational safety and health (K3) terminology, and the accuracy of the inspection

procedure sequence for electrical equipment. These findings align with the research by Saparini et al. (2021), who developed e-learning materials and received an 88% validation score from subject matter experts in the “highly valid” category, thereby deeming the product suitable for use in the learning process.

2. Media & Systems

The validation results from media and systems experts showed a score of 68 out of 80, representing 85%, indicating that it is highly suitable for this category. This achievement demonstrates that the media created using QR codes offers good accessibility, navigation, efficiency, and ease of data summarization. This finding aligns with research conducted by researchers at UIN Malang in 2023 on the development of web-based instructional materials. The results received an 89% validation score from design and media experts and were deemed highly valid, meaning that the product can be used in technology-based learning.

Effectiveness Evaluation (Disseminate)

Research on the effectiveness of barcode systems in inspecting APARs showed results that differed from those of manual inspection methods. Although the differences were not statistically significant, it appears that the majority of respondents experienced improved results after using the barcode system. This indicates that barcode systems can assist OSH inspectors in conducting inspections that are more targeted, more organized, and easier to document. These findings align with the study by Hasibuan et al. (2024), which showed that an Android-based APAR inspection app using QR codes improves efficiency compared to manual record-keeping. Additionally, research by Setiawan et al. (2026) indicates that the use of QR codes in fire safety equipment inspections can also make the process more efficient and easier to monitor. These results suggest that barcode or QR code technology could be a good solution for inspecting fire extinguishers, although further testing on a larger scale is needed to determine just how effective this technology is.

CONCLUSION

1. The main issue with fire extinguisher inspections at PT Industri Jamu dan Farmasi Sido Muncul Tbk. is that they still rely on manual methods using paper checklists, making the inspection process more time-consuming, less efficient, and prone to errors in data recording.
2. This study successfully developed a fire extinguisher inspection system design based on Android that uses QR codes to identify and record inspection data.

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3. Testing results for the developed system indicate that it is suitable for use as an APAR inspection tool. Evaluations by subject matter experts and media specialists confirm that the system meets requirements in terms of content, appearance, and functionality, enabling a more streamlined and organized inspection process.
4. The effectiveness assessment results show that QR codes facilitate the inspection process, particularly in data entry, monitoring, and summarizing information. However, based on feedback from respondents, the QR code system still needs improvement to ensure optimal use.

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