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## Simplify Standard Operations Procedure Electrical Equipment with QR Codes in Order to Optimize Practical Learning at PT PLN (PERSERO) UPDL Palembang



**Abstract:** - PT PLN UPDL Palembang is one of the training units for all PLN employees in the southern Sumatra region. In organizing practicum learning, it is very important to ensure that all equipment used is covered by standard operating procedure (SOP) documents. The unavailability of SOP documents has the potential to result in work accidents for participants and learning instructors. In addition, the unavailability of SOP can result in damage to equipment. The unavailability of SOP documents is due to several things. Among them: its existence is unknown; the SOP is too large to be impractical; and the SOP is lost or damaged. Based on data from the last 10 years at PLN UPDL Palembang, there are 45 pieces of practicum equipment damaged because they did not follow SOP, or equivalent to Rp. 283,405,000. To ensure the SOPs are always available, they are made in digital and online form. The SOP document is then created as a QR code, which is printed in small size. The QR code sticker is affixed to the practice equipment. To use digital SOP, users only need to scan the QR code via smartphone on each device. One piece of equipment has one QR code.

**Keywords:** QR code, standard operating procedure, electrical equipment, practical learning.

### I. INTRODUCTION

In a global landscape where The task of PT PLN (Persero) UPDL Palembang is to organize learning in order to improve the competence of PLN employees both in terms of knowledge and skills. In order to fulfill the current practicum learning, PT PLN UPDL Palembang is equipped with laboratory facilities. The laboratory must prepare and ensure that all practicum learning equipment and needs are met in accordance with applicable standards. During the implementation of practicum learning, the laboratory sometimes experiences some problems meeting the needs of practicum equipment because the amount of equipment available is not great. The lack of equipment availability is due to a lot of equipment that is damaged after being used by learning participants. The equipment rejuvenation process carried out by PT PLN UPDL Palembang was delayed due to budget constraints. Data on laboratory equipment at PT PLN UPDL Palembang that was damaged after being used in the period 2013–2023 can be seen in Table 1 below.

**Table 1.** UPDL Palembang Equipment Damage for the period 2013-2023

No	Item	Number of Damaged Equipment	Total cost
1	Laboratory equipment damage	45 unit	Rp.283,405,000

Based on the data in Table 1, there were 45 pieces of damaged practical equipment worth Rp. 283,405,000. If averaged, the value of equipment damage in one year is Rp. 28,340,500.

The impact of a lot of damaged equipment in the laboratory of PT PLN UPDL Palembang has resulted score in the evaluation level 1 being decreased. Evaluation level 1 is the Kirkpatrick method used to determine the effectiveness of learning at PT PLN UPDL Palembang. Data on complaints of learning participants against the availability of equipment at Evaluation level 1 in January–May 2023 can be seen in Table 2.

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Table 2 UPDL Palembang Equipment Damage for the period 2013-2023

Date	Training Title	Attendees	Evaluation Level 1 Results	Commentary
20-Feb-23	Wiring and testing APP TR TM Direct and indirect measurement	18	3,67	lack of measuring instruments and lack of materials during practicum
27-Feb-23	Wiring APP and DLPD (BL) Analysis and Evaluation	12	3,75	Incomplete kwh meter test equipment
27-Mar-23	APP Installation and Sealing	13	3,6	Please upgrade/equip the practice equipment according to practice needs

II. ROOT CAUSE PROBLEM SOLVING

The root cause of equipment damage in the laboratory of PT PLN (Persero) UPDL Palembang can be found to be a problem-solving analysis method. The results of RCPS equipment damage can be seen in Figure 1.

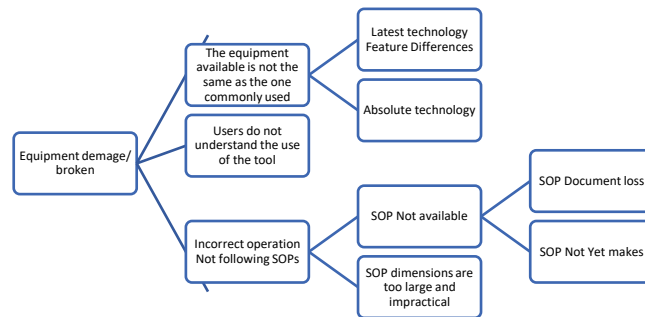


Figure 1. RCPS analysis of damage in PT PLN (Persero) UPDL Palembang

Based on the results of the RCPS analysis in Figure 1, it is stated that the majority of equipment damage is caused by errors in equipment operation due to the unavailability of SOPs and equipment work instructions.

The unavailability of SOP and equipment work instructions documents occurs because of many things, including damaged or shabby documents due to age, lost documents, and documents taken home by learning participants. In some cases, SOP and equipment work instructions documents are not available because the instructor does not know where the documents are stored, and in other cases, when practicum is carried out outside UPDL, SOP and equipment work instructions documents are not brought for impractical reasons. The above problems will certainly hamper the practicum learning process for participants in the last few years and have the potential to reduce the performance value of PT PLN UPDL Palembang.

In practicum learning, the most important thing besides personal protective equipment is to ensure that everyone who carries out practicum learning works in safe conditions. To ensure these conditions, it is very important for instructors and learning participants to carry out practicum activities based on established SOPs and equipment work instructions. Practicum activities that run without SOP and equipment work instructions are very dangerous, both to humans and to tools. In some cases, laboratory equipment is damaged due to incorrect operation. One of the factors that causes errors in operating equipment is that users operate the equipment not in accordance with SOP and equipment work instructions.

In organizing practicum learning, it is very important to ensure that all activities are carried out in accordance with the procedures contained in the SOP document or laboratory equipment work instructions. By following the procedure, practicum activities can run safely for personnel as well as for the practice tool itself.

III. LITERATURE

A. Standard Operating Procedure (SOP)

Standard operating procedures are guidelines that aim to ensure the work and operational activities of organizations or companies run smoothly [1]. In line with this definition, that SOP as a guideline to perform work in accordance with the functions and performance assessment tools of government and non-government agencies,

business and non-business, based on technical, administrative, and procedural indicators in accordance with work procedures and work systems in the work unit concerned [2].

Standard Operating Procedure (SOP) is a system prepared to simplify, tidy up, and put our work in order [3]. SOP has three descriptions, namely standards, operating, and procedures [4].

The three descriptions will be outlined below:

- a. The standard contains the meaning set out below
  - Provisions that are the main reference.
  - As a reference, where each member must comply with these standards.
  - It can also be as a law that must be obeyed by certain agreements.
  - Therefore, what needs to be emphasized is its binding nature.
- b. Operating has the following meanings:
  - Understood more to be an applicable work activity.
  - The activity describes the flow of work activities, both routine and non-routine.
  - Operations are work activities or activities in them that are related to predetermined rules.
  - In their application, these activities must be in accordance with the rules or standards applied.
- c. Procedure has the following meanings
  - Steps or stages related to processes in work activities.
  - As a procedure, it should be described clearly and in detail.
  - The procedure can be a picture or a detailed written description.

*B. QR Code*

The QR code is a two-dimensional matrix symbol consisting of a string of square squares arranged in a larger square pattern. These squares are then referred to as modules. The area of this square pattern will determine the version of the QR Code [5]. In figure 2 below, the QR Code consists of a large square box, then there is a small square box section, and there is a pattern structure in the data storage contained in the QR Code [5].



Figure 2. QR code example

*C. QR Code Structure*

QR Codes have specially designed parts as code information. An explanation related to this section is in figure 3 below [9]:

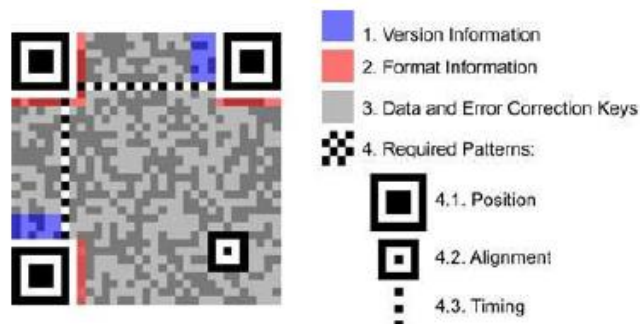


Figure 3. QR Code Structure

The QR Code was actually developed to take advantage of PDF 147, high data density from Datamatrix, and Maxicode reading speed. Two-dimensional symbols generally contain more data when compared to linear symbols, approximately 100 more.

IV. HYPOTESIS

This study will prove several hypotheses, as follows:

- Is there a relationship between the damage to practical equipment and the unavailability of SOPs for equipment use?
- Will the absence of equipment have an impact on the results of evaluation level 1?

V. METHODS

A. Research Method

The research used in this journal uses research and development (R&D) methods. Research and development (R&D) is a research method used to produce certain products and test their effectiveness [6]. Research and development (R & D) is a research method intentionally and systematically used to find, improve, develop, produce, and test the effectiveness of products, models, methods, strategies, and ways that are superior, new, effective, efficient, productive, and meaningful. [7].

In this study, research was conducted on the manual version of the SOP that has been used and a new SOP in the form of digitization was developed. A new SOP concept will be created by utilizing online digital information system technology. Then the address or link to access the SOP is made in QR code format, with the hope that the SOP equipment will always be available. As long as the user has a cellphone that has internet access, the user can easily access the SOP of the equipment used.

B. Data Analisis

Research and development of QRCode-based SOPs will be carried out based on the 4-D model approach. The 4-D development model consists of four stages: define, design, develop, and disseminate [8]. The development for this research procedure to be carried out can be seen in Figure 4.

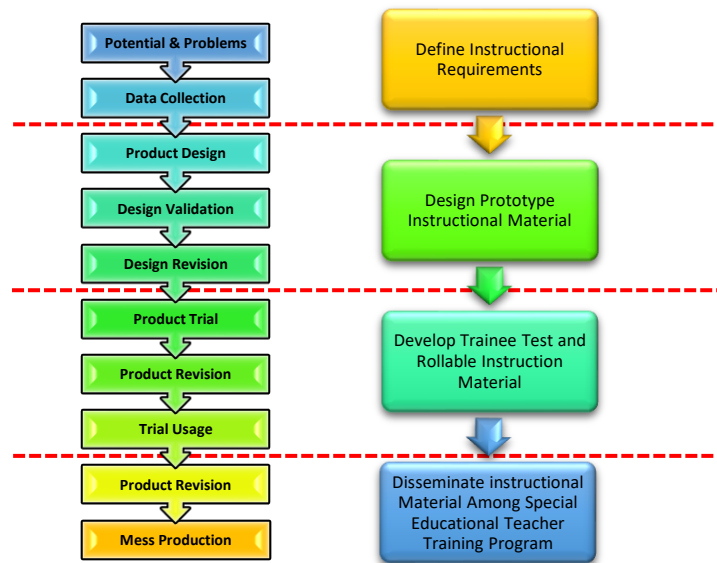


Figure 4. Development reasearch procedure

VI. RESULT

A. Product Design

The first process is the document collection process, where all existing SOP and work instruction documents are inventoried and verified for completeness. For documents that only contain hardcopies, the document is retyped. Furthermore, the collected documents are stored on the lab's hard drive and uploaded to the database. Documents that have been uploaded to the database will then be converted into QR codes with the help of QR Code Generator tools. SOP documents and work instructions that have been generated by QRCode codes are then printed using sticker paper in small sizes, generally 2.5 x 2.5 cm or several centimeters larger, depending on the size of the tool. Equipment that has been affixed with a QR Code containing SOPs and work instructions means that it is ready to use. In Table 3, there are examples of some SOPs and equipment work instructions that have been given QR Code codes. Making this SOP digitization goes through important stages, as shown in figure 5.

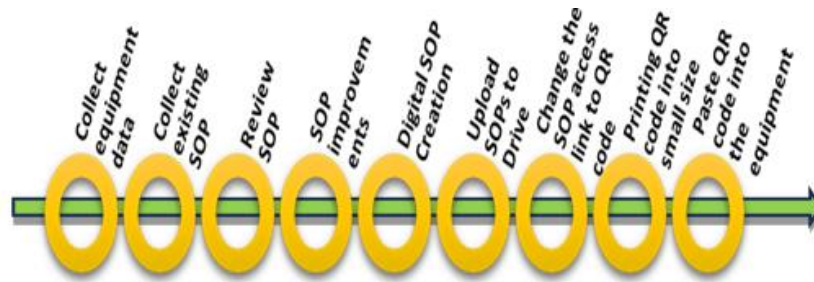





Figure 5. Development Process of SOP for Equipment

Table 3. Example of an SOP that has been given a QR Code

NO	SOP TITLE/ MANUAL BOOK	ONLINE SOP ADDRESS LINK	BARCODE SCAND
1	SOP Earth Ground Clamp Digital	<a href="https://goo.gl/NhEpJH">https://goo.gl/NhEpJH</a>	
2	SOP GPS Garmin GPSMAP 78s	<a href="https://goo.gl/3rar6E">https://goo.gl/3rar6E</a>	
3	SOP Clamp Meter	<a href="https://goo.gl/0rqBvS">https://goo.gl/0rqBvS</a>	

To use SOPs and digital work instructions, users can simply scan via smartphone the QR code on each piece of equipment. One piece of equipment has one QR Code. The QR code that has been pasted onto the equipment can be seen in figure 6. The QR code scan application can be downloaded for free on the Play Store or iStore.



Figure 6. QR code pasted onto the equipment

*B. Product Test and Trial*

According to Sivasailam Thiagarajan, the 4-D model must be tested before mass production. Testing is carried out in several stages, including:

The first stage is testing for weather resistance. The QR code sticker paper is soaked in water and then dried in the sun, and the activity is repeated many times to ensure that the QR code sticker will never be damaged or faded. Then the sticker paper that has been tested for weather resistance is a scanned QR code using a mobile phone in various conditions, such as sufficient light conditions and low light conditions.

The results of the first test were analyzed for shortcomings, and improvements were made to the quality of the QR code stickers. After the first test, improvements were made to the QR code sticker print.

The second testing phase was carried out using the QR code-based equipment SOP in practicum learning. QR Code-based SOPs were used for the first time in one of the practicum lessons at PT PLN (Persero) UPDL Palembang, namely the Distribution Transformer Maintenance learning on May 10, 2023. The documentation of the second testing activity can be seen in Figure 7.





Figure 7. Learning Students scan QR codes on practicum equipment

After being tested in practicum learning, the next step was an interview with one of the learning participants to get feedback on the use of digital-based SOPs they used and to get input on improvements. Based on input from participants, an improvement analysis is carried out, and QR code-based SOPs that have gone through the test stage will be made en masse for all equipment.

C. Result implementation

After being tested in practicum learning, the next step was an interview with one of the learning participants to get feedback on the use of digital-based SOPs they used and to get input on improvements. Based on input from participants, an improvement analysis is carried out, and QR code-based SOPs that have gone through the test stage will be made en masse for all equipment.

The results of research that has been conducted at PLN UPDL Palembang can be concluded that QR Code-based digital SOPs can be used safely and are very helpful in the process of preparing SOP documents during practical learning. This is evident from the decrease in the number of complaints from the evaluation of level 1 learning about learning participant feedback, as shown in Table 4.

Table 4. Number of complaints before and after QR Code-Based SOP Implementation

Problems	Before				After
	2018	2019	2020 - 2022	2023 (TW1)	2023 (TW 2-TW3)
Complaints of learning participants related to the frequency of unavailability of equipment and SOP	4 times	5 times	No Practical Learning because of COVID	3 times	Nihil

From Table 4, we can see that before implementing QR Code-Based SOPs, there was a decrease in the number of complaints related to equipment SOP documents that were not available during practicum. When learning does not provide SOPs, there were three complaints in the 1st quarter of 2023. After the SOPs for QR-code-based equipment are implemented, there are no more complaints.

With the availability of SOPs for all equipment, it can be ensured that practicum learning will be carried out safely, both for the learning participants and for the equipment used.

VII. CONCLUSION

The QR Code-Based SOP is an SOP in digital form to be a solution to problems while ensuring SOP documents and work instructions are always available during practicum learning. With the availability of SOPs, the use of practicum equipment and instructions can have an impact on the security of participants and equipment during practicum learning. QR Code-Based SOPs contribute to the PLN Go-Green Environment Program by reducing paper usage. By implementing QR Code-Based SOPs, it has been proven to reduce the number of complaints of

practicum learning participants related to the completeness of practicum equipment in quarter 1 of 2023 from 3 (three) times to 0 (zero) after implementation, so that it can be concluded that practicum learning can be carried out optimally.

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