Journal of Artificial Intelligence and Engineering Applications

Website: https://ioinformatic.org/

15th October 2025. Vol. 5. No. 1; e-ISSN: 2808-4519

Implementation of the Rad Method in the Application of Digital Recording of Part Measurements Printing Machines in Pharmaceutical Companies

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Abstract

This study aims to develop a digital recording system for measuring printing machine parts in pharmaceutical companies by applying the Rapid Application Development (RAD) method. In the pharmaceutical industry, routine measurements of PunchDies are very important to ensure the quality of the tablet products produced. However, the paper-based recording system causes various obstacles, such as data loss, input errors, and slow approval processes. The developed system uses the Laravel framework to create a digital interface that facilitates measurement and data approval for operators and supervisors. By digitizing measurement forms and implementing an integrated e-approval workflow, this system is expected to improve efficiency, accuracy, and transparency in the recording process. Test results show that the developed system has successfully reduced document search time, eliminated the risk of data loss, and accelerated the approval process. Thus, this digital recording system contributes significantly to improving product quality in pharmaceutical companies and serves as a reference for further research in the field of industrial process digitization.

Keywords: *Digital Recording System, RAD, Laravel, PostgreSQL, Approval*

1. Introduction

In the pharmaceutical industry, the PunchDies tool is recognized as a critical component in the tablet manufacturing process, requiring regular measurements to ensure the quality of the final tablet products. However, the existing operational system relies heavily on manual processes, specifically using paper forms for measurements and manual procedures for approval. This reliance on manual methods has led to significant operational challenges. Field observations reveal that paper measurement forms are highly susceptible to loss, often getting misplaced among other production documents, which consequently hinders the retrieval of crucial initial measurements (baseline measurements) needed for verification purposes. Furthermore, the manual data recording process is prone to human error, resulting in calculation inaccuracies and inconsistencies. According to [1], *"Human error often disrupts activities such as daily data entry. Therefore, this issue is worth further investigation because without digitalization, everyday tasks will feel difficult.*" While the manual system provides a basic audit trail, it lacks the detailed historical information, such as precise approval timestamps, data revision versions, and user log activities, that a digital system can offer for efficient historical data tracking. The manual approval process also presents limitations, requiring face-to-face interaction within the production area, which reduces supervisor flexibility and impedes real-time data access for departments like Quality Assurance, thereby hampering cross-team coordination. Additionally, administrative risks such as smudged signatures, document loss, and difficulties in remote tracking further compromise data integrity.

To address these critical issues, this research proposes the development and implementation of a digital measurement recording system for PunchDies, employing the Rapid Application Development (RAD) methodology. The RAD approach is selected for its ability to emphasize speed and flexibility in software development, enabling the creation of a system that can effectively meet user needs and deliver quality results [2]. This is supported by [3], who states that "RAD allows for rapid system development by leveraging prototyping and continuous iteration, resulting in a system that aligns with user needs in a shorter timeframe compared to other methods like the Waterfall model."

The implementation of this digital system is expected to resolve several key problems faced by operators, including eliminating the risk of lost measurement data, significantly reducing the time required for document searches from one to two hours to an instant through digital search features, and providing enhanced ease in tracking historical measurement data. Specifically, the system aims to facilitate users in easily searching and viewing previous measurement documents, enable approvals from any location at any time, automatically determine measurement status (OK/NOK) through formula calculations, and provide reminders for measurements that require routine attention. By addressing these fundamental challenges in measurement recording and approval, this digital system is anticipated to make a substantial contribution to maintaining the consistency and quality of tablet products within the pharmaceutical company.

2. Methodology

The methodology employed in this research is the Rapid Application Development (RAD) method. This approach is chosen for its ability to accelerate the software development process by emphasizing speed and flexibility. As noted by [4], *"the application of RAD in the development of a community-based ecotourism monitoring system enables active user involvement throughout the development process, which contributes to more relevant and effective outcomes."*

The RAD methodology consists of four main stages [5]:

1. Requirement Planning: This initial stage involves identifying the system's requirements through discussions between developers and users to understand the desired goals and functions.
2. System Design: This stage utilizes a "Prototype – Test – Refine" cycle. A system prototype is developed and tested collaboratively with users to ensure that the design meets their needs and expectations.
3. Development: Once the final prototype is approved, the development team proceeds with coding and integrating all system modules. This phase leverages the validated design to expedite the application development process.
4. Implementation**:** This is the final stage where the developed system is deployed into the operational environment. This includes providing user training and performing system maintenance.

RAD is characterized by its iterative nature and the use of prototyping, which allows for rapid iterations based on user feedback. This method is particularly suitable for projects with rapidly changing requirements and tight deadlines, as it facilitates quick adaptation to evolving needs and environments. RAD is one of several software development methods used in Agile Development. This method allows development teams to build applications quickly and effectively by using a more flexible approach.

According to [6], Agile development is an advancement of SDLC (System Development Life Cycle) designed to support the application creation process in a short time and increase project success compared to structured design methods. Agile development focuses on iterative processes, so that if revisions occur in one stage, the iteration can be carried out immediately without having to wait for the entire development process to be completed.

3. Results and Discussion

3.1. Design

3.1.1. Use Case Diagram

Use case diagrams are an important part of UML in system development. [7] explain that "UML can be used to describe systems visually and in a way that is easily understood by all parties involved." According to [8], "Unified Modeling Language (UML) during requirements analysis is used for visualization, determining the scope, and effectively documenting system artifacts that are useful for various stakeholders of an application." Use case diagrams describe interactions between actors and the information system being created[9].

The research results show that there are six user roles involved, namely Engineering, Production Operator, Engineering Supervisor, Production Supervisor, Production Manager, and Administrator. The following are use case diagrams for each role:

a. Engineering use case diagram

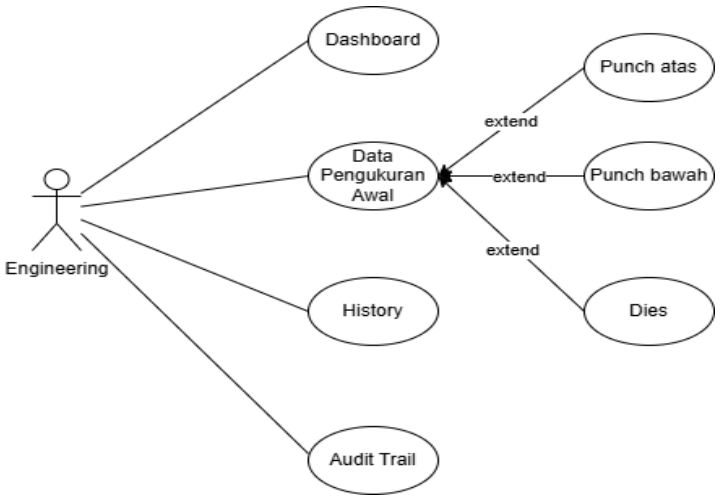

Fig. 1: Engineering Use Case Diagram

b. Production Operator use case diagram

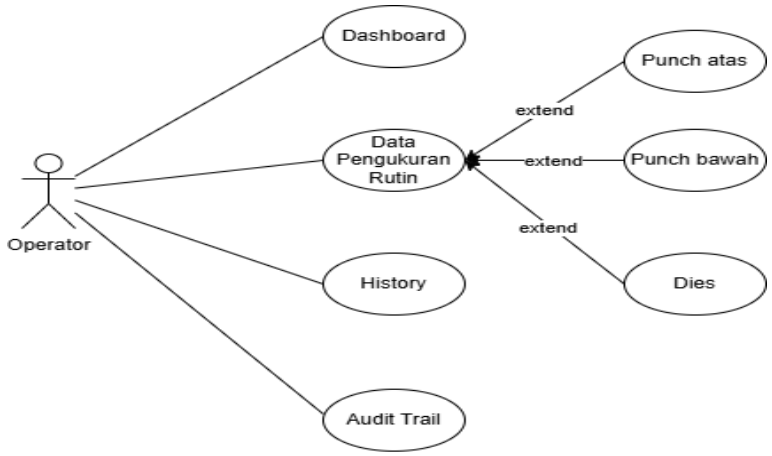

Fig. 2: Production Operator Use Case Diagram

c. Engineering Supervisor use case diagram

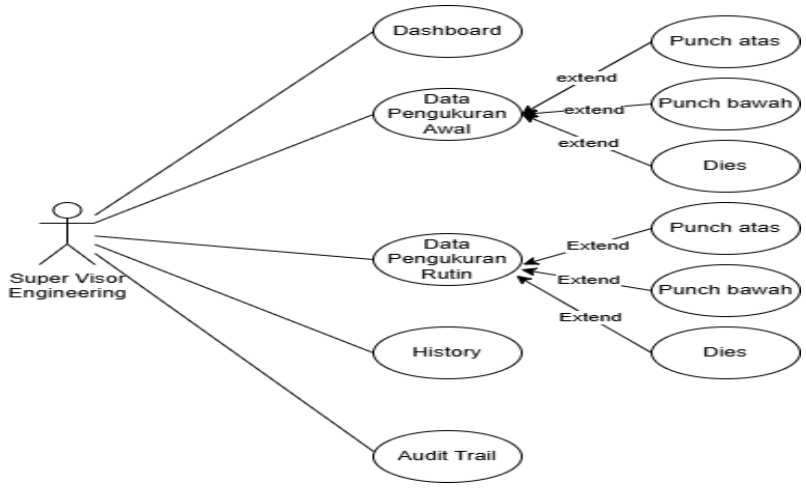

Fig. 3: Engineering Supervisor Use Case Diagram

d. Production Supervisor use case diagram

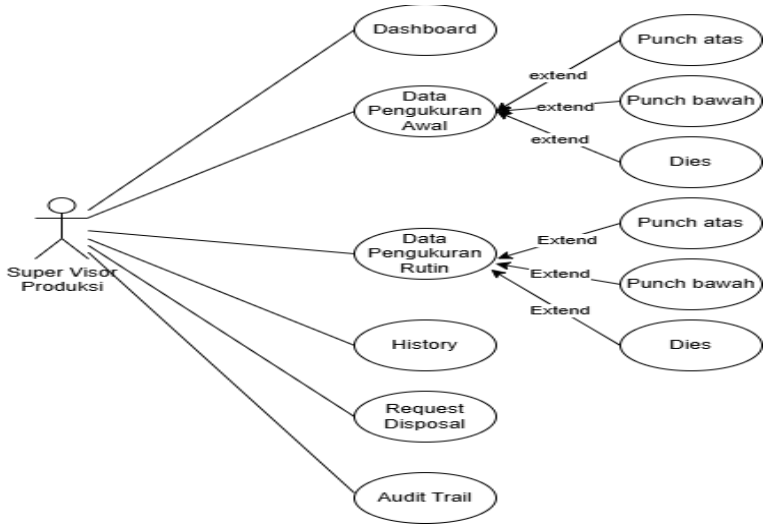

Fig. 4: Production Supervisor Use Case Diagram

e. Production Manager use case diagram

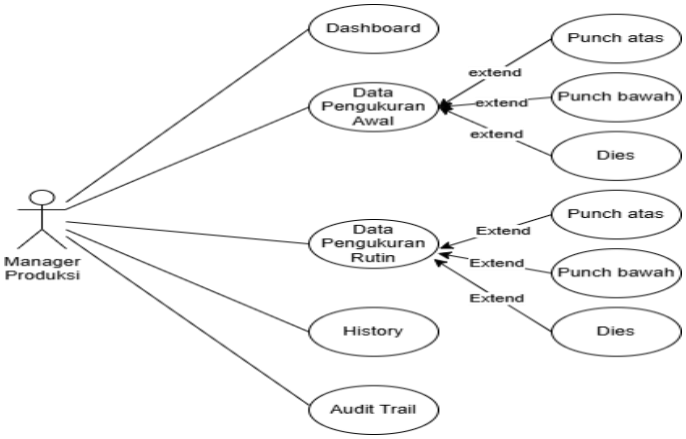

Fig. 5: Production Manager Use Case Diagram

f. Administrator use case diagram

Fig. 6: Administrator Use Case Diagram

3.1.2. Entity Relation Digram

An Entity Relationship Diagram (ERD) serves to illustrate the relationships between entities in a database. ERDs are also used to determine entity requirements for building systems and to assess the cardinality of each entity.

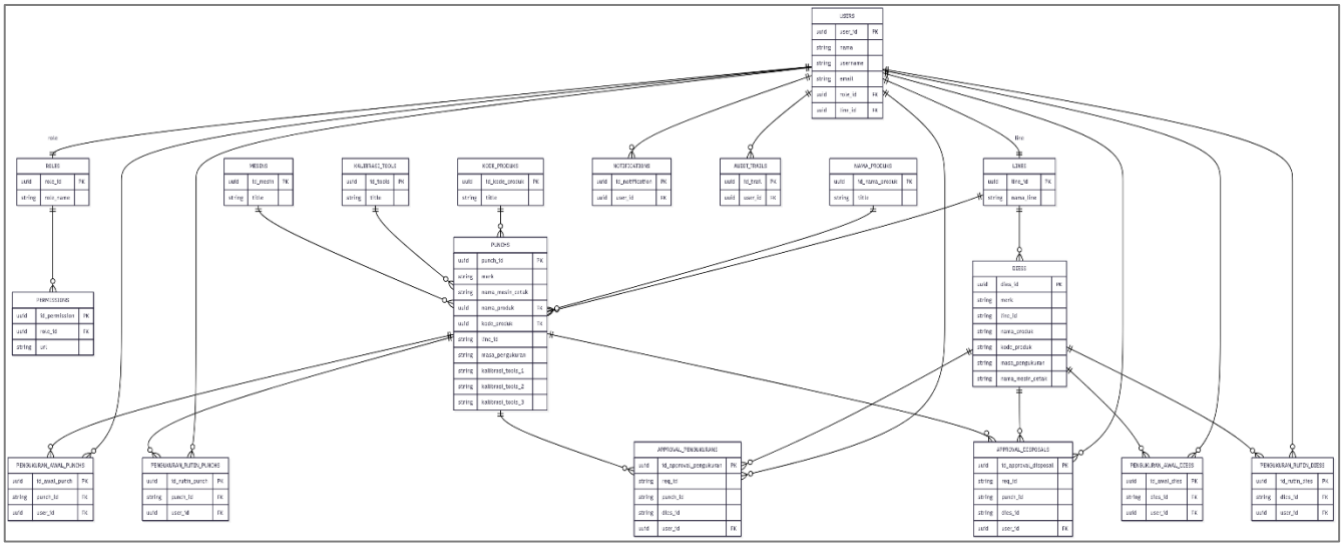

Fig. 7: Entity Relation Diagram

3.2. System Implementation

The system implementation was carried out using RAD as the method and Laravel as the framework in its development. Laravel is an open-source PHP framework developed by Taylor Otwell and actively used by the developer community to efficiently build modern web applications. Laravel is designed to simplify various common tasks in web development such as routing, authentication, sessions, caching, and more. Laravel 11, released in March 2024, requires at least PHP version 8.2 and introduces a more concise directory structure and performance improvements to the routing and caching systems.

Laravel implements the Model–View–Controller (MVC) pattern to separate application logic into Model, View, and Controller, facilitating team maintenance and collaboration. “The Model is responsible for data logic and database management, the View handles the user interface, and the Controller manages the flow of data between the Model and View and handles user interactions” [10].

3.2.1. Login Form

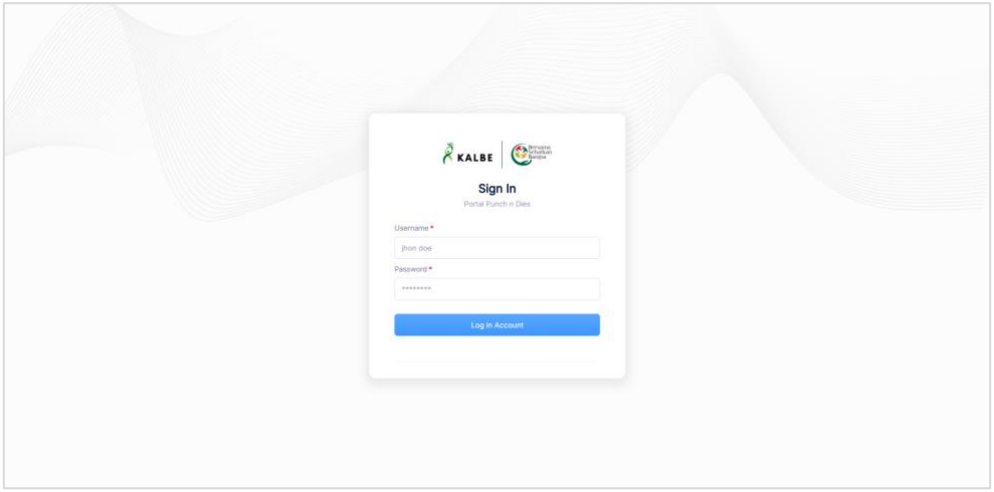

Fig. 8: Login Form Interface

3.2.2. Dashboard Page

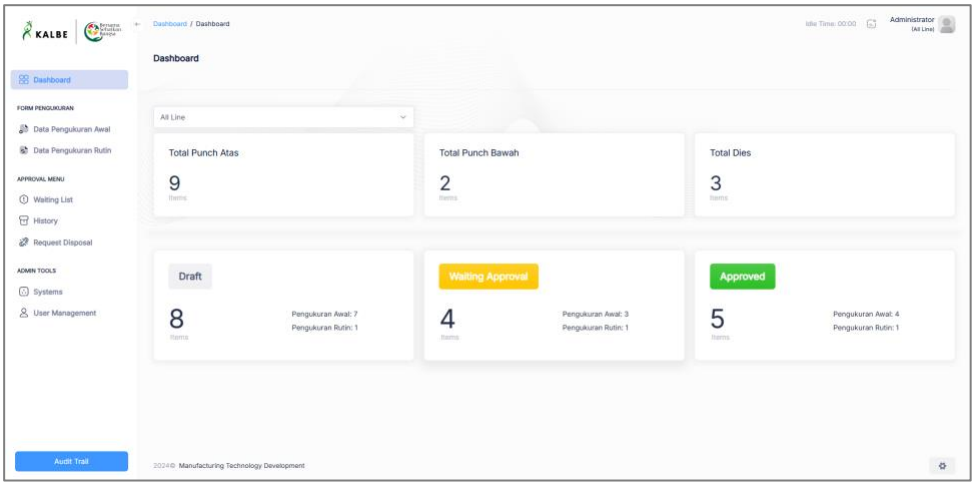

Fig. 9: Dashboard Interface

3.2.3. Measurement Input Form

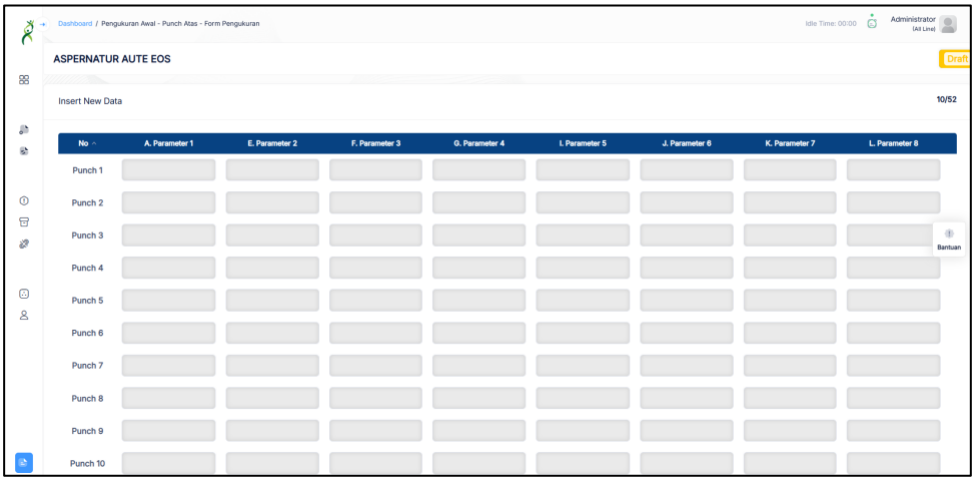

Fig. 10: Measurement Input Form

3.2.4. Measurement results page

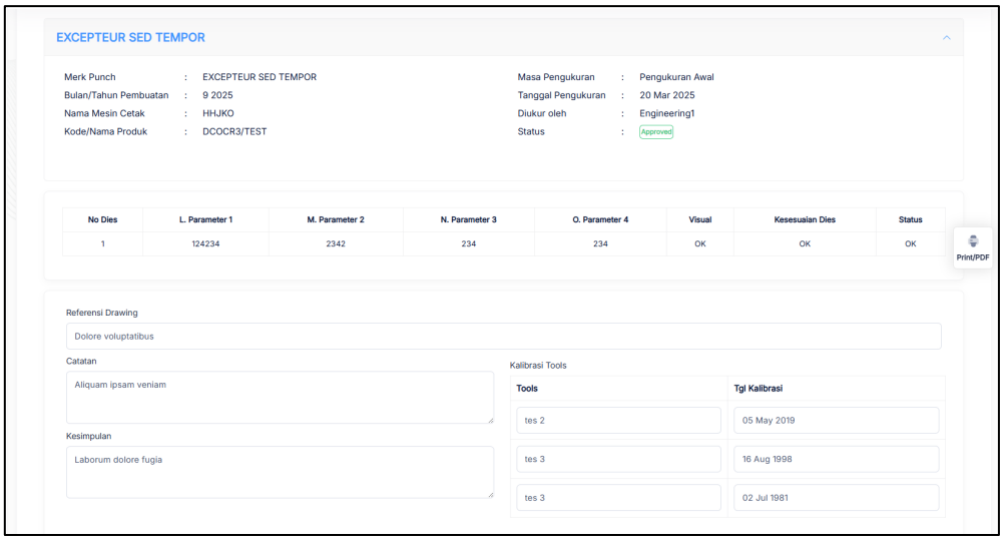

Fig. 11: Measurement Results Page

3.2.5. Measurement Approval Request List Page

Fig. 12: Measurement Approval Request List Page

3.2.6. Request Approval Details Page

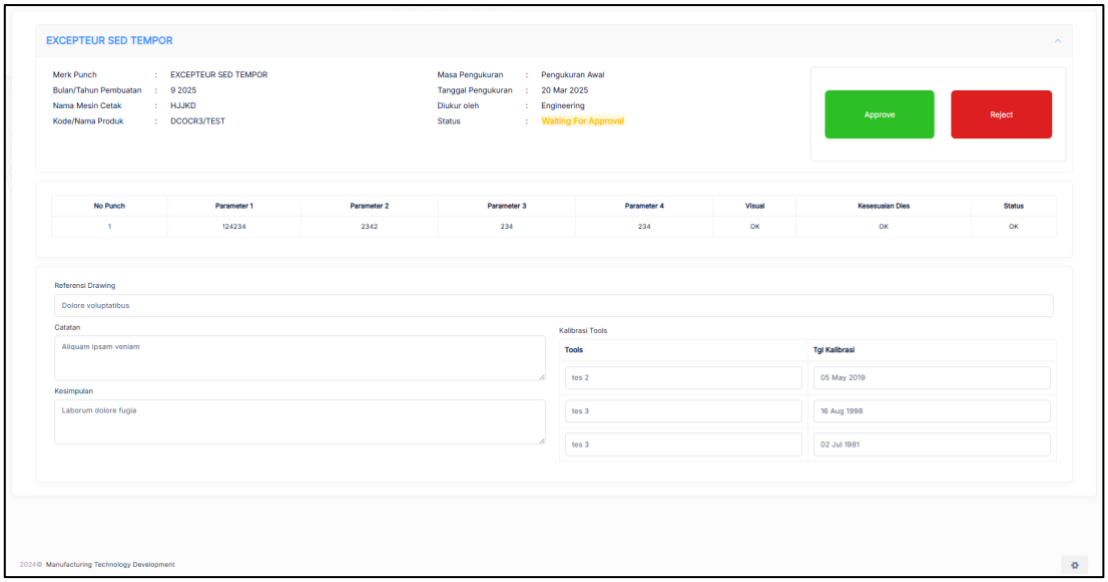

Fig. 13: Request Approval Details Page

4. Conclusion

This research was conducted with the aim of developing a web-based information system to digitize the PunchDies measurement process in the production environment of a pharmaceutical company. Based on all the stages that have been carried out, starting from needs analysis, system design, interface creation, to implementation using the Rapid Application Development (RAD) method, it can be concluded that the system that has been built has met the main objectives of this research.

This system has successfully replaced the manual paper-based process with a more structured digital form. In addition, the system also provides a data input mechanism equipped with validation to minimize potential recording errors, as well as centrally storing measurement data for easier access and tracking. The e-approval feature that was designed has enabled the approval process to be carried out by several different roles without having to be in the same location, responding to the need for flexibility in the approval process. In addition, the activity log and approval history features provide transparency to the data and processes that take place.

Thus, this information system has been able to answer the problem formulation proposed at the beginning of the research, namely how to design and build a PunchDies measurement recording and approval system that not only replaces the manual process but also provides convenience in data tracking and flexibility in the approval flow. These results serve as the basis that the system built is in line with user needs and can be used as a solution to overcome problems that occur in the manual PunchDies measurement process.

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