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Inventory control system using threshold method for automotive industry

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ABSTRACT

Inventory control is a critical aspect in manufacturing companies to ensure the availability of materials and support smooth production processes. Ineffective inventory management can lead to stock shortages or overstock conditions, which may disrupt operational activities. This study aims to develop a web-based inventory control system using the Reorder Point (ROP) method to optimize stock management in a manufacturing environment. The system is designed to monitor stock levels, calculate Average Daily Usage (ADU), safety stock, and reorder points automatically. When stock reaches a predefined threshold, the system provides notifications to assist decision-making in replenishment processes. The development method used in this study is the Waterfall model, including analysis, design, implementation, and testing stages. The system is implemented using the CodeIgniter framework and MySQL database. Testing results show that the system can accurately calculate ROP values and effectively provide early warnings for low stock conditions. Therefore, the proposed system can improve efficiency, reduce the risk of stock shortages, and support better inventory management in manufacturing companies. The system achieved an accuracy rate of 100% in calculating ROP values based on Black Box testing results, and successfully generated real-time notifications for all critical stock conditions. The novelty of this study lies in the integration of threshold-based logic with automated notification features in a web-based system, which provides a more responsive and practical solution compared to previous inventory control approaches that rely on manual monitoring.

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1. INTRODUCTION

The automotive industry is characterized by complex production processes that involve various types of components and materials which must be available in the right quantity and at the right time. Any delay in material availability can disrupt assembly schedules and reduce overall production efficiency. Therefore, precise inventory control becomes a crucial aspect in ensuring that production activities run smoothly without interruptions caused by stock shortages or overstock conditions. In addition, effective inventory management also plays an important role in maintaining production stability and supporting overall operational performance (Nurcahyawati et al., 2023).

To maintain optimal inventory availability, a system is required that can monitor stock movements systematically and provide accurate, real-time information regarding current inventory conditions (Syawanda et al., 2024). One effective approach to support this requirement is the implementation of a threshold-based reorder mechanism. In conventional inventory systems, stock monitoring is often performed manually, relying on periodic checks and human judgment, which can lead to delays, inaccuracies, and increased risk of stock discrepancies. In contrast, automated inventory systems provide real-time monitoring, faster decision-making, and higher accuracy by minimizing human error. This difference highlights the importance of implementing technology-based solutions, such as the Reorder Point (ROP) method, to improve efficiency and reliability in inventory management within manufacturing industries (Bisri & Kurniawan, 2025). This approach enables the system to automatically generate alerts or recommendations when stock levels reach a predefined minimum limit. By incorporating this mechanism, inventory monitoring, comparison, and decision-making processes can be conducted automatically without relying on manual calculations. This automation not only reduces human error but also improves the efficiency and reliability of inventory management processes (Selvi Dwi Granita, 2021).

The application of threshold-based logic in inventory control provides several strategic advantages. It assists procurement teams in determining the appropriate timing for replenishment, reduces the risk of material shortages, and ensures production stability. Furthermore, the determination of reorder thresholds can be adjusted based on historical consumption patterns and production requirements. As a result, the system supports faster, more consistent, and data-driven decision-making in managing inventory levels. This approach also enables organizations to respond more effectively to dynamic changes in demand and supply conditions (Rakhmad Maulidi & Prima Listianti, 2023).

In this study, an inventory control system is developed using a web-based platform to ensure accessibility for multiple stakeholders, such as administrators and warehouse operators. A web-based system enables real-time data updates and facilitates efficient information delivery regarding stock levels, reorder requirements, and daily usage reports (Riyondha Aprilian Brahmantyo, 2022). This approach enhances not only monitoring capabilities but also improves the accuracy and efficiency of the replenishment process within the manufacturing environment (Putra, 2025; Rahardiyanto & Taufik Hidayat, 2024).

In addition to monitoring and reorder functionalities, the system is designed to present data in structured tabular reports, allowing users to analyze inventory usage efficiently. This feature supports periodic evaluation of material consumption and assists organizations in optimizing inventory levels according to production demands (Gagah Primayoga, 2024). By providing clear and accessible data visualization, the system contributes to better operational planning and decision-making. Moreover, the availability of well-organized data helps users in identifying trends and making more accurate predictions for future (Tua Sitio & Sari, 2025).

Based on these considerations, this research aims to develop a web-based inventory control system that enhances the efficiency of material replenishment through the implementation of threshold reorder logic. The proposed system is expected to help manufacturing industries maintain optimal inventory levels, minimize the risk of stock shortages, and improve overall production efficiency. In addition, this research is expected to contribute to the development of more effective and technology-driven inventory management systems.

2. RESEARCH METHOD

Type of Research

This study uses a quantitative and applied research approach, focusing on the development and implementation of an inventory control system based on threshold and Reorder Point (ROP) logic (Ahmad Dalimunthe & Alda, 2024). The research aims to solve practical problems in inventory management within a manufacturing environment by designing a system that can support decision-making for material replenishment (Isma Nurlita Dalimunthe & Suendri, 2024). The approach emphasizes system development, data processing, and evaluation of system effectiveness in managing stock levels (ACHMAD LUKMAN HAKIM, 2025; Sbai & Berrado, 2023).

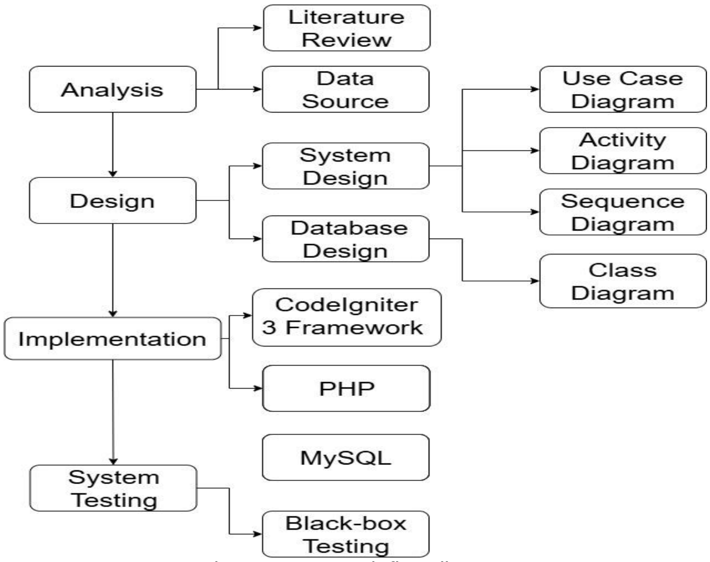


Figure 1. Research flow diagram

Based on the research flow shown in the figure, the system development proceeds to the design stage using UML. This stage focuses on defining system functionality and user interactions. The design is represented through use case diagrams, which describe how each user interacts with the system and the main processes involved in inventory management (Yasid et al., 2025).

The calculation of inventory parameters in this study follows standard formulas, including:

ADU = Total Usage / Number of Days

Safety Stock = (Maximum Usage × Maximum Lead Time) – (Average Usage × Average Lead Time)

ROP = (ADU × Lead Time) + Safety Stock

To ensure data validity, the system calculations were compared with manual calculations using Microsoft Excel. This validation confirms that the system produces consistent and accurate results. In addition, system performance is evaluated using indicators such as calculation accuracy and notification effectiveness in detecting critical stock conditions (Lei et al., 2024).

Data Collection Method

The data used in this study were obtained through a structured data synthesis approach. The dataset was constructed based on references from the Toyota Global Parts Catalog and the Japan Auto Parts Industries Association (JAPIA), which provide standard classifications and naming conventions for automotive components (A. L. Hananto et al., 2020; Ki et al., 2023). In addition, operational data such as daily usage, lead time, and initial stock were reconstructed based on the author's professional experience in the automotive industry, supported by literature studies and Bill of Materials (BOM) analysis. This study uses a quantitative and applied research approach, focusing on the development and implementation of an inventory control (Dimas Faesal Amaldie, 2020; Shofiah Hilabi et al., 2021).

System Development Method

The system development in this study adopts the Waterfall model, which provides a structured and sequential approach consisting of analysis, design, implementation, and maintenance stages. In the analysis phase, system requirements are identified based on the need for efficient inventory control using threshold, safety stock, and Reorder Point (ROP) calculations (Guijarro et al., 2022). The design phase utilizes UML modeling, including use case, activity, sequence, and class diagrams, to clearly represent system processes and interactions (Saputra et al., 2025). The implementation phase involves developing a web-based application using the CodeIgniter 3 framework with PHP, HTML, CSS, and JavaScript, supported by a MySQL database, where core calculations such as Average Daily Usage (ADU), threshold, safety stock, and ROP are integrated into the system logic (A. Hananto & Pramono, 2022). Additionally, the system applies a rule-based automatic control mechanism that continuously monitors stock levels, compares them with predefined thresholds, and generates status indicators and notifications automatically when stock conditions reach critical levels (Huda et al., 2023; Roy & Abdul-Nour, 2024).

System Testing

System testing in this study is conducted using the Black Box Testing method, which focuses on evaluating system functionality based on input and output without considering the internal structure of the code (Tukino et al., 2024). The testing process includes validation of input data, verification of stock update processes, accuracy of ADU and threshold calculations, correctness of ROP determination, and the effectiveness of the notification system when stock levels fall below the defined threshold (Nurapriani et al., 2025). This approach ensures that all system features operate properly and meet user requirements in supporting efficient and accurate inventory management (Novalia & Voutama, 2022; Priyatna et al., 2025).

3. RESULTS AND DISCUSSIONS

This section presents the results of system development and discusses the implementation of the proposed inventory control system. It covers the stages of requirement planning, system design, implementation, and testing, followed by an analysis of the system's performance and practical implications. The discussion focuses on how the integration of threshold and Reorder Point (ROP) logic contributes to improving inventory monitoring, decision-making accuracy, and operational efficiency within the manufacturing environment.

Requirement Planning

This stage describes the system requirements identified during the initial phase of development. The system is designed to support warehouse inventory management by providing features such as item data management, stock transactions (inbound and outbound), supplier management, and stock monitoring. In addition, the system integrates threshold-based logic to automatically detect stock conditions and provide notifications when inventory reaches critical levels. The system is intended to be used by two types of users, namely administrators and staff, each with different access rights based on their roles. This requirement planning ensures that the system aligns with operational needs in managing inventory effectively.

Design

The system design is developed to ensure that all functionalities can be implemented efficiently and systematically. The application adopts a web-based architecture using the Model-View-Controller (MVC) concept provided by the CodeIgniter framework. This approach separates the system into three main components, namely model, view, and controller, which helps organize the application structure and simplifies the development process.

a. Usecase Diagram

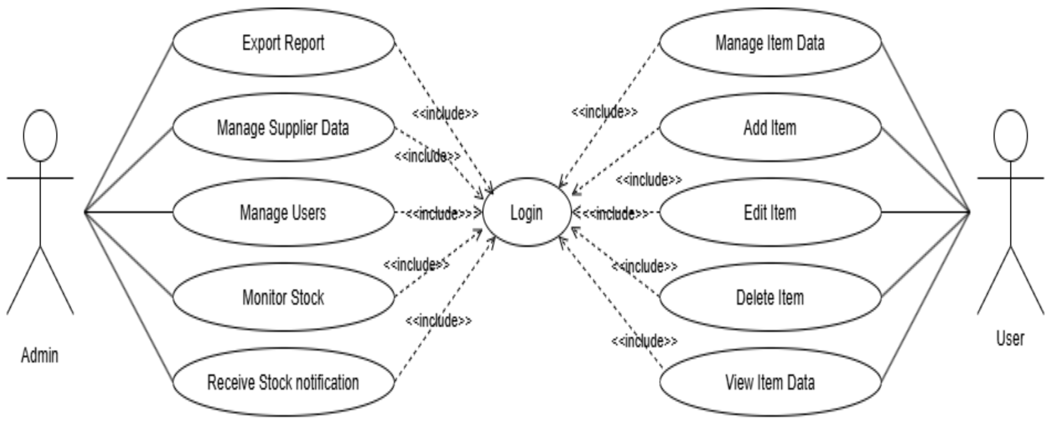


Figure 2. Usecase diagram

The use case diagram illustrates the interaction between two main actors, namely the admin and the staff, with the system. Both actors can perform several core functions, including managing item data, processing incoming and outgoing goods transactions, and managing supplier data. In addition, the admin has access to user management features to control system access. These functionalities support the overall inventory management process, ensuring that stock data is updated accurately and can be monitored effectively.

b. Class Diagram

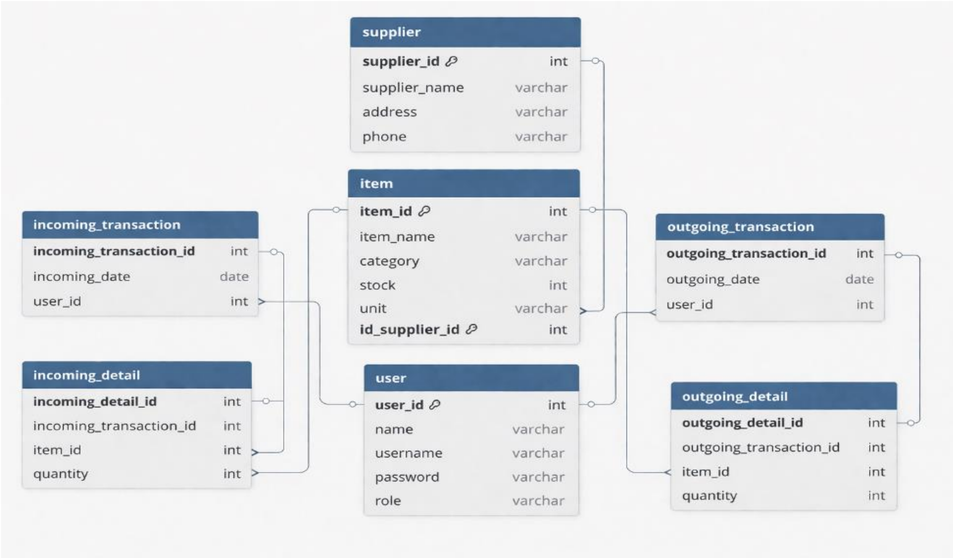


Figure 3. Class diagram

The class diagram represents the structure of the system by illustrating the relationships between classes such as items, suppliers, users, and transactions. Each class contains attributes and methods that define its behavior and interaction within the system. This diagram helps in understanding how data is organized and processed, ensuring that the system functions efficiently in managing inventory operations.

Implementation

The implementation stage involves transforming the system design into a functional web-based application. The system is developed using PHP with the CodeIgniter 3 framework, supported by MySQL as the database and executed on a local server using XAMPP. Visual Studio Code is used as the development environment, while Google Chrome is used for system testing and access. The system provides key functionalities including item management, stock transaction recording, supplier data management, and real-time stock monitoring. Additionally, the system implements threshold, safety stock, and Reorder Point (ROP) calculations to determine stock conditions such as safe, near reorder, and critical levels. An automatic notification feature is also integrated to alert users via email when stock levels fall below the defined threshold, enabling faster and more accurate decision-making.

a. Login Page

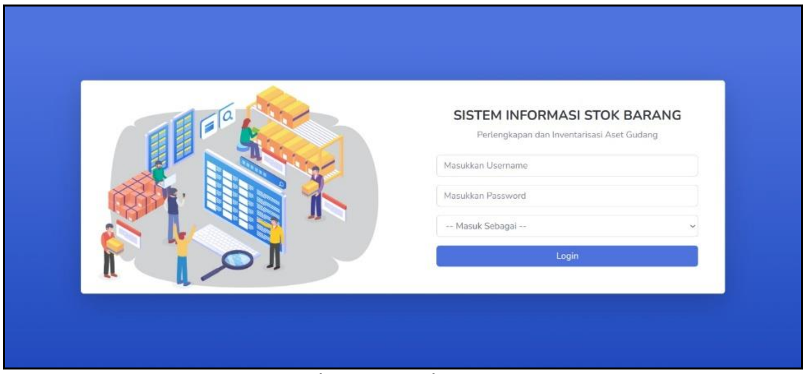


Figure 4. Login page

The login page serves as the initial access point for users to enter the system by providing a valid username and password. This feature is designed to ensure system security by restricting access only to authorized users. Through this authentication process, users can securely access the system and perform their respective roles in managing inventory data.

b. Dashboard Page

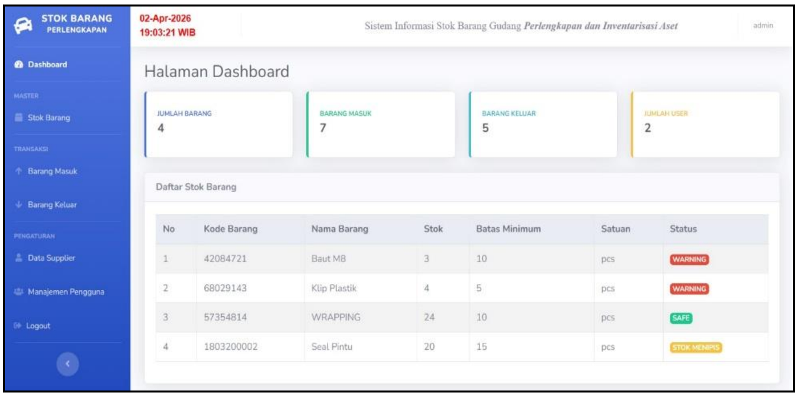


Figure 5. Dashboard page

The dashboard provides an overview of the system by displaying summary information related to inventory conditions. It presents key data such as stock status and system activity in a structured manner. Each indicator reflects the current condition of inventory, such as safe, warning, or critical levels. This feature helps users monitor inventory in real time, access main menus quickly, and support decision-making through clear and concise data visualization.

c. Item Data Page

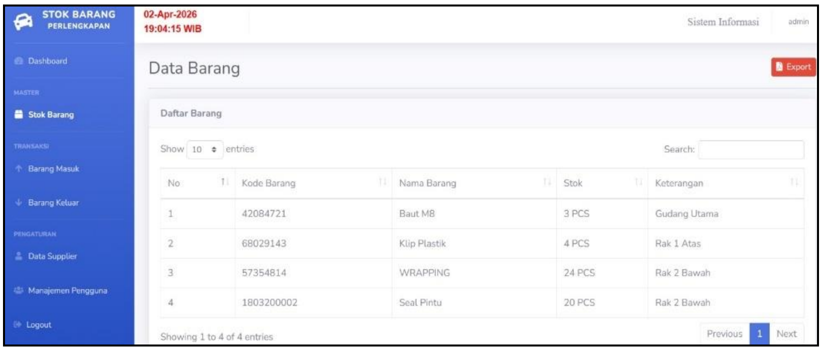
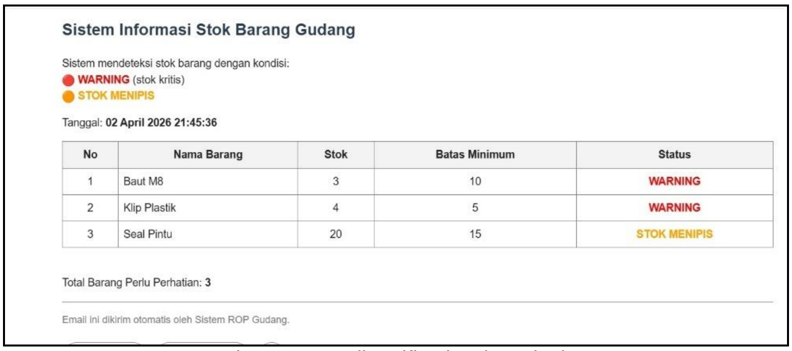


Figure 6. Item data page

The dashboard provides an overview of the system by displaying summary information related to inventory conditions. It presents key data such as stock status and system activity in a structured manner. This feature helps users monitor inventory in real time, access main menus quickly, and support decision-making through clear and concise data visualization.

d. Email Notification (Warning)



Sistem Informasi Stok Barang Gudang

Sistem mendeteksi stok barang dengan kondisi:
🔴 **WARNING** (stok kritis)
🟠 **STOK MENIPIS**

Tanggal: **02 April 2026 21:45:36**

No	Nama Barang	Stok	Batas Minimum	Status
1	Baut M8	3	10	WARNING
2	Klip Plastik	4	5	WARNING
3	Seal Pintu	20	15	STOK MENIPIS

Total Barang Perlu Perhatian: **3**

Email ini dikirim otomatis oleh Sistem ROP Gudang.

Figure 7. Email notification (warning)

The system provides automatic email notifications when stock levels reach or fall below the defined Reorder Point (ROP). This notification feature is designed to inform users in real time about critical stock conditions. By receiving timely alerts, users can take immediate action to replenish inventory, thereby reducing the risk of stock shortages and maintaining operational continuity.

System Testing

System testing is conducted using the Black Box Testing method to ensure that all system functionalities operate as expected. The testing process includes validating input data, verifying stock update processes, evaluating the accuracy of threshold and ROP calculations, and ensuring the effectiveness of the notification system. Each module is tested based on its functionality to confirm that the system meets user requirements. The results indicate that the system functions properly and is capable of supporting inventory management processes efficiently.

Table 1. Black box testing system functionality

No	Feature	Input	Expected Output	Result
1	Login	Correct username & password	System displays dashboard	Success
2	Login	Incorrect username / password	System displays error message	Success
3	Add Supplier	Complete supplier data	Data is stored in the database	Success
4	Add Supplier	Incomplete data	System displays validation message	Success
5	Add User	Complete user data	Data is stored and displayed in the table	Success
6	Add User	Incomplete data	System displays error message	Success
7	Incoming Goods	Input incoming goods data	Stock increases	Success
8	Outgoing Goods	Input outgoing goods data	Stock decreases	Success
9	Export Report	Click export button	Report file is successfully downloaded	Success
10	Stock Monitoring	Stock < minimum threshold	Status changes to WARNING	Success

Based on the results presented in Table 1, all system functionalities operate as expected according to the defined test scenarios. Each feature, including login validation, data management, transaction processing, report export, and stock monitoring, shows successful outcomes without errors. The system is able to handle both valid and invalid inputs appropriately, indicating that input validation and system responses function correctly. In addition, the stock monitoring feature successfully detects when inventory reaches the minimum threshold and automatically changes the status to a warning condition. These results demonstrate that the system is reliable and capable of supporting inventory management processes effectively.

Discussion and Practical Implications

The implementation of a web-based inventory system integrated with threshold and ROP logic demonstrates significant benefits in improving inventory control. The system enables real-time monitoring of stock levels and provides automatic alerts, reducing the risk of stock shortages and delays in procurement. Compared to manual methods, the automated approach enhances accuracy, consistency, and responsiveness in decision-making. The integration of threshold logic also introduces a more adaptive mechanism for classifying stock conditions, allowing users to identify critical situations earlier. Practically, this system can assist manufacturing companies in maintaining optimal inventory levels, improving operational efficiency, and supporting better planning in supply chain management. In addition, the system helps streamline inventory processes by reducing manual intervention and minimizing human error.

The results show that the system is able to detect all stock conditions that fall below the predefined threshold with a 100% success rate based on testing scenarios. The implementation of automated notifications significantly reduces the response time compared to manual monitoring, which typically depends on periodic checks. Compared to conventional inventory systems, the proposed system provides higher efficiency, improved accuracy, and faster decision-making capabilities. This is because the integration of threshold logic and ROP calculations enables real-time monitoring and automatic alerts. These findings are consistent with previous studies that highlight the effectiveness of ROP-based systems in inventory management, but this study extends the application by integrating real-time notification features within a web-based environment.

4. CONCLUSION

This study has successfully developed a web-based inventory control system using the Reorder Point (ROP) method to support stock management in a manufacturing environment. The system is able to monitor stock levels, calculate reorder points, and provide automatic notifications when inventory reaches critical conditions. Based on the implementation and testing results, the system performs effectively in managing inventory data and assisting users in making timely decisions for stock replenishment. The use of threshold indicators and notification features further enhances the system's ability to prevent stock shortages and improve operational efficiency. Therefore, the proposed system can be considered as a reliable solution for improving inventory control processes. Future research can focus on integrating more advanced forecasting methods and expanding system features to support broader supply chain management. In addition, the system contributes to improving data accuracy and supports more efficient inventory monitoring processes. The main contribution of this study lies in the development of an integrated web-based inventory control system that combines threshold logic and ROP calculations to provide real-time monitoring and automatic notifications. This approach enhances the effectiveness of technology-based inventory management compared to traditional methods. Practically, the system can be applied in both large-scale and small-scale manufacturing industries, as it helps improve inventory accuracy, reduce stock shortages, and support faster decision-making processes. This makes the system a flexible and scalable solution for various operational needs.

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