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Development of Inventory Management System for SME using DevOps Sofware Development Process

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ABSTRAK

Usaha Kecil dan Menengah (UKM) memegang peranan penting dalam perekonomian Indonesia, dengan jumlah pelaku usaha sebanyak 65,4 juta orang pada tahun 2019. Namun, pengelolaan inventaris secara manual masih menjadi tantangan utama bagi UKM, yang berujung pada kesalahan stok, kesulitan dalam menemukan produk, kesalahan pelabelan, dan perbedaan antara catatan dan stok fisik. Masalah-masalah ini mengurangi efisiensi operasional dan menimbulkan risiko finansial dan reputasi. Penelitian ini bertujuan untuk menganalisis dampak kesalahan stok, menilai tantangan dalam pencarian produk, mengidentifikasi dampak kesalahan pelabelan, dan mengevaluasi perbedaan stok. Selain itu, penelitian ini juga mengeksplorasi potensi sistem pengelolaan inventaris berbasis teknologi dengan menggunakan pendekatan DevOps. Hasil penelitian ini diharapkan dapat meningkatkan pemahaman tentang masalah pengelolaan inventaris di UKM dan memberikan wawasan tentang solusi teknologi yang potensial. Hal ini akan memungkinkan UKM untuk meningkatkan efisiensi operasional dan keberlanjutan dalam lingkungan bisnis yang kompetitif.

Kata kunci: UKM, DevOps , sistem manajemen inventaris, pengambilan stok, produk

ABSTRACT

Small and Medium Enterprises (SMEs) play a vital role in Indonesia's economy, with 65.4 million business actors in 2019. However, manual inventory management remains a major challenge for SMEs, leading to stock errors, difficulty in locating products, labeling mistakes, and discrepancies between records and physical stock. These issues reduce operational efficiency and pose financial and reputational risks. This research aims to analyze the impact of stock errors, assess challenges in product search, identify labeling mistakes' effects, and evaluate stock discrepancies. Additionally, it explores the potential of a technology-based inventory management system using a DevOps approach. The results are expected to enhance the understanding of inventory management problems in SMEs and provide insights into potential technological solutions. This would enable SMEs to improve operational efficiency and sustainability in a competitive business environment.

***Keywords**: UKM, DevOps , sistem manajemen inventaris, pengambilan stok, produk*

1. INTRODUCTION

Indonesia's economy relies heavily on the Small and Medium Enterprise (SME) sector, which not only plays an important role in creating jobs, but also in accelerating overall economic growth. Data from the Ministry of Cooperatives and SMEs shows that in 2019, the number of SMEs in Indonesia reached an astounding 65.4 million businesses **(Kementerian Koperasi dan Usaha Kecil dan Menengah, 2019).** With this significant contribution, SMEs play a vital role in building the country's economy and creating opportunities for people to participate in the business world.

One example of an SME that reflects the important role of inventory management is Merrylan Cake & Cookies, which operates in Cirebon district.**(Garamendi-Colos et al., 2020)**. The SME is known for its various superior products such as nastar, snow princess, castangel, atomic bakpia, and gandaria coconut cookies. An interview with the owner, Ms. Uun Suni, revealed that efficiency in inventory management is key to the SME's operational success. Ms. Uun Suni emphasized the importance of an effective inventory management system in optimizing their business operations. For her, a good system will help reduce stock errors, facilitate product searches, and ultimately improve customer satisfaction and work efficiency.

However, many SMEs still face challenges in managing their inventory manually. Stock errors, difficulty in locating products in the warehouse, and discrepancies between stock records and actual physical stock are some of the common problems faced. Moreover, inventory management practices are still limited to point of sale (POS) systems that only record product stock and product names, without paying attention to other important aspects such as expiration dates, storage locations, and product variant tracking.**(Retnawati Siregar & Eko Sudarmanto, 2023)**

A number of previous studies have highlighted the potential benefits of adopting digital technology in inventory management for SMEs. For example, a previous study entitled "Agile Inventory Management Model Under a Digital Transformation Approach for Stockout Reduction in Chemical Industry's MSE" showed that a digital transformation approach can reduce stockouts in SMEs, with the results of trials implementing inventory management showing reduced stockouts and increased margins **(Luis Martin Gonzales-León et al., 2023)** Furthermore, the study "Management Challenges for DevOps Adoption within UK SMEs" highlights the benefits of DevOps adoption in improving collaboration between development and operations teams to accelerate software release times, improve quality and operational efficiency.**(Sah & Füredi-Fülöp, 2022)**. However, the study also noted several shortcomings, including a lack of technical knowledge and cultural resistance within the organization, which may lead to resistance from operations teams due to their different roles to development teams**. (Hermawan & Manik, 2021; Jones et al., 2016)**

The research titled "Development of an Alignment Model for the Implementation of DevOps in SMEs: An Exploratory Study" reveals that SMEs often face challenges in terms of human resources and finances. DevOps, with a focus on automation and more efficient processes, can help SMEs maximize the use of existing resources and reduce operational costs **(Sanjeetha et al., 2023)** . Therefore, this research aims to fill this knowledge gap by exploring the development of a DevOps-based inventory management system for SMEs. The main focus of this research is to analyze the effectiveness of DevOps methods in developing inventory management systems by paying attention to increasing efficiency, speed and quality of inventory management**. (Salih et al., 2023).** Apart from that, this research also aims to evaluate the results of User Testing using the System Usability Scale (SUS), with the aim of

measuring the level of satisfaction, efficiency and ease of use of the system by SME users. **(Fowler, 2006)**

Through this approach, it is hoped that this research can provide a deeper understanding of how the development of a DevOps-based inventory management system can help SMEs overcome challenges in managing their inventory **(Hüttermann, 2012).** By integrating digital technology and DevOps practices, it is hoped that SMEs can improve their operational efficiency, increase customer satisfaction, and ultimately achieve sustainable growth in an increasingly rapidly developing digital economy **(Callanan et al. 2016)**

1.1 SMEs

Microenterprises are production businesses owned by individuals or individual business entities, while Small Enterprises (SEs) are stand-alone production businesses that have certain assets or sales results. Medium-sized enterprises (MSEs) have assets or sales results that are greater than those of SEs. Law of the Republic of Indonesia No. 20/2008 regulates the classification of SMEs based on net worth and annual turnover. Merrylan Cake & Cookies was chosen as a case study because it fit the criteria. Located in Cirebon district, the SME produces a wide range of processed food products and is involved in all stages of operations. This research is expected to provide insights into the dynamics and challenges of SMEs in the processed food sector in Cirebon. **(Pemerintah Pusat, n.d.).**

1.2 Inventory Management

Inventory management is the control of assets used in the production or sales process in a business. The goal is to minimize costs by analyzing the most economical inventory levels **(Christopher et al., 2019).** This process involves overseeing the purchase, storage, and use of production components and finished products. Effective inventory management can reduce the costs of excessive storage or stock shortages, which can have a negative impact on company performance if not managed properly. Managing inventory can be complex, especially for companies with many SKUs (Stock Keeping Units) and long supply chains **(Silver et al., 2016)**. Inventory that is not managed properly can cause products to become obsolete, which means losses for the company. Studies show that ineffective inventory management can have a negative impact on company performance.

1.3 DevOps

DevOps is a methodology that combines development and operations in software development. DevOps encourages collaboration between development and operations teams to produce quality and reliable software. By introducing automation of change, configuration, and release processes, DevOps extends the development goal from Agile to continuous integration **(Lwakatare et al., 2019)**. The stages include planning, design, build, test, release, deploy, operate, and monitor the software. With the implementation of DevOps, the software development process becomes more efficient and the results become better. **(Luz et al., 2019)**

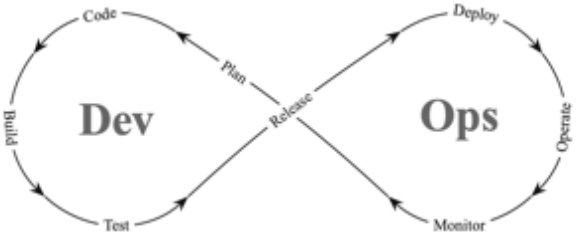

Figure 1. DevOps live cycle

1.4 Usability testing

Usability testing is the process of evaluating a system by testing it on users, which aims to identify problems related to the use of the system so as to get feedback from users **(Bruun & Stage, 2012; Muhammad Ulul Albab Iryanto et al., 2019)**. Usability is an important reference in designing a system because it determines how effectively, efficiently and satisfied the user is in operating the system **(Muhammad Ulul Albab Iryanto et al., 2019)**.

To measure usability, there are several aspects such as learnability which can be measured through the success rate. Success rate is a way to calculate the respondent's level of success in completing a given task scenario, defined as the percentage of tasks successfully completed by the respondent. **(Beny et al., 2019)**.

$$Success\ Rate = \frac{Success\ Task + (\ Partial\ Success\ Task\ x\ 0{,}5)}{Total\ Task}\ x\ 100\% \quad (1)$$

The measurement of efficiency metrics is done through the calculation of time-based efficiency, where the time required by respondents in completing one task scenario becomes the main indicator in evaluating the level of efficiency of the system or interaction being tested **(Beny et al., 2019)**.

$$Time\ Based\ Efficiency = \frac{\sum_{j=1}^{R}\sum_{i=1}^{N}\frac{nij}{tij}}{NR} \quad (2)$$

In usability testing, to measure errors made by users, the error rate metric can be used. This metric measures how often users make errors during interaction with a system or application. Error rate measurement is a way to evaluate the effectiveness of the system, where a low error rate tends to indicate a higher level of usability. **(Beny et al., 2019).**

$$Defective\ Rate = \frac{Total\ Defects}{Total\ Opportunities} \quad (20)$$

Table 1. SUS Question Indicator

No	Question
1	I would like to use this inventory management system frequently.
2	I think this inventory management system is too complicated.
3	I feel this inventory management system is easy to use.
4	I need technical assistance to be able to use this inventory management system.
5	I feel the various features in this inventory management system are well integrated.
6	I feel there's an inconsistency in this inventory management system.
7	Most people can learn to use this inventory management system quickly.
8	I find it difficult to use this inventory management system.
9	I feel confident in using this inventory management system.
10	This inventory management system will require me to learn a lot before I can use it effectively.

The System Usability Scale (SUS) is an assessment tool that uses a 1-5 scale, with meanings from "strongly disagree" to "strongly agree". Odd questions use the respondent's answer scale minus 1, while even questions use the calculation of 5 minus the respondent's answer scale.

The total score obtained is then multiplied by 2.5 to get the final SUS score. The following is the process and formula for calculating respondent scores **(Arthana et al., 2019)(Lestari et al., 2021).**

$$skor\ responde = ((Q1 - 1) + (5 - Q2) + (Q3 - 1) + (5 - Q4) + (Q5 - 1) + (5 - Q6) + (Q7 - 1) + (5 - Q8) + (Q9 - 1) + (5 - Q10) \quad (3)$$

To determine the average value of the System Usability Scale score is to add up the scores of each respondent and divide them by the number of respondents, with the following formula **(Lestari et al., 2021)**:

$$\bar{x} = \frac{\sum x}{n} \quad (4)$$

Notes:

$\bar{x} = average\ skor$

$\sum x = total\ skor\ SUS$

$n\ = total\ responden$

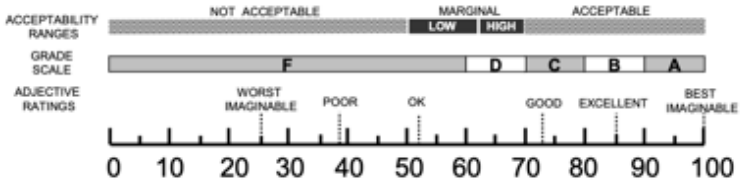

Figure 2. SUS Assesment

2. RESEARCH METHOD

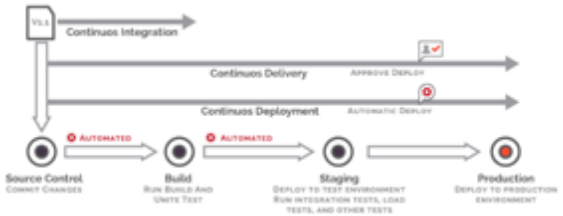

Figure 3. Software Delivery Pipeline

This research uses the Development and Operation (DevOps) methodology in the software delivery pipe line, there are several phases for implementation **(Zaeske & Durak, 2022).**

2.1 Continuos Integration

In the continuous integration phase, it is a practice of the application development process where developers routinely and regularly perform or merge each code change into a central repository or main repository with builds and units **(Mikael Krief, 2019)**. The testing process will run automatically. The main goal of Continuous integration is to find and fix bugs/errors faster. Thus improving application quality, reducing the time required to validate and release software updates **(Mikael Krief, 2019; Zaeske & Durak, 2022)**.

2.2 Continuos Delivery

In the continuous delivery phase is an application development process that automatically prepares code changes before sending them to the production envirolment. applies to the build process and unit testing, whereas with CD, continuous deliver only applies to processes limited to testing, pre-production and deployment of all code changes to the production envirolment but before deploying to production must manually request approval from a more senior developer, manager, or authorized person. **(Zaeske & Durak, 2022)**

2.3 Continuos Deployment

In the continuous deployment phase, it is similar to the continuous delivery phase in that continuous delivery manually requests approval from the entitled person, while continuous deployment automatically deploys the application to the production envirolment. **(Zaeske & Durak, 2022).**

2.4 Data Collection

The data collection process at the SMEs involved interviewing the SME owners to understand the operational processes and inventory management policies as well as conducting on-site observations at Merrylan SME. In addition, related documents such as inventory records, sales reports, and production processes were also collected and analyzed **(Ming Huo et al., n.d.).** Software development methods play an important role in the development cycle, where traditional methods such as Waterfall lack support for effective communication between the development team and the product owner. In contrast, Agile methods emphasize team collaboration, influencing better project outcomes **(Leite et al., 2020)**. This research uses the DevOps method because it integrates development with operations, enabling good collaboration between development and operations teams for faster and more responsive solutions. **(Bolung & Tampangela, 2017).** DevOps also emphasizes automation, ensuring faster and more reliable software delivery, so it was chosen as the main method. In the evaluation of the inventory management system, the System Usability Scale (SUS) was used through a structured questionnaire to assess user satisfaction and effectiveness with the system, providing a systematic way to measure the extent to which the system meets user needs.

3. RESULTS AND DISCUSSION

DevOps-based inventory management system development aims to create a web-based platform that can help small and medium-sized enterprises (SMEs) manage their inventory more efficiently. In this study, system design begins with modeling the problems associated with SME inventory management into the form of a Unified Modelling Language diagram. (UML). Use Case Diagrams, Activity Diagram, and Class Diagrams are used to compile the design of this application.

3.1 Use Case Diagram

The usage case diagram on this system identifies three main types of users, namely Superadmin, Admin, and Staff. These three actors require authentication (login) to access the system. Once successfully logged in, each actor will be directed to the dashboard with menus tailored to their roles. Superadmin has the most extensive access rights, covering overall store management and setting up other user access rights. Admin has the responsibility to manage product data, employees, customers, suppliers, payment methods, and generate various reports. Meanwhile, Staff has limited access, especially to certain point of sale features and settings.

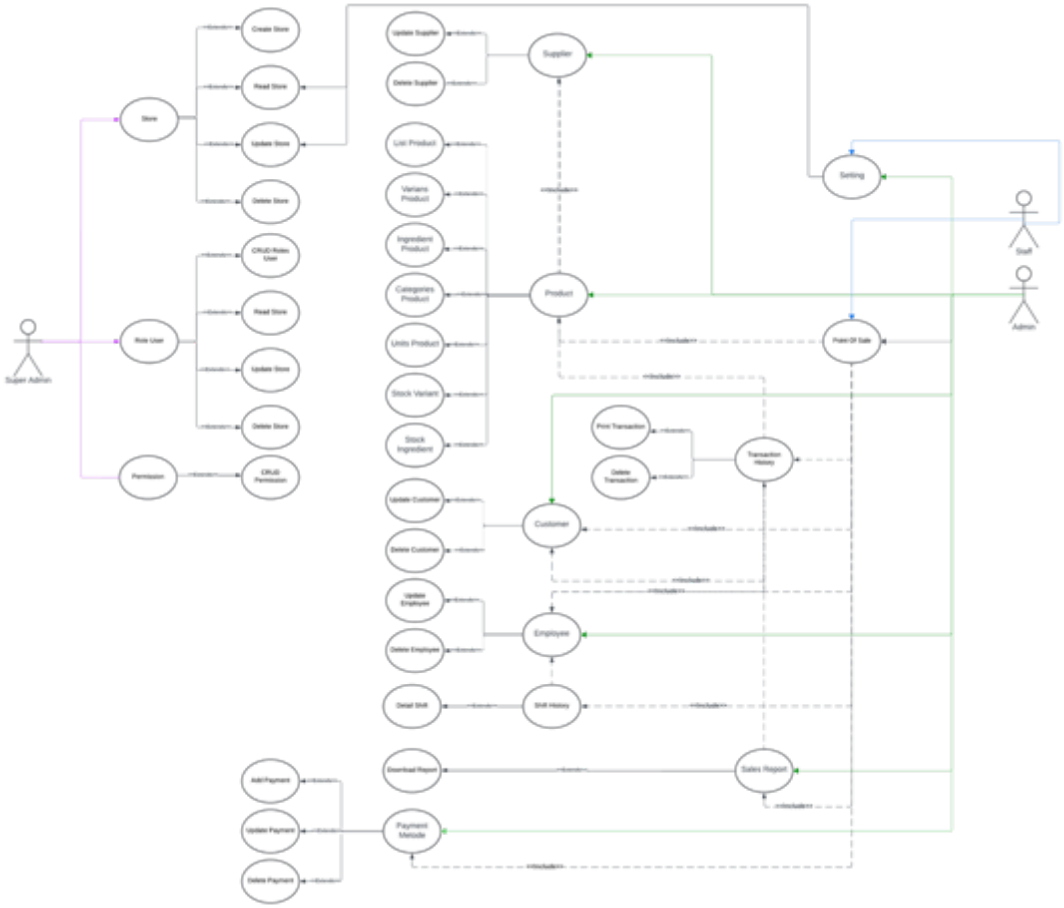

Figure 4. Use Case Diagram

3.2 ERD Diagram

On this system use MySQL database to store all the data needed. The image below is a basic drawing of the Entity Relationship Diagram (ERD) used to create the platform.

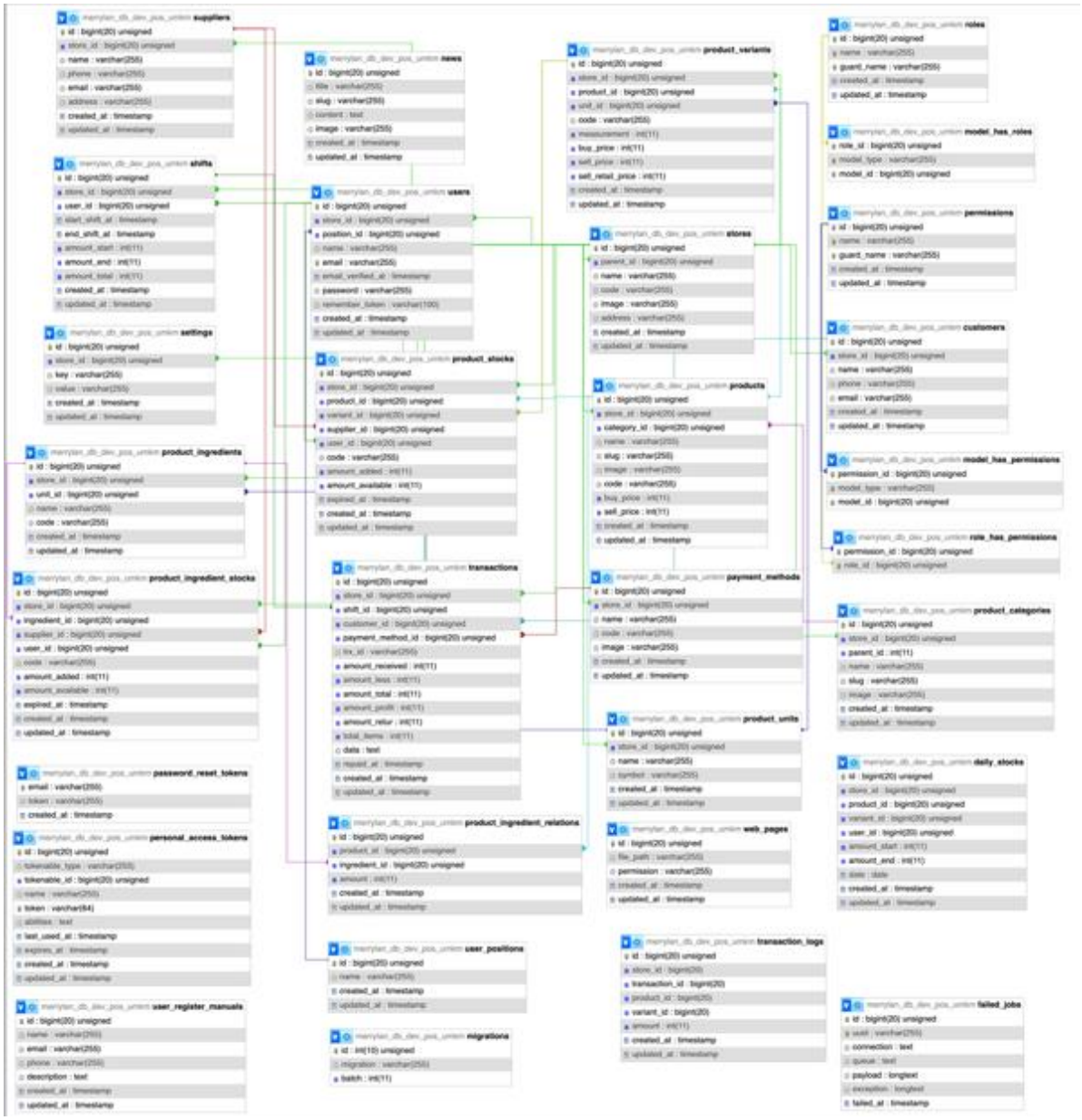

Figure 1. Entity Relationship Diagram

3.3 Calculation of Success Rate

Table 2. Success Rate Test Results

R	Task				
	T1	T2	T3	T4	T5
1	S	S	S	S	S
2	S	S	S	S	S
3	S	S	S	S	S
4	S	S	S	S	S
5	P	S	S	S	S

The success rate of the testing in this evaluation can be seen below. Calculation of Success Rate

$$Success\ Rate = \frac{24 + (1\ x\ 0{,}5)}{25}\ x\ 100\%$$
$$= \frac{24{,}5}{25}\ x\ 100\%$$
$$= 98\%$$

From the calculations, it can be determined that the success rate is 98%, reflecting that all tasks assigned were successfully completed by the participants.

3.4 Calculation of Time Based Efficiency

Table 3. Time Base Efficiency Testing

R	Time (s)				
	T1	T2	T3	T4	T5
1	70	8	11	20	3
2	56	6	8	16	2
3	68	11	14	22	3
4	88	11	15	25	3
5	91	13	15	28	5

In calculating Time Based Efficiency, data on the time users spend on each task is needed. If the task is successfully completed, it is worth 1 point, and if the task is not successfully completed, it is worth 0 points. The success value of the task completion is then divided by the time taken to complete it.

$$Time\ Based\ Efficiency = \frac{\sum_{j=1}^{R}\sum_{i=1}^{N}\frac{nij}{tij}}{NR}$$

$$Time\ Based\ Efficiency = \frac{2.974}{25} = 0{,}118$$

According to the calculations above, the value obtained is 0.118 goals/sec.

3.5 Calculation of Error Rates

$$Defective\ Rate = \frac{0}{25} = 0$$

Calculating error rates is useful for understanding the level of user mistakes in completing testing tasks. The result obtained for this component is 0, indicating that the assigned task was completed successfully without any errors.

3.6 Usability Testing

Once the system has been created, the next step is to perform a usability test using the System Usability Scale (SUS) to measure user perception of the ease of use of the application. The test is done by giving a SUS questionnaire to the user.

Table 4. Result Question SUS

R	Question										Total
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	
1	5	1	4	4	4	1	5	1	5	4	80
2	4	2	5	1	4	2	4	1	4	2	82.5
3	5	2	5	1	4	1	4	1	4	4	82.5
4	4	1	4	1	4	4	4	1	5	3	77.5
5	4	1	4	2	5	1	5	3	5	1	87.5
Average											82

The results of this study indicate that this system has a very good level of usability. Almost all participants (98%) successfully completed all tasks, indicating that the system is user-friendly. User time efficiency is also high, with an average of 0.118 tasks per second. In addition, user assessment through the SUS yielded an average score of 82, indicating high satisfaction. Overall, these results indicate that the system has been well-designed and meets user needs.

4. CONCLUSION

DevOps-based inventory management system development research concludes that DevOPS has met the needs of users, the results are as follows. DevOps has eight stages of development: plan, code, build, test, release, deploy, operate, and monitor. Based on the results of testing using the System Usability Scale, five respondents received an average score of 82 with acceptability acceptable, grade scale B, and Adjective Rating Excellent.

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