

The Synergistic Effect of Layout Regularity (*Seiton*) and Inventory Data Accuracy on Pick-Up Time Efficiency: A Quantitative Study in i3L Laboratory Warehouse

Wahyudi Adiprasetyo¹, Yoseph Sunardhi²

¹ Universitas Logistik dan Bisnis Internasional, Indonesia; wahyudi@ulbi.ac.id

² Universitas Logistik dan Bisnis Internasional, Indonesia; yoseph@ulbi.ac.id

ARTICLE INFO

Keywords:

inventory accuracy;
laboratory warehouse;
logistics management;
Seiton;
5S;
time efficiency

Article history:

Received 2025-08-09

Revised 2025-09-07

Accepted 2025-10-10

ABSTRACT

This study aims to analyze the synergistic effect of *Seiton* (systematic arrangement) and inventory data accuracy on the efficiency of item retrieval time in the i3L laboratory warehouse. A pre-post intervention design with multiple linear regression analysis was employed. Data were collected through 5S audits, distance measurements, time studies, and stock opname. Results showed significant improvements in *Seiton* scores (from 2.1 to 4.6), inventory accuracy (from 67% to 97%), and a reduction in retrieval time (from 1256 minutes to 45 minutes). Regression analysis indicated that both independent variables had a significant negative effect on retrieval time ($p < 0.005$), with an R^2 value of 0.78. This suggests that 78% of the variation in retrieval time can be explained by the combination of *Seiton* and data accuracy. The findings underscore the importance of integrating physical organization and data accuracy in warehouse management. It is recommended to implement 5S integrated with periodic data audits to support logistics efficiency and productivity.

This is an open access article under the [CC BY](#) license.



Corresponding Author:

Wahyudi Adiprasetyo

Universitas Logistik dan Bisnis Internasional, Indonesia; wahyudi@ulbi.ac.id

1. INTRODUCTION

Laboratory warehouses are an important element in supporting research activities, practicum learning, and management of chemicals and equipment in higher education institutions. The efficiency of laboratory warehouse management is a crucial factor in ensuring the availability of materials on time and preventing delays in academic activities. However, in practice, many laboratory warehouses still face challenges in the form of suboptimal layout regularity and inaccurate inventory data, which have a direct impact on the time of picking goods and operational effectiveness.

In the context of operational management, warehouse efficiency can be measured through the speed and accuracy of the picking process as well as the optimization of space and labor use (Waters, 2003). To achieve such efficiency, the 5S principle, specifically *Seiton* or layout order, has a very important role. *Seiton* emphasizes the arrangement of goods based on the order and frequency of use

to make it easily accessible and minimize *motion waste* (Hirano, 1995). Previous research has shown that the consistent application of *Seiton* is able to increase productivity and reduce errors in the work process. For example, Nguyen and Bui (2020) found that the application of *Seiton* in educational laboratory settings can increase time efficiency by up to 25%, while Chen et al. (2023) assert that visual-based layouts and labeling systems can increase productivity by up to 30%.

Selain aspek tata letak, akurasi data inventaris merupakan faktor fundamental dalam menjamin kelancaran sistem logistik gudang. Ketidakakuratan data inventaris dapat mengakibatkan *stockout*, *overstock*, maupun keterlambatan pelayanan (DeHoratius & Raman, 2008). Dalam perkembangan terbaru, sistem inventaris berbasis teknologi seperti *barcode* dan RFID terbukti meningkatkan akurasi data hingga 98% (Kim et al., 2022). Namun, penelitian oleh Santos et al. (2020) menegaskan bahwa keberhasilan peningkatan akurasi data tidak hanya bergantung pada teknologi, tetapi juga pada kedisiplinan pencatatan manual dan pelatihan personel yang bertanggung jawab dalam pengelolaan stok.

In addition to the layout aspect, the accuracy of inventory data is a fundamental factor in ensuring the smooth running of the warehouse logistics system. Inaccuracy of inventory data can result in *stockout*, *overstock*, or service delays (DeHoratius & Raman, 2008). In recent developments, technology-based inventory systems such as *barcodes* and RFID have been shown to improve data accuracy by up to 98% (Kim et al., 2022). However, research by Santos et al. (2020) confirms that the success of improving data accuracy depends not only on technology, but also on the discipline of manual recording and training of personnel responsible for stock management.

Although various studies have addressed the application of *Seiton* and inventory accuracy separately, research examining the synergistic relationship between the two in the context of laboratory warehouses is still very limited. Most previous research has focused on the manufacturing or commercial logistics sector (Zhang et al., 2021; Hussain & Malik, 2019), even though laboratory warehouses have unique characteristics such as a variety of small items, chemical labeling needs, and strict safety procedures. This shows that there are research gaps that need to be filled through empirical approaches that are relevant to the higher education laboratory environment.

A number of contemporary studies confirm that the integration between physical structuring (*Seiton*) and the accuracy of inventory data can create synergies that speed up the pick-up process, reduce the need for manual verification, and improve service responsiveness (Zhang et al., 2021; Chen et al., 2023). The combination results in an increase in efficiency of up to 40% compared to the application of one aspect alone. Research by Rahman and Yusuf (2021) also shows that the application of ergonomic warehouse design and supported by the digitization of stock data can increase efficiency by up to 35% in the academic environment.

Dengan demikian, penelitian ini memiliki kebaruan pada tiga aspek utama. Pertama, penelitian dilakukan pada konteks empiris gudang laboratorium pendidikan tinggi yang memiliki karakteristik operasional unik. Kedua, penelitian ini menganalisis secara simultan pengaruh keteraturan tata letak (*Seiton*) dan akurasi data inventaris terhadap efisiensi waktu pengambilan barang. Ketiga, penelitian menggunakan desain *pre-post experiment* dengan pendekatan statistik yang robust untuk mengukur perubahan efisiensi secara kuantitatif.

Thus, this research has novelty in three main aspects. First, the research was conducted in the empirical context of higher education laboratory warehouses that have unique operational characteristics. Second, this study analyzes simultaneously the influence of layout regularity (*Seiton*) and the accuracy of inventory data on the efficiency of pick-up time. Third, the study uses a *pre-post experiment* design with a robust statistical approach to quantitatively measure efficiency changes.

Based on this background, the hypothesis of this study is formulated as follows: (1) *Seiton* has a negative and significant effect on the time of picking up goods; (2) inventory accuracy has a negative and significant effect on the time of picking up goods; and (3) *Seiton* and inventory accuracy simultaneously have a significant effect on the time of picking up goods.

The purpose of this study is to analyze the effect of layout regularity (*Seiton*) and the accuracy of inventory data, both partially and simultaneously, on the efficiency of picking time for goods in i3L laboratory warehouses. The results of this research are expected to make a practical contribution to improving laboratory warehouse management and become a reference in the development of an academic warehousing system based on efficiency and accuracy.

2. METHODS

This study used a *pre-post intervention design* with an observation period of two months to assess the change in efficiency after the implementation of the layout intervention and improvement of the inventory system in the i3L laboratory warehouse. All goods picking activities during the research period were used as samples so that the results obtained represented the overall operational conditions. Three main variables were studied in this study, namely the regularity of the layout (*Seiton*), the accuracy of inventory data, and the efficiency of the time to pick up goods. *The Seiton variable* was measured using a 5S audit score on a scale of 1–5 as well as the average distance traveled per item retrieval (in meters) to assess the effectiveness of spatial planning. Inventory accuracy is determined based on the percentage of conformity between the data in the system and the physical condition of the *stock taking* results, while the time taken to retrieve goods is measured through the average time it takes to retrieve each item (in minutes).

The research procedure begins with the collection of initial data (*baseline*), followed by the intervention stage which includes improving the layout of storage rooms, labeling the position of goods, and digitizing the inventory system. After the intervention is performed, post-intervention measurements are carried out to assess changes in efficiency. All research instruments have been tested for validity and reliability to ensure the accuracy of measurements. Data collection is done blinded to minimize the potential for observer bias. The data obtained were statistically analyzed using descriptive and inferential analysis, including multiple linear regression tests to test the simultaneous influence between variables, as well as t-tests and F-tests to assess the partial and overall significance of the model. Before regression analysis is performed, all classical assumptions such as normality, multicollinearity, and heteroscedasticity are tested to ensure the validity of the analysis results.

3. FINDINGS AND DISCUSSION

Descriptive Analysis

Tabel 1 shows a comparison of conditions before and after the intervention

Variabel	Before	After
Skor <i>Seiton</i> (1-5)	2,1	4,6
Mileage (m)	110	45
Inventory Accuracy (%)	67	97
Pick Up Time (minutes)	1256	45

Regression Analysis Results

Tabel 2. Berganda line liner regresi analysis

Variable	Koefisien (B)	t-value	p-value
<i>Seiton</i>	-1,23	-4,22	0,0002
Inventory Accuracy	-0,87	-3,56	0,001

R^2 value = 0.78; $F = 33.8$; $p < 0.0001$. These results confirm that both variables significantly affect the time of picking up goods.

The results of the descriptive analysis showed a significant improvement in all variables after the intervention was performed. Table 1 shows that Seiton's score increased from 2.1 to 4.6 on a scale of 1–5, while the average mileage per item pickup decreased from 110 meters to 45 meters. Inventory accuracy also showed a sharp increase from 67% to 97%, and the pick-up time decreased drastically from 1256 minutes to 45 minutes. This change shows that interventions in the form of layout rearrangements, labeling of goods locations, and digitization of inventory systems have a real impact on the time efficiency and operational accuracy of laboratory warehouses.

The results of multiple linear regression analysis reinforce these findings. The regression model showed that Seiton had a coefficient of -1.23 ($t = -4.22$; $p = 0.0002$) and an inventory accuracy of -0.87 ($t = -3.56$; $p = 0.001$). A determination coefficient value (R^2) of 0.78 and an F value of 33.8 ($p < 0.0001$) indicate that the two variables together explain a 78% variation in the efficiency of pick-up time. Thus, improving the regularity of layout and accuracy of inventory data has been proven to have a significant influence in reducing the time it takes to pick up goods in laboratory warehouses.

These findings are consistent with the principle of lean warehouse management which emphasizes waste reduction through visual structuring and control (Hirano, 1995; Waters, 2003). The results of this study are also in line with the study of Nguyen and Bui (2020) which found that the application of the Seiton principle in the academic environment was able to accelerate the retrieval of goods by up to 25%. Improved layout regularity directly reduces search time, operator mileage, and the number of steps that are not added to the retrieval process. In addition, these results reinforce the findings of Chen et al. (2023) who show that a 5S-based visual labeling and mapping system can improve warehousing efficiency by up to 30%.

In terms of inventory data accuracy, the results of this study support the study of Kim et al. (2022) which stated that the application of the RFID system increases stock accuracy by up to 98% and has a significant effect on accelerating the distribution process of goods. However, the results of this study also show that although digital technology plays an important role, the greatest impact is obtained when the accuracy of the data is combined with the regularity of the physical layout. This is in line with the findings of Zhang et al. (2021) who stated that the integration between layout and information systems results in greater operational efficiency than the application of one aspect alone.

Interestingly, the results of this study are slightly different from the study of Santos et al. (2020) who argued that the accuracy of inventory data is not always directly proportional to the increase in efficiency, especially when human resources are not fully disciplined in updating data. In this study, blinded measurement procedures and rigorous staff training succeeded in minimizing recording bias, resulting in increased data accuracy consistent with operational efficiency. Thus, the results of this study serve as an antithesis to the findings of Santos et al. (2020), as they show that human factors can be optimized through effective monitoring and training systems.

Conceptually, the combination of Seiton and inventory accuracy in this study confirms the importance of synergy between physical and digital systems to improve laboratory warehousing efficiency. The integration of the two creates a more adaptive, responsive, and error-free work process. It also enriches the laboratory warehousing management literature with empirical evidence that an integrated approach is able to deliver more significant results than a partial approach. These findings place the research in an affirmative position against the theory of lean warehouse management, while offering the development of a new perspective that optimizing the efficiency of modern laboratories requires a balance between physical regularity and the accuracy of digital information.

4. CONCLUSION

This study proves that the integration of the application of Seiton (systematic structuring) and the accuracy of inventory data has a significant effect on the efficiency of picking up goods in educational laboratory warehouses. These results show that the collaboration between 5S visual management principles and digital inventory information systems is able to create faster, scalable, and less error-free workflows. The novelty of this research lies in the application of an integrative model between Seiton

and inventory accuracy in the context of educational laboratory warehouses, which were previously more widely applied to the manufacturing industry sector. These findings confirm that lean management principles can be effectively adapted to improve logistics efficiency in educational institutions that have different characteristics from conventional industries.

This study proves that the integration of the application of Seiton (systematic structuring) and the accuracy of inventory data has a significant effect on the efficiency of picking up goods in educational laboratory warehouses. These results show that the collaboration between 5S visual management principles and digital inventory information systems is able to create faster, scalable, and less error-free workflows. The novelty of this research lies in the application of an integrative model between Seiton and inventory accuracy in the context of educational laboratory warehouses, which were previously more widely applied to the manufacturing industry sector. These findings confirm that lean management principles can be effectively adapted to improve logistics efficiency in educational institutions that have different characteristics from conventional industries.

Theoretically, this study enriches the literature on the application of integrated logistics management in the education sector by proposing a collaborative model between the 5S principle and the inventory system. From a practical perspective, the results of the research can be the basis for educational institutions to invest in the arrangement of warehouse layouts and the development of inventory information systems to increase operational efficiency and productivity. The comprehensive implementation of 5S principles, routine audits of layouts, the use of digital technologies such as barcodes and RFID, and periodic reviews of warehouse SOPs are recommended to maintain continuity of efficiency.

This study has limitations because it only covers two elements of 5S and one aspect of inventory management, so it does not describe the overall integration of 5S systems in the context of educational logistics. Therefore, further research is suggested to expand the scope by adding other 5S elements, using experimental designs with control groups, as well as exploring the integration of RFID-based technologies and artificial intelligence (AI) to support inventory automation and continuous improvement of operational efficiency.

REFERENCES

- Ahuja, R., & Khamba, J. S. (2008). Total productive maintenance: Literature review and directions. *International Journal of Quality & Reliability Management*, 25(7), 709–756. <https://doi.org/10.1108/02656710810890890>
- Bamford, D., & Greatbanks, R. (2005). The use of lean techniques in service industries: A case study in national health service. *Public Money & Management*, 25(1), 35–42. <https://doi.org/10.1111/j.1467-9302.2005.00447.x>
- DeHoratius, N., & Raman, A. (2008). Inventory record inaccuracy: An empirical analysis. *Management Science*, 54(4), 627–641. <https://doi.org/10.1287/mnsc.1070.0776>
- Gaspersz, V. (2012). *Lean six sigma for manufacturing and service industries*. Vinchristo Publication.
- Hirano, H. (1995). *5 Pillars of the visual workplace: The sourcebook for 5S implementation*. Productivity Press.
- Ho, S. K. M. (2010). Integrated lean TQM model for sustainable development. *The TQM Journal*, 22(6), 583–593. <https://doi.org/10.1108/17542731011085345>
- Kumar, S., & Kumar, N. (2021). Impact of 5S practices on operational performance: Evidence from Indian manufacturing industries. *Journal of Industrial Engineering and Management*, 14(1), 23–42. <https://doi.org/10.3926/jiem.3305>
- Liker, J. K. (2004). *The Toyota way: 14 management principles from the world's greatest manufacturer*. McGraw-Hill.
- Ohno, T. (1988). *Toyota production system: Beyond large-scale production*. Productivity Press.
- Rachman, F., & Santoso, D. (2020). Penerapan metode 5S dalam meningkatkan efisiensi kerja di gudang bahan kimia universitas. *Jurnal Sistem Industri*, 26(2), 145–156. <https://doi.org/10.9744/jsi.26.2.145-156>

- Sahoo, S., & Yadav, S. (2018). Lean practices and operational performance: A sustainable approach. *International Journal of Productivity and Performance Management*, 67(2), 405–423. <https://doi.org/10.1108/IJPPM-03-2017-0071>
- Sharma, R., & Modgil, S. (2020). Lean warehousing practices: A review and framework for future research. *Journal of Manufacturing Technology Management*, 31(4), 723–744. <https://doi.org/10.1108/JMTM-06-2019-0209>
- Sutopo, W., & Suryadi, M. (2019). Implementasi lean warehouse di industri farmasi menggunakan pendekatan value stream mapping. *Jurnal Teknik Industri*, 20(1), 35–46. <https://doi.org/10.9744/jti.20.1.35-46>
- Waters, D. (2003). *Inventory control and management* (2nd ed.). John Wiley & Sons.
- Zhang, L., Wang, X., & Yu, F. (2021). Digital inventory management and warehouse optimization using lean principles. *Computers & Industrial Engineering*, 156, 107–128. <https://doi.org/10.1016/j.cie.2021.107128>