BULLETIN OF ENGINEERING SCIENCE, TECHNOLOGY AND INDUSTRY
(BESTI Journal) | ISSN(e): 3025-5821
Website: https://bestijournal.org/index.php/go/index A| Volume 4 No. 2 (2026)

MEASUREMENT OF LOADING AND UNLOADING TIME FOR KIMSUA SALTED FISH PRODUCTS AT A COLD STORAGE WAREHOUSE USING TIME STUDY TECHNIQUES AND THE IMPLEMENTATION OF THE FIFO METHOD AT CV. XYZ

Risky Darma Putra [1]*, Marwan [2]
[1,2] Industrial Engineering Study Program / Universitas Potensi Utama, Medan, Indonesia
E-mail: riskydarmaputra86@gmail.com[1]* , marwan2192@gmail.com[2]

Received: 06/09/2026 | **Revised:** 11/09/2026 | **Accepted:** 30/09/2026 | **Published:** 29/10/2026

Abstract

This research aims to; (1) Determine the standard time for the loading and unloading process of Kimsua salted fish products from reefer trucks (refrigerated trucks) to Cold storage (cold storage warehouse using the Time Study technique at CV. XYZ, (2) Identify work activities and measure the actual time duration required for the loading and unloading process of Kimsua salted fish products from reefer trucks to Cold storage at CV. XYZ, (3) Evaluate the application of FIFO (First In, First Out) in managing the flow of Kimsua salted fish products at CV. XYZ, (4) Analyze the standard time used to compile improvements in efficiency and compliance with work standards in the process of transferring Kimsua salted fish products from reefer trucks to Cold storage at CV. XYZ. Measurement of working time is carried out using the Stopwatch Time Study method and the application of the FIFO (First In, First Out) method based on warehouse operational data. The data obtained are analyzed through data adequacy tests, data uniformity tests, determining performance ratings using the Westinghouse method, calculating normal time, allowances, and standard time. The results showed that all observation data met the requirements of data sufficiency and uniformity, making it suitable for use in the analysis. The Performance Rating (PR) value obtained was 1.06. The calculations yielded a normal time of 79.62 minutes and a standard time of 93.65 minutes per work cycle. The work element with the highest standard time was the activity of carrying goods to the warehouse (42.97 minutes), while the smallest standard time was the activity of returning goods (7.35 minutes). The results of the inventory management analysis indicate that the company has effectively implemented the FIFO method, characterized by the issuance of goods in the order of their arrival date. The FIFO implementation has been proven to maintain product quality, reduce the risk of old stock buildup, facilitate inventory tracking, and support smooth warehouse operations. Based on the results of the study, it can be concluded that the application of the Time Study technique and the FIFO method can improve the efficiency of the loading and unloading process the of inventory management at the cold storage warehouse of CV. XYZ.

Keywords: Loading and Unloading, Cold Storage, Time Study, FIFO

INTRODUCTION

A company's ability to operate with a high level of efficiency has become a key factor in achieving a competitive advantage. Amidst the rapid pace of innovation in the contemporary logistics industry—specifically regarding the movement of goods through the supply chain—temperature-controlled storage facilities, known as "cold storage," play a crucial role. Their primary function is to ensure the quality and freshness of products, particularly for commodities sensitive to temperature fluctuations, such as processed fishery products. In essence, they serve to maintain the integrity, quality, and freshness of various goods—especially those requiring extra protection against temperature changes. CV. XYZ is a private company that provides cold storage rental services for businesses operating in the food industry. Initial observations at the cold storage facility of CV. XYZ indicate that the unloading process for 'Kimsua' salted fish—from the moment a refrigerated (reefer) truck arrives until the task is completed—varies in duration depending on the operator. The unloading workflow consists of several elements: setup (opening the truck doors and preparing equipment), retrieving the goods from the truck, transporting them into the cold storage, placing the items according to the FIFO (First-In, First-Out) method, and the return trip.

These tasks lack standardized time benchmarks, and the current management and movement of commodities—which could be further optimized—may potentially hinder the distribution process. This situation suggests an opportunity to enhance operational efficiency by systematically measuring and evaluating the existing work methods. The global logistics and warehousing industry is increasingly driven by the demand for greater efficiency, making the measurement of operational performance a vital strategic tool (Ivanov et al., 2022). A "time study" enables the identification of individual steps within a process, the measurement of time spent on each step, and the pinpointing of areas prone to waste or inefficiency. Applying this technique to the loading and unloading process of Kimsua (salted fish) at the cold storage warehouse of CV. XYZ is expected to yield quantifiable data regarding activity durations, bottlenecks, and factors that influence efficiency. Beyond time measurement, effective inventory management is also crucial to warehouse operations. The First-In, First-Out (FIFO) principle is a stock management method ensuring that products entering the warehouse first are also the first to be dispatched. Implementing FIFO is essential for preventing product expiration, maintaining quality, and minimizing losses (Chen et al., 2022).

The application of the FIFO method to *Kimsua* products at CV. XYZ is highly strategic, given that the product has a limited shelf life, even when kept under cold storage conditions. Nevertheless, there remains potential for further optimization in the implementation of the FIFO method. Companies like CV. XYZ currently face the reality that they must not only provide adequate storage facilities but also ensure the efficiency and effectiveness of their entire internal operations. Managing the inflow and outflow of goods under controlled temperatures—particularly for Kimsua (salted fish) products, which have specific shelf-life limitations—presents unique challenges that require an organized strategy. In this context, implementing a "First In, First Out" (FIFO) approach becomes crucial, as it ensures that products arriving first are prioritized for dispatch, thereby maintaining product quality. Consequently, conducting research on the measurement of loading and unloading process times—using a "Time Study"—along with an evaluation of the FIFO implementation, is of great importance.

Furthermore, the inventory management practices implemented within the warehouse require careful attention. A consistently applied First-In, First-Out (FIFO) system serves as a crucial foundation for maintaining the integrity of fishery products, which have a limited shelf life. If the FIFO system is not effectively implemented, there is an increased risk of older stock accumulating in the warehouse—a situation that can lead to a decline in product quality or even spoilage. Based on the background for the selection of this title, the problem identification for this thesis is as follows:

1. The occurrence of uncertain waiting times during the unloading process of Kimsua salted fish products from trucks to the cold storage warehouse.
2. A lack of identification regarding which specific work activities most significantly influence the duration of the unloading process for Kimsua salted fish products from trucks to the cold storage warehouse at CV. XYZ.
3. The process of unloading Kimsua salted fish from refrigerated trucks into the cold storage warehouse requires the measurement of work times to establish a standard time for each activity; the results of these measurements can then serve as a basis for identifying opportunities to improve the efficiency of the work process.

Based on the identification of problems in this study, the problem formulations are as follows:

1. How can a standard time be established for the unloading process of Kimsua (salted fish) products from a reefer truck into cold storage, given the current absence of standardized work time, which causes the execution to depend entirely on prevailing field conditions?
2. How can the specific work activities that influence the duration of the unloading process—from the reefer truck to the cold storage facility at CV. XYZ—be identified?
3. What improvements can be proposed for the unloading process of Kimsua (salted fish) products from a reefer truck into cold storage, based on the analysis of standard time at CV. XYZ?

The objectives of this study are as follows:

1. To establish optimal time standards for the unloading process of Kimsua (salted fish) products, specifically the transfer from refrigerated trucks (reefer trucks) to cold storage facilities at CV. XYZ.
2. To identify work activities and measure the actual time required for the unloading and handling of Kimsua products from reefer trucks to cold storage at CV. XYZ.
3. To utilize standard time analysis to develop improvements in efficiency and adherence to operational standards during the transfer of Kimsua products from *reefer trucks* to cold storage at CV. XYZ.

OPEN ACCESS

4. To evaluate the implementation of the FIFO (First In, First Out) method in managing the product flow of Kimsua at CV. XYZ.

LITERATURE REVIEW

Time Study

Time study is a technique used to determine the time required for a trained worker, operating at a normal performance level, to complete a specific task using established work methods. The primary objective of a time study is to derive a "standard time," which can serve as a basis for production planning, labor allocation, productivity measurement, and the setting of work targets (Ramadhan et al., 2024). According to the industrial engineering approach, work-time measurement is conducted through direct observation of work activities using the stopwatch time study method; the resulting observations are then analyzed by incorporating performance rating factors and allowances, thereby yielding an objective and justifiable standard time (Habibah et al., 2024).

Frozen Product Distribution System

A distribution system is an integrated chain of processes—encompassing producers, distributors, warehousing, transportation, and retailers—that work continuously to create a flow of value (Bowersox et al., 2020). A cold chain system is a crucial component of the supply chain, designed to maintain product temperatures to ensure optimal quality throughout the distribution process (Pertiwi et al., 2023).

First In, First Out (FIFO) Method

In financial statements, the value of inventory under the FIFO (First-In, First-Out) method is based on the most recent cost (Lubis, 2023). The First-In, First-Out (FIFO) method is a valuation approach. A distribution system is an integrated chain of processes—encompassing producers, distributors, warehousing, transportation, and retailers—that work continuously to create a flow of value (Bowersox et al., 2020).

Warehouse Management

A Warehouse Management System (WMS) is a database-driven application used to manage inventory by recording every transaction that occurs within a warehouse (Lee et al., 2025). A WMS supports inventory management by providing real-time stock data, thereby preventing stock shortages or surpluses. The implementation of a WMS can lead to positive improvements in warehouse operational efficiency and inventory optimization, while also helping to meet customer requirements (Larutama et al., 2022).

Cold Storage and the Fishing Industry

Cold storage is a storage facility equipped with a cooling system designed to maintain products at a specific temperature, thereby preserving their quality, freshness, safety, and shelf life. Cold storage plays a crucial role in maintaining the quality of fishery products and reducing post-harvest losses (Panjaitan et al., 2024). The presence of cold storage and air blast freezer facilities plays a crucial role in maintaining the quality of the catch and supporting the distribution of fish to consumers.

METHOD

This study employs a descriptive quantitative research approach. Descriptive research aims to systematically, factually, and accurately describe and explain the actual conditions occurring in the field. A quantitative approach is used because the study involves the measurement and analysis of numerical data—specifically, the duration of loading and unloading processes, collected through time study techniques—as well as the application of the FIFO (First In, First Out) method based on warehouse operational data. The data sources consist of both primary and secondary data. The research will be conducted from early February to June 2026. Data collection was carried out through field studies and literature research. Data obtained from observations and work-time measurements were processed using a Time Study technique to determine the standard time for the loading and unloading process of Kimsua salted fish products at the cold storage warehouse of CV. XYZ. The data processing stages are as follows:

1. Data Uniformity Test, conducted to ensure that the collected observation time data originates from the same system and is free from extreme values that could distort the analysis results.

OPEN ACCESS

2. Data Adequacy Test, conducted to verify that the quantity of collected observation data is statistically sufficient, using a data adequacy formula with a 95% confidence level and a 5% margin of error.
3. Calculation of Normal Time, normal time is calculated by multiplying the average observed time by a rating factor—using the Westinghouse system—which accounts for skill, effort, working conditions, and consistency.
4. Calculation of Standard Time, standard time is determined by adding allowances to the normal time, covering personal needs, fatigue, and unavoidable delays.
5. Evaluation of FIFO Implementation, the actual application of the FIFO method is analyzed descriptively based on observational data and documentation, then compared against the ideal standards for FIFO implementation in warehouse management.

RESULTS AND DISCUSSION

Results

Stopwatch Time Study Calculation Data

Work-time measurement was conducted using the stopwatch time study method for the loading and unloading process of *kimsua* (salted fish) products at the cold storage warehouse of CV. XYZ. The observed data, expressed in minutes, were recorded on observation sheets detailing the work elements of each process. Observations were carried out during working hours using either digital or analog stopwatches. The time study data were collected directly via the "snap-back" stopwatch method—a technique chosen because the work processes are repetitive and consist of short work cycles. A total of 33 observations were performed.

Table 1. Work Element Observation Time Data

Data No.	Observation Time per Work Element (minutes)				
	A	B	C	D	E
1	8,61	14,48	30,91	8,89	6,47
2	8,92	15,23	30,13	9,69	5,06
3	9,48	15,92	30,98	8,80	6,30
4	10,05	16,76	31,02	11,24	5,01
5	8,03	17,47	36,33	8,62	6,91
6	8,69	13,77	37,39	11,39	6,21
7	9,02	14,46	37,74	11,89	5,76
8	9,71	15,34	31,81	11,45	6,15
9	10,02	15,73	32,88	9,16	5,16
10	7,93	16,56	33,81	10,54	5,73
11	8,67	17,15	34,52	11,75	6,30
12	9,11	14,04	35,25	8,65	5,76
13	9,84	14,54	36,39	10,74	6,69
14	10,06	15,43	37,05	9,26	5,54
15	8,11	16,03	37,67	9,26	6,31
16	8,63	16,51	32,23	9,06	5,49
17	9,24	17,23	32,9	11,59	5,80
18	9,47	14,08	33,68	8,36	5,09
19	10,33	14,90	34,64	9,69	5,13
20	7,81	15,38	35,33	11,88	6,72
21	8,37	15,76	36,05	10,15	5,53
22	9,06	16,47	36,88	9,81	6,91
23	9,67	17,22	37,7	8,71	6,83
24	10,11	14,18	32,19	10,44	5,31
25	8,18	14,84	32,77	10,12	5,00
26	8,44	15,17	33,51	11,51	6,66
27	8,90	15,83	34,60	11,79	5,17
28	9,83	16,63	35,32	11,06	5,30
29	10,27	17,31	36,26	9,06	6,74
30	8,15	14,14	37,34	10,92	5,40
31	8,39	14,6	37,89	9,75	6,04
32	8,98	15,08	31,74	10,35	5,46
33	9,45	15,73	32,75	8,92	6,81

OPEN ACCESS

Data Sufficiency Test

The data adequacy test aims to determine the number of observations required. In general, a larger number of observations is preferable, as it ensures the collected data is more representative. The confidence level indicates the degree of certainty that the obtained results meet the required level of precision. This data collection activity employs a confidence level of 95% (k=2) and a 5% margin of error (degree of precision). The following is the calculation for the data adequacy test of work elements in the loading and unloading process, given the following parameters:

N = 33
k = 95% = 2
s = 5% = 0.05

Table 2. Data Sufficiency Test Results

Work Element	N	N'	Decription
A	33	10,62	Sufficient
B	33	7,62	Sufficient
C	33	7,35	Sufficient
D	33	19,86	Sufficient
E	33	18,94	Sufficient

Sources: processed by the author (2026)

Therefore, the 33 observations conducted are sufficient, and no additional observations are required. These data are suitable for use as a basis for determining the standard time for the loading and unloading process of *Kimsua* (salted fish) products at the cold storage warehouse of CV. XYZ.

Data Uniformity Test

A data uniformity test is conducted to determine whether the observed data fall within acceptable control limits, ensuring that the data can be considered uniform and suitable for further analysis. The test is performed using a 95% confidence level, with an upper control limit (UCL) and a lower control limit (LCL).

Table 3. Data Uniformity Test Results

Work Element	Average (minutes)	Standard Deviation	BKA (minutes)	BKB (minutes)	Description
A	9,07	0,75	10, 57	7,57	Even
B	15,57	1,09	17,75	13,48	Even
C	34,47	2,37	39,21	29,73	Even
D	10,13	1,14	12,41	7,85	Even
E	5,90	0,65	7,2	4,6	Even

Sources: processed by the author (2026)

Based on the data uniformity test conducted on the five work elements of the *Kimsua* (salted fish) loading and unloading process, it was found that all observed data points fall within the established control limits. No data points were found to deviate significantly or to fall outside the upper or lower control limits. Work element C exhibits greater data variation compared to the other elements, with a standard deviation of 2.37 minutes. Nevertheless, this variation remains within statistical control limits; therefore, the data are still considered uniform. Meanwhile, work element E demonstrates the highest level of stability, as it has the smallest standard deviation—0.65 minutes. These results indicate that the observed work methods were applied consistently throughout the observation period. Consequently, all the observed data can be used for the subsequent stage of analysis: the calculation of normal time and standard time.

Determination of Performance Rating

The determination of a performance rating is carried out to adjust the observed time based on the operator's work pace. This assessment is performed using the Westinghouse method, which considers the factors of skill, effort, conditions, and consistency. In the Westinghouse method, each factor is assigned specific classes and corresponding adjustment values. For the skill factor, the table is as follows:

OPEN ACCESS

Table 4. Determining Performance Rating using the Westinghouse method

Class	Skill Category	Value
A1	Super Skill	+0,15
A2	Super Skill	+0,13
B1	Excellent	+0,11
B2	Excellent	+0,08
C1	Good	+0,06
C2	Good	+0,03
D	Average	0,00
E1	Fair	-0,05
E2	Fair	-0,10
F1	Poor	-0,16
F2	Poor	-0,22

Source: Niebel (2012:456)

In the Westinghouse method, the Performance Rating (PR) value is not derived from mathematical calculations of time study data; rather, it is determined by an observer's assessment of the operator based on four factors: skill, effort, condition (working conditions), consistency. Based on observations using the Westinghouse method, the operator's skill is rated as "Good" (C1), with an adjustment value of +0.06, as the operator has mastered the loading and unloading process and is able to perform the work effectively in accordance with established operating procedures. Meanwhile, the factors of effort, condition, and consistency are categorized as "Average" (D), with an adjustment value of 0.00.

Table 5. Westinghouse Assessment of Each Work Element

Work Element	Factor	Class	Value	Reason for Assessment
A. Opening the door and preparing the tools (*Setup*)	*Skill*	*Good* (C1)	+0,06	The operator understands the procedure for opening the cold storage door and prepares the work tools properly so that the work is carried out smoothly and with minimal errors.
	Effort	*Average* (D)	0,00	The work effort carried out is classified as normal and does not show significant acceleration or deceleration of work.
	Condition	*Average* (D)	0,00	The condition of the work area is quite good; the lighting and workspace are conducive to preparatory activities.
	Consistency	*Average* (D)	0,00	The time required to complete the work remains relatively stable across each observation.
B. Removing items from a refrigerated truck	*Skill*	*Good* (C1)	+0,06	The operator is able to retrieve items accurately and understands the layout of goods within the refrigerated truck.
	Effort	*Average* (D)	0,00	The level of physical effort exerted is within a normal range.
	Condition	*Average* (D)	0,00	Working conditions in the loading and unloading area remain conducive to the item retrieval process.
	Consistency	*Average* (D)	0,00	The work performance observed remained relatively consistent across each observation cycle.
C. Bring Kimsua salted fish items to cold storage	*Skill*	*Good* (C1)	+0,06	The operator demonstrated proficiency in moving goods and understood the designated routes to the cold storage facility.
	Effort	*Average* (D)	0,00	The task of transporting goods was carried out at a normal, measured pace.
	Condition	*Average* (D)	0,00	The condition of the goods transport route is quite good and does not hinder operations.
	Consistency	*Average* (D)	0,00	The operator demonstrated a relatively consistent work pattern throughout the observation period.

OPEN ACCESS

Work Element	Factor	Class	Value	Reason for Assessment
D. Goods placement according to FIFO (*Put Away*)	*Skill*	*Good* (C1)	+0,06	The operator understands the application of the FIFO (First-In, First-Out) method and is able to position items according to the order of their arrival.
	Effort	*Average* (D)	0,00	The level of effort exerted by the operator is normal and in accordance with company procedures.
	Condition	*Average* (D)	0,00	The cold storage environment is conducive to the tasks of organizing and placing items.
	Consistency	*Average* (D)	0,00	The time taken to complete tasks remained relatively uniform across all observations.
E. Time to return	*Skill*	*Good* (C1)	+0,06	The operator is able to return to the initial starting position smoothly to begin the next cycle.
	Effort	*Average* (D)	0,00	Activities are performed at a normal level of effort.
	Condition	*Average* (D)	0,00	The conditions within the work area do not present any significant obstacles to the operator's movement.
	Consistency	*Average* (D)	0,00	The time taken to return to the starting position remained relatively stable throughout the observation period.

Source: Niebel (2012:456)

Based on the assessment results using the Westinghouse method, the skill factor for all work elements is categorized as "Good" (C1), with an adjustment value of +0.06, as the operator is experienced in the loading and unloading process for *Kimsua* (salted fish) products and is familiar with the applicable work procedures. Meanwhile, the factors of effort, condition, and consistency are categorized as "Average" (D), with an adjustment value of 0.00, as the level of work effort, the working environment conditions, and the consistency of work output are all within the normal range. Thus, the total adjustment value obtained is +0.06, resulting in a Performance Rating (PR) value of 1.06 for use in this study. This value indicates that the operator's work capability is approximately 6% above that of a normal worker.

Normal Time Calculation

In a work-time study, the normal time is obtained by multiplying the average cycle time by a performance rating factor. Since the performance rating in the previous section was 1.00 (100%)—based on the Westinghouse method (Skill = 0, Consistency = 0, Condition = 0)—the normal time (W_n) is calculated using the following formula:

$$Wn = WsxP$$

Table 6. Normal Time

Work Element	Cycle Time (minutes)	Performance Rating	Normal Time (minutes)
Opening doors and preparing equipment	9,61	1,06	9,61
Retrieving items from the refrigerated truck	16,50	1,06	16,50
Transporting items to cold storage	36,53	1,06	36,53
Storing items according to the FIFO (First-In, First-Out) method	10,73	1,06	10,73
Return time	6,25	1,06	6,25
Total	79,62	1,06	79,62

Sources: processed by the author (2026)

Based on the data uniformity test results for the five work elements involved in the loading and unloading process of Kimsua (salted fish) products, all observed data points fall within the established control limits. No data

points were found to deviate significantly or fall outside the upper or lower control limits. The calculations indicate that the total normal time for the loading and unloading process of Kimsua products is 79.62 minutes per work cycle. The normal time value is equal to the average cycle time because the performance rating applied in this study is 1.06 (100%), indicating that the operator is working at a normal performance level. Among all the observed work elements, the activity of transporting Kimsua products to the cold storage (C) accounts for the longest normal time at 36.53 minutes, while the return activity (E) has the shortest normal time at 6.25 minutes. This suggests that the process of moving goods to the storage area is the most time-consuming activity within the entire loading and unloading cycle. Based on the normal time calculation using a performance rating of 1.06, the total normal time for the loading and unloading process of Kimsua products is 79.62 minutes per work cycle. This normal time value is subsequently used as the basis for calculating the standard time, with the inclusion of an allowance factor.

FIFO (First In First Out)

Data processing results indicate that 145 goods-receipt transactions were recorded in the warehousing system. The total weight of goods entering the cold storage reached approximately 9,947 kg. The high volume of goods received suggests that the processes of receiving and storing products in the cold storage are intensive, necessitating an effective inventory management system to ensure that product quality is maintained throughout the storage period.

Table 7. Data on Highest Product Receipts

No	Product Name	Receipt Frequency	Total Weight (kg)
1	KIMSUA A	31	1.279,5
2	KIMSUA B	16	749,5
3	KIMSUA C	14	674,5
4	KIMSUA D	16	652,5
5	KIMSUA E	10	551,5

Sources: processed by the author (2026)

Based on the data processed regarding goods received during the research period, it was found that the KIMSUA product had the highest receipt volume. This product was recorded as having been received 31 times, with a total weight reaching 1,279.5 kg. The high frequency of receipts indicates that KIMSUA is the primary commodity most frequently supplied to the cold storage warehouse, thereby requiring a larger storage capacity compared to other products.

Table 8. Goods Outflow Transaction Data

No	Item Name	Frequency of Issuance (Item Qty)	Total Weight (kg)
1	KIMSUA (1)	12	694,5
2	KIMSUA (2)	5	237,5
3	KIMSUA (3)	3	162,5
4	KIMSUA (4)	3	146,0
5	KIMSUA (5)	2	112,5
6	KIMSUA (6)	1	65,5
7	KIMSUA (7)	1	57,0
8	KIMSUA (8)	1	46,5

Source: Processed primary data (2026)

Data processing results indicate that there were 28 outbound inventory transactions recorded in the warehousing system. The total weight of goods removed from cold storage reached approximately 1,522.0 kg. These outbound activities were dominated by 'Kimsua' salted fish products, spanning various quality classifications and product codes.

OPEN ACCESS

Table 9. Implementation of FIFO

No	Item Name	Date In	Date Out	FIFO Details
1	KIMSUA (1)	24-12-2025	05-03-2026	Items that enter first are removed first.
2	KIMSUA (2)	24-12-2025	05-03-2026	In accordance with the FIFO principle.
3	KIMSUA (3)	24-12-2025	05-03-2026	In accordance with the FIFO principle.
4	KIMSUA (4)	24-12-2025	05-03-2026	In accordance with the FIFO principle.
5	KIMSUA (5)	24-12-2025	05-03-2026	In accordance with the FIFO principle.
6	KIMSUA (6)	24-12-2025	05-03-2026	In accordance with the FIFO principle.
7	KIMSUA (7)	24-12-2025	05-03-2026	In accordance with the FIFO principle.
8	KIMSUA (8)	24-12-2025	05-03-2026	In accordance with the FIFO principle.

Source: Processed primary data (2026)

Discussion

The research results indicate that work measurement and the implementation of the First-In, First-Out (FIFO) method are closely linked to enhancing operational efficiency in cold storage warehouses. Through time studies, the company establishes standard work times that serve as a benchmark for labor productivity. Meanwhile, the FIFO method provides a more organized inventory management system, accelerating the processes of locating, retrieving, and placing goods. Effective implementation of FIFO contributes to reduced labor time, particularly during the retrieval and placement of items within the warehouse. By arranging goods according to their arrival sequence, workers avoid spending excessive time searching for products intended for dispatch.

An analysis of inbound and outbound inventory data reveals that CV. XYZ employs the FIFO method to manage its *Kimsua* (salted fish) inventory. This is evidenced by the use of arrival dates as the primary criterion for dispatching goods; products that arrive first are prioritized for removal before those that arrive later. This system enables the company to maintain product quality throughout the duration of cold storage. The application of FIFO is particularly critical for *Kimsua* products; although they have a relatively longer shelf life than fresh goods, their quality can still deteriorate if stored for too long. Consequently, dispatching stock based on the order of arrival is an appropriate strategy for preserving product quality. Beyond maintaining quality, FIFO also facilitates efficient storage space management. Organizing goods by their arrival sequence simplifies the processes of locating and retrieving items, thereby reducing the time required for distribution activities.

These findings align with the perspective of Pradana (2026), who asserts that the FIFO method can mitigate the risk of obsolete inventory and improve the effectiveness of inventory control. Furthermore, this study supports research from various experts in warehouse management, who conclude that FIFO is the most suitable method for food products, as it effectively preserves product quality during storage. It can be concluded that the FIFO (First-In, First-Out) method is an inventory valuation approach based on the assumption that the first items to enter the inventory are the first ones to be sold. This method is widely adopted by companies due to its computational simplicity—applicable to both periodic and perpetual inventory systems—while yielding the same inventory valuation. The FIFO method is considered a realistic inventory approach, suitable for products with diverse characteristics (Setiawan, 2023).

Consequently, the combination of established work-time standards and the FIFO method can enhance the efficiency of loading and unloading processes, accelerate inventory turnover, preserve the quality of *Kimsua* salted fish, and ensure smooth warehouse operations at the cold storage facility of CV. Fajarindo Anugerah Sukses Sejati.

The implementation of the FIFO method is evaluated to determine the extent to which the product storage and retrieval system adheres to the FIFO principle—ensuring that the first items to enter are the first to leave. Applying this method is crucial for maintaining the quality of *Kimsua* salted fish while in cold storage, preventing the accumulation of old stock, and minimizing the risk of product spoilage or quality degradation caused by excessive

storage duration. The evaluation results are expected to provide insight into the effectiveness of the FIFO method in supporting the company's inventory management.

Standard time is determined to establish the benchmark duration required to complete one full cycle of the *Kimsua* salted fish loading and unloading process. The standard time, derived through a time study, serves as a reference for workforce planning. Furthermore, the analysis of standard time helps identify inefficient activities and supports the development of process improvements, ensuring that the transfer of products from reefer trucks to the cold storage facility is conducted more effectively, efficiently, and in compliance with the company's operational standards.

CONCLUSION

The conclusions of this study are as follows:

1. The results of work-time measurements using the Stopwatch Time Study method—based on 33 observations—indicate that all data meet the criteria for sufficiency and uniformity, rendering them suitable for analysis. The Performance Rating (PR), calculated using the Westinghouse method, is 1.06; this suggests that the operator is performing 6% more efficiently than a "normal" worker.
2. Analysis of inventory management reveals that CV. XYZ has effectively implemented the FIFO (First In, First Out) method. This is evidenced by the use of entry dates as the basis for stock issuance, ensuring that items arriving first are also the first to be dispatched. The application of FIFO helps the company maintain the quality of its *Kimsua* (salted fish) products, mitigates the risk of accumulating old stock, facilitates inventory tracking, and streamlines loading and unloading operations at the cold storage facility.
3. The integration of Time Study and the FIFO method contributes to enhanced operational efficiency within the warehouse. The standard work times derived from the Time Study serve as a benchmark for labor productivity, while the FIFO system ensures a more organized flow of stored goods—thereby accelerating and improving the effectiveness of locating, retrieving, and placing items.
4. Calculations yield a normal time of 79.62 minutes and a standard time of 93.65 minutes per work cycle. The work element requiring the most time is the transport of goods to the cold storage, with a standard time of 42.97 minutes, while the "return" element requires the least amount of time, at 7.35 minutes.

Based on the discussion and conclusions of this study, the following recommendations are provided:

1. It is recommended that the company adopt a standard time of 93.65 minutes per work cycle as an operational standard for loading and unloading activities. This can then be utilized for workforce evaluation, capacity planning, and the establishment of completion targets.
2. The company should implement improvements to the work element involving the transport of goods to the cold storage, as this activity accounts for the longest standard time. Potential measures include optimizing the movement of goods, incorporating additional material handling equipment, or adjusting the number of personnel assigned to this task.
3. Increasing the quantity or capacity of material handling equipment—such as hand pallets, pallet movers, trolleys, or forklifts—will help shorten the time required to transport goods to the cold storage.
4. The application of the FIFO (First-In, First-Out) method should be maintained and strengthened through stricter oversight of the recording of goods' entry and exit dates; this will prevent errors in warehouse management and ensure the preservation of product quality.
5. For future research, it is suggested that work-time measurements be conducted on different types of products or by employing alternative work-measurement techniques—such as work sampling or a Predetermined Motion Time System (PMTS)—to provide comparative results that could further enhance the effectiveness of warehouse operational management.

REFERENCES

Afiani, R., & Pujotomo, D. (2017). *Penentuan Waktu Baku Dengan Metode Stopwatch Time Study Studi Kasus CV. Mans Group.* Industrial Engineering Online Journal, 6(1).

Agustin, T. T. (2022). Penerapan Metode Fifo (First in First Out) Dalam Pengendalian Persediaan Barang. *Jurnal Bisnis, Logistik Dan Supply Chain (BLOGCHAIN), 2(2), 92-102.*

Akbar, M. K., & Fajar, A. N. (2024). *Evaluation of the Warehouse Management System Application Using DeLone and McLean Model in North Jakarta Indonesia.* Ingénierie des Systèmes d'Information, 29(6).

Akhmad, E. P. A., & Prawirosastro, C. L. (2026). RFID-based warehouse management system for improving inventory accuracy and operational efficiency. *Jurnal Aplikasi Pelayaran dan Kepelabuhanan, 16(2), 293-309.*

OPEN ACCESS

Chen, X., Yang, J.-B., & Xu, D. (2022). Inventory policy and heuristic for long-term multi-product perishable inventory routing problem with static demand. *Operations Research Society of China, 10(3), 659–683.*

Dohar, R., Qisthy Qawariri., M. Diva Alifia Rizqullah., & Nukhe Andri Silviana. (2025). Analisis Pengukuran Waktu Dengan Metode Time Study (Studi Kasus Pada Proses Produksi UD Zahira Shoes). *Jurnal ARTI : Aplikasi Rancangan Teknik Industri, 20(1), 93-100.*

Fahmi, M., Karman, A., Achmad, M. J., Taeran, I., Wahidin, N., & Aris, M. (2024). Development of Cold Chain Facilities Tiley Fishery Port Morotai Island District. *Agrikan Jurnal Agribisnis Perikanan, 17(2), 191-198.*

Fauziah, S., & Ratnawati, R. (2018). Penerapan Metode FIFO Pada Sistem Informasi Persediaan Barang. *Jurnal Khatulistiwa Informatika, 4(1), 98-108.*

Habibah, R. U., Ramadhani, A., Hayyata, F. B., & Khairi, I. (2024). Pengukuran waktu kerja dengan metode stopwatch time study pada konveksi Galeri Hebu. *PROFISIENSI: Jurnal Program Studi Teknik Industri, 12(2), 096-102.*

Hasanah, T. H., & Syaputra, A. E. (2024). Pembangunan Sistem Informasi Persediaan Toko Kinara menggunakan Bahasa Pemrograman PHP dan MySQL. Jurnal Pustaka AI (Pusat Akses Kajian Teknologi Artificial Intelligence), 4(1), 09-16. https://doi.org/10.35134/jcsitech.v10i3.107

Ivanov, D., & Dolgui, A. (2022). A digital supply chain twin for managing disruption risks and resilience in the era of Industry 4.0. Transportation Research Part E: Logistics and Transportation Review, 152, 102406. https://doi.org/10.1016/j.tre.2021.102406

Julia, A., Alfareza, D., Novianti, D., Supriyono, F., & Baharudin, P. (2022). Pengamatan Terhadap Pegawai Bengkel untuk menentukan waktu baku menggunakan metode Work Sampling. Bulletin of Applied Industrial Engineering Theory, 3(1).

Larutama, W., Bentar, D. R., Risdayanto, R. O., & Alvariedz, R. S. (2022). Implementation of warehouse management system planning in finished goods warehouse. Journal of Logistics and Supply Chain, 2(2), 81-90.

Lee, R. I., Alvina, C., & Pawitan, G. (2025). Analisis Efektivitas Penerapan Warehouse Management System (WMS) Dalam Menopang Operasi E-commerce "IND ONDERDIL". Jurnal Media Informatika, 6(3), 1714-1722.

Lubis, H., Fitriyani, A., & Prayitno, M. H. (2023). Sistem Informasi Persediaan Barang Jadi Menggunakan Metode First In First Out (Fifo) Pada Pt Rubberman Indonesia. JSI (Jurnal sistem Informasi) Universitas Suryadarma, 10(2), 1-10.

Mardiati, E. (2019). Analisis penerapan metode LIFO dan FIFO dalam penilaian persediaan barang dagang pada perusahaan ritel. Jurnal Akuntansi Dan Keuangan Indonesia, 16(2).

Panjaitan, F. C. A., Samanta, P. N., Utari, S. P. S. D., & Sitepu, G. S. B. (2024). Implementation Of Cold Chain System In Peeled Deveined Tail-On Vannamei Shrimp (Litopenaeus vannamei) Products. Jurnal Pangan dan Agroindustri, 12(2), 67-78.

Prabowo, A., Wahyuni, E. S., Tanjung, Y., Wijaya, M. R., & Adam, A. A. (2025). *Manajemen Pemasaran (Strategi Pemasaran Era Digital: Menguasai Tren dan Teknologi Sebagai Konsep Baru Meningkatkan Penjualan).* Serasi Media Teknologi.

Pradana, A. L., Wijana, K., & Sutedjo, B. (2022). Sistem informasi inventory bahan baku dan barang menggunakan metode FIFO studi kasus Sinergi Co-Working. Jurnal Terapan Teknologi Informasi, 6(1), 11-25.

Pratama, A. F., & Hidayat, R. (2022). Penerapan metode FIFO pada sistem informasi persediaan barang berbasis web. Jurnal Informatika Dan Sistem Informasi (JIFOSI), 3(1), 25–33.

Putri, D. R. K., & Satoto, H. F. (2026). Perancangan Ulang Alat Pengepres Ikan Berbasis Antropometri untuk Meningkatkan Efisiensi Produksi Tepung Ikan pada CV Hasil Laut. Jurnal Surya Teknika 13(1), 252-257.

Rais, D., Iksan, K. H., & Achmad, M. J. (2024). Evaluation of Capacity and Function of Cold Chain Facilities at Fishing Port of Integrated Marine Fisheries Center (PP SKPT) Daeo, Morotai Island Regency. Agrikan Jurnal Agribisnis Perikanan, 17(2), 76-84.

Ramadhan, M. F., Kukreja, R., & Duran, C. (2024). Productivity Improvement through Work Measurement and Time Study Analysis. RESWARA: Jurnal Riset Ilmu Teknik, 2(3), 93-99.

Setiawan, D., Purnamasari, A. N. R., & Dianta, I. A. (2023). Web-Based Inventory Management System Utilizing The First In First Out (Fifo) Method: A Case Study Of CV Berkah Foam Furniture. Jurnal Teknologi Informasi Dan Komunikasi, 14(2), 370-383.

Sihombing, A. P. N., Wandana, J., & Indra, H. (2024). Penerapan Metode First In First Out (FIFO) Dalam Mengontrol Persediaan Barang. Jurnal Minfo Polgan, 13(2), 1877-1886.

OPEN ACCESS

Sugiyono, M. R. (2023). Metode Penelitian Kualitatif. Untuk penelitian yang bersifat: eksploratif, enterpretif, interaktif dan konstruktif. Cocok Untuk: 1. Mahasiswa SI, S2, S3. 2. Dosen dan peneliti Ed. 3 Cet. 2 Thn. 2018.

Wahyudi, R., Setiawan, B. A., & Juniwati, J. (2024). Penentuan Waktu Proses Produksi Menggunakan Metode Stopwatch Time Study (Studi Penelitian Balai Besar Perikanan Budidaya Laut Lampung). Jurnal Industri dan Inovasi (INVASI), 2(2), 24-31.

Wijaya, S. D., & Agusti, F. (2026, January). Penetapan Waktu Kerja Standar Pada Mesin Bubut CNC Berdasarkan Waktu Kerja dan Jenis Produk Mengguakan Metode Time Study. In Prosiding Seminar Nasional Hukum, Bisnis, Sains dan Teknologi (Vol. 6, No. 1, pp. 886-895).

Zakarsi, D. A., & Hartono, R. (2026). Analisis Pengukuran Waktu Produksi Menggunakan Metode Time Study pada Produk Nakas di PT X. Factory Jurnal Industri, Manajemen dan Rekayasa Sistem Industri, 4(3), 435-450.

OPEN ACCESS