American Journal of
Supply Chain Management
(AJSCM)

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American Journal of Supply Chain Management
ISSN 2518-4709 (online)
Vol.9, Issue 3, pp 16 - 25, 2024
www.ajpojournals.org

Labor-Saving in Order Picking- A Real Time Study Advancing Lean Operations

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Article history

Submitted 11.07.2024 Revised Version Received 15.08.2024 Accepted 18.09.2024

Abstract

Purpose: Efficient warehouse operations rely heavily on optimizing order picking processes, which are known to constitute a significant portion of overall operational costs. The aim is to enhance operational efficiency and cost-effectiveness by minimizing non-value-added tasks in warehouse operations.

Materials and Methods: This study investigates the transition from an Assisted-Picker model to a Solo-Picker model at a prominent 3PL service provider in India. The analysis compares two approaches for picking orders—pairing laborers versus employing a Solo-Picker—using metrics such as travel time and picking time.

Findings: Results reveal that while the Assisted-Picker model may initially show faster completion times for individual orders, the Solo-Picker model proves more efficient overall. This is attributed to the elimination of idle time associated with helpers and enhanced labor utilization efficiency. Real-time productivity data collected during the study period demonstrate a remarkable 44% increase in productivity with the Solo-Picker model, resulting in substantial Labor-Savings and significant reductions in operational costs.

Implications to Theory, Practice and Policy: This study highlights the critical importance of reevaluating traditional labor allocation strategies in warehouse environments. By identifying and eliminating non-value-added work, warehouses can move closer to lean and efficient supply chain management practices, ultimately enhancing overall productivity and cost-efficiency.

Keywords: *Supply Chain, Order Picking, Non-Value-Add, Lean Operations, Labor-Saving*

JEL Code: J22

1.0 INTRODUCTION

Essence of the Study

MOVING IS NOT WORKING. This is a classic example of advancing lean operations by removing non-value-added tasks in the picking process, all without requiring additional investment or changes to inventory strategies or infrastructure.

Background

Order picking is the most labor-intensive and costly activity for almost every warehouse [1]. The cost of order picking is estimated to be 55% of the total warehouse operating expense [2]. Any underperformance in order picking can lead to unsatisfactory service and high operational cost for the warehouse, and consequently for the whole supply chain. In order to operate efficiently, the order-picking process needs to be robustly designed and optimally controlled [3].

Order Picking

A warehouse typically encompasses four primary processes: receiving, putaway, picking, and shipping. Receiving involves the activities related to accepting products and associated information into the warehouse, while putaway refers to the movement of items from the receiving area to their designated storage locations [4]. Order picking is the critical process of pulling items from inventory to fulfill customer orders. This operation can be either labor-intensive or manual or fully automated [5]. The primary objective of picking is to ensure the accurate and timely assembly of the required quantity of items for each customer order [6].

In manual picking processes, workers physically select and retrieve items from storage locations. This method requires significant human labor and can be costly, particularly due to time spent traveling between storage areas, which becomes increasingly inefficient in large warehouses [7]. Automated warehouse picking leverages advanced technologies such as Automated Storage and Retrieval Systems (ASRS). ASRS systems automate the storage and retrieval of goods, enhancing operational efficiency and accuracy while reducing labor costs. These systems utilize various computer-controlled mechanisms to automatically place and retrieve loads from predefined storage locations [8].

The majority of warehouses employ humans for order picking. Among these, the picker-to-parts systems, where the order picker walks along the aisles to pick items, are most common. Two types of picker-to-parts systems are distinguished: low-level picking and high-level picking. In low-level order-picking systems, the order picker picks requested items from storage racks or bins (bin-shelving storage), while travelling along the storage aisles. Other order-picking systems employ high storage racks; order pickers travel to the pick locations on board of a lifting order-pick truck or crane. The crane automatically stops in front of the appropriate pick location and waits for the order picker to perform the pick. This type of system is called a high-level or a man-aboard order-picking system [9]. These systems are typically used in very narrow aisle (VNA) warehouses or environments where vertical space is optimized for storage, and high-density shelving is utilized. Man-up systems are crucial for operations in warehouses where goods are stored at great heights and manual or automated solutions like ladders or ground-level picking are insufficient.

Five frequently used types of storage assignments are described: random storage, closest open location storage, dedicated storage, full turnover storage and class based storage. For random storage every incoming pallet (or an amount of similar products) is assigned a location in the warehouse that is selected randomly from all eligible empty locations with equal probability [10]. It optimizes space utilization but can sometimes result in increased travel time, as items may be stored far apart. This dispersion necessitates accurate inventory records to avoid time-consuming searches for misplaced or improperly scanned items. Effective management of a random storage system relies on sophisticated Warehouse Management Systems (WMS) and inventory tracking systems, which help minimize travel time through optimized picking routes, dynamic slotting, and order batching. Thus, a random storage system can either be an asset or a liability, depending on the effectiveness of these management strategies.

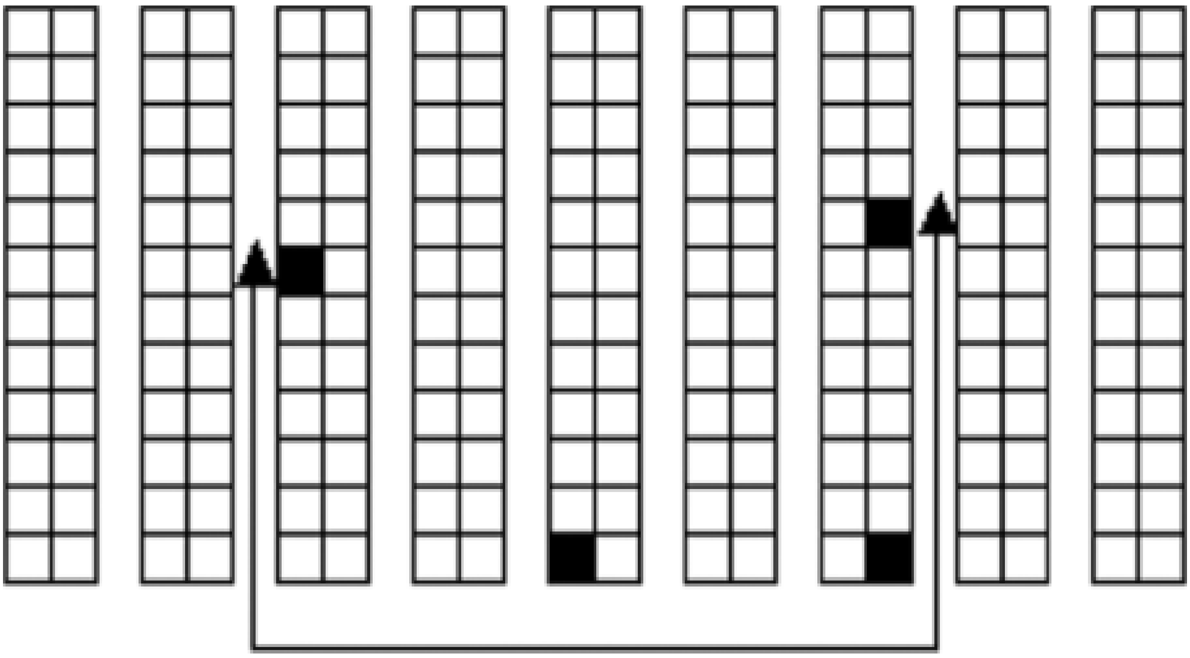

Figure 1: Traditional Rack Combination

Study Conditions

Figure 2: Study Location

This study was conducted as part of a continuous improvement initiative within the picking operations at the Bangalore distribution center of one of India's largest third-party logistics (3PL) providers. They provide logistics support to several businesses, and the inventory of one of these businesses was the subject of this study.

1. 1486 storage locations

2. 31000 sq. ft. area

Key Features of Warehouse

The warehouse features parallel aisles, each approximately 1.5 meters wide, with three cross-aisles running perpendicular at the front, middle, and back. Pickers can manually retrieve products from both sides of each aisle, with items stored on two levels.

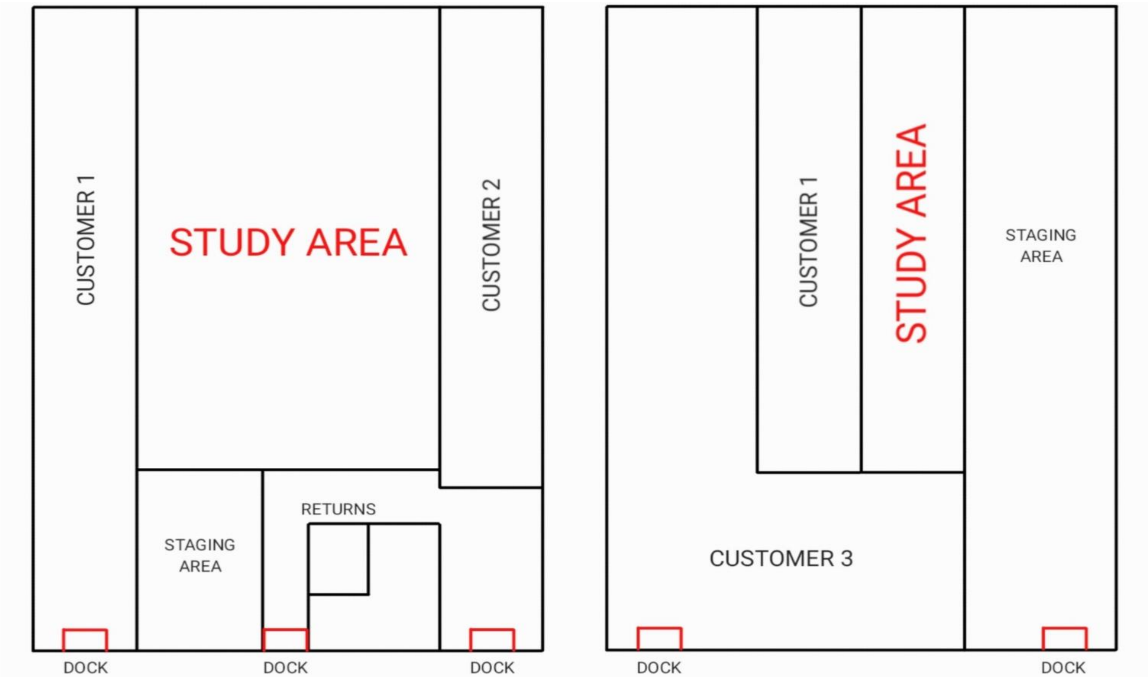

Figure 3: Warehouse Layout

Picking Process at the Study Location

In the study location, the picking operation is carried out by 7 laborers. 5 of them are experienced pickers and 2 are helpers. Occasionally, idle laborers from other departments are utilized as helpers for picking tasks. According to the SOP, each picking assignment requires an Assisted-Picker pair. However, based on the availability of labor, size of the order and experience of the picker, the picklist is given either to a *SOLO-PICKER* or to an *ASSISTED-PICKER* pair.

The warehouse employs a random storage system, which significantly impacts travel time. Since the upper racks are relatively low and easily accessible, a low-level order-picking method is used. This allows pickers to retrieve items while moving along the aisles without the need for lifting order-pick trucks or cranes. The picker receives a picking list from the computer station, picks an empty cart at the pick-up point, travels to the picking locations to pick the products, delivers them to a drop off point and completes the picking with the computer station.

Figure 4: Assisted-Picker

Figure 5: Solo-Picker

Problem Statement

There is a widespread misconception that movement equates to productive work in operational environments. Non-value-added tasks, such as excessive walking, are difficult to quantify and visualize, leading to labor misallocation based on perceived activity rather than actual value-added contributions. This misallocation increases non-value-added tasks, resulting in significantly higher operating expenses with no corresponding return on investment.

Taichi Ohno, the father of lean manufacturing, identified motion as one of the seven types of waste, alongside overproduction, waiting, transport, extra processing, inventory, and defects. Our study exemplifies waste in the form of unnecessary motion. Proper labor allocation is crucial and requires accurately identifying and eliminating waste, even though it may be challenging to detect physically. In our study, we collected and analyzed real-time data to pinpoint and eliminate non-value-added work. This approach led to a 44% increase in productivity and a reduction in operating costs in the picking department, thereby advancing lean operations in warehouse environments.

A Model Case to Reflect the Non-Value-Add Work

Scenario: Two orders, each consisting of 5 line items of the same weight and two equally skilled laborers available

Objective: Determine the most efficient method for picking these orders

Methods of Picking

Approach 1: Pair Them Up

- Both laborers work together on one order at a time.
- After completing the first order, they proceed to the second order together.

Approach 2: Simultaneous Picking

- Each laborer picks items from a separate order simultaneously.
- Laborer 1 works on Order 1 while Laborer 2 works on Order 2 concurrently.

Metrics for Evaluation

- Travel Time: Time taken to travel between picking locations [11]
- Picking Time: Time taken to pick after reaching the location [11]

Approach 1: Assisted-Picker

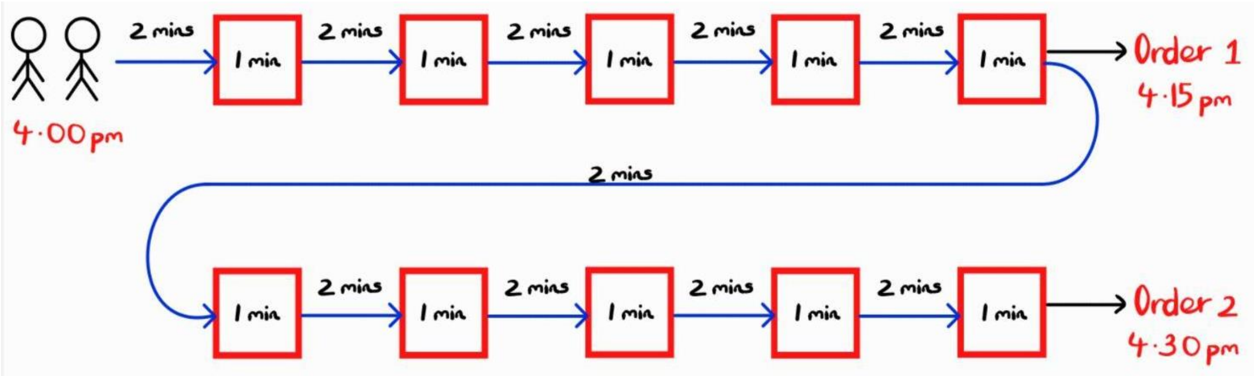

Figure 6: Assisted-Picker Model

Time taken to complete both orders = 30 minutes

Man Hours	*= 1 hour*	(2 laborers x 30 minutes = 60 minutes)
Idle Time	*= 20 minutes*	(1 helper x 2 minutes travel time x 10 line items)
Labor Content	*= 40 minutes*	(60 minutes - 20 minutes)

Labor Utilization = 66.66% ($\frac{Labor\ Content}{Labor\ Content + Idle\ Time} = \frac{40}{40+20} = \frac{2}{3}$)

Approach 2: Solo-Picker

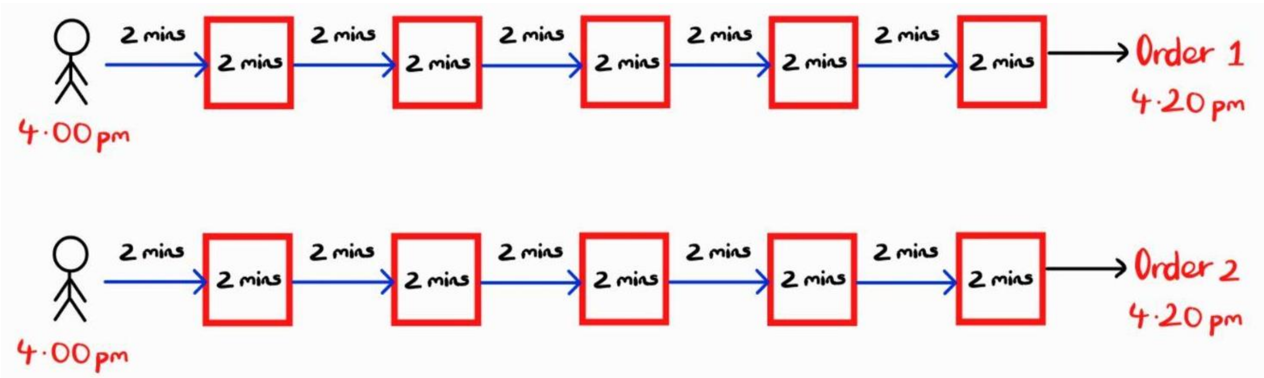

Figure 7: Solo-Picker Model

Time taken to complete both orders = 20 minutes

Man Hours	*= 0.67 hours*	(2 laborers x 20 minutes = 40 minutes)
Idle Time	*= 0 minutes*	
Labor Content	*= 40 minutes*	

Labor utilization = 100% ($\frac{Labor\ Content}{Labor\ Content + Idle\ Time} = \frac{40}{40} = 1$)

Initially, it appears that the Assisted-Picker model is more efficient than the Solo-Picker model, as the first order is completed in 15 minutes compared to 20 minutes in the Solo-Picker model. However, focusing solely on the completion time of the first order overlooks the overall efficiency. In the Solo-Picker model, both orders are fulfilled within a total time of 20 minutes. In contrast, in the Assisted-Picker model, despite the quicker initial completion of the first order in 15 minutes, the total time to complete both orders is 30 minutes. This broader perspective reveals that while the Assisted-Picker model shows faster completion for the first order, it ultimately requires more time to fulfill both orders compared to the Solo-Picker model.

Underlying Cause

It might seem like the work is getting done faster in the Assisted-Picker model. However, the helper is not actively engaged in value added tasks (pulling HPT) when the picker is moving to the next location. *The helper comes into action only after reaching the location.* By transitioning to the Solo-Picker model the idle time of the helper is eliminated, by having the picker handle both picking and pulling HPT which results in Labor-Saving. But for urgent order dispatches, the Assisted-Picker model can speed up single-order completion, though it results in some wasted man hours.

Real Time Productivity Numbers

Table 1: Productivity Numbers

Average Line productivity per person for **SOLO-PICKER**	**14.24**	**44%** increase in productivity
Average Line productivity per person for **ASSISTED-PICKER**	**9.86**	

Data was recorded for

1. 5 Days
2. 66 Orders
3. 2166 Line items
4. 102748 Kgs

The significant increase in productivity observed when transitioning from the Assisted-Picker model to the Solo-Picker model was largely due to the high ratio of travel time to picking time. This high travel time stemmed from the random storage system and the warehouse layout, which included inventory being split between two adjacent warehouses, thus increasing travel distances. Additionally, discrepancies between the system (WMS) and physical inventory meant that items were often not found in the correct locations or quantities, necessitating extra searching.

Manpower Saved

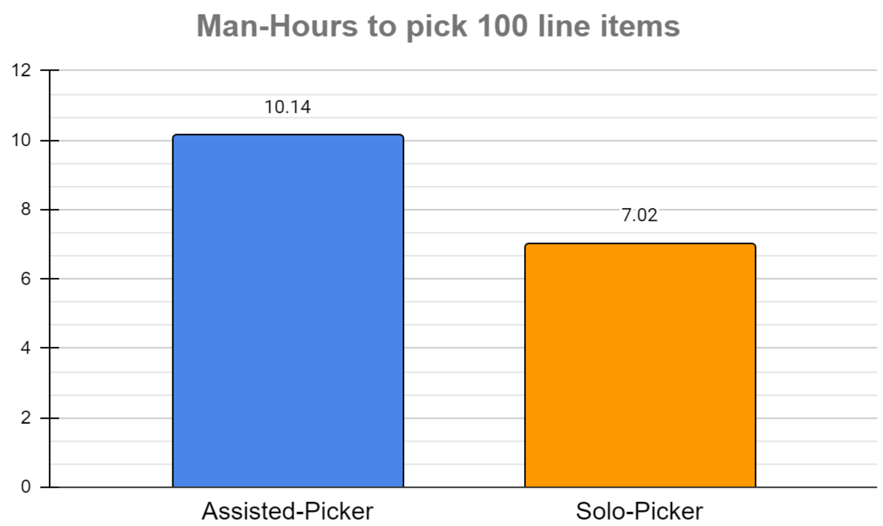

Figure 8: Man-Hours Comparison

Table 2: Man Hours Saving

METRIC	NUMBERS	CALCULATION
Available man-hours for picking in a day	56 hours	7 laborers x 8 hours
% Man-Hours Saved	44.4%	$\frac{10.14\ \text{hours} - 7.02\ \text{hours}}{7.02\ \text{hours}}$
Total man-hours saved in a day	24.9 hours	$\frac{44.4}{100}$ x 56 hours

By transitioning from Assisted-Picker model to Solo-Picker model, there is a saving of about 24 man hours i.e. 3 man days for a day. Hence, we can reduce the picking Labor from 7 laborers to 4 laborers.

Labor cost saved in picking department = $\frac{3}{7}$ *x 100 = 43%*

Performance Metrics

Line productivity = Line items picked per hour [12]

Man-Hours to pick 100 line items = $\frac{100\ x\ Labor\ count\ for\ the\ order}{Line\ productivity\ per\ person}$

Idle time- *In our context, idle time specifically refers to non-value-added activities, i.e., the travel time of the helper.*

Implications of the Study

Despite the perception that all laborers are actively engaged in tasks, the essence of productivity lies in activities that directly contribute to value creation. The study result shows that the transition from the Assisted-Picker model to the Solo-Picker model eliminates the non-value-added work associated with helper roles. This is a pivotal step towards optimizing picking operations in warehouses. It significantly boosts productivity by eliminating waste in the form of unnecessary motion, thereby reducing order picking costs and overall supply chain expenses. Warehouses that use random storage systems can particularly benefit from switching to a Solo-Picker model, as these environments often have a low ratio of picking time to travel time. An Assisted-Picker may still be utilized when an order needs to be dispatched immediately, due to its faster single-order completion time.

The percentage increase in productivity for a warehouse when transitioning from an Assisted-Picker model to a Solo-Picker model primarily depends on the ratio of picking time to travel time. A higher ratio suggests that more time is devoted to picking items relative to travel time, resulting in a smaller increase in productivity. Conversely, a lower ratio indicates that travel time is high, leading to a greater increase in productivity. The increased productivity not only enhances operational output but also translates directly into substantial cost savings for warehouse operations. In this particular case, a 44% increase in productivity resulted in savings equivalent to the cost of three Labor.

Potential Areas of Application

This concept is applicable in scenarios involving multiple individuals working together on a task. This issue becomes especially pertinent when one individual serves primarily in a supporting role. In such cases, it's essential to evaluate whether the supporting work adds value. If non-value-added tasks are identified, they should be phased out by exploring alternative models. While alternatives may not always be readily available, it's imperative to seek them out if the current model includes non-value-added tasks. While addressing productivity by resolving bottlenecks can be challenging, identifying and eliminating non-value-added work can significantly boost productivity in a straightforward manner, as it primarily involves identification. This process will enhance productivity by enabling us to use additional man-hours effectively or reduce labor costs.

Multi-Level Warehouses

In multi-level warehouses without lifting technology, picking items individually using a ladder from upper racks can consume additional man-hours, often necessitating assistance to retrieve items from these elevated positions. This process adds complexity and time to the picking operation due to the height and accessibility challenges posed by upper racks [13]. In our specific location, the upper racks were easily reachable, as the upper shelves were less than 2 meters from the ground. This eliminated the need for additional helpers to assist with picking from the upper racks.

For warehouses facing this challenge, employing shared helpers throughout the facility could optimize efficiency. The decision on the number of helpers needed can be determined based on the quantity of upper rack storage locations and the frequency of product movement from these areas. For example, if a warehouse has 1,600 storage locations, with 400 of these located on upper racks, then the percentage of upper rack storage locations is calculated as:

Percentage of upper rack storage locations = $\frac{400}{1600}$ x 100 = 25%

Assuming the warehouse employs a random storage system, the probability of picking goods from each location is uniform. Consequently, if there are four pickers working in the warehouse, it is expected that one picker will be picking from the upper racks, given the 25% proportion of such locations. Therefore, to assist with the additional task of retrieving items from the upper racks, it would be necessary to employ one common helper for every four pickers in the warehouse.

2.0 CONCLUSION AND RECOMMENDATIONS

Order picking is one of the most labor-intensive and costly activities in almost every warehouse, accounting for an estimated 55% of total warehouse operating expenses. Therefore, the order-picking process must be robustly designed and optimally controlled. The first step in achieving this is ensuring proper labor allocation and eliminating inefficiencies. A key strategy for attaining lean operations in a warehouse is to eliminate the primary type of waste: motion.

This study highlights the importance of waste elimination in warehouse environments. Transitioning from an Assisted-Picker model to a Solo-Picker model can lead to a substantial increase in productivity, especially in warehouses with a random storage system where travel time is a significant factor. While it can be challenging to physically identify non-value-added tasks, such as excessive motion, it is crucial to address them, as there is no return on the investment made in those activities.

The study, conducted at a leading 3PL warehouse in India, demonstrated the benefits of this approach. By shifting to a Solo-Picker model, the warehouse reduced its picking department costs by 44%, leading to significant cost savings and increased profitability. This underscores the significance of eliminating waste and optimizing labor allocation in warehouse operations.

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