Proceedings of the International Conference on Industrial Engineering and Operations Management

Publisher: IEOM Society International, USA DOI: 10.46254/GC03.20260119
Published: February 2, 2026

Bottleneck Identification and Process Improvement in Outbound Logistics: An Integrated Work Study and Simulation Framework

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Abstract

Prolonged truck turnaround time (TTT) is a critical bottleneck in outbound logistics, leading to operational congestion, increased costs, and customer dissatisfaction. This study addresses this challenge by implementing an integrated methodology combining work study and discrete-event simulation (DES) at a food industry company in Saudi Arabia. The research followed a structured four-phase approach: (1) empirical data collection through time studies and historical records to establish a baseline; (2) data analysis to identify process patterns, bottlenecks, inefficiencies; (3) development and validation of a DES model using Arena software; and (4) proposal of evidence-based improvements evaluated through key performance indicators. The findings demonstrate that the validated model accurately replicated real-world operations and identified key inefficiencies. The proposed improvements revealed significant potential for enhancing efficiency, with the optimal scenario achieving a substantial reduction in average TTT and waiting time, alongside an increase in system throughput. This study confirms the value of integrating empirical work study with simulation to create a robust, data-driven framework for logistics enhancement. It provides managers with a practical and replicable model for diagnosing bottlenecks and validating solutions prior to implementation, thereby enhancing operational efficiency and supply chain resilience.

Keywords
Outbound Logistics, Truck Turnaround Time, Discrete-Event Simulation, Work Study, Process Optimization, Supply Chain Management

1. Introduction
The efficiency of outbound logistics is a critical determinant of overall supply chain performance, directly impacting operational costs, customer satisfaction, and environmental footprint. In sectors with high-volume, time-sensitive distribution, such as the food industry, the optimization of truck loading and shipping procedures is paramount. Prolonged Truck Turnaround Time (TTT), the total time a truck spends from arrival at a plant to its departure, is a pervasive bottleneck that leads to yard congestion, increased fuel consumption, driver dissatisfaction, and significant financial penalties due to delayed deliveries (Sun et al., 2022). This challenge is particularly acute in regions experiencing rapid economic growth, such as Saudi Arabia, where supply chain infrastructure is constantly evolving to meet increasing demand. Within manufacturing facilities, the outbound logistics process is a complex system involving multiple interdependent stages, including weighing, loading, documentation, and final inspection. Inefficiencies at any single stage can create ripple effects, causing systemic delays. Traditional approaches to diagnosing these issues often rely on symptomatic problem-solving or piecemeal improvements, which fail to capture the dynamic interactions and stochastic nature of the entire system. Therefore, a more rigorous, data-driven methodology is required to not only identify the root causes of delays but also to predict the systemic impact of potential interventions before committing to costly real-world changes.

This study addresses the critical problem of excessive truck turnaround time at a food industry company in Saudi Arabia. The primary objective is to apply a structured, two-phase methodology that integrates the empirical rigor of Work Study with the predictive power of Discrete-Event Simulation (DES). The Work Study phase establishes a validated baseline of the current process through direct observation and time-motion analysis, grounding the research in empirical reality. Subsequently, the DES phase utilizes this data to create a virtual model of the logistics system, enabling the safe and efficient testing of various "what-if" improvement scenarios. This hybrid approach ensures that proposed solutions are not only theoretically sound but are also practical, validated, and tailored to the specific operational context of the company case.

This paper aims to accomplish the following specific objectives:

1. To examine the current outbound logistics procedure and identify the root causes of bottlenecks through systematic work study and process mining.
2. To evaluate primary performance metrics (Truck Turnaround Time, resource utilization, queue lengths) and pinpoint deficiencies using descriptive analytics.
3. To develop a validated discrete-event simulation model of the outbound logistics process, grounded in empirical data.
4. To utilize the simulation model to propose data-driven process improvement strategies and establish a decision-support foundation for future evaluation and implementation.

The remainder of this paper is structured as follows: Section 2 provides a literature review on the application of Work Study and Simulation in logistics, establishing the theoretical foundation for the integrated methodology. Section 3 details the four-step methodological framework. Section 4 presents the data collection and model development, then Section 5 shows the analysis for the model and possible improvements. Finally, in Sections 6 we discussed the results, findings, and conclusions.

2. Literature Review

The pursuit of efficiency in logistics and supply chain operations has been a central theme in industrial engineering research. Modern logistics systems are complex, dynamic, and stochastic, demanding methodologies that can both diagnose problems and prospectively evaluate solutions. This review synthesizes literature from two pivotal domains-Lean-based Work Study and Discrete-Event Simulation (DES)-to establish a research gap for their integrated application in a novel context.

Work Study, encompassing time and motion study, is a foundational industrial engineering technique for establishing performance standards and improving operational methods (Barnes, 1980).. It involves systematic examination of activities to eliminate unnecessary work and set standard times for tasks. This provides an empirical basis for understanding the actual process performance and identifying waste.

The principles of Work Study are deeply aligned with Lean manufacturing, a philosophy aimed at maximizing value by eliminating waste (Muda)(Liker, 2021). The seven classic types of waste (e.g., defects, overproduction, waiting, transportation, inventory, motion, and extra-processing) are readily identifiable in outbound logistics (Ahmad et al., 2022). For instance, waiting is manifested as truck idle time; unnecessary motion is seen in inefficient material handling during loading; and transportation waste occurs within the plant yard itself.

Several studies demonstrate the application of Lean tools, such as value stream mapping (VSM), to identify non-value-added activities in warehouse operations, leading to significant reductions in lead time (Chen et al., 2010). The strength of this Lean-oriented Work Study approach lies in its ability to provide a granular, data-rich diagnosis of the current state. However, a primary limitation of these tools is that they are often static. They excel at mapping the current state but struggle to predict the complex and system-wide effects of changes, especially in environments with high variability (e.g., random truck arrivals or fluctuating order patterns). This limitation of static analysis is precisely where Discrete-Event Simulation (DES) becomes an indispensable tool. DES is a powerful computational method for modeling complex, dynamic systems as sequences of events over time, making it ideal for analyzing logistics processes characterized by queues, resource sharing, and stochasticity (Skapinyecz, 2025).

Truck loading procedures, warehouse operations, and port logistics have been prime candidates for simulation analysis. DES models can incorporate real-world variability, such as random truck arrival patterns, fluctuating loading times, and resource availability (Bett et al., 2024; Caballini et al., 2020). Recent research demonstrates how simulation can optimize warehouse operations by testing different layout and resource allocation scenarios, leading to substantial reductions in order cycle time (Amorim-Lopes et al., 2021; De Vito et al., 2024). Furthermore, DES is particularly effective for evaluating key performance indicators (KPIs) like throughput, resource utilization, and average waiting time (Ganbold et al., 2020; Staudt et al., 2015). The critical challenge for DES, however, is model validity. A simulation built on poor assumptions or inaccurate input data risks being a "garbage-in, garbage-out" exercise, leading to flawed conclusions (Agalianos et al., 2020).

The respective limitations of Work Study (static) and DES (data-dependent) highlight their powerful synergy when integrated. The empirical data collected through Work Study (e.g., precise activity times, process flows, delay frequencies) serves as the critical input for building a valid and credible DES model (Guasch et al., 2011; Skapinyecz, 2025). This integrated approach creates a closed-loop, data-driven framework and mitigates the risk of implementing sub-optimal solutions and ensures that resources are committed to changes with the highest potential for impact (Bett et al., 2024).

Despite the well-documented success of this integrated Lean-Simulation framework, a critical review of the literature reveals two significant gaps. First, there is a strong sectoral bias. While this methodology is prevalent in discrete manufacturing and general warehousing, its application in the food logistics sector is noticeably less mature. This sector presents unique challenges-such as cold chain integrity, product perishability, strict quality controls, and high-demand volatility-that are not adequately captured by generic logistics models. Second, and most critically, there is a distinct geographical and contextual gap. The vast majority of published empirical studies applying Lean-Simulation frameworks originate from developed economies in North America and Europe. A systematic search of major databases reveals a demonstrable scarcity of rigorous, data-driven optimization studies within the context of the Middle East and North Africa (MENA) region. Specifically, the logistics sector in Saudi Arabia represents a high-impact, under-researched environment. Driven by the national goals of Saudi Vision 2030 to become a global logistics hub and ensure food security, the country's food supply chain is undergoing rapid transformation. The unique operational characteristics, infrastructure developments, and economic drivers of this context mean that optimization models from other regions cannot be assumed to be directly applicable.

Therefore, this research aims to address this critical gap by developing and applying a validated, integrated Work Study and Discrete-Event Simulation model to optimize outbound logistics processes within the Saudi Arabian food industry. This study bridges the theoretical synergy of Lean-Simulation with a practical, empirical application in a high-impact, under-researched context.

3. Methodology

This research was conducted as a case study at a leading food industry company in Saudi Arabia. The study focused on the outbound logistics process, with the primary aim of diagnosing inefficiencies, identifying bottlenecks, and proposing data-driven improvements to reduce Truck Turnaround Time (TTT). To achieve this, a four-phase methodological framework was employed, integrating empirical data collection through Work Study with analytical power of Discrete-Event Simulation (DES). The overall research framework is illustrated in Figure 1.

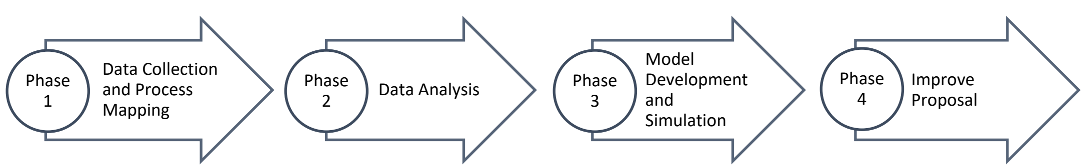

Figure 1. The overall research framework.

Step 1: Data Collection: Data were collected from both historical records and direct field observations. Historical operational data including arrival patterns, proportions of customers categories, resource schedules, were obtained from the company's ERP system. In addition, on-site observations and informal interviews with SCM team and trucks drivers were conducted to validate the recorded data and capture qualitative insights. Data were collected over an eight-weeks period to ensure representation of different operating conditions, including peak and off-peak days.

Quantitative measurements, such as processing times at each station, were conducted using stopwatch and video recording to ensure accuracy and consistency.

Step 2: Data Analysis: The collected data were cleaned, organized, and analyzed to identify process patterns, bottlenecks, inefficiencies. Statistical analysis was used to determine probability distributions and parameter relevant to the outbound logistics operations.

Step 3: Model Development and Simulation: A discrete-event simulation model using was developed using Arena software to replicate the current system. The model included major entities, resources (workers, forklifts), and processes like (weighing, loading, document handling and processing) . Verification and validation ensured that the model accurately reflected real operations by comparing simulated outputs with actual performance indicators.

Step 4: Improve Proposal: Based on simulation results and identified bottlenecks, several improvement suggestions were proposed to enhance operational efficiency. These proposals focused on reducing waiting, optimizing resource allocation, and streamlining process flow for better overall performance.

4. Data Collection and Model Development

In this section, we first provide an overview of the data collected from the outbound logistics process, highlighting key observations. Based in this data, we then outline the development of the DES model that represents the current system and serves as a foundation for further analysis.

4.1. Data Collection

To simulate the real system properly within the simulation environment, the working process was first set and structured. The system was divided into distinct areas and stations, as shown in Table 1, the system includes four areas dedicated to shipment delivery. Three of these areas are warehouses, and each warehouse contains an office for processing shipment documentation as well as a loading area for handling the shipments. Field visit to the plant provided opportunity for collecting operational information required, such as:

- Warehouse storage types: each warehouse was dedicated to specific product categories;
- Resource capacities and processing times associated with shipments loading operations;
- Facility data relating to entrances and internal distances;
- Shipments types, palletized, bagged, and bulk;
- Order data for clients, order quantities, and frequency;
- Client classification and segmentation based on shipment and order attributes.
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Table 1. Areas and stations within the system.

Area No.	Area 0	Area 1	Area 2	Area 3	Area 4
Station Name	Gates	Warehouse 1 Office (WHO-1)	Warehouse 2 Office (WHO-2)	Warehouse 3 Office (WHO-3)	Weighing
		Warehouse 1 Loading Area (WHL-1)	Warehouse 2 Loading Area (WHL-2)	Warehouse 3 Loading Area (WHL-3)	
		Bulk Filling Area (BFA)			

To confirm simulation inputs to a high accuracy, gathered data were modeled and analyzed to appropriate probability distributions according to distribution fitting methods. Additional supporting data were gathered; however, this part only represents the most applicable and most important information. Due to confidentiality reasons, some of the operating data gathered from the site are not revealed to the public. Later, the system entities were explicitly defined, as the clients' trucks. These trucks are categorized according to three main factors: the client's delivery method (*Personal* or *External Transporter*), the shipment type (*Palletized, Bagged, or Bulk*), and client classification (*Premium or Non-premium)* clients. Figure 2, illustrates these categories and their distribution across the loading areas. For clarity and consistency thought this paper, the following definitions are established:

- ***Personal Transporters*** are clients who use their own trucks to collect shipments.
- ***External Transporters*** are clients who utilize third-party transport companies for shipment collection.
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Premium Clients are clients who maintain a trusted and ongoing business relationship with the company, characterized by being *Personal Transporters*, having regular orders and periodic product loading from WH-2. These clients are exempted from the weighing process and therefore bypass the weighing station.

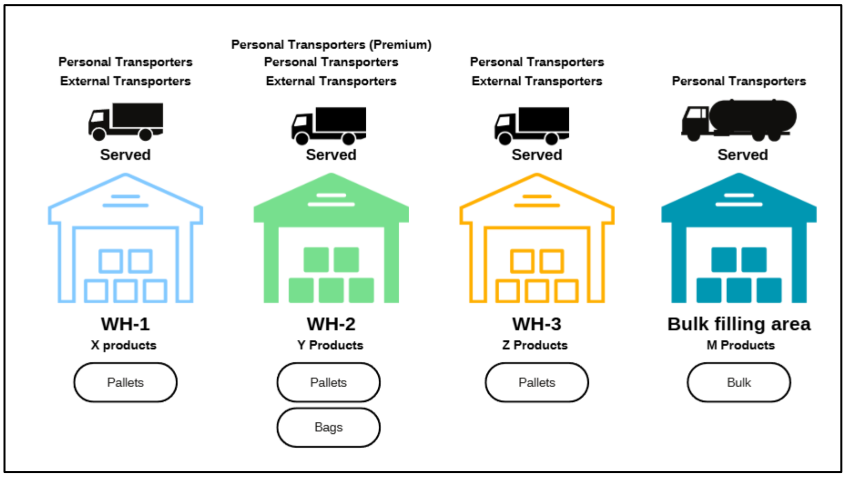

Figure 2. Clients distribution among loading areas.

Moreover, Figure 3 presents the overall process flowchart of the system, illustrating how the operational procedures vary according to the client type and shipment characteristics. Each type of client has a variable procedure than the other. For example, if the client is not *Premium*, they proceed directly to the weighing station. Following this step, an additional condition is evaluated based on the availability of Out Bound Delivery (OBD), which determines the next stage in their process flow.

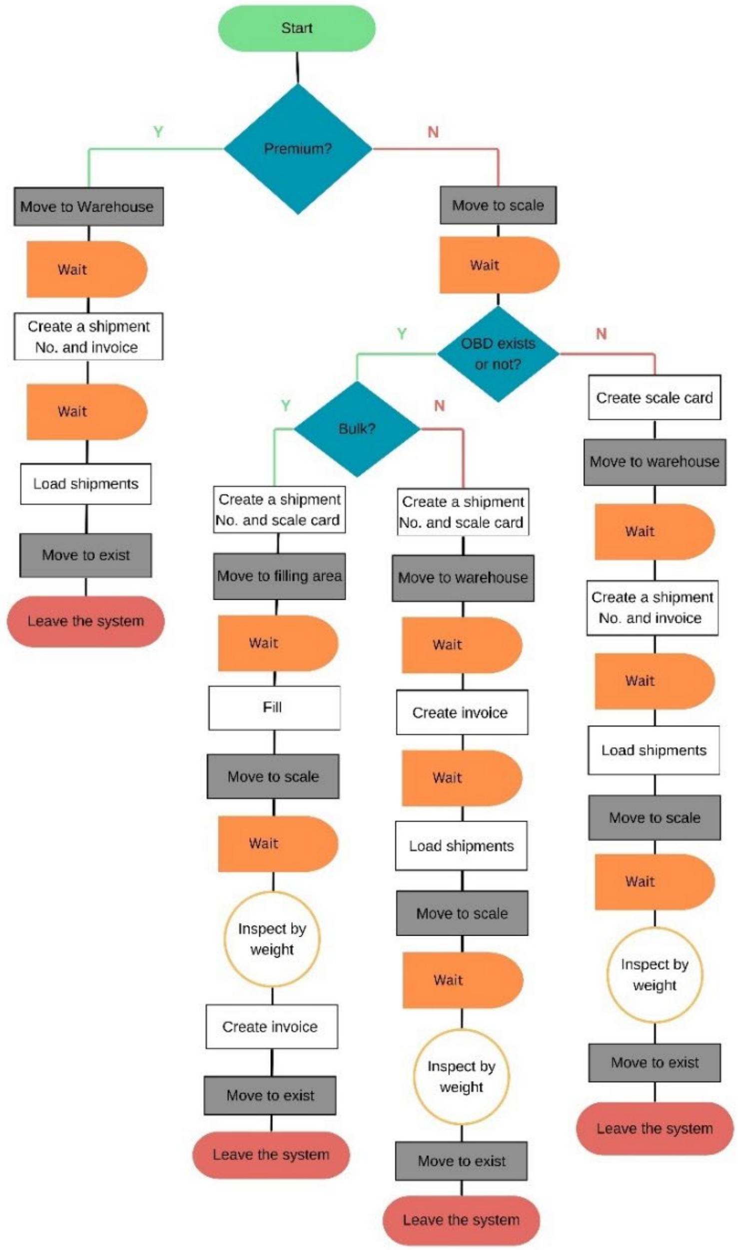

Figure 3. Process flow chart.

Additionally, the resource allocation corresponding to each station is summarized in Table 2. Mostly all the resources are assigned to a full shift (starts from 7 AM until 3 PM) at the same station, except one resource (shaded with green) was assigned to two stations. It first starts the shift at WHL-2 (Pallets) station and then completed the shift at WHL-1 station. Moreover, at WHL-1, WHL-2 (Pallets), WHL-3 the worker and forklift are considered as a single entity. Since forklifts are typically operated by individual workers, and their numbers are equal.

Table 2. Recourses allocation in the stations

No.	Station Name	Resource Type	Quantity	Schedule	No.	Station Name	Resource Type	Quantity	Schedule
1	WHO-1	Worker	1	Full Shift	5	WHL-2 (Bags)	Worker	2	Full Shift Full Shift
2	WHL-1	Worker/Forklift	2	Full Shift 9:30 AM to 3 PM	6	WHO-3	Worker	1	Full Shift
3	WHO-2	Worker	1	Full Shift	7	WHL-3	Worker/Forklift	2	Full Shift Full Shift
4	WHL-2 (Pallets)	Worker/Forklift	3	Full Shift Full Shift 7 AM to 9:30 PM	8	Weighing	Worker	1	Full Shift
					9	BFA	Worker	1	Full Shift

Based on the historical data analysis, a key insight emerged regarding the proportional distribution of client types across different warehouses. This analysis revealed that WH-2 clients represent the largest share, accounting for 79.66% of the total truck arrivals, as shown in Figure 4A. Given that this percentage was the highest among all warehouses, it warranted a more in-depth investigation to uncover underlying causes and performance effects. First in Figure 4B, breaking down WH-2 clients into *personal* and *external transporters*, revealing that *personal transport* clients dominate (78.77%), indicating a major contributor to operational load. Then, Figure 4C, shows the distribution between *Premium* and *Non-premium* clients of *WH-2 personal transporters*, where the *Non-Premium* clients of them constitute the majority (75.79%), making them a subject of attention for process optimization efforts. Later, the percentages for *Non-premium* clients of *WH-2 Personal Transporters* was analyzed according to the shipment type (palletized or bagged) was determined in Figure 5. Therefore, we can conclude that *88.57%* of *WH-2 Non-Premium* clients have orders based on pallets, and thus we can state that they are our primary focus in this study because they form the highest percentage of entities.

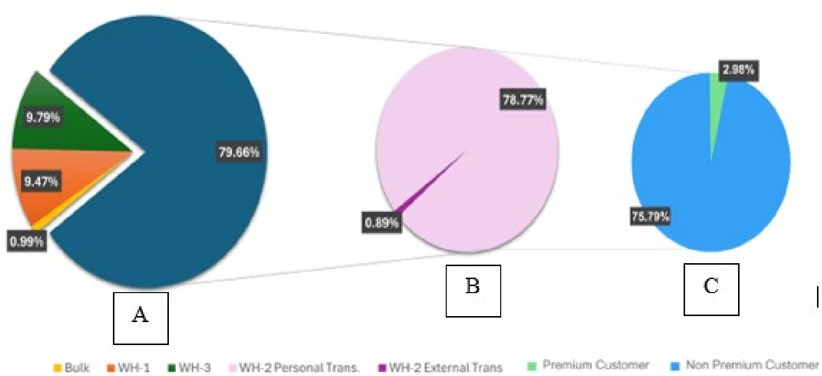

Figure 4. Percentages distribution of clients.

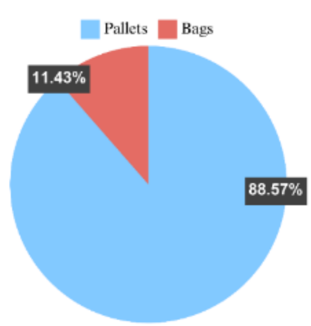

Figure 5. Non-Premium WH-2 clients

4.2. Model Development

The initial step in developing the simulation model involved conducting a requirements survey with the key stakeholders engaged in the project. Based on the insights gathered, it was determined that the model would primarily focus on analyzing the outbound logistics operations flow and assessing their impact on the overall performance as shown in Figure 6. Accordingly, the following assumptions were established to guide the model's development:

- The quantity of materials in the warehouses is infinite since it is always available.
- Individual characteristics of trucks such as size and acceleration profiles were not considered;
- A truck cannot carry more than one product, which ensure that it will load only in one location inside the plant;
- WH-1, WH-3 and Bulk Filling Area are involved in the model but they are not a focused area for this study, instead we defined WH-2 as a major focus because of the high percentage of entities heading up to it.
- The transfer time between the entrance/exit gate and the weighing station for all client types defined in the system, except for *Premium* client.

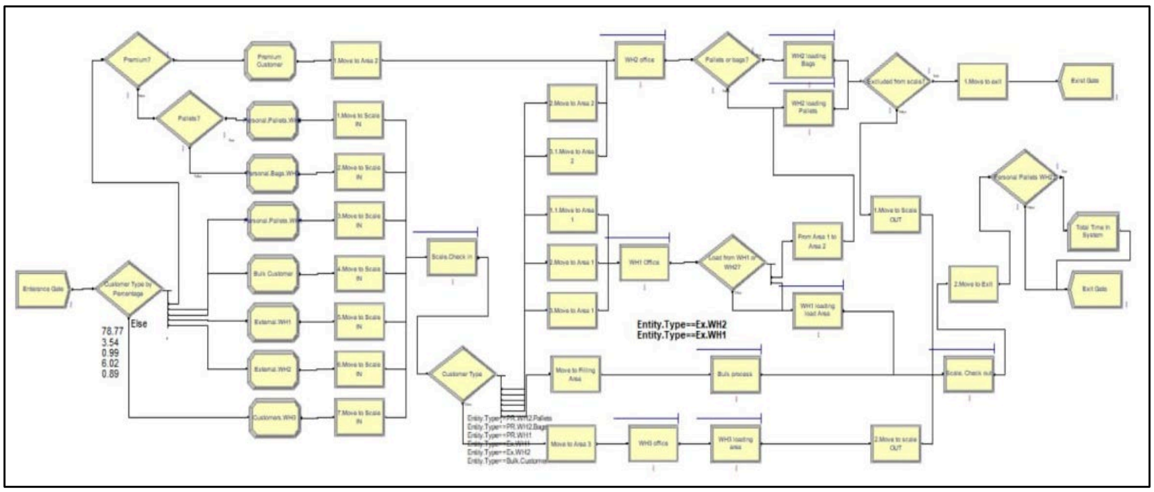

Figure 6. Simulation Model In Arena Software.

4.2.1. Entities and Arrival Rate Establishing

Historical records indicate an average of 130 truck arrival per day. Accordingly, an 8-hour working shift (from 7:00 AM - 3:00 PM), was set in the simulation, with 75% of arrivals during the first four hours. The model distinguish client types based on their actual proportions. Since *WH-2 Non-Premium (Pallets)* clients are the main focus, a decision module was added to separate *WH-2 Personal Transporters* into *Premium* and *Non-Premium* clients. Another decision module classifies *Non-Premium WH-2 Personal Transporters* clients based on their shipment type (Palletized, Bagged).

4.2.2. Weighing Station

As shown in Table 3, the cycle time for the weighing process vary among the type of clients according to two factors (delivery method and loading area), these data were compiled from time measurement observations. It should be noted that there is single weighing station with one operator serves both initial and final weighing operations.

Table 3. Cycle time for weighing operations.

	Personal Transporter				External Transporter		
	WH-1	**WH-2**	**WH-3**	**Bulk**	**WH-1**	**WH-2**	**WH-3**
Initial weighing	104.5s	104.5s	90s	141s	90s	90s	90s
Final weighing	100s	100s	81.5s	178s	81.5s	81.5s	81.5s

4.2.3. Loading Stations

Naturally, the loading process time varies between shipment types. To capture this variation, we measured the average loading time for each pallet and each bag, allowing us to model the process behavior using a statistical distribution.

5. Model Analysis and Proposed Improvements

Based on the simulation model run, we began analyzing the results to identify insights and evaluate system performance. Table 4 presents the baseline metrics which serve as a quantitative reverence point for system performance prior to implementing any improvement scenarios. These metrics include total time, total waiting time, value added time, waiting time at loading and weighing stations, and transfer time.

Table 4. Current Simulation Model Results

Event	Time (minutes)
Total Time	95
Total waiting time	62
Waiting time at initial weighing	20
Waiting time at final weighing	20
Waiting time at WHL-2 (pallet)	21
Transfer time	19

Lean Analysis

This section focuses on applying Lean principles to improve process efficiency and eliminate waste. The study aims to identify non–value-added activities, analyze their causes, and propose practical solutions that enhance productivity and overall performance. Numerous research studies have utilized VSM for continuous improvement in various industries; a systematic review of 24 articles that used VSM in the food industry has visibly improved the entire value stream and production efficiency and reduced food losses.(De Steur et al., 2016) . A Value Stream Mapping (VSM) illustrates in Figure 7, the entire system from the entrance gate to the exit gate for *WH-2 Non-Premium clients (Pallets)* clients. Based on this analysis, the three most time-consuming events are weighing, loading, and internal transfer. As Figure 7 indicates, only 14.33 minutes of the 94.71 minutes lead time are value-added. From this standpoint, more analysis was constructed for each of the three events.

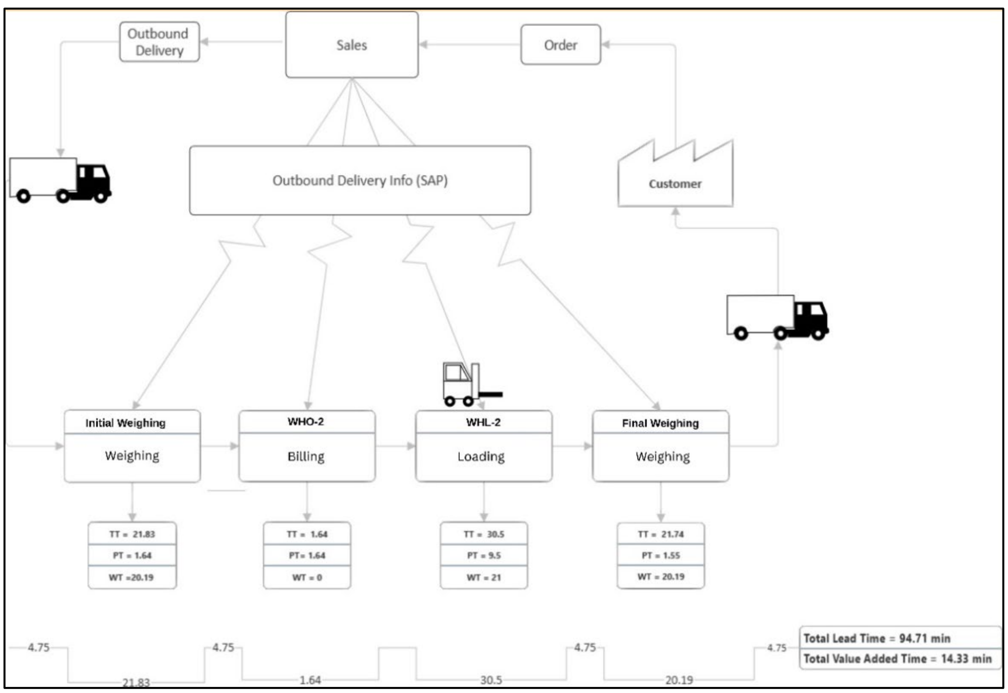

Figure 7. Value Stream Mapping

Weighing Station Analysis

During the analysis of the weighing process, two primary questions were identified; why is the waiting time at this station excessively long? and why is the process time variable? The prolonged waiting time was investigated using 5-Whys analysis in Table 5, which helped identify the root cause of delays. On the other hand, the variability in process time was examined through a detailed audit of the activities involved in weighing process for each client type, as shown in Figure 8. The audit revealed discrepancies across certain activities, highlighting opportunities for process standardization and elimination of non-value-added steps. This will lead us to rearrange the method steps, combine some work elements, and eliminate non-added value activates from the process to achieve a lean flow.

Table 5. 5-Whys analysis for scale station

Scale	
Why Question	Answer
Why there is too long waiting time?	Because trucks spend a long time waiting before being weighed.
Why are trucks waiting so long?	Because there is only one server handling all trucks.
Why is having only one server causing delays?	Because the process time for each truck is highly variable
Why does the process time vary?	Because each truck may need different procedures and there is no standardized workflow
Why is there no standardized workflow to reduce variability?	Because the process has not been analyzed or optimized

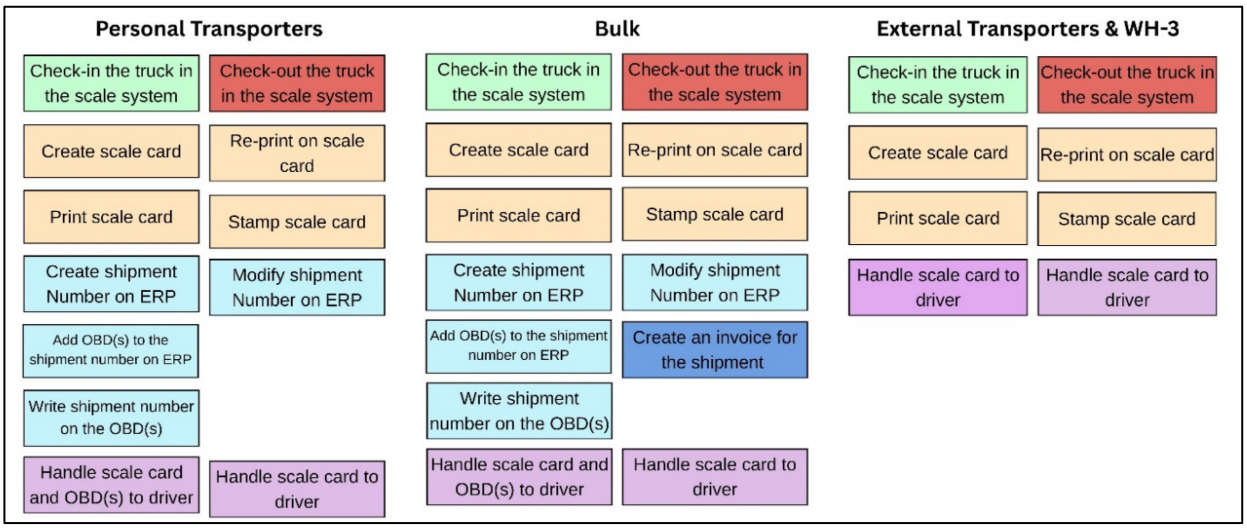

Figure 8. Activities in weighing process.

- **Proposed Improvements for Weighing Station**

A. Standardize Weighing Station Process

To support the standardization of the weighing process, this study proposes conducting a motion and time study for both the station's operator and the truck driver, as their activities are closely interrelated. The analysis indicated that "printing the scale card" during the initial weighing process is nonessential, since its primary function is merely to provide the driver with proof to departure. Additionally, the "creation of shipment number on ERP" can be integrated into the final weighing stage, rather than being issued and later modified after loading. This step currently applies only to Personal Transporters regardless their loading area, who possess an Out Bound Delivery (OBD).

- ***Out-Bound Delivery (OBD):*** created on SAP and printed to the client/ driver to manage the shipment and it contains details such as materials and quantities.
- **Shipment Number:** created on SAP and it groups one or more OBD for management purposes.

B. Introducing A New Scale System

Additionally,(*News - China's Leading Truck Weighing Scales*, n.d.) An Unmanned Automatic Truck Weighing System with Traffic Lights and Cameras was implemented to automate weighing process and minimize human supervision. The cameras will display the vehicle's information (license plate), which is required for system entry by the worker who will controls the traffic light to signal the driver when weighing process is complete.

Warehouse 2 Loading Area Analysis

To address the congestion in the WHL-2 area, the 5-Whys technique in Table 6 was applied to analyze the bottleneck. The study revealed inefficient resource utilization, resulting in reduced productivity, slower processing, and longer queues. The insufficiency in the process is linked to the loading methods: pallets are handled with forklifts, whereas bags are requiring manual loading, which is more time-consuming. Based on this analysis, process improvements can focus on optimizing resource allocation and adopting more efficient loading methods to reduce congestion and increase throughput.

Table 6. 5-Whys analysis for loading.

Loading	
Why Question	Answer
Why is waiting time long?	Because trucks are not loaded immediately upon arrival.
Why are trucks not loaded immediately?	Because forklifts/workers cannot handle them immediately
Why can't forklifts and workers handle them immediately?	Because the loading process takes a long time is to complete
Why does the loading process take so long?	Because capacity of forklifts and number of workers affect the processing time.
Why is the capacity insufficient?	Because the available resources (equipment and manpower) are insufficient to meet demand

- **Proposed Improvements for WHL-2 Station**

C. Introducing Double Forklift At WHL-2

To reduce the waiting time at loading area, the loading process must be accelerated through improve resource utilization or allocation. Currently, all forklifts are single-pallet; introducing a double forklift allows two pallets to be moved simultaneously, effectively reducing loading time. This streamlines the entire cycle, making it as smooth as possible.

D. Increase A Single Forklift Utilization At WHL-2

Another way to eliminate the waiting time at the loading area is to increase the resources utilization in terms of machines or human. In this scenario we assume that the resource (shaded in green) listed in Table 2, will complete the shift at the same station, which is WHL-2 area.

E. Add One Single Forklift At WHL-2

In this scenario we increased the number of workers and forklifts assigned to WHL-2, in order to accelerate the loading process, whether through reallocating current resources or introducing additional resources.

Transferring Analysis and Improvements

Even though that the enhancing of the facility layout is out of scope for this study, we believe that if some stations were changed it will facilitate the movements. However, Figure 9 summarized the path for *Premium* and *Non-Premium* clients, noting that *Premium* clients bypass the scale station.

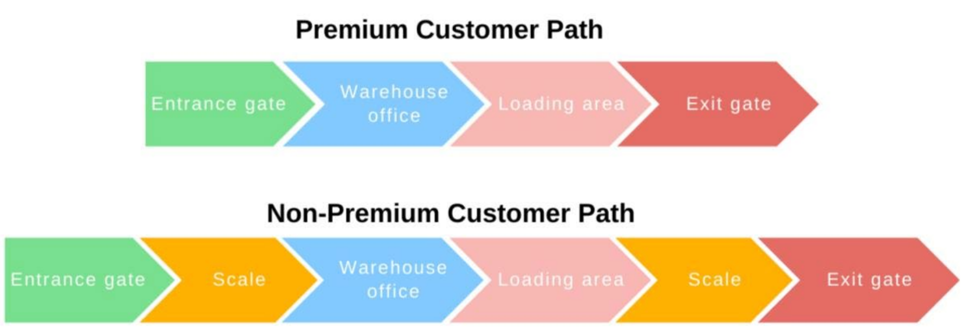

Figure 9. Premium vs. *Non-premium* client path

- **Proposed Improvements for Transferring**

F. Introducing New Clients to Premium Category

As previously defined, *Premium* clients are *Personal Transporters* who maintain a long-term and trusted business relationship with the company and load palletized shipments from WHL-2 only. Based on this definition, an analysis of client data identified six additional clients who exhibit the same characteristics but are not officially classified as *Premium*. These clients, belonging to the *Personal Transporters WH-2 (Pallets)* segment, show regular ordering and loading patterns similar to existing *Premium* clients. Incorporating them into the *Premium* category, is expected to enhance the system flow. Accordingly, the simulation model distinguishes between *Non-Premium Personal Transporters WH-2 (Pallets)* and *Premium Personal Transporters WH-2 (Pallets)* clients, with an updated Premium percentage reflecting the inclusion of the newly identified clients.

5. Discussion and Conclusion

In this section, we focused on developing a number of improvements that we think they have a potential to address the most three time-consuming events. As Table 7 shows, there were six possible improvements that targeted resource utilization, waste elimination, and adjust clients' categories. All of the improvements were suggested in terms to optimize the time consumed and they were feasible and approved by SCM team.

Table 7. Proposed improvements summary

Proposed Improvements	**Standardize Weighing Station Process**	**Introducing A New Scale System**	**Introducing Double Forklift At Whl-2**	**Increase A Single Forklift Utilization At Whl-2**	**Add One Single Forklift At Whl-2**	**Introducing New Clients To Premium Category**
Primary aim	Reduce waiting and Speed up scaling process	To minimize the influence of human variability	Reduce waiting and Speed up loading process	Reduce waiting and Speed up loading process	Reduce waiting and Speed up loading process	Minimize transferring, pass scaling process

In order to improve logistics performance in the Saudi food industry, this study highlights how important it is to optimize truck-loading operations. The study found significant inefficiencies like lengthy wait times, inefficient use of resources, and inconsistent workflow through process analysis and simulation modeling. The findings showed that process modifications, like bettering resource allocation, standardizing practices, and improving client classifications, can greatly cut down on overall operation time and boost system efficiency. The results demonstrate that simulation modeling is a useful technique for assessing process modifications prior to implementation, enabling decision-makers to envision possible enhancements and reduce operational risks. These observations advance both theoretical knowledge and effective logistics management, especially in sectors with highly variable demand and stringent service standards. Future studies will concentrate on implementing the suggested enhancements to the simulation model in order to quantify their impact on system performance. The research team hopes to determine the best set of adjustments and confirm their effects on waiting times, resource usage, and truck turnaround times by evaluating these scenarios inside the model. Following validation, these improvements can be progressively incorporated into the actual system, with performance monitoring to guarantee long-term viability and ongoing development. To sum up, one of the most important steps in reaching operational excellence in Saudi Arabia's food logistics industry is streamlining the loading procedure. The suggested framework complements national efforts to increase logistics competitiveness under Vision 2030 and encourages data-driven decision making.

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