Research on Haps DC Opening Time

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Problem Definition

1.1. Introduction

1.1.1. Company and operation challenge introduction

Danone is one of the world's leading food and beverage companies, operating across nutrition-related categories including dairy and plant-based products, early life nutrition, and medical nutrition. In 2021, Danone opened a new distribution center in Haps to strengthen its European distribution network for nutrition products. From this distribution center, products are shipped to more than 80 countries worldwide and serve pharmacies, hospitals, and retailers. Warehouse execution is operated in close collaboration with the third-party logistics partner DSV. In this arrangement, DSV is responsible for day-to-day warehouse operations, while Danone remains responsible for performance management, cost control, and continuous improvement.

In recent years, the Haps DC has faced increasing operational pressure. This pressure is associated with rising order volumes, complex customer requirements, and higher internal expectations for service levels. Within this context, a prominent operational pain point is the extended warehouse opening time. The current opening window is from 6:00 to 24:00. Prolonged opening windows do not only signal inefficiencies in inbound and outbound execution. They also translate into higher labor hours, leading to increased handling and operational costs. Despite local improvement attempts, the underlying drivers of long opening windows remain insufficiently understood, due to fragmented data availability, multiple stakeholder involvement, and variability in daily operations. Consequently, Danone aims to understand productivity patterns and identify opportunities to reduce Haps DC opening time in order to improve operational efficiency and reduce 3PL costs. This project responds to that need by systematically analyzing factors that drive opening time and by supporting the ambition of building a more efficient distribution center operation.

1.1.2. Problem statement and project objective

The operational problem addressed in this project can be expressed as follows. The Haps DC currently operates with a comparatively long daily opening window. The duration of this window is shaped by the interaction of inbound and outbound activities, planning decisions, resource allocation, and execution variability. As long as the drivers behind this opening window are not transparent and measurable, improvement efforts risk remaining local, fragmented, and difficult to validate. Therefore, Danone requires a structured, data-driven understanding of the opening-time mechanism and of feasible improvement levers that can reduce opening time while maintaining operational performance and service requirements.

Aligned with this need, the objective of the project is to build a systematic understanding of opening time at Haps DC, identify the most influential bottlenecks and operational drivers, and translate the insights into feasible actions and a validated proposal for a reduced and stable opening time. In doing so, the

project is positioned not as a facility redesign initiative, but as a process and performance analysis project that connects operational data, stakeholder knowledge, and improvement design.

1.1.3. Project Scope

The scope of this project is situated within supply chain and logistics management, with a specific focus on understanding and improving the opening time of Danone's Haps DC, in collaboration with Danone and DSV.

The project scope covers operational processes and managerial aspects that directly influence the duration of the opening window. This includes the analysis of inbound receiving and unloading, put-to-rack activities, outbound picking, and loading processes. It also includes quantitative analysis using warehouse datasets such as dock utilization, truck arrival patterns, resource allocation and throughput fluctuations, complemented by qualitative insights gathered through interviews and discussions with Danone teams, DSV operators, planners, and process owners. The scope explicitly includes bottleneck identification as a basis for improvement design and subsequent validation of a reduced opening time.

To preserve feasibility and alignment with project constraints, several topics are explicitly out of scope. These include structural or physical redesign of the Haps DC facility such as layout optimization or equipment replacement, financial analysis, IT or digital technology implementation, and assessment of upstream production or downstream transport processes that are not directly linked to warehouse opening time. These exclusions are essential to keep the project centered on operational drivers that can be diagnosed and influenced through performance management and process improvement within the existing facility and collaboration model.

1.1.4. Research Question

To address the challenges faced by Danone at the Haps Distribution Center, we formulated the following main research question. A set of sub questions is defined to guide the study in a structured manner.

Main Research Question

Based on an analysis of the current warehouse operations of Danone's Haps DC under DSV's management, what opportunities can be identified to potentially reduce warehouse opening time while maintaining warehouse operation performance, thereby lowering overall operating costs?

Sub Research Questions

1. **Current Process Description**
   What are the main activities performed in the Haps DC, and how is the current process flow structured?

2. **Utilization Pattern**
   What are the current warehouse capacity and throughput characteristics, and what general patterns can be observed in how these capabilities are utilized today?

3. **Indicators**
   Which key performance indicators (KPIs) can be used for assessing warehouse productivity, throughput, efficiency, and resource utilization in relation to opening-time reduction?

4. **Bottleneck Identification**
   Which activities or process steps represent the primary bottlenecks that most strongly influence the current warehouse opening time?

5. **Trade-off Analysis**
   What trade-offs may arise between reducing warehouse opening time and maintaining the required levels of throughput, productivity, and service performance?

6. **Product-Specific Feasibility**
   Specifically, for different product categories (e.g., time-sensitive products) handled in the Haps DC, how feasible is it to reduce opening time without causing severe impacts?

7. **Plan Development**
   Based on the identified bottlenecks, trade-offs, and feasibility, what operational changes can be implemented to realistically reduce the warehouse opening time?

1.1.5. Methodology

The methodological structure of this study is based on the DMAIC framework presented by Girmanova et al (Girmanova et al., 2017), which provides a clear phase-by-phase overview of descriptions, outputs, and tools. It is particularly suitable because it offers a systematic and diagnostic framework for analyzing warehouse operational processes and looking for improvement methods.

The DMAIC cycle (Define–Measure–Analyse–Improve–Control) is one of the core process-improvement methodologies within the broader Six Sigma philosophy (Linderman et al., 2003). However, given the scope of this research—which focuses on diagnosing the drivers of long opening hours at Danone Haps DC and identifying improvement opportunities rather than implementing solutions—only the *Define*, *Measure*, *Analyse* and *Improve* phases of the DMAIC framework are applied. The *Control* phase is therefore excluded.

The resulting methodology framework is provided in Table 1.1.

Table 1.1: Adapted DMAIC phases and corresponding sub-research questions

Phase	Description	Outputs	Tools & Techniques	RQ
Define	Clarify the research problem, objectives, and analytical boundaries. Provide a description of the main warehouse processes (inbound, put-away, picking, loading) and identify the initial factors potentially influencing opening time	Defined research problem; High-level process description; Preliminary influencing factor; Project scope	Brainstorming; Expert interviews; Process flowcharting	Q1
Measure	Collect and process operational data to quantify throughput characteristics, capacity utilisation patterns, and time distribution profiles	Data collection structure; KPI (throughput, utilisation, peak periods, time distribution characteristics); Basic analysis of KPI	Data cleaning; Descriptive statistics; Pareto analysis; Histogram analysis; Time-distribution analysis	Q2–Q3
Analyse	Identify the root causes driving extended opening hours and analyze process bottlenecks. Evaluate operational trade-offs (service level & resource requirements) and perform feasibility assessment for different product types and operational contexts.	Root-cause structure; Bottleneck identification; Trade-off assessment; Feasibility evaluation; Prioritized list of influential factors	Ishikawa diagram; Hypothesis testing; Sensitivity analysis; What-if scenario analysis; Constraint mapping	Q4–Q6
Improve	Develop feasible improvement levers, focusing on actions that are operationally realistic and minimise service-level impact	Actionable improvement list; Prioritization (high-impact / low-effort)	Brainstorming; Effort–impact matrix; Lean waste identification; Simulation-based evaluation	Q7

2

Background

This chapter provides the operational background required to analyze the current state of Danone Haps DC. It first explains how the site functions and the operating model with the third party logistics provider DSV, when also identifying stakeholders for the project. It then describes the warehouse operating hours and the common inbound and outbound mechanisms that shape daily workload. Finally, it elaborates the three main business streams at Haps DC, namely Finished Goods (FG), Raws and Packs (R&P), and Value Added Logistics (VAL), and explains why and how each stream contributes to the warehouse opening time. The intention is to connect the contractual and process design described in the Service Level Agreements to the practical problem of extended daily operations that motivates this project.

2.1. Haps DC Operation and Stakeholders

The operational execution at the Haps site is performed in close collaboration with DSV, where DSV manages daily warehouse execution while Danone retains responsibility for performance management, cost control, and continuous improvement. In contractual terms, the FG scope is described in the service level agreement between Danone Nutricia and DSV Solutions for the warehouse at Kokerbijl 27 in Haps, the Netherlands. The document notes that the SLA is valid as of 1 September 2023 and focuses on finished goods, while the R&P scope is defined separately and agreed at a later stage. This separation is important for understanding why Haps DC effectively operates as a multi flow distribution center with different planning rhythms and service requirements.

The Haps DC operating model is shaped by the division of responsibilities between Danone and DSV. At a general level, DSV is responsible for running warehouse operations, while Danone governs performance and improvement. This division is made more explicit in R&P, where it is stated that three main parties participate in the R&P integration scope: Danone as client and producer of goods, DSV as the operator responsible for the warehouse execution and related value added services, and Nabuurs as the party arranging transport between the factory and warehouse, managed by Danone.

Beyond organizational responsibilities, the operating model also includes resource and infrastructure governance. For the resource scope, warehouse and office staff are managed by DSV, and that DSV builds capacity plans based on forecast requirements while changes in resource needs are discussed in daily operational updates. It also states that the building is owned or leased by Danone, while equipment and other infrastructure are purchased or leased by DSV after alignment, and that costs are covered via an open book construction as agreed in the contract.

This governance logic matters for the opening time problem for two reasons. First, because DSV's labor planning is contractually tied to Danone's forecast and operational requests, mismatches between planned volumes and realized daily patterns can translate into overtime hours and a longer operating window. Second, because multiple coordination interfaces exist, including Danone's planning and order creation, DSV's execution and slot management, and carriers' arrival behavior. These interfaces

introduce variability and dependencies that can amplify into late completion of daily workload, which the project aims to analyze in a structured manner.

The potential change of Haps DC opening time will surely impact a number of stakeholders inside and outside Danone. Therefore, a stakeholder analysis is conducted to provide an idea on the power and interest of these stakeholders as well as identifying potential impact on them.

Danone Haps DC management and 3PO organization

Danone's site and management team have high power because they define performance targets, govern costs, and can authorize or reject operational changes in the Danone–DSV collaboration. Their interest is also high because the project objective explicitly targets reducing the long operating window and the associated labor and 3PL-related costs, while maintaining service performance. Their engagement would be focusing on agreeing the definition of opening time, aligning on the KPI set, and validating proposed levers against business constraints before any recommendation is presented as feasible.

Haps Factory (Supply Point Haps)

The factory side has high power over opening time because production runs continuously and the warehouse schedule must accommodate factory-driven material flows. The R&P agreement describes weekly forecasts, daily STO planning, team leader call-offs that may shift timing, a daily handshake in the early evening, and the requirement to fulfill "rush orders" within two hours, including outside office hours. These mechanisms can directly create late-day workload and therefore extend the operational window, so the factory should be engaged closely when diagnosing root causes and when designing any rule changes around call-off timing, priority setting, and evening coordination.

DSV team

DSV has high power because it controls day-to-day execution, workforce planning, dock assignment, and the practical feasibility of any process change. However, DSV's interest in changing opening time can be lower because it is a third party operator and changes typically introduce operational risk, transition effort, and workload uncertainty. The R&P agreement also frames DSV's capacity planning around forecasts and discusses how volume deviations are handled, which reinforces that stability and predictability are core concerns. The engagement of DSV may put a focus on interventions that reduce variability and rework, clarify priorities, and improve planning reliability, rather than proposing disruptive redesigns that increase execution complexity.

Country Business Units (CBUs)

CBUs have high power over transport planning because a proportion of CBUs are assigned with responsibility for transport from Haps DC to end customer and states that communication with carriers is done by the CBUs. This means this part of transportation is not governed by transport team in Danone logistics. CBUs often care most about service and delivery performance rather than the internal opening time metric itself, so their interest in opening time reduction is typically indirect. They should be informed with clear evidence showing that the change will not harm departure reliability and will respect fixed pick-up structures and slot commitments.

Carriers

Carriers affect opening time through arrival discipline, slot adherence, and the knock-on effects of early or late arrivals on dock congestion and labor peaks. They do not decide internal warehouse staffing, but their behavior strongly shapes the daily operation pattern, so they should be kept informed through clear slot rules, consistent communication through Danone's TMS processes, and feedback loops on delays and non-compliance that create late-day workload.

Planners

Danone's planning roles have influence because orders and special instructions trigger warehouse work, and planning cut-offs fix the outbound plan. These stakeholders are highly interested in avoiding instability because planning quality determines whether work is spread smoothly or compressed into the late hours. They should be kept informed and actively involved in analyzing cut-off compliance, rush-order frequency, and the alignment between planned and executed volumes.

Shunting and shuttle flows between factory and warehouse

As Haps DC is closed between 00:00 and 06:00, buffering in trailers is used, and shunting drivers managed by Danone keep goods moving between Supply Point Haps and the warehouse. These actors may not own warehouse policy, but they are highly affected by any change in the operating window and can either smooth or amplify late-evening workload. They should be kept informed with new timing constraints.

Customers

Customers have limited direct power over warehouse process design, but they represent the service-level boundary conditions of the system. The SLA context emphasizes service reliability, and it includes complaint handling processes that reflect the downstream impact of quality and delivery performance. Customers usually do not engage with opening time as a warehouse management variable, but any shift in opening time that affects cut-offs or departure reliability can indirectly affect delivery timeliness and therefore customer experience. They should be monitored via service performance indicators and complaint trends, ensuring that opening time reduction is not achieved at the expense of delivery performance.

To summarize the stakeholder analysis, a stakeholder power-grid map is concluded:

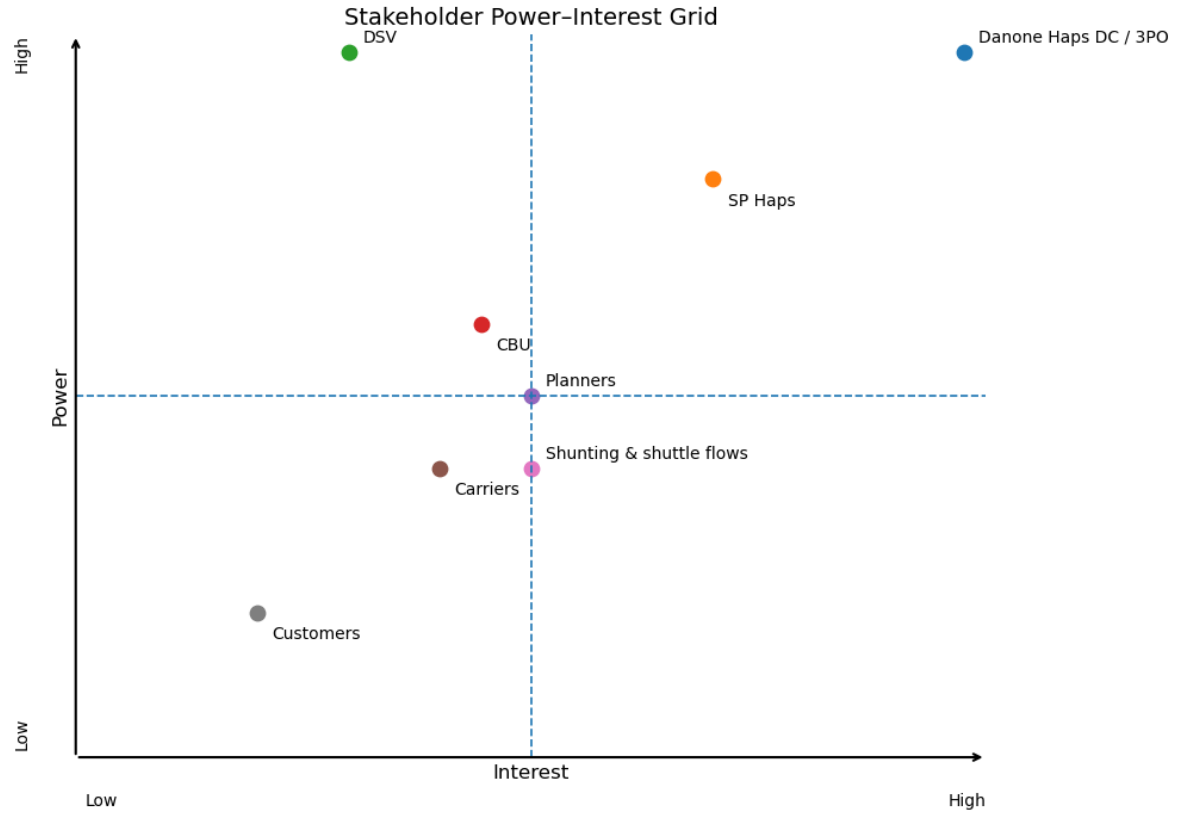

Figure 2.1: Stakeholder Powergrid Map

2.2. Definition of the opening time problem

A core contextual feature at Haps DC is the relationship between production and warehousing. For the R&P integration, it is stated that Supply Point Haps produces 24 hours per day and seven days per week. In response, the warehouse operation is defined with open hours from 06:00 to 24:00, seven days a week and by default 365 days per year including bank holidays, although adjustments can be discussed based on forecast and planning cycles. The same section clarifies that the DSV site is closed between 00:00 and 06:00 and that no trailers can be collected or placed on the DSV site during these hours. To bridge the night closure with continuous production, the R&P SLA specifies an operational buffering mechanism. Between 24:00 and 06:00, finished goods from Supply Point Haps are buffered in trailers at the parking near the factory warehouse, and for R&P a buffer in trailers is also available at the same parking area. Shunting drivers are managed by Danone, including their schedules and working times, and they keep goods moving between Supply Point Haps and the DSV warehouse, as well as direct shipment volume from the supply point to the parking of Supply Point Haps.

For FG operations, the SLA describes standard operating hours for inbound and outbound as between 06:00 and 24:00 on weekdays, and it states that during standard operating hours, deliveries to Country Business Units must take place. The SLA also describes how overtime, night shifts, or weekend shifts may be requested if business requires, with typical lead times of at least 24 hours for overtime and at least 48 hours for night or weekend shifts, while also acknowledging that shorter notice can be necessary in exceptional circumstances.

Within this context, the “opening time” addressed by the project is not merely a formal time range written in contracts. It is the realized daily window during which operational work must be executed to meet service requirements, including inbound receiving, put away, outbound picking, packing, loading, and the coordination tasks around these activities. When the realized workload extends late into the evening, the opening window becomes longer, which increases labor hours and handling costs and can create higher risk of delays in deliveries. This is exactly the pain point described in the project definition, and it motivates the need to connect process characteristics and utilization patterns to the observed opening time.

2.3. Operational mechanisms that shape daily workload

2.3.1. Finished goods

The finished goods business at Haps DC is governed by the SLA between Danone Nutricia and DSV Solutions and focuses on the distribution of finished products from Haps to customer facing business units and global destinations. The SLA defines two main destination groupings: G2, referring to Belgium (BE) & Netherlands (NL), and Rest of the World (ROW), referring to other global countries.

A defining operational feature of the FG stream is the presence of time anchored outbound schedules. For outbound transport in the G2 scope, the SLA states that transport from Haps to end customer is the responsibility of the Country Business Unit (CBU), while communication with carriers about transport planning is done by the CBU and must be agreed with DSV. It further specifies that Belgium has daily fixed pick up slots that are pre-aligned with DSV. The document provides a concrete truck schedule, including start loading times and departure times for Belgium departures, with loading starting in the early afternoon and departures extending into the evening.

This schedule structure is directly relevant to opening time because loading activities, staging, and any rework needed to meet outbound requirements must be completed before these departures. When outbound volumes increase or when execution disturbances occur, the warehouse may require more labor hours later in the day to complete loading in time, which can extend the operational window toward late evening. The SLA explicitly states that DSV must load effectively to avoid departure delays and that late arrivals are not prioritized, which implies that the warehouse must manage both internal efficiency and external uncertainty without simply shifting the schedule.

A second relevant feature is the reliance on short horizon forecasting and capacity adaptation. For the G2 scope, the SLA states that each CBU has to provide an expected forecast volume for the next three days by 15:00, and that during holiday periods such as Christmas and Easter, expected forecasts

are provided weeks in advance to anticipate peaks. The SLA also notes that capacity increases are possible via extended shifts or night shifts.

Forecasting and shift extensions are not just planning details. They define how workload peaks are handled operationally. If volumes exceed planned capacity or if arrivals and departures cluster, additional shifts become a tool to preserve service levels, but they also increase labor hours and can expand the daily opening window. The project's focus on opening time therefore requires analyzing to what extent daily volume variation, and outbound schedule adherence jointly explain why operations extend to late hours, and whether improved balancing can reduce the need for extended operations.

2.3.2. Raws and Packs

The R&P stream at Haps DC is documented in the SLA for Raws and Packs plus semi finished goods integration for Haps DC 4.0. The R&P scope is broad and includes both inbound and outbound flows. Inbound flows include receipts from external suppliers for raw materials and packaging, receipts from other supply points, semi finished goods receipts from the factory, returns, and co-packed materials from co packers. Outbound flows include deliveries of R&P and semi finished goods from the DC to the factory, semi finished goods shipped to other supply points, and several external outbound flows including co packing related movements and export related processes. The document also includes associated activities such as pick and pack processes, storage, cycle counting, return flows, scrapping, transport management, and reporting.

Compared to FG, the R&P stream has a distinctive operational dependency: its outbound flows support factory production, and Supply Point Haps produces continuously. As a result, the operating hours section specifies that while the DSV site closes between 00:00 and 06:00, buffers in trailers are used to bridge the night period, and shunting drivers managed by Danone maintain movements between the factory and the warehouse.

Slot planning requirements in the R&P SLA further illustrate why this stream can influence opening time. It specifies default daily slot requirements for inbound from the supply point of semi finished goods, inbound returns, and inbound external suppliers, and it also specifies typical outbound volumes for R&P deliveries back to Supply Point Haps, with an average range and an exceptional maximum. It further states that slots booked by or for Supply Point Haps cannot be used by the third party organization and vice versa, which limits flexibility in reallocating dock capacity between flows.

From an opening time perspective, these characteristics imply a workload profile that is both time constrained and sensitive to variation. If production driven requirements generate urgent movements, or if external supplier arrivals deviate from the expected slot pattern, the warehouse may need to respond with additional labor hours to maintain service continuity. The document also describes a flexibility rule where DSV secures that 10 percent deviation from weekly communicated volumes can be covered without KPI impact, while larger deviations are handled on a best effort basis without guaranteeing timelines. This highlights that variability management is a central operational challenge and a plausible driver of extended daily operations that needs to be quantified in Chapter 3 using throughput, timeslot utilization, and labor hour data.

2.3.3. Value Added Logistics

The VAL stream covers activities that go beyond standard receiving, storage, and shipping. It is defined as services executed outside the standard process, either on special request via the order or based on a specific occurrence. VAL is specified more explicitly as an operational domain with its own business hours and governance. The SLA states that business hours for VAL operations are from 07:30 until 16:30 Central European Time (including one hour rest time), and that shifts can be extended to night shift depending on volumes, subject to discussion and approval with Danone and DSV. Several VAL subtypes are described, including VAL at receipt, VAL to stock, VAL to picking, and rework. VAL to stock has an explicit planning routine where Danone provides a planning of VAL to stock activities for the coming three weeks on a biweekly basis, and DSV adjusts weekly activities according to capacity, workforce, availability of stock, and prioritization requested by Danone, consulting Danone before proceeding with adjustments. VAL to picking is defined as being performed at the preparation of an order

of specific delivery, which means it can directly affect outbound readiness and timing when it is linked to shipments. Rework requests require feasibility assessment and estimation of hours and timeline, which again links VAL workload to capacity availability.

In relation to opening time, VAL matters because it consumes shared warehouse resources, including labor, space, and supervision capacity. Also, some VAL types can be coupled with outbound operations. Even when VAL is executed within a narrower time band, its workload can displace labor from core inbound or outbound tasks, or it can create additional steps that must be completed before shipping. Since cancellation is not allowed once VAL is in progress, workload can become rigid within the day, which reduces flexibility to recover from disturbances and may increase the likelihood that the overall daily workload extends later into the evening. These are mechanisms that can be tested empirically in the analysis in the next chapter by examining correlations between VAL volumes, labor allocation, and the realized length of the operational window.

2.4. Summary

The three business streams share the same site infrastructure and are governed by related, but not identical, service requirements. This creates a combined operational system in which opening time emerges from the interaction between time anchored outbound schedules, continuous production support needs, slot based arrival constraints, and additional value added workload.

For FG, the outbound schedule and slot discipline create hard completion targets across the afternoon and evening, and forecast driven peaks can trigger extended shifts. For R&P, continuous production at Supply Point Haps, the night closure of the DSV site, and buffering and shunting arrangements create a system in which some workload is physically constrained in when it can be processed, even though production continues. For VAL, the activity governance and the existence of VAL to picking and rework processes introduce workload that can be coupled with outbound execution and cannot be easily canceled or postponed once started.

These characteristics provide a concrete explanation of why opening time is a meaningful and challenging performance indicator for Haps DC. It is not a single process metric but a daily system outcome reflecting workload variability, planning quality, execution efficiency, and coordination across stakeholders. This chapter therefore establishes the factual and contractual context needed for analysis of current state, where the project will examine the current state through qualitative process mapping and quantitative analysis of volumes, slot utilization, resource allocation, and timing patterns, consistent with the data requirements and analytical goal defined in the project plan.

3

Current State

In order to achieve the objective of shortening the warehouse opening time, this chapter analyzes the current state of the three business streams, R&P, FG, and VAL, in the Haps warehouse. The analysis is structured as follows.

First, for the two main business categories, Finished Goods (FG) and Raws and Packs (R&P), the current state is analyzed to provide a clear data-based story of:

1. **How is the daily operation timeline shaped**, so that we would know how the operation such as shipments will be directly impacted in terms of time schedule by changing opening time;

2. **What is the current productivity status**, so that we would know how many orders or pallets should be satisfied in the design phase.

They are discussed from the following aspects.

- **Related Service** The diagram is drawn for illustrating the main services related to the business in DC Haps, serving as a general overview of the operational context before the quantitative analysis.
- **Time Slot Utilization** The usage of time slots is analyzed by comparing the number of booked slots with the number of available slots. Based on this, the time slot utilization rate is calculated to evaluate whether time slots are sufficiently utilized. From the perspective of unused time slots, the potential for shortening the warehouse opening hours can be explored.
- **Inbound and Outbound Volume** The inbound and outbound volumes at different time periods are analyzed to describe the daily workload of the warehouse. This analysis reflects the operational demand that the warehouse needs to satisfy within a given time window and can be used as the parameter for subsequent mathematical modeling.
- **Productivity** Productivity is evaluated using the workload and the given FTE. The resulting indicator is an important measure of th warehouse's current state in terms of working efficiency and also serves as a key input for the mathematical model.

For Value Added Logistics (VAL), since it represents value-added services without fixed processes or available volumes, a different analytical approach is applied. The feasibility of reducing the opening time is assessed by calculating the required working hours for VAL activities.

Overall, these analyses help to identify the amount of workload that may not be completed under reduced opening hours, which can be interpreted as the cost of shortening the warehouse opening time, and the analysis of time slots helps us explore the feasibility of reducing the opening hours. Meanwhile, they provide a basis for the subsequent modeling work.

3.1. R&P

R&P refers to Raws and Packs, including the inbound, storage, and outbound logistics flows for raw materials and packaging used by the factory, and notably, the scope has been extended to integrate Semi-Finished Goods (SFG) materials as well.

3.1.1. R&P related service in DC HAPS

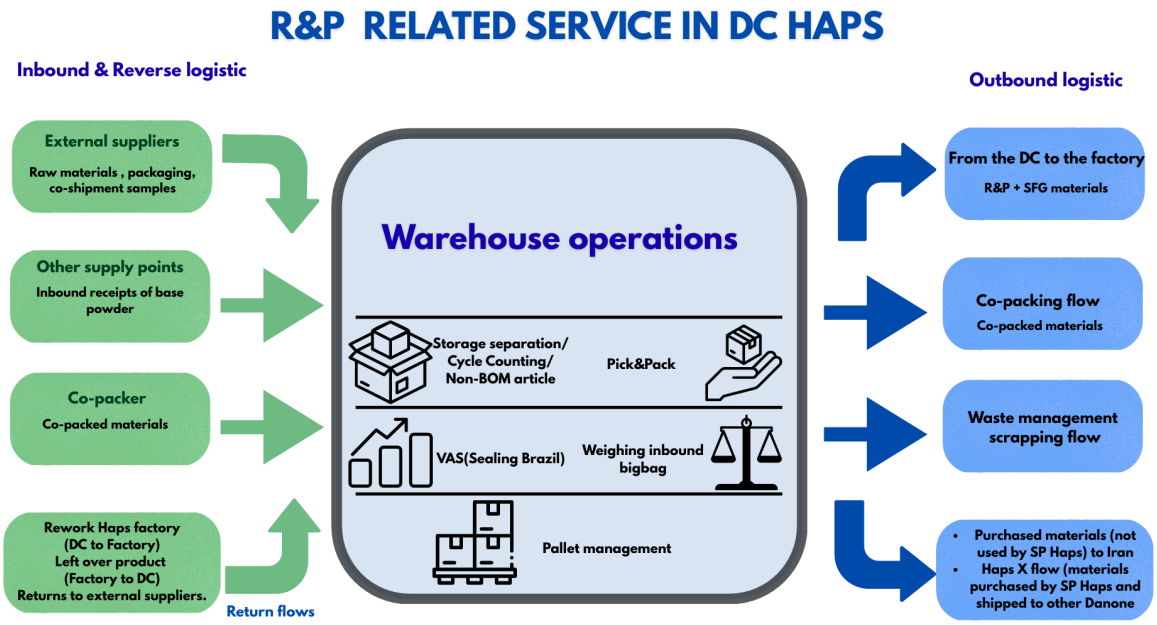

Figure 3.1: R&P related service in DC HAPS

The provided diagram illustrates the complete R&P (Raw Materials and Packaging) Related Service in DC Haps, managed by DSV. This logistics framework is structured around three core phases: Inbound & Reverse Logistics, central Warehouse Operations, and Outbound Logistics.

Inbound and Reverse Logistics

This initial phase details how materials arrive at the Distribution Center (DC). The DC receives supplies from four primary sources. External Suppliers provide the basic inputs, including raw materials, packaging, and co-shipment samples. Other Supply Points contribute specialized items, specifically inbound receipts of base powder. A third source is the Co-packer, which supplies pre-packaged materials. Furthermore, the DC handles Return Flows, which encompasses rework materials coming from the Haps factory (DC to factory) or product returns sent back to external suppliers (Factory to DC).

Central Warehouse Operations

Once materials are inside, the Warehouse Operations act as the central processing hub. This phase involves several critical activities to manage inventory and prepare for dispatch. Key activities include Storage, which covers physical separation, meticulous Cycle Counting, and managing non-BOM (Bill of Materials) articles. The operation also includes Handling and Value-Added Services (VAS) such as Pick & Pack, systematic Pallet Management, Weighing inbound big bags, and specific compliance services like Sealing Brazil.

Outbound Logistics

The final phase, Outbound Logistic, focuses on the dispatch and shipment of materials from the DC. The primary flow is to The Factory, delivering R&P and Semi-Finished Goods (SFG) materials necessary

for production. Other flows include a Co-packing flow that sends materials to co-packers and a Waste management scrapping flow for discarding unusable materials. Finally, the DC manages Other External Shipments, such as purchased materials (not used by SP Haps) sent to Iran, and Haps X flow materials that are shipped to other Danone companies.

3.1.2. The distribution of regulated time slot for R&P services

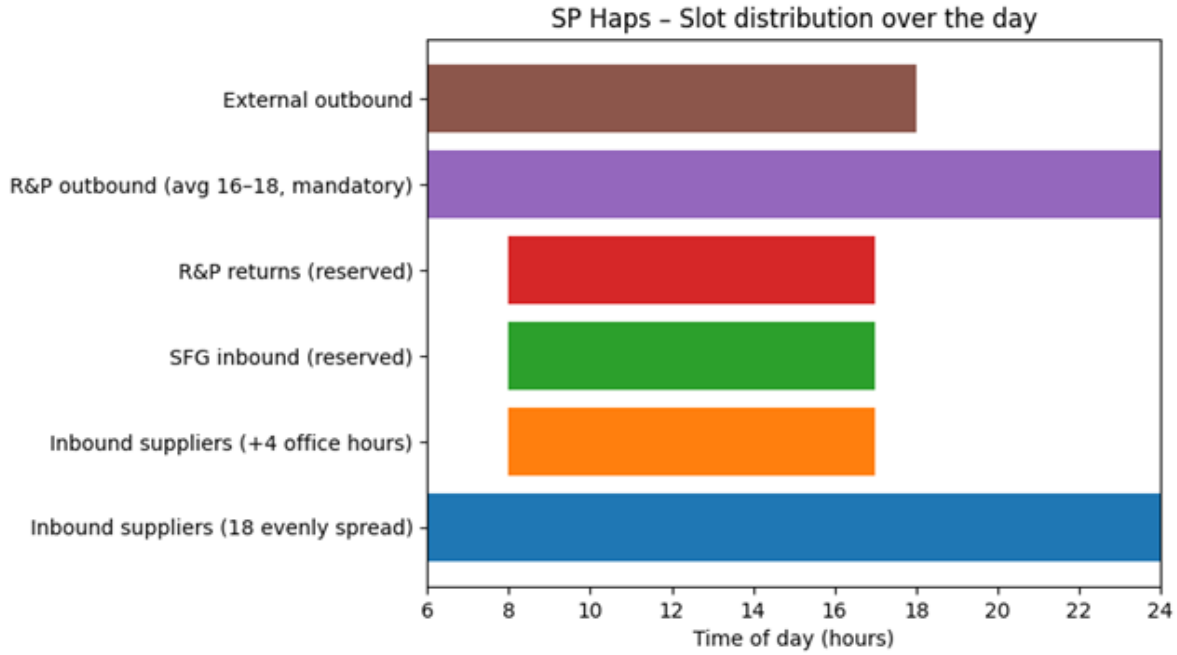

Figure 3.2: The distribution of regulated time slot for R&P services

The figure (3.2) illustrates the daily slot distribution that can be booked for R&P flows. Within the R&P scope, inbound flows account for the largest share of planned daily slots and are mainly concentrated during office hours. Outbound flows are smaller on average but demand-driven and can reach up to 30 slots during peak periods. The concentration of slots during office hours indicates higher inbound and outbound demand in this time window, as returns and SFG inbound are both scheduled mainly within office hour. The time slot distribution of different R&P services can be regarded as the constraint in our model, which forces the service can only be provided in specific time period.

3.1.3. Time slots analysis for R&P tasks in warehouse operations

The utilization data for R&P inbound services in 2025 reveals a distinct two-phase pattern: a high-performance period from January to August, where mean utilization consistently hovered between 0.70 and 0.80, followed by a sharp decline to approximately 0.55 during the September-November quarter. Among all months, February has the highest utilization rate, with mean equals 8.1 and median=0.85 which are significantly higher than in other months. Beyond these averages, the box plot highlights significant volatility. Even in peak months, we can still find days with very low utilization rate.

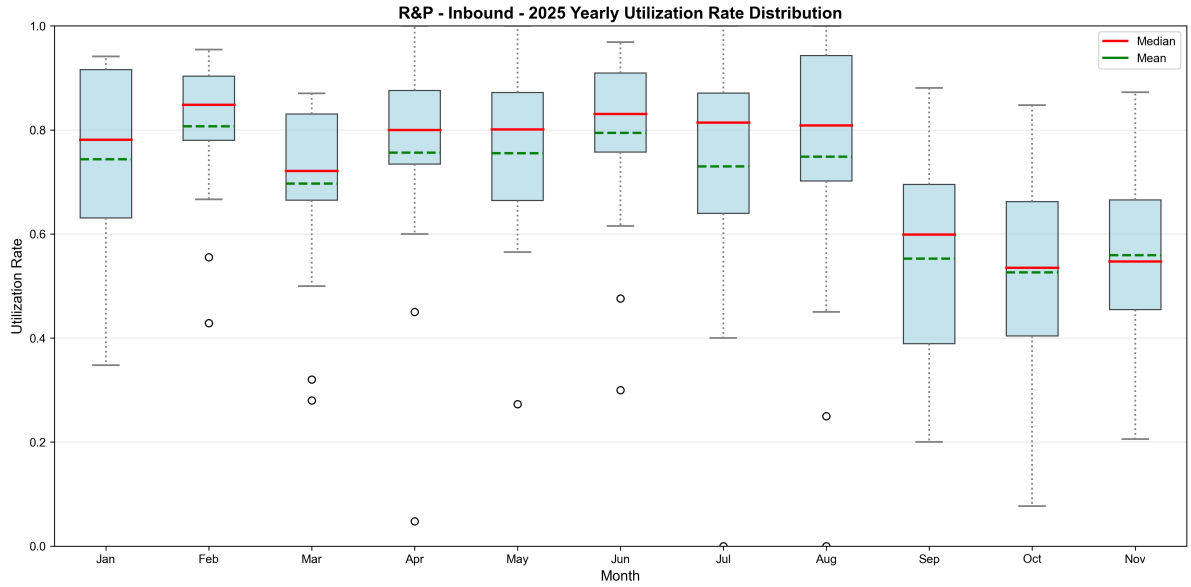

Figure 3.3: R&P Inbound Time Slot Utilization - 2025.

The following figure shows the available capacity of inbound time slots each month in 2025. February has the tightest capacity, averaging only about 4 to 5 slots available per day, which is consistent with its status as the month with the highest utilization of the year. Throughout the year, we frequently see days with zero availability, indicating that demand occasionally hits our current operational ceiling. When considering a reduction in warehouse opening hours, we must be cautious about these fully-booked days. The high concentration of data near the zero-mark suggests that certain days are already at maximum capacity and cannot absorb further time-slot cuts. Rather than a blanket reduction in hours, a more effective strategy would be to redistribute the inbound workload from these peak days to underutilized time slots or quieter days later in the week.

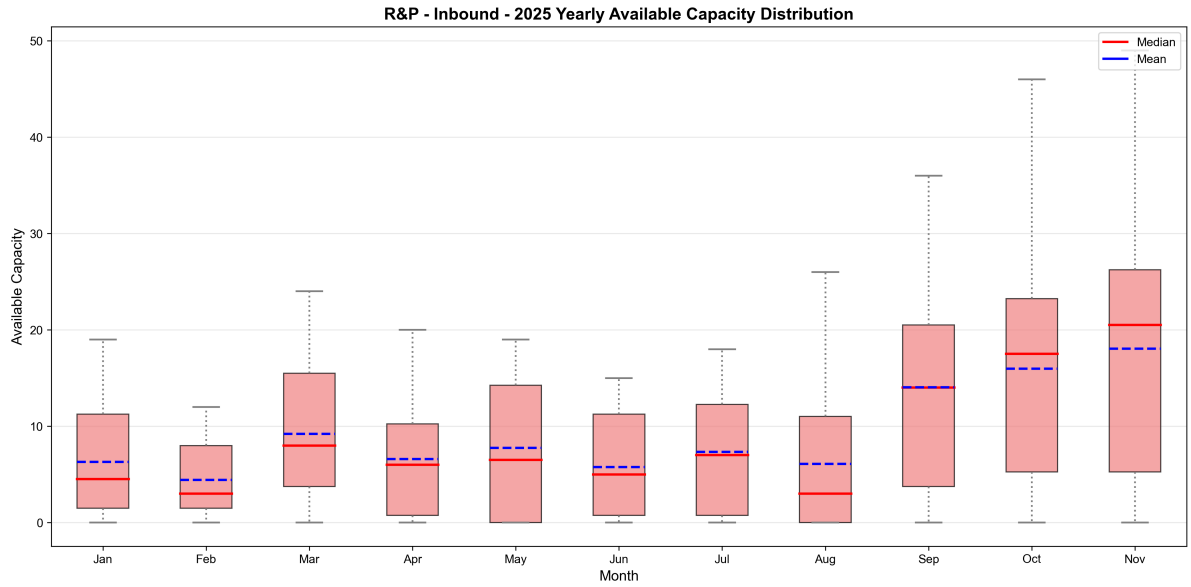

Figure 3.4: R&P Inbound Time Slot Available Capacity- 2025.

The utilization data for R&P outbound services in 2025 shows a much lower and more stagnant performance compared to inbound, with mean utilization never exceeding 0.40 throughout the year. The mean utilization rates of January to August are around 0.2-0.3 and sharply decrease to nearly 0.01 in

October. A significant operational gap can be found between inbound and outbound services: inbound services maintain a robust 0.70–0.80 mean for much of the year, while outbound services struggle to reach even half of that level. Although both departments experience a sharp downturn starting in September, the outbound decline is far more severe, dropping to near-zero levels while inbound stabilizes around 0.55. This imbalance suggests that while inbound requires better slot management to handle volatility, the outbound side has massive excess capacity that justifies a more aggressive reduction in opening hours.

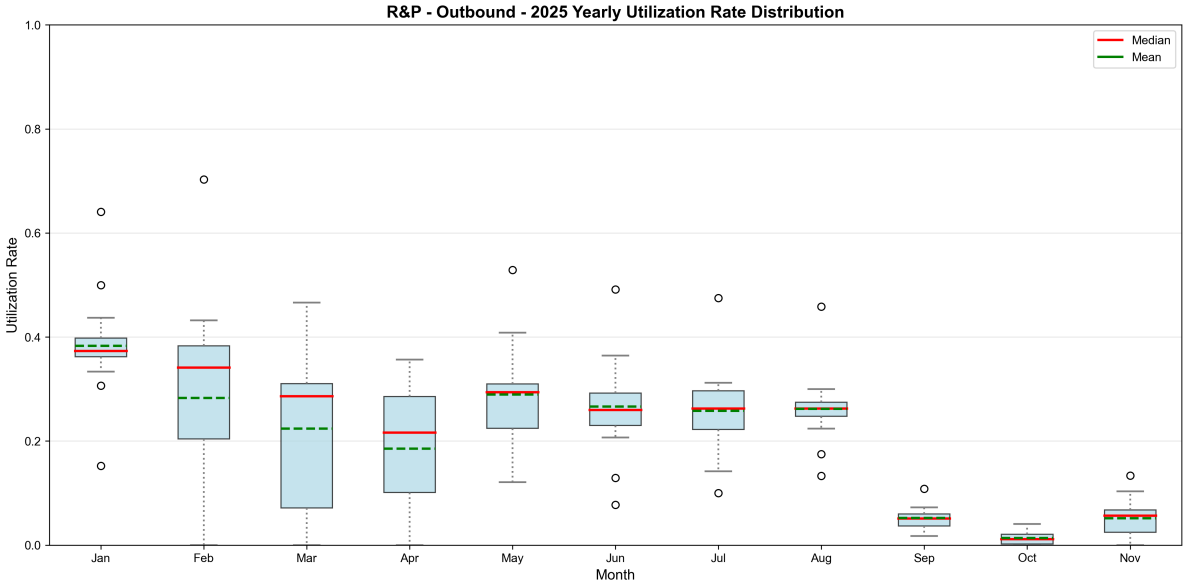

Figure 3.5: R&P Outbound Time Slot Utilization - 2025.

While inbound available time slots frequently hits zero, outbound vacant slots rarely drop below 20 for most of the year, peaking with a median of over 100 available slots in November.

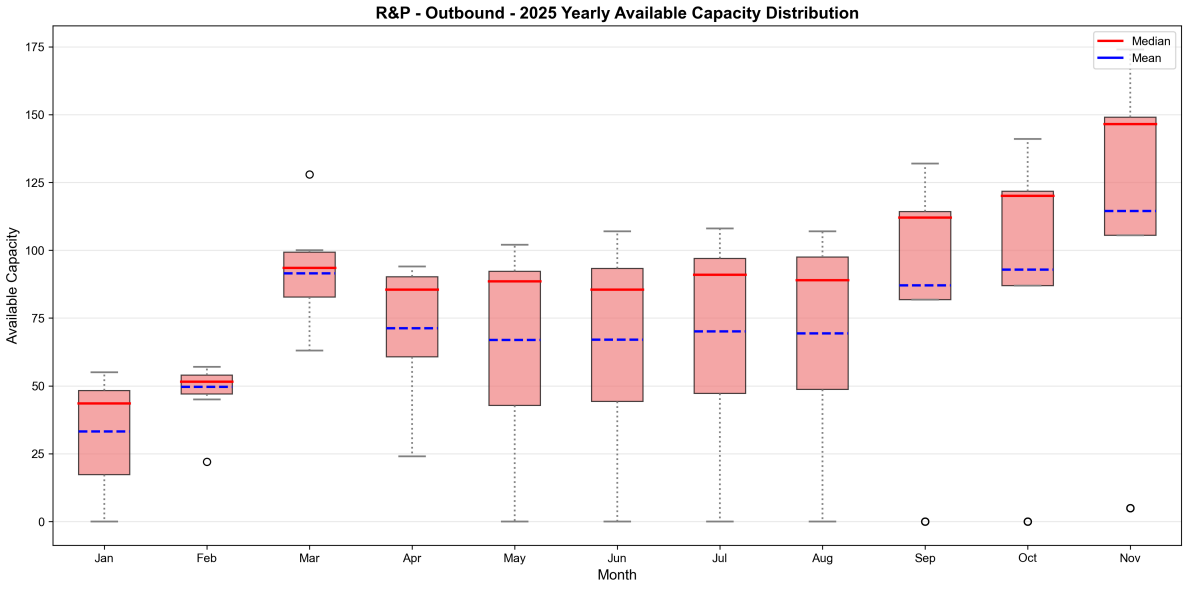

Figure 3.6: R&P outbound Time Slot Available Capacity- 2025.

3.1.4. Volume

Based on the 2025 monthly trend data for R&P inbound services, we can see a steadily increasing trend from January to August and a sudden drop from September to November. The peak of volume over the year shows in August at over 650 total orders and approximately 16,500 pallets. This peak period represents a significant increase in intensity compared to the start of the year, where volumes hovered around 550 orders and 12,000 pallets. However, the final quarter shows a steep decline, with November reaching the annual low of under 400 orders and approximately 11,500 pallets. Throughout the year, pallet volumes generally scaled in proportion to order counts, though the higher pallet-to-order ratio in the middle of the year suggests an increase in average shipment size during those months.

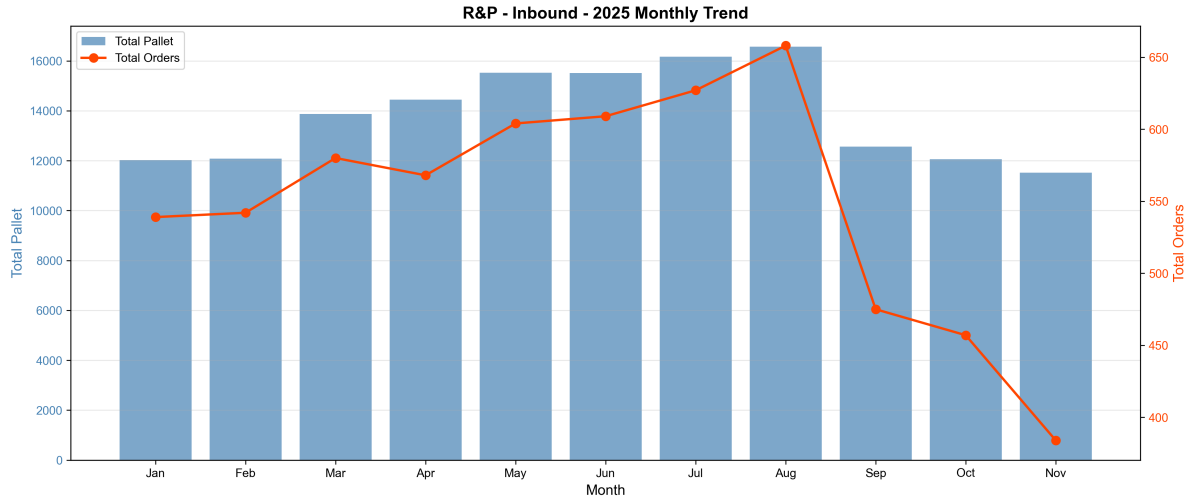

Figure 3.7: Daily R&P Inbound volume

The 2025 monthly trend for R&P outbound activities shows a significant drop-off in volume during the final quarter, similar to the inbound pattern. From January to August, outbound operations remained active, with monthly totals often exceeding 500 orders and 10,000 pallets. March and May were the peak months, both reaching nearly 700 orders and approximately 13,500 pallets. However, volume collapsed in September and continued to fall, hitting an annual low in November with only 33 orders and 435 pallets.

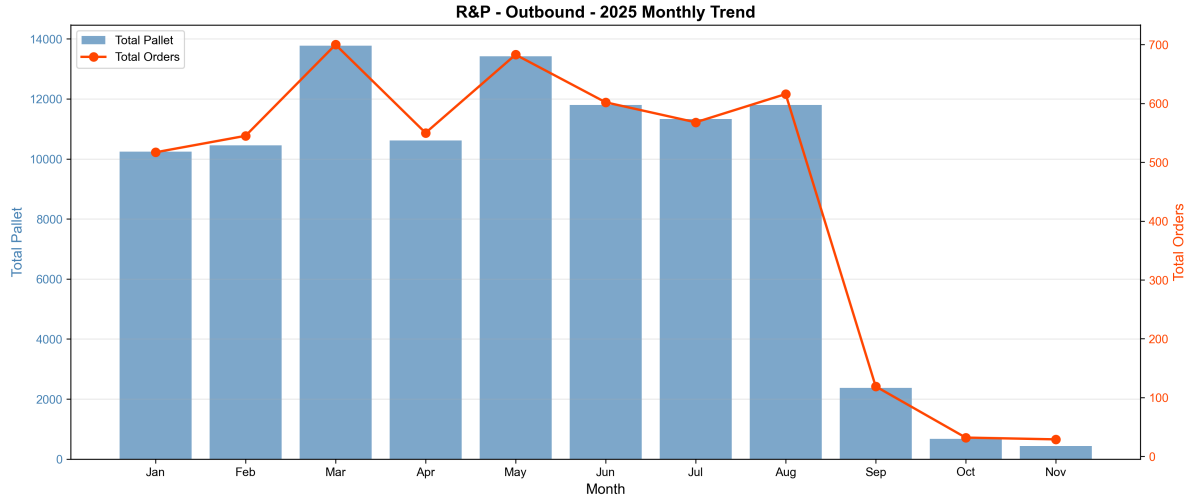

Figure 3.8: Daily R&P Outbound volume

3.1.5. Productivity

The analysis of the 2025 monthly data establishes an average productivity efficiency ($\bar{E}$) of approximately 5.81 Pallets per Hour. This data shows moderate volatility, with a standard deviation (σ) of about 0.416. The highest efficiency was observed in August at 6.53, while the lowest was recorded in September at 5.38. For our modeling, we recommend using the average of 5.81 as the base efficiency parameter because this represents the sustained, long-term performance capability of the operation. However, since the warehouse cannot always operate at this level, we can also use a more conservative figure for stress testing. Therefore, the model should incorporate the lowest observed efficiency of 5.38, or the statistically safer benchmark of $\bar{E} - 1\sigma \approx \mathbf{5.39}$, to conservativey assess the risk of delays in reducing the overall opening time.

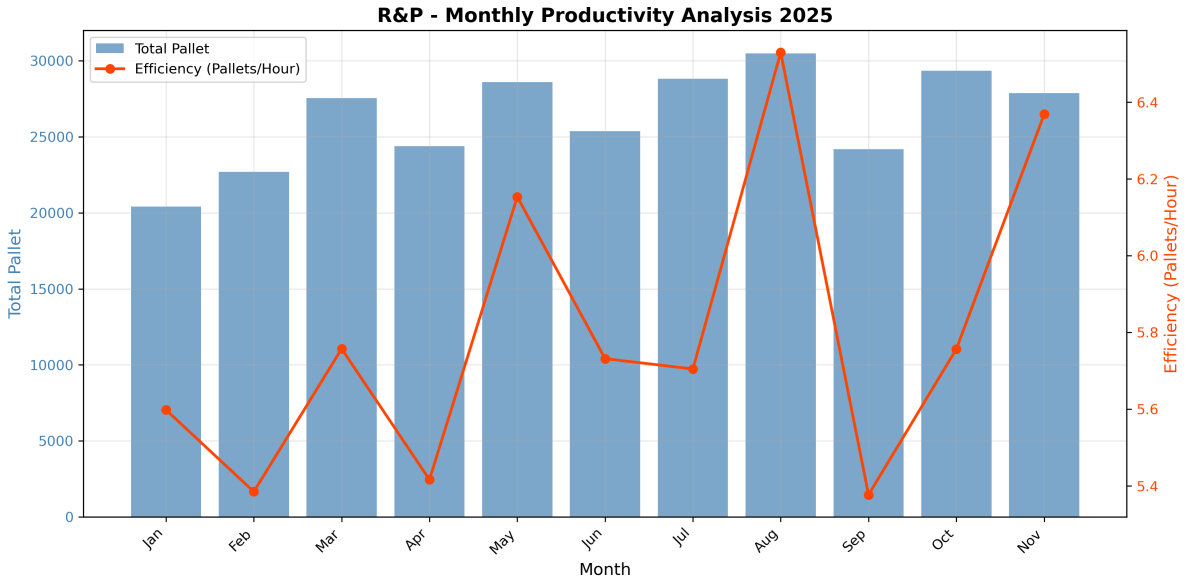

Figure 3.9: Monthly productivity of R&P inbound & outbound services

After the analysis of R&P related services, distribution of regulated time slot, actual time slot used and its utilization, volume and productivity. We can access the impact of reducing opening time on R&P services at a broader level.The services affected are limited to nighttime R&P inbound and outbound operations, while RP returns and SFG inbound are not impacted as they end at 17:00. Based on November data, the reduction in opening time mainly affects inbound services, since outbound time slot usage is low and largely concentrated in the morning. The productivity calculation provides an initial indication of the impact of a shorter opening time. A more detailed estimation of the feasible reduction in opening time will be carried out in the subsequent modeling phase.

3.2. FG

Finished Goods (FG) refer to products that have completed the entire manufacturing process, passed all quality checks, and are ready for sale, distribution, or consumption by the end customer.

3.2.1. FG related service in DC HAPS

Finished Goods (FG) related services in DC Haps cover the full set of warehouse operations required to handle, store, and distribute finished products. On the inbound side, these services include inbound receiving, quality and compliance checks, and the put-away of inbound pallets, ensuring that finished goods are correctly received and stored in the distribution center. Within the warehouse, FG services comprise storage, order picking, as well as value-added activities such as packing or repacking and labelling or relabelling, which support order customization and downstream distribution requirements. On the outbound side, FG-related services include outbound order preparation, loading of finished

goods, and dispatch administration, enabling the efficient and accurate release of products from the DC to subsequent nodes in the supply chain.

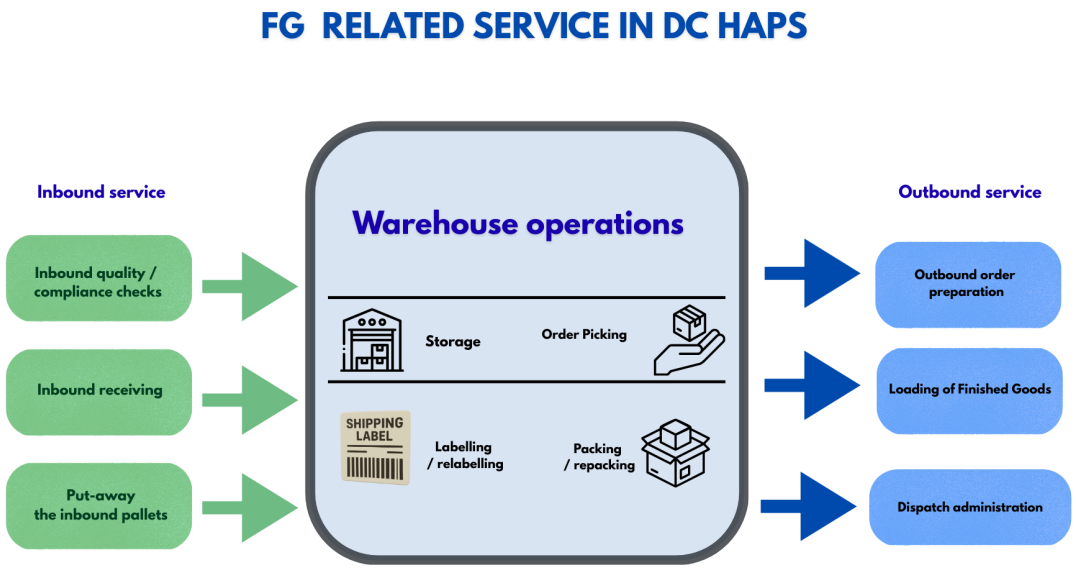

Figure 3.10: FG related service in DC HAPS.

3.2.2. Time Slot

The 2025 utilization data for FG inbound services shows a consistently strong and stable performance, with monthly means mostly hovering between 0.80 and 0.90. Peak utilization occurred in July, where the mean reached its highest point at approximately 0.89, while the lowest performance was recorded in November with a mean of 0.69. Throughout the year, the box plots remain tightly concentrated at the top of the scale, and medians frequently exceed the means, indicating that the majority of operating days achieve very high efficiency. Despite this high baseline, the presence of several low-end outliers—particularly in March, May, and November—highlights specific days where utilization dropped significantly below the typical range.

1. FG Inbound Time Slot Performance

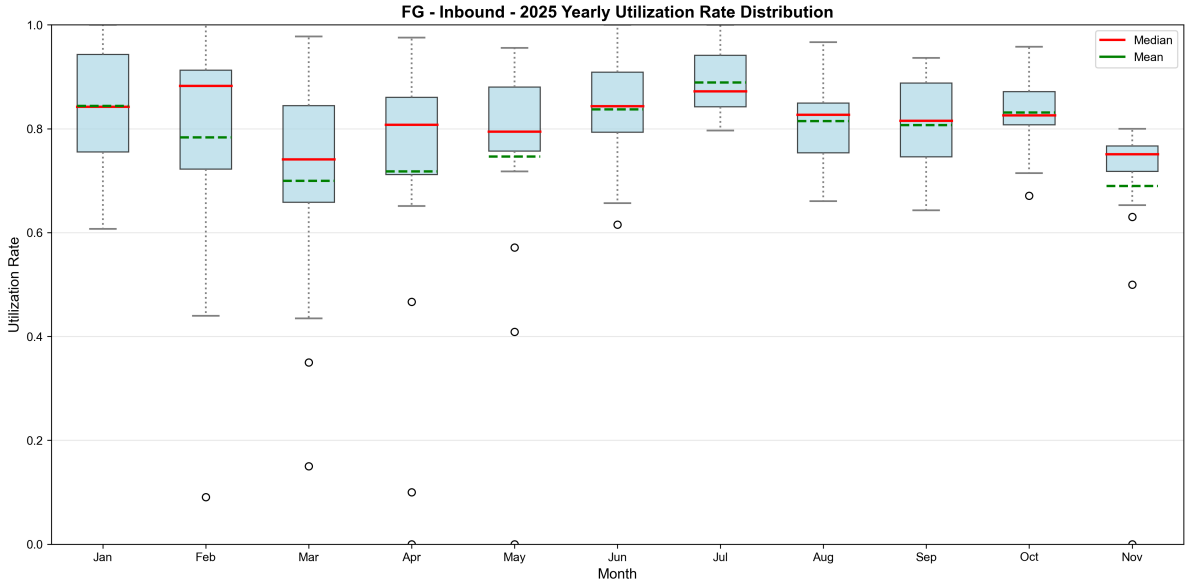

Figure 3.11: FG Inbound Time Slot Utilization - 2025.

The 2025 data for FG inbound available capacity shows a consistently tight schedule, with daily vacant slots often averaging below 10. July is the most constrained month, reaching a median of only 4 available slots, which aligns with its peak utilization period. Throughout the year, the frequent occurrence of zero available slots indicates that the operation routinely hits its maximum capacity ceiling. While November shows a significant surplus with a median jumping to over 20 slots, the first ten months remain under constant pressure.

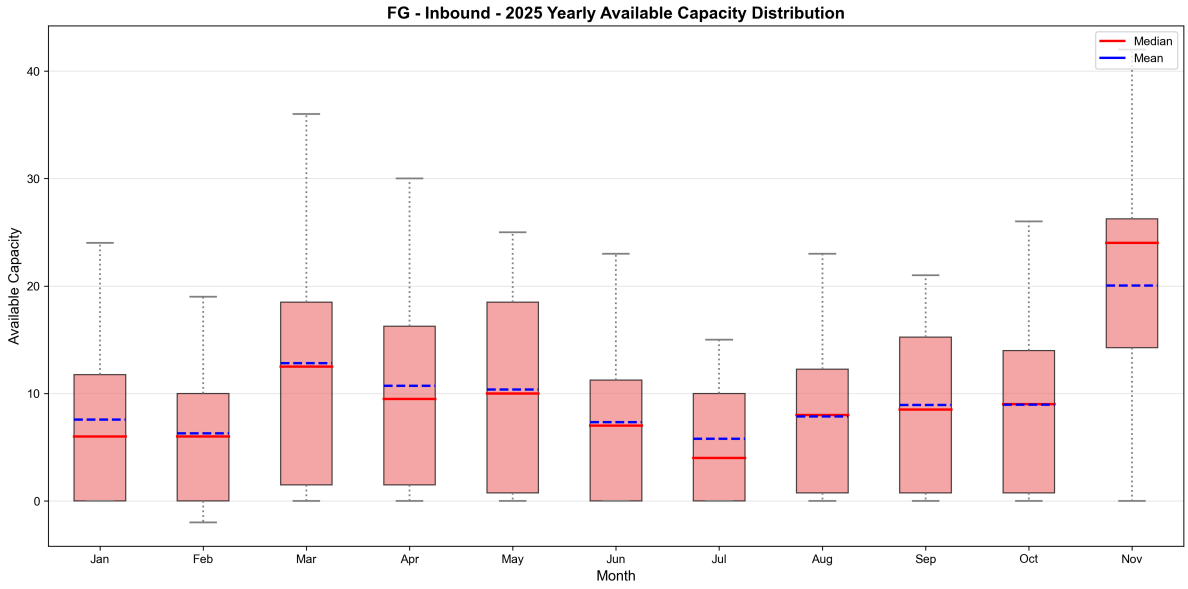

Figure 3.12: FG Inbound Time Slot Available Capacity - 2025.

2. FG Outbound Time Slot Performance

The 2025 utilization data for FG outbound services shows a high and consistent performance level, with monthly mean utilization rates primarily ranging between 0.75 and 0.88. The peak performance

occurred in July, where both the mean and median reached approximately 0.90, while May saw the lowest monthly mean at 0.74. The box plots for the entire year are relatively tight and positioned high on the scale, suggesting that outbound operations maintain a very stable efficiency with minimal day-to-day fluctuation. Despite this overall stability, several low-end outliers appear between February and June, indicating occasional days where outbound utilization dropped significantly below the standard operating level.

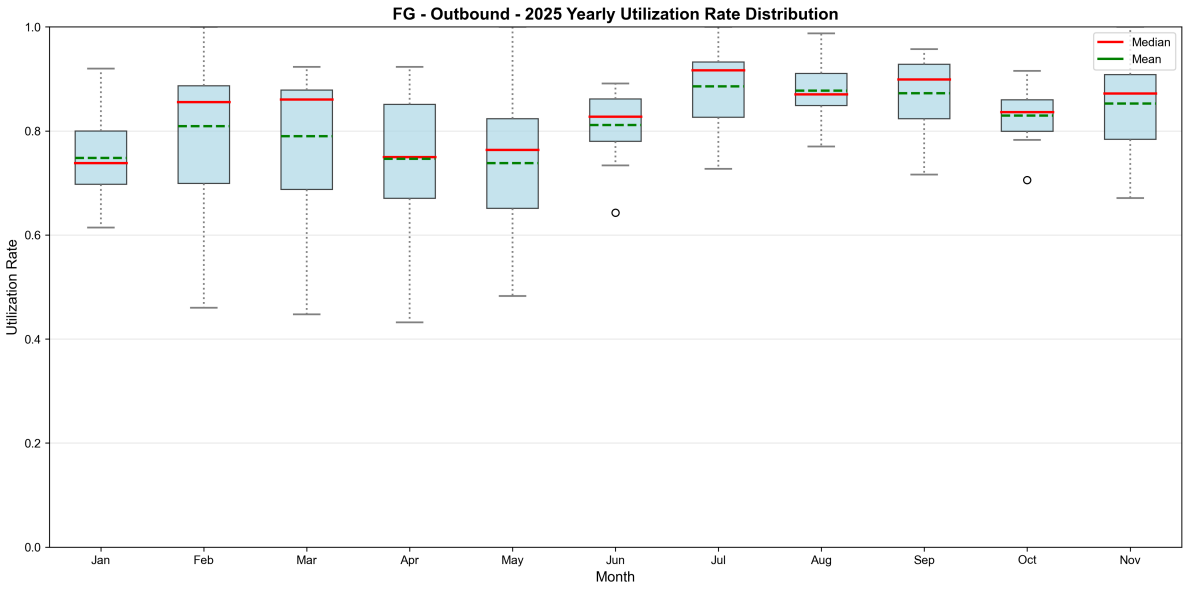

Figure 3.13: FG Inbound Time Slot Utilization - 2025.

The 2025 data for FG outbound available capacity shows a consistently tight schedule, with daily vacant slots often averaging below 10 across most months. July and September are the most constrained periods, with medians dropping to approximately 5 available slots. Throughout the year, the frequent occurrence of zero available slots confirms that outbound operations, like inbound, routinely hit their maximum capacity ceiling.

Compared to inbound, the FG outbound capacity is similarly saturated for the majority of the year, showing very little surplus. While inbound sees a significant capacity relief in November with a median jump to over 20 slots, the outbound side remains relatively constrained during the same period with a median under 10. This suggests that outbound operations have even less flexibility for hour reductions at year-end than the inbound department.

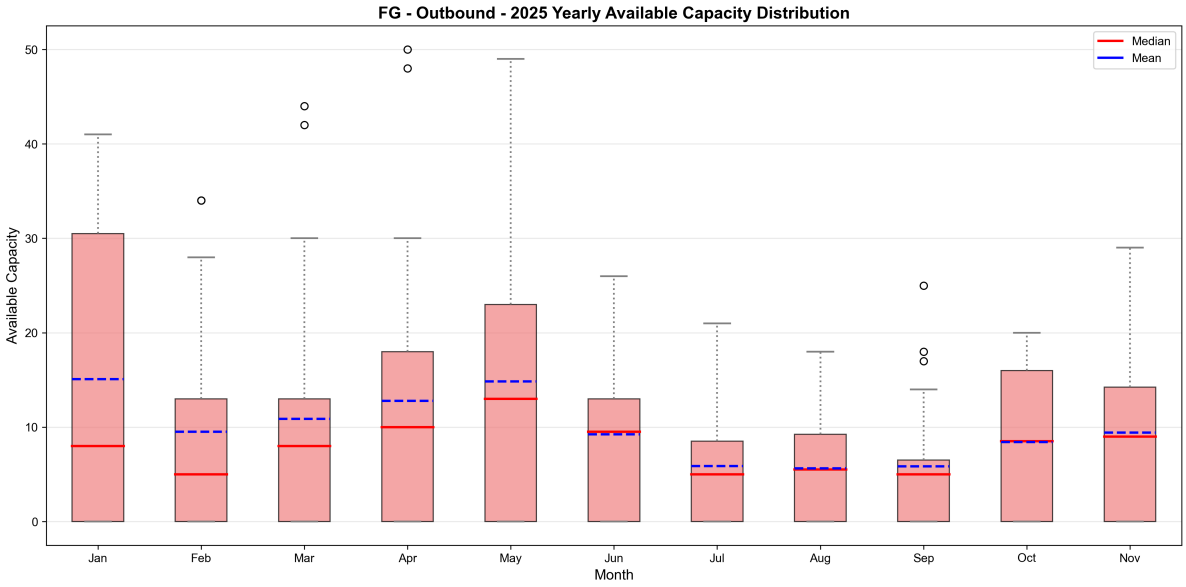

Figure 3.14: FG Outbound Time Slot Available Capacity - 2025.

3.2.3. Volume

1. FG Inbound November 2025 Performance

Based on the 2025 monthly trend data for FG inbound services, the annual workload is characterized by high volume and frequent, sharp fluctuations. Monthly order counts consistently stay above 900, peaking in May with over 1,100 orders and approximately 33,000 pallets. Other significant peaks occur in January, July, and October, showing that the operation must manage repeated surges throughout the year rather than a single seasonal peak.

While pallet volumes and order numbers generally follow similar patterns, certain months like June and August show a drop in order frequency while pallet counts remain relatively high. This indicates that the average shipment size increases during these specific periods.

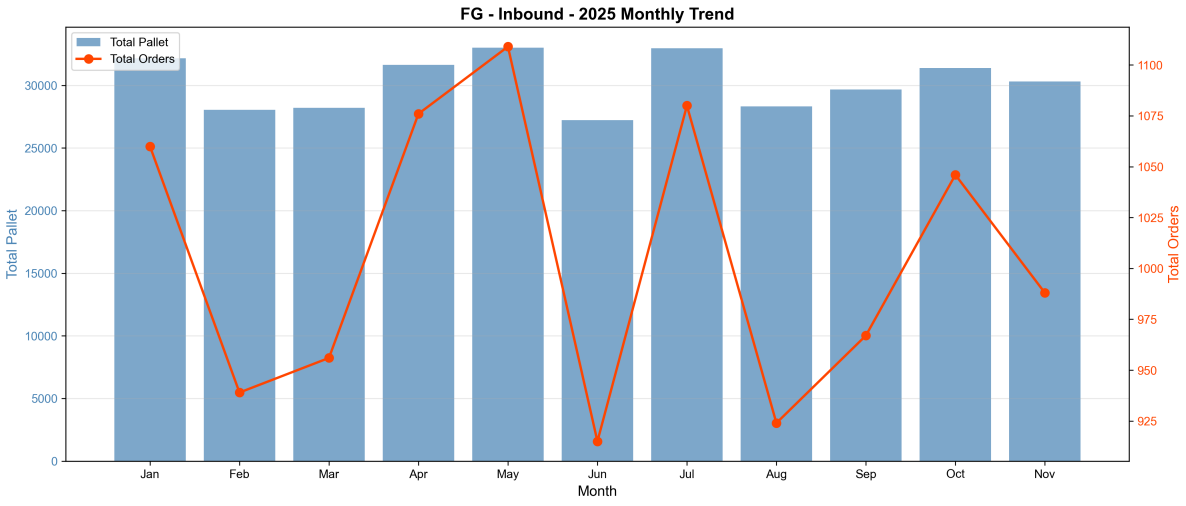

Figure 3.15: Daily FG outbound volume

2. FG Outbound November 2025 Performance

The 2025 monthly trend for FG outbound activities remains high throughout the year, with monthly totals consistently exceeding 1,000 orders and 27,000 pallets. Volume peaked in July at over 1,100 orders and approximately 34,000 pallets, followed by a steady baseline until a sharp decline in November.

Compared to inbound, the FG outbound flow follows a very similar pattern of high-volume peaks and rapid fluctuations. Both departments handle nearly identical pallet totals—peaking above 33,000—and experience the same significant drop in November, showing that inbound and outbound workloads are tightly linked throughout the year.

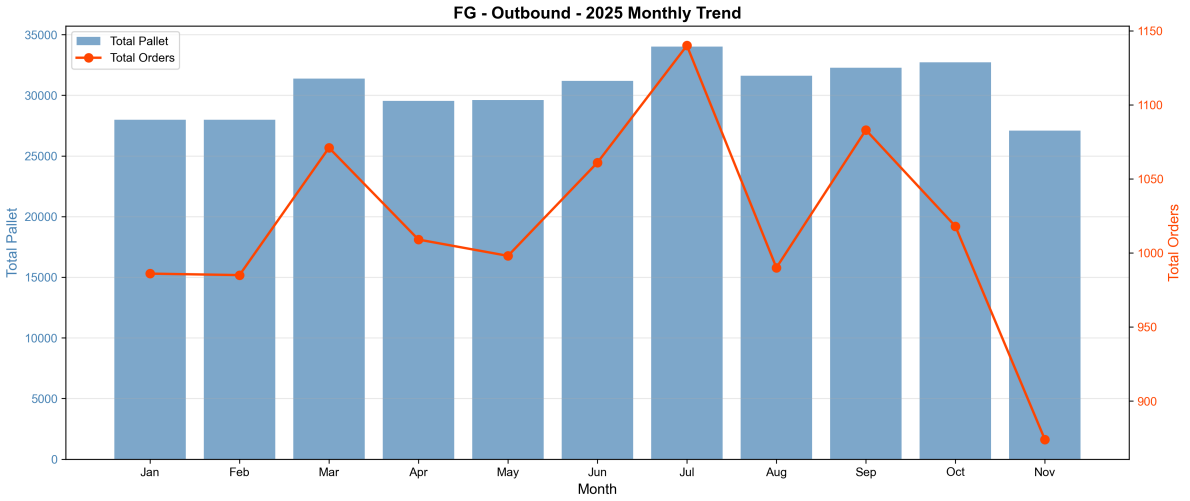

Figure 3.16: Daily FG outbound volume

3.2.4. Productivity

2025 FG Monthly Productivity Performance

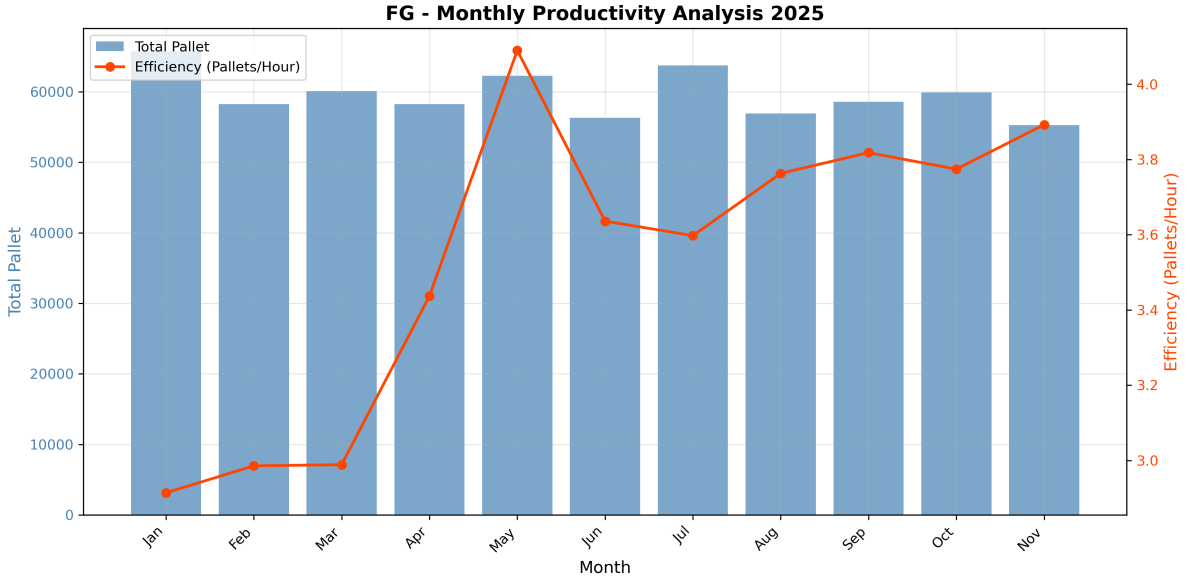

Figure 3.17: FG Monthly Productivity Analysis - 2025.

Analysis of the full year 2025 productivity data reveals:

Productivity Range: Throughout 2025, the facility maintained efficiency levels between 2.9-4.1 pallets per hour, showing relatively stable operational performance with approximately 40% variance between lowest and highest months.

Peak Efficiency Achievement: May 2025 achieved the highest productivity at 4.1 pallets per hour, potentially due to optimal staffing levels and experience curve effects, seasonal demand patterns allowing better workflow optimization, and process improvements implemented in Q2.

Current Performance (November 2025): The facility operates at 3.9 pallets per hour, representing 95% of peak efficiency (May 2025), a 34% improvement over low-efficiency periods (January at 2.9 pallets/hour), and strong year-end performance indicating sustained operational excellence.

Monthly Volume Stability: Monthly processing volumes consistently ranged from 55,000-65,000 pallets, with November processing approximately 60,000 pallets. This stability indicates consistent customer demand through the year, effective capacity management across seasonal variations, and a reliable operational planning baseline.

Efficiency Trends: The year shows an improving trend from Q1 (2.9-3.0 pallets/hour) through Q2 peak (4.1 pallets/hour), followed by sustained high performance in Q3-Q4 (3.6-3.9 pallets/hour).

3.3. VAL

Value-Added Logistics (VAL) are mainly performed to adapt products to different destination requirements, which may vary depending on country-specific regulations. In this context, VAL activities involve relabelling and repacking of products before they are delivered to different places.

VAL activities can be classified into four categories based on the logistics stage at which they are performed. The first category is *VAL at receipt*, carried out during the inbound process, before products are booked into stock. The second category is *VAL to stock*, which takes place during storage. The third category is related to the outbound process, where additional labelling or repacking activities may be required between picking and shipment preparation. The fourth category is rework, which is performed to correct.

3.3.1. General State

At the Haps warehouse, the standard operating hours for VAL activities are from 07:30 to 16:30 (including 1 hour break). In principle, VAL activities themselves do not significantly contribute to extended warehouse opening hours.

VAL processes are not fully standardized and do not follow a fixed sequence. The execution of VAL activities depends on specific order requirements and operational constraints, which results in variability in work flows.

3.3.2. Analytical Approach

Due to the nature of VAL, this analysis does not rely on predefined process flows. Instead, the assessment is based on daily operational volumes and productivity related parameters.

The required operation time (opening time of warehouse) per day for VAL activities is derived from the daily workload measured in cartons (Q), the available FTE, and the average productivity expressed in cartons per hour (μ). The formula is shown below. Based on this approach, the minimum time required for VAL operations is calculated.

$$H_{\text{VAL}} = \frac{Q}{\mu \times \text{FTE}} \tag{3.1}$$

The resulting required VAL operating time is then compared with the current warehouse opening hours in order to evaluate, from a VAL perspective, the feasibility of reducing the warehouse opening time.

3.3.3. Results

Figure 3.18 presents the calculated daily required VAL operating hours for November 2025, compared with the current standard business time of 8 hours.

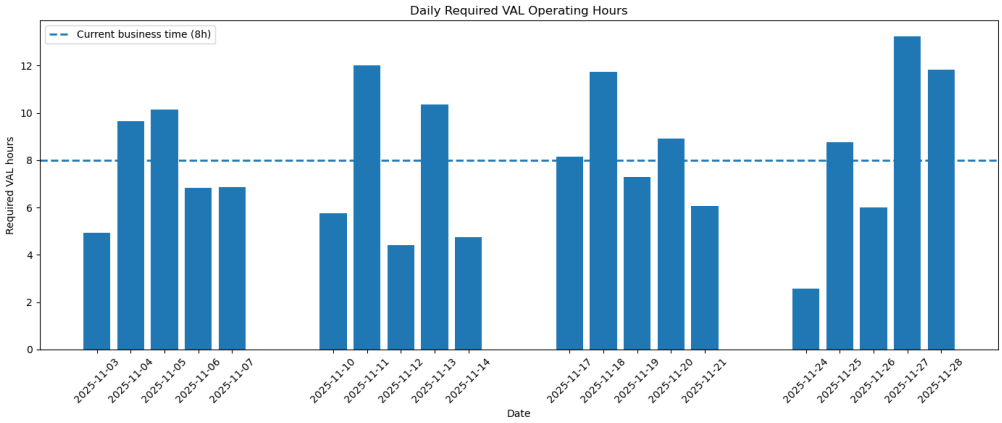

Figure 3.18: Daily Required Operating Hours of VAL

The required VAL operating hours vary significantly across days. It can be concluded that half of days fall within the current 8 hour business window, and half of peak days require extended operating time, with a maximum of approximately 13.2 hours.

This indicates that, on a considerable number of peak days, VAL activities can become a contributing factor to extended opening hours in the warehouse.

3.4. Discussion

Result and discussion

Chapter 3 examined time slot utilization, volume, and productivity for R&P and FG, and required vs actual operating hours for VAL. The results indicate that the observed long opening window cannot be explained by a single stream. Instead, it emerges from the interaction between uneven demand distribution, limited visibility of internal activities, and the way capacity is actually used in practice.

For R&P, the time slot structure provides broadly available capacity across the operating day, and the observed booking pattern does not show a strong late evening concentration. Inbound bookings are mainly concentrated during office hours and gradually decline afterwards, which suggests that the slot system itself does not inherently push R&P work into the late hours. However, the overall utilization is not high, and it is especially low for outbound. However, outbound utilization remained close to zero for most of the day. This indicates that a long opening window is unlikely to be justified by outbound R&P workload alone, and it also implies that reducing opening time may be feasible from an R&P outbound perspective, provided that inbound peaks and variability are still covered.

For FG, the findings are different. Both inbound and outbound show higher utilization and clearer time dependent patterns. FG inbound utilization stays consistently high during core operating hours, with a noticeable peak in the early evening, while FG outbound shows a critical mid day window in which utilization approaches capacity. These patterns imply that FG operations are more tightly coupled to time anchored execution rhythms, and therefore they are more likely to shape the practical constraints of opening time reduction. At the same time, the current dataset only captures inbound and outbound slot behavior, which limits our ability to explain what happens inside the warehouse between receiving and dispatch. The presence of extended shifts, including the night shift, suggests that there may be additional activities such as picking, packing, or other activities that are not visible in the available inbound and outbound slot records. As a result, even though the slot utilization trends describe when docks are used, they do not fully describe when warehouse work is completed.

For VAL, the estimated required operating hours vary substantially across days. Most days can be handled within the standard business window, but a limited number of peak days require extended time, with a maximum of approximately 13.2 hours in November. This indicates that VAL is not a continuous driver of long opening hours, but it can become relevant on peak days and should not be ignored when evaluating the feasibility and risk of a reduced opening window. The average required VAL operating time should be reported together with the dispersion across days, since the main managerial challenge is driven by variability rather than by the typical day.

Next step

A key implication of these findings is that the current analysis likely underestimates internal warehouse workload, because it relies mainly on inbound and outbound time slot data. To address this limitation, we propose a complementary data collection approach based on daily scheduled extraction from DSV WMS (eVisibility). At two fixed time each day, we will extract the status distribution of all relevant orders, distinguishing at least the following states: completed, in progress, allocated, picking, packing, and ready to load. This provides a direct operational proxy for work in process and backlog, and it helps connect dock activity to internal processing progress and completion timing.

Based on this additional data stream, the next steps are as follows. First, we will extend the analysis from the November case study to full year data to capture seasonality and structural volume shifts. Second, we will systematically document and analyze the WMS order status to build visibility of internal activities that are currently missing from the dataset. Third, we will enter the design phase and evaluate improvement options using a quantitative approach, either through a mathematical model or through simulation, so that opening time reduction proposals can be tested against workload variability and operational constraints rather than being assessed only qualitatively.

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