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Evaluating Supply Chain Efficiency: A Multiple Cases Study of Expedited and Intermodal Shipping Performance

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ABSTRACT

This thesis aims to assess the effectiveness of the company's supply chain operations and offer recommendations for improvement. This thesis evaluates the transportation decision-making process of Company A, focusing on the trade-off between expedited and non-expedited shipping in its top five lanes. A multiple case study approach was employed to analyze the on-time delivery (OTD) rates of expedited and intermodal orders in the selected lanes, as well as to explore the performance trends across different months from 2021 to 2022. The findings reveal significant room for improvement in OTD rates, with substantial variations in performance rates throughout the year attributable to factors such as seasonality, capacity issues, and external factors like rail strikes. The comparison between expedited and non-expedited orders highlights that intermodal shipping may be more effective in certain scenarios, while expedited shipping may be a viable option for others. Based on these insights, recommendations are proposed to help Company A optimize its transportation decision-making process, including consistent performance monitoring, in-depth analysis of underlying causes, and the development of a predictive model for informed transportation mode selection. The implementation of these recommendations can contribute to enhanced supply chain performance and customer satisfaction.

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Chapter 1

Introduction

In today's rapidly evolving and competitive global market, effective supply chain management has become increasingly crucial for businesses seeking to gain a competitive edge. Efficient transportation decision-making processes play a vital role in ensuring that goods are delivered on time, contributing to customer satisfaction, and enhancing overall supply chain performance. One of the key aspects of transportation management involves deciding between expedited and non-expedited shipping methods. Expedited shipping is typically faster and more expensive, while non-expedited shipping or intermodal transportation is slower but more cost-effective and environmentally friendly. Balancing these trade-offs and optimizing transportation decisions is a complex task that requires a deep understanding of supply chain dynamics and performance metrics.

Company A, a global organization with a vast supply chain network, faces the challenge of optimizing its transportation decision-making process. By analyzing Company A's transportation data and evaluating the performance of expedited and intermodal orders in these lanes, this study aims to provide valuable evaluations of the effectiveness of the company's current decision-making process and suggest potential improvements.

The paper is organized as follows: background, methodology, analysis, results, and conclusion. The background section presents a brief overview of Company A’s background and highlights Company A's challenge in balancing timely deliveries with transportation costs. The methodology section outlines the multiple case study approach used to analyze the top five

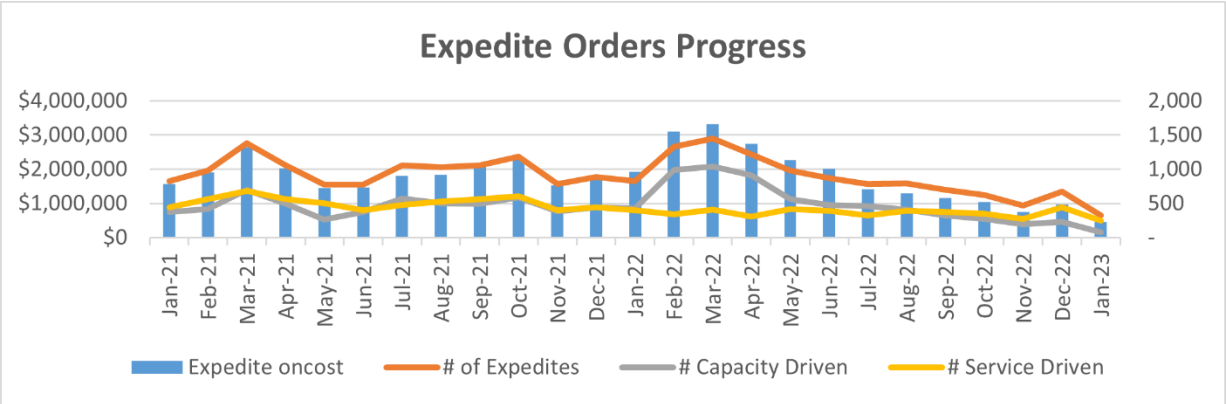
shipping lanes and the various performance tables employed to assess the performance of expedited and intermodal orders and emphasize the role of on-time delivery as a key performance indicator. The analysis and results sections present the findings of the study, focusing on the comparison of on-time delivery rates between expedited and non-expedited orders, as well as the analysis of monthly performance trends. Lastly, the conclusion summarizes the study's key findings and offers actionable suggestions for Company A to optimize its transportation decision-making process and improve its overall supply chain performance.

Chapter 2

Background

The company at the center of this research will be referred to as Company A due to confidentiality agreements. Company A is a global consumer goods enterprise that manufactures and distributes a diverse array of products, including food, drinks, cleaning supplies, and personal care products. Company A has a strong global supply chain network and operates in over 190 countries. A critical challenge Company A encounters in its supply chain management involves making strategic decisions regarding the transportation of goods between distribution centers, particularly the trade-off between expediting orders or utilizing standard intermodal shipping methods. Figure 1 presents the progress of expedited orders from 2021 to 2022, illustrating the monthly number of expedited orders, associated oncost, and the two primary reasons for expedited orders: capacity-driven and service-driven.

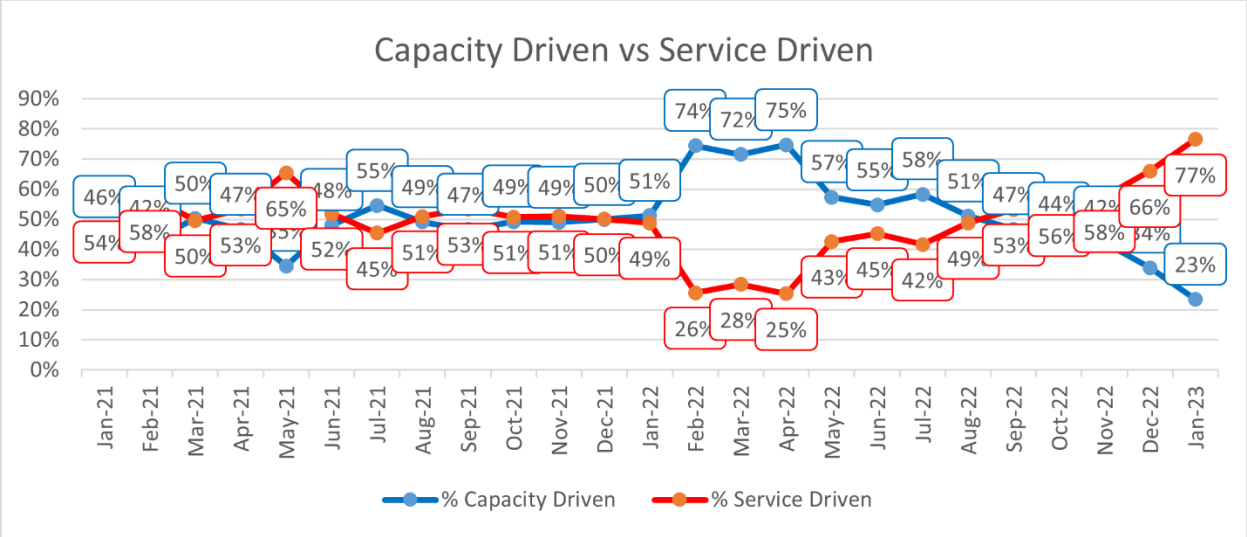
Figure 1 Expedited orders progress over time (company presentation)



The core issue for Company A is striking a balance between timely deliveries and the expenses related to transportation and logistics. The problem is driven by capacity and service factors. Capacity-driven circumstances arise when Company A lacks available intermodal boxes

or trailers, compelling them to resort to over-the-road shipping to avoid jeopardizing production or capacity at any location. External factors, such as rail strikes, may also contribute to capacity-driven challenges. Service-driven situations occur when the planning team requests expedited orders to prepare for promotional periods, discount dates, gifting seasons (e.g., Christmas, Halloween), or product launches. Figure 2 showcases the evolution of expedited orders over time, including the comparative proportion of capacity-driven and service-driven expedited orders.

Figure 2 Capacity driven vs. service driven over time (Company Presentation)



This research intends to contribute to the field of transportation and logistics management by offering insights into Company A's top five lanes with the highest number of expedited orders. Employing a multiple case study analysis, the research will evaluate Company A's overall performance and support the company in making strategic transportation decisions involving goods movement from distribution centers to customers.

The current thesis will focus on conducting a thorough, data-based analysis of the raw data provided by Company A, aiming to assess the effectiveness of their order expediting

decisions during the 2021-2022 period. A detailed examination of historical data, including expedited orders, intermodal shipping, and other relevant factors, will offer a comprehensive evaluation of Company A's past performance in transportation and logistics management. This analysis will enhance the understanding of the efficiency and appropriateness of their choices, revealing patterns and trends within the data. As a result, the insights derived from this investigation will be a valuable asset for guiding Company A's future strategic decisions, allowing for transportation process optimization while balancing the conflicting priorities of expediting orders and using standard intermodal shipping methods.

Chapter 3

Methodology: Multiple Case Study Analysis

To thoroughly examine the factors influencing the choice between expedited and intermodal shipping methods for Company A, a multiple case study analysis was conducted. This research methodology involves the in-depth investigation of multiple cases to gain a comprehensive understanding of a complex issue (Yin, 2009). In this study, the top five lanes with the highest number of expedited orders were selected as cases, and the trade-offs between expedited and intermodal shipping methods were analyzed to provide insights for optimizing transportation mode selection.

Data Collection

The data collection for this study primarily relies on the raw data provided by Company A, which encompasses various aspects of their transportation and logistics operations from 2021 to 2022. This dataset includes information about expedited orders, intermodal shipping, associated costs, and other pertinent factors that influence the company's decision-making process in the realm of transportation mode selection.

Utilizing this rich dataset, a comprehensive assessment of Company A's past decisions in transportation and logistics management will be conducted. By examining the historical data, the study aims to reveal patterns and trends that may not be readily apparent, offering valuable insights into the effectiveness and suitability of Company A's past choices.

By using the analysis of the raw data from the Company, this research aims to present a rigorous, fact-based evaluation of the company's past transportation decisions, with the ultimate

goal of informing and optimizing future strategic choices in the transportation and logistics management domain.

Data Preparation and Analysis

The raw data were first sorted by lane, and the top five lanes with the most expedited orders were identified as our sample. Each order on these lanes was then categorized into Late, Missing, and On-Time performances. To better understand why an order was expedited, the arrival and departure dates of each order were recorded and compared with the performance category to see whether expedited orders arrived on time.

A pivot table was used to display the performance of each category of orders, including Total Orders, Expedited Orders, and non-expedited orders. This helped identify any patterns or trends in the data related to expedited orders. This table, named the Arrival Performance Table (see Appendix A), was conducted five times for the top five lanes. The arrival performance table illustrated the on-time delivery performance of the five lanes by including the on-time delivery rate in the bottom row.

After the arrival performance tables were conducted, the methodology focused more specifically on the arrival performance by time (sorted by each month from 2021 to 2022). The new table, named Arrival Performance Table by Time, performed almost the same function as

the Arrival Performance Table but was sorted by months and five lanes combined for overall performance. This table helped identify which month had the most expedited orders.

Synthesis

For the top five lanes with the highest number of expedited orders, the results of the multiple case study analysis were synthesized to understand the trade-offs between expedited and intermodal shipping methods. Based on these findings, recommendations were formulated for Company A on how to optimize their transportation mode selection by considering the specific factors and trade-offs identified for each lane (Eisenhardt & Graebner, 2007).

By conducting a multiple case study analysis, this study aimed to provide a thorough understanding of the factors influencing the choice between expedited and intermodal shipping methods for the top five lanes at Company A and to offer strategic recommendations for enhancing their transportation decision-making process.

On-time Delivery

In this study, on-time delivery (OTD) is employed as a primary performance indicator (KPI) to assess the efficacy of Company A's transportation decision-making procedures. OTD represents the proportion of orders fulfilled within the stipulated time frame, serving as an essential metric for evaluating customer satisfaction and overall supply chain performance (Lambert & Cooper, 2000). Researchers and practitioners have extensively acknowledged the significance of OTD in supply chain management, as it directly affects a company's capacity to

fulfill customer expectations and sustain a competitive edge in the marketplace (Chen & Paulraj, 2004).

To assess the performance of expedited and non-expedited orders in Company A's top five lanes, this study will examine OTD rates alongside other pertinent factors influencing the transportation decision-making process. Utilizing this methodology allows for areas necessitating improvement in Company A's supply chain operations.

Chapter 4

Analysis

Overview of Top five Lanes with the Most Expedited Orders

Based on the analysis of the raw data provided by Company A, it was found that the top five lanes with the most expedited orders are Edwardsville to Newville, Edwardsville to Jacksonville, Newville to Jacksonville, Newville to Edwardsville, and Newville to Rialto. These lanes account for a significant portion of Company A's expedited orders and present a diverse range of transportation scenarios.

Edwardsville to Newville is the lane with the highest number of expedited orders, totaling 1196. This lane is a domestic route within the United States, connecting the states of Illinois and Pennsylvania. Newville to Edwardsville, the second most expedited lane, connects Pennsylvania and Illinois, with a total of 937 expedited orders. Edwardsville to Jacksonville, the third most expedited lane, connects Illinois and Florida, with a total of 903 expedited orders. The fourth and fifth most expedited lanes are Newville to Jacksonville, connecting Pennsylvania and Florida with a total of 851 orders, and Newville to Rialto, connecting Pennsylvania and California with a total of 655 orders.

The high volume of expedited orders on these lanes suggests that they are critical to Company A's supply chain operations. The geographic locations of these lanes, spanning from coast to coast within the United States and connecting the Americas with Asia and Europe, demonstrate the global reach of Company A's supply chain network.

Performance Analysis of Expedited and Intermodal Orders

The second part of the analysis focuses on the performance of expedited and non-expedited orders in the top five lanes. The actual performance of these lanes was determined using the Arrival Performance table, which categorizes orders as either Late, Missing, or On-Time based on their arrival times. It is worth noting that the company's time table for receiving shipments from one distribution center to another is twenty-four hours. Any arrival date that is more than one day late compared to the requested arrival date is considered Late, while a shipment that arrives under twenty-four hours and is confirmed by the destination distribution center is classified as On-Time. If the destination distribution center does not receive the shipment from the originating distribution center, then the shipment is marked as Missing.

The below Tables 1 to 5 show the number of Late, Missing, and On-Time orders for the three categories of orders - total, expedited, and non-expedited - in each of the top five lanes. Table 1 displays the performance of lane 3175 Edwardsville to 3990 Newville. Table 2 displays the performance lane 3990 Newville to 3175 Edwardsville. Table 3 displays the performance of lane 3175 Edwardsville to 3512 Jacksonville. Table 4 displays the performance of 3990 Newville to 3512 Jacksonville. Table 5 displays the performance of lane 3990 Newville to 3154 Rialto. Additionally, each lane's performance is thoroughly described in these tables, including information on warehouse management, transportation management, and other elements that affect delivery times. However, a significant portion of the reasons for poor performance is listed as blank cells in the raw data file, which help in making assumptions and recommendations in the later stages of the study.

The On-Time Delivery (OTD) rate is an essential metric that evaluates the transportation decision-making process. The OTD rate is calculated by dividing the number of On-Time orders

by the total number of orders. For example, in Table 1, the OTD rate for all orders is 60.96 percent, indicating that 1569 out of 2574 orders were delivered on time.

Interestingly, the first and second lanes exhibit a significant difference in OTD rates between expedited and non-expedited orders. For instance, in Table 1, the difference in OTD rates between these two categories is 21.71 percent (71.04 percent - 49.33 percent). Similarly, in Table 2, the difference in OTD rates is 19.87 percent (69.6 percent - 49.73 percent). However, in the other three tables, the differences are relatively small, with Table 3 showing a difference of 0.26 percent, Table 4 showing a difference of 0.01 percent, and Table 5 showing a difference of 1.89 percent. This suggests that intermodal shipping may be a more effective solution for ensuring on-time delivery for these lanes, while expedited shipping may be a viable option for the other three lanes.

Table 1 Order performance of lane 3175 to 3990

Total Orders	Number of Orders	Expedite Orders	Number of Orders	Non-Expedite Orders	Number of Orders
Late	545	Late	394	Late	151
Customer Delivery Issues	32	Customer Delivery Issues	25	Customer Delivery Issues	7
DC Replenishment	9	DC Replenishment	9	DC Replenishment	0
Force Majeure	28	Force Majeure	14	Force Majeure	14
Order Capturing & Processing	5	Order Capturing & Processing	5	Order Capturing & Processing	0
Supply Related	1	Supply Related	1	Supply Related	0
Transportation Management	95	Transportation Management	31	Transportation Management	64
Warehouse Management	252	Warehouse Management	212	Warehouse Management	40
Indiscernible Reason	123	Indiscernible Reason	97	Indiscernible Reason	26
Missing 214	460	Missing 214	212	Missing 214	248
Transportation Management	5	Transportation Management	5	Transportation Management	0
Warehouse Management	8	Warehouse Management	7	Warehouse Management	1
Indiscernible Reason	447	Indiscernible Reason	200	Indiscernible Reason	247
OnTime	1569	OnTime	590	OnTime	979
Customer Delivery Issues	12	Customer Delivery Issues	11	Customer Delivery Issues	1
DC Replenishment	3	DC Replenishment	3	DC Replenishment	
Force Majeure	4	Force Majeure	3	Force Majeure	1
Transportation Management	14	Transportation Management	5	Transportation Management	9
Warehouse Management	22	Warehouse Management	18	Warehouse Management	4
Indiscernible Reason	757	Indiscernible Reason	550	Indiscernible Reason	207
Grand Total	2574	Grand Total	1196	Grand Total	1378
On-Time Delivery	60.96%	On-Time Delivery	49.33%	On-Time Delivery	71.04%

Table 2 Order performance of lane 3990 to 3175

Total Orders	Number of Orders	Expedite Orders	Number of Orders	Non-Expedite Orders	Number of Orders
Late	490	Late	321	Late	169
Customer Delivery Issues	26	Customer Delivery Issues	25	Customer Delivery Issues	1
Force Majeure	13	Force Majeure	10	Force Majeure	3
IT & Master Data	1	IT & Master Data	1	IT & Master Data	0
Order Capturing & Processing	4	Order Capturing & Processing	4	Order Capturing & Processing	0
Transportation Management	133	Transportation Management	31	Transportation Management	102
Warehouse Management	208	Warehouse Management	194	Warehouse Management	14
Indiscernible Reason	105	Indiscernible Reason	56	Indiscernible Reason	49
Missing 214	410	Missing 214	150	Missing 214	260
Customer Delivery Issues	2	Customer Delivery Issues	2	Customer Delivery Issues	0
Transportation Management	2	Transportation Management	2	Transportation Management	0
Warehouse Management	2	Warehouse Management	2	Warehouse Management	0
Indiscernible Reason	404	Indiscernible Reason	144	Indiscernible Reason	260
OnTime	1448	OnTime	466	OnTime	982
Customer Delivery Issues	34	Customer Delivery Issues	31	Customer Delivery Issues	3
Force Majeure	10	Force Majeure		Force Majeure	10
Transportation Management	33	Transportation Management	6	Transportation Management	27
Warehouse Management	18	Warehouse Management	15	Warehouse Management	3
Indiscernible Reason	1353	Indiscernible Reason	414	Indiscernible Reason	939
Grand Total	2348	Grand Total	937	Grand Total	1411
On-Time Delivery	61.67%	On-Time Delivery	49.73%	On-Time Delivery	69.60%

Table 3 Order performance of lane 3175 to 3512

Total Orders	Number of Orders	Expedite Orders	Number of Orders	Non-Expedite Orders	Number of Orders
Late	405	Late	315	Late	90
Customer Delivery Issues	46	Customer Delivery Issues	38	Customer Delivery Issues	8
DC Replenishment	9	DC Replenishment	9	DC Replenishment	0
Force Majeure	23	Force Majeure	16	Force Majeure	7
Supply Related	1	Supply Related	1	Supply Related	0
Transportation Management	91	Transportation Management	55	Transportation Management	36
Warehouse Management	119	Warehouse Management	105	Warehouse Management	14
Indiscernible Reason	116	Indiscernible Reason	91	Indiscernible Reason	25
Missing 214	232	Missing 214	101	Missing 214	131
Customer Delivery Issues	1	Customer Delivery Issues	0	Customer Delivery Issues	1
IT & Master Data	1	IT & Master Data	1	IT & Master Data	0
Transportation Management	5	Transportation Management	2	Transportation Management	3
Warehouse Management	1	Warehouse Management	1	Warehouse Management	0
Indiscernible Reason	224	Indiscernible Reason	97	Indiscernible Reason	127
OnTime	743	OnTime	487	OnTime	256
Customer Delivery Issues	9	Customer Delivery Issues	8	Customer Delivery Issues	1
DC Replenishment	3	DC Replenishment	3	DC Replenishment	0
Force Majeure	2	Force Majeure	2	Force Majeure	0
Transportation Management	10	Transportation Management	10	Transportation Management	0
Warehouse Management	11	Warehouse Management	8	Warehouse Management	3
Indiscernible Reason	708	Indiscernible Reason	456	Indiscernible Reason	252
Grand Total	1380	Grand Total	903	Grand Total	477
On-Time Delivery	53.84%	On-Time Delivery	53.93%	On-Time Delivery	53.67%

Table 4 Order performance of lane 3990 to 3512

Total Orders	Number of Orders	Expedite Orders	Number of Orders	Non-Expedite Orders	Number of Orders
Late	183	Late	130	Late	53
Customer Delivery Issues	24	Customer Delivery Issues	19	Customer Delivery Issues	5
DC Replenishment	2	DC Replenishment	2	DC Replenishment	0
Force Majeure	10	Force Majeure	7	Force Majeure	3
Transportation Management	73	Transportation Management	47	Transportation Management	26
Warehouse Management	46	Warehouse Management	40	Warehouse Management	6
Indiscernible Reason	79	Indiscernible Reason	68	Indiscernible Reason	11
Missing 214	177	Missing 214	92	Missing 214	85
Customer Delivery Issues	1	Customer Delivery Issues	1	Customer Delivery Issues	0
Transportation Management	2	Transportation Management	1	Transportation Management	1
Warehouse Management	4	Warehouse Management	3	Warehouse Management	1
Indiscernible Reason	172	Indiscernible Reason	87	Indiscernible Reason	85
OnTime	861	OnTime	576	OnTime	285
Customer Delivery Issues	8	Customer Delivery Issues	3	Customer Delivery Issues	5
Force Majeure	1	Force Majeure	0	Force Majeure	1
Transportation Management	21	Transportation Management	9	Transportation Management	12
Warehouse Management	9	Warehouse Management	5	Warehouse Management	4
Indiscernible Reason	822	Indiscernible Reason	559	Indiscernible Reason	263
Grand Total	1272	Grand Total	851	Grand Total	421
On-Time Delivery	0.676886792	On-Time Delivery	67.69%	On-Time Delivery	67.70%

Table 5 Order performance of lane 3990 to 3154

Total Orders	Number of Orders	Expedite Orders	Number of Orders	Non-Expedite Orders	Number of Orders
Late	190	Late	114	Late	76
Customer Delivery Issues	24	Customer Delivery Issues	19	Customer Delivery Issues	5
DC Replenishment	1	DC Replenishment	1	DC Replenishment	0
Force Majeure	9	Force Majeure	9	Force Majeure	0
IT & Master Data	1	IT & Master Data	1	IT & Master Data	0
Transportation Management	53	Transportation Management	11	Transportation Management	42
Warehouse Management	61	Warehouse Management	41	Warehouse Management	20
Indiscernible Reason	41	Indiscernible Reason	32	Indiscernible Reason	9
Missing 214	313	Missing 214	117	Missing 214	196
Transportation Management	2	Transportation Management	1	Transportation Management	1
Warehouse Management	2	Warehouse Management	2	Warehouse Management	0
Indiscernible Reason	309	Indiscernible Reason	114	Indiscernible Reason	195
OnTime	884	OnTime	424	OnTime	460
Customer Delivery Issues	84	Customer Delivery Issues	83	Customer Delivery Issues	1
Force Majeure	2	Force Majeure	2	Force Majeure	0
Transportation Management	20	Transportation Management	6	Transportation Management	14
Warehouse Management	15	Warehouse Management	15	Warehouse Management	0
Indiscernible Reason	763	Indiscernible Reason	318	Indiscernible Reason	445
Grand Total	1387	Grand Total	655	Grand Total	732
On-Time Delivery	63.73%	On-Time Delivery	64.73%	On-Time Delivery	62.84%

Monthly Performance Analysis

The third part of the analysis focuses on the monthly performance of expedited and intermodal orders across the top five lanes during the study period of 2021-2022. By using a pivot table, the orders' performance of the five lanes was combined, and a table of Overall Order Performance by Time was created (Table 6), which contained the number of expedited orders and non-expedite orders by month, their three types of arrival performance, and the on-time delivery rate for expedite, non-expedite, and total orders by month.

In examining the 2021 performance data, a total of 2,387 expedited orders were recorded. The month with the highest number of expedited orders was October 2021, with 298 orders, while January had the lowest with only 127 orders. The on-time delivery rate in December was the highest at 71.16 percent, while February recorded the lowest at 26.67 percent.

For 2022 performance, March had the highest number of expedited orders, while December had the lowest. The on-time delivery rate in May was the highest at 75.93 percent, while October had the lowest at 39.86 percent. Seasonality, capacity issues, and external factors, such as rail strikes, can all affect performance rates.

Table 6 Overall Order Performance by Time

2021 Performance	January	February	March	April	May	June	July	August	September	October	November	December	Grand Total
Expedite Orders	127	180	190	169	147	135	294	246	230	298	156	215	2387
Late	69	109	110	91	65	78	138	100	105	66	44	55	1030
Missing 214	3	23	22	25	40	17	20	27	20	24	23	7	251
OnTime	55	48	58	53	42	40	136	119	105	208	89	153	1106
Grand Total	127	180	190	169	147	135	294	246	230	298	156	215	2387
Expedite On-Time Delivery	43.31%	26.67%	30.53%	31.36%	28.57%	29.63%	46.26%	48.37%	45.65%	69.80%	57.05%	71.16%	46.33%

2022 Performance	January	February	March	April	May	June	July	August	September	October	November	December	Grand Total
Expedite Orders	183	207	335	232	162	164	217	171	211	138	87	48	2155
Late	40	57	46	20	12	19	17	15	29	22	9	11	297
Missing 214	9	7	43	38	27	37	49	51	56	61	29	14	421
OnTime	134	143	246	174	123	108	151	105	126	55	49	23	1437
Expedite On-Time Delivery	73.22%	69.08%	73.43%	75.00%	75.93%	65.85%	69.59%	61.40%	59.72%	39.86%	56.32%	47.92%	66.68%
Non-Expedite Orders	399	378	429	438	352	291	293	368	387	526	459	99	4419
Late	65	86	60	39	47	20	44	40	43	59	28	6	537
Missing 214	74	145	92	91	58	72	81	68	76	86	58	19	920
OnTime	260	147	277	308	247	199	168	260	268	381	373	74	2962
Non-Expedite On-Time Delive	65.16%	38.89%	64.57%	70.32%	70.17%	68.38%	57.34%	70.65%	69.25%	72.43%	81.26%	74.75%	67.03%
Grand Total	582	585	764	670	514	455	510	539	598	664	546	147	6574
Total On-Time Delivery	67.70%	49.57%	68.46%	71.94%	71.98%	67.47%	62.55%	67.72%	65.89%	65.66%	77.29%	65.99%	66.92%

Chapter 5

Results

Results of Arrival Performance tables

The analysis of the Arrival Performance tables revealed that the overall on-time delivery rate (OTD) for the top five lanes ranged from 49.33 percent to 71.04 percent in Table 1, indicating that there is significant room for improvement in the company's transportation processes.

The comparison of OTD rates between expedited and non-expedited orders provides valuable insights into the factors that influence Company A's transportation decision-making process. For instance, the high difference in OTD for the first and second lanes may be due to capacity constraints or other operational challenges that make it difficult for the company to ensure timely delivery without expedited shipping. On the other hand, the low difference in OTD for the other three lanes may indicate that expedited shipping is a more viable option, given the lower cost and potential environmental benefits.

Moreover, the data indicates that there are several indiscernible reasons recorded as blank cells in the raw data file, which may have contributed to the lower overall OTD rates. This highlights the need for better data collection and management practices to identify potential issues and make informed decisions regarding transportation mode selection.

Overall, the analysis of the performance of expedited and non-expedited orders in the top five lanes indicates that the transportation decision-making process may benefit from further optimization. The significant differences in OTD rates between the two categories in some lanes

suggest that the decision to expedite orders may not always result in improved performance. These findings highlight the need for a more nuanced approach to transportation mode selection that considers the specific factors and trade-offs identified for each lane.

Results of Monthly Performance Table

Based on the monthly performance analysis of expedited and intermodal orders across the top five lanes during the study period (2021-2022), performance rates vary significantly from month to month. The Overall Order Performance by Time table (Table 6) showed that in 2021, there were only expedited orders in the top five lanes, and there were 2,387 expedited orders in total. The month with the highest number of expedited orders was October 2021, with 298 orders, while January had the lowest with only 127 orders. The on-time delivery rate in December was the highest at 71.16 percent, while February recorded the lowest at 26.67 percent.

In 2022, the month with the most expedited orders was March, and the month with the least expedited orders was December. The on-time delivery rate in May was the highest at 75.93 percent, while October had the lowest at 39.86 percent. These variations in performance rates can be attributed to various factors such as seasonality, capacity issues, or external factors like rail strikes.

One possible explanation for the low-performance rate in February 2021 could be attributed to the extreme winter weather conditions that impacted transportation operations across the United States. Adverse weather conditions such as snowstorms and ice storms could have caused significant delays in shipment deliveries, resulting in a lower on-time delivery rate.

On the other hand, the higher on-time delivery rate in May 2022 may have been caused by a combination of factors, including favorable weather, a efficient supply chain management system, and enough capacity to deal with the volume of shipments.

The high proportion of expedited orders in the top five lanes, which emphasizes the significance of these lanes to Company A's supply chain operations, is another intriguing finding from the analysis. Furthermore, it suggests that there is a high demand for prompt and reliable delivery of goods in these lanes, which may be brought on by a number of variables including the nature of the goods, consumer demand, or competition.

Overall, the monthly performance analysis offers useful information about the performance patterns of Company A's supply chain operations. For instance, on-time delivery rates can be observed to spot potential bottlenecks and areas for development. Developing strategies to reduce risks and enhance supply chain performance can be made easier by understanding the underlying causes of performance variations.

Assumptions

Based on the analysis of the data provided by Company A, a number of assumptions can be made about its supply chain operations.

First off, it appears that the top five lanes are essential to Company A's supply chain network based on the high volume of expedited orders in those lanes. These lanes might be used to ship expensive or time-sensitive goods that require expedited shipping to guarantee prompt delivery.

Secondly, the significant difference in OTD rates between expedited and non-expedited orders in the first and second lanes indicates that intermodal shipping may be a more effective solution for ensuring on-time delivery in certain scenarios. The transportation management for these lanes may need to focus more on intermodal shipping to meet customer demand and reduce loss and delay.

Thirdly, the observed variations in performance rates across different months can be attributed to various factors, including seasonality, capacity issues, and external factors such as rail strikes. For instance, the lower OTD rate in October 2022 could be due to capacity constraints during the holiday season, which may have resulted in delays in transportation.

Lastly, another assumption that can be drawn from the analysis of the top five lanes is that it offers a useful way to evaluate how the business decides to handle expedited shipping. These lanes appear to be crucial to the company's supply chain operations given the high volume of expedited orders that they receive. It might be possible to ascertain whether the business's decision to expedite orders is working well or if there are any areas for improvement by looking at how expedited orders are performed in these lanes. This analysis can shed light on how the company manages its supply chain and point out areas where performance and customer satisfaction could be improved.

Limitations

Although the analysis offers insightful information about the monthly performance of expedited and intermodal orders in the top five lanes, there are some limitations that should be noted.

Firstly, the analysis is based solely on Company A's internal data and does not take into account external factors that may have impacted performance, such as weather events or political disruptions.

Secondly, the study only examines a subset of Company A's supply chain operations and does not provide a comprehensive view of its overall performance.

Furthermore, another assumption that can be made based on the analysis is that Company A could improve its performance evaluation process by providing a clear standard for some performance measures, such as its goal for On-Time Delivery (OTD). Having a clear target for OTD could provide a more meaningful basis for evaluating their performance and making recommendations for improvement.

Additionally, it would be beneficial for the company to label blank cells in the arrival performance description column to better understand the reasons behind poor performance. Clear labeling of these cells would help in identifying and addressing the root causes of poor performance, leading to more effective recommendations for improving the company's supply chain operations.

Also, the limited sample size of expedited orders, especially in 2021 when only expedited orders were included, may restrict the generalizability of the results.

Lastly, the study assumes that Company A's data is accurate and complete, and any inconsistencies or errors in the data could potentially have an impact on the findings.

Chapter 6

Conclusions

This paper aimed to provide a performance analysis of Company A's decision-making process regarding the trade-off between expedited and non-expedited shipping in its top five lanes. Based on the analysis of Company A's transportation decision-making process, several key insights can be drawn regarding the performance of expedited and intermodal orders in the top five lanes. The top five lanes with the most expedited orders are critical to the company's supply chain operations. These lanes experience a high volume of expedited orders and connect important geographical locations within the United States and globally. By employing a multiple case study approach, the study evaluated the on-time delivery (OTD) rates for expedited and intermodal orders in these lanes, shedding light on the company's transportation decision-making process. The performance of expedited and intermodal orders in these lanes offers valuable insights into the effectiveness of Company A's transportation decision-making process.

The results show that there is significant room for improvement in on-time delivery rates. The comparison between expedited and non-expedited orders' performance reveals that intermodal shipping may be more effective in certain scenarios (first and second lane), while expedited shipping might be a viable option for others.

The monthly performance analysis demonstrates that there are substantial variations in performance rates throughout the year, which can be attributed to factors such as seasonality, capacity issues, and external factors like rail strikes. This highlights the importance of understanding these underlying factors and developing strategies to mitigate risks and improve overall supply chain performance.

Recommendations

The following recommendations are put forth to assist Company A in streamlining its transportation decision-making process and enhancing the efficiency of its supply chain based on the study's findings.

First, Company A can leverage the methodology presented in this paper to consistently monitor the performance of any specific routes and months they wish to examine further. This approach will allow the company to identify patterns, potential bottlenecks, and areas that need enhancement in its supply chain operations.

Second, company A ought to carry out more in-depth analyses to discover the underlying causes of subpar performance in months with the lowest OTD rates. By delving into supplementary data from their database, they can devise tailored solutions to tackle these problems and improve supply chain performance. Furthermore, the company should dedicate time to identifying the unclear reasons for poor performance. Rather than leaving the reason cell blank, they should strive to uncover the root cause, which will enable them to gain a better understanding of their operations and contribute to the company's overall improvement.

Lastly, it is recommended that Company A utilize this research paper as a foundation to create a predictive model that assists in decision-making related to expedited and non-expedited shipping for upcoming orders. The model should include a variety of inputs, such as net sale value, perfect order rate, and customer receiving dates, to produce precise forecasts and inform the selection of transportation modes. By leveraging on the findings presented in this paper, the predictive model can aid Company A in refining its transportation decision-making process, ultimately resulting in enhanced OTD performance and increased supply chain effectiveness.

Appendix A: Arrival Performance Table

Total Orders	Number of Orders	Expedite Orders	Number of Orders	Non-Expedite Orders	Number of Orders
Late		Late		Late	
Customer Delivery Issues		Customer Delivery Issues		Customer Delivery Issues	
DC Replenishment		DC Replenishment		DC Replenishment	
Force Majeure		Force Majeure		Force Majeure	
Supply Related		Supply Related		Supply Related	
Transportation Management		Transportation Management		Transportation Management	
Warehouse Management		Warehouse Management		Warehouse Management	
Indiscernible Reason		Indiscernible Reason		Indiscernible Reason	
Missing 214		Missing 214		Missing 214	
Customer Delivery Issues		Customer Delivery Issues		Customer Delivery Issues	
IT & Master Data		IT & Master Data		IT & Master Data	
Transportation Management		Transportation Management		Transportation Management	
Warehouse Management		Warehouse Management		Warehouse Management	
Indiscernible Reason		Indiscernible Reason		Indiscernible Reason	
OnTime		OnTime		OnTime	
Customer Delivery Issues		Customer Delivery Issues		Customer Delivery Issues	
DC Replenishment		DC Replenishment		DC Replenishment	
Force Majeure		Force Majeure		Force Majeure	
Transportation Management		Transportation Management		Transportation Management	
Warehouse Management		Warehouse Management		Warehouse Management	
Indiscernible Reason		Indiscernible Reason		Indiscernible Reason	
Grand Total		Grand Total		Grand Total	
On-Time Delivery		On-Time Delivery		On-Time Delivery	

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EDUCATION

The Pennsylvania State University University Park, PA
Smeal College of Business 2019.09 - 2023.05
Schreyer Honors College 2021.09 - Present

- **Majors:** Supply Chain and Information Systems (BS) Major, Information Systems Management (UMNR) Minor

PROFESSIONAL EXPERIENCE

Guangdong Zhida Private Equity Fund Management Co., Ltd. Guangzhou, China
Research Assistant | Investment and Research Department 2022.05 - 2022.08

- Collected and organized the latest information on supply chain companies listed in A-share and H-share markets and analyzed the prospect of each niche market to provide value evaluation references for primary market investment decision-making.
- Assisted in briefing the market size, market penetration, and industry prospects of 5 companies featuring intelligent supply chain services, and evaluated their financial performances, the popularity of the product mixes, and the growth of their management to highlight their value for investment.
- Conducted data analysis via Stata taking the number of patents of corresponding companies in the OrbisIP database as the proxy for the outcome, and used Multiple Linear Regression and Beta Regression Model to determine the important indicators from influencing factors, which include the level of development spending, and lastly improve their chances of success in the patenting process.

Hefei Jac Xinfa Automobile Co., Ltd. Hefei, China
Data Mining Engineer Intern 2021.05 - 2021.08

- Analyzed the market behavior and social interactions of the automobile industry before and after COVID-19 to quantify the impact of the epidemic, and investigated the underlying reasons for changes in market activities.
- Obtained transaction data of our automobile transaction system with relevant influencing factors from public and private databases by using SQL, managed data cleaning process, and extracted structural influencing factors via R.
- Explored the impact of target customers' personal attributes and social activities via questionnaire based on a variety of regression analyses (ANOVA, Linear Regression), and built a preliminary prediction model for company management warning system.
- Performed data processing, analysis, and visualization using Python, managed data visualization and model-comparison results via Tableau, and utilized R Markdown for document editing, presenting findings intuitively in 15+ weekly research reports.

RESEARCH PROJECTS

Rockwell Automation | Penn State MOQ Project University Park, PA
Data Mining and Analyst Member 2021.08 - 2022.01

- Developed a Minimum Order Quantity Project obtaining the best transportation optimization and increasing the revenue opportunity to solve the challenges in the Rockwell Automation Distribution Center with two other members.
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EXTRACURRICULAR ACTIVITIES

Sigma Chi Mu Tau University Park, PA
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- Simulated more than 20 small business cases featuring exemplary members to gain expertise in supply chain management.
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Ascend Pan-Asian Leader Organization University Park, PA
ALDP Director 2020.08- 2020.12

- Led an Ascend Leadership Development Program (ALDP) team of twelve students through a series of projects and assignments, developing their business professionalism.
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SKILLS & INTERESTS

- **Languages:** English, Mandarin, Cantonese, German (Intermediate)
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