JFK Cargo View: A system to speed Truck Traffic Flow at JFK Airport

FINAL REPORT
March 2022

Submitted by:

Kazem Oryani, PhD
Principle Investigator (PI)
Senior Research Scientist
and Adjunct Professor
Center for Advanced Infrastructure
and Transportation
Rutgers University
kazem.oryani@rutgers.edu
kazem.oryani@farmingdale.edu

Jing (Peter) Jin, PhD
Co-Principle Investigator (Co-PI)
and Modelling Manager
Associate Professor of Civil and
Environmental Engineering
Center for Advanced Infrastructure
and Transportation
Rutgers University
peter.j.jin@rutgers.edu

Andrew J. Huber, MBA
Associate and Senior Consultant
Cayuga Partners
andy@cayugapartners.com

External Project Manager:
Scott Grimm-Lyon
Executive Director
GatewayJFK
167-43 148th Ave. Suite 203
Jamaica, NY 11434

Contributors in alphabetical order:

Anjiang Chen, PhD Candidate
Department of Civil
and Environmental Engineering
Rutgers University
anjiang.chen@rutgers.edu

Ethan Connor-Ross, MPA
Senior Vice President and Principle
Econsult Solutions Inc.
ConnerRoss@EconsultSolutions.com

Scott Grimm-Lyonn, AICP
Former Executive Director
GatewayJFK
director@gatewayjfk.org

Andrew J. Huber, MBA
Associate and Senior Consultant
Cayuga Partners
andy@cayugapartners.com

M. Nazril Islam
Professor and Chair
Computer Security
Farmingdale State College
islamn@farmingdale.edu

Jing (Peter) Jin, PhD
Associate Professor of Civil and Environmental
Engineering
Rutgers University
peter.j.jin@rutgers.edu

John Juzbasich, D.Ed.(c), MLD, PMP
Associate and Senior Consultant
Cayuga Partners
john@cayugapartners.com

John. A. Muckstadt, PhD
Founding Partner
Cayuga Partners
and Professor Emeritus, Cornell University
jmuckstadt@cornell.edu

Kazem Oryani, PhD
Senior Research Scientist
and Adjunct Professor
Center for Advanced Infrastructure
and Transportation
Rutgers University
kazem.oryani@rutgers.edu
kazem.oryani@farmingdale.edu

Michael Shenoda, PhD, P.E.
Assistant Professor
of Civil Engineering Technology
Farmingdale State College
shenodm@farmingdale.edu

In cooperation with

Rutgers, The State University of New Jersey
And
GatewayJFK

Disclaimer Statement

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. This document is disseminated under the sponsorship of the Department of Transportation, University Transportation Centers Program, in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof.

The Center for Advanced Infrastructure and Transportation (CAIT) is a Regional UTC Consortium led by Rutgers, The State University. Members of the consortium are Atlantic Cape Community College, Columbia University, Cornell University, New Jersey Institute of Technology, Polytechnic University of Puerto Rico, Princeton University, Rowan University, SUNY - Farmingdale State College, and SUNY - University at Buffalo. The Center is funded by the U.S. Department of Transportation.

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. CAIT-UTC-REG55	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle JFK Cargo View: A system to speed Truck Traffic Flow at JFK Airport		5. Report Date March, 2022 6. Performing Organization Code	
7. Author(s) Jing (Peter) Jin https://orcid.org/0000-0002-7688-3730 Kazem Oryani https://orcid.org/0000-0002-5821-0030 Andrew Huber https://orcid.org/0000-0002-8830-8493 Jack Muckstadt https://orcid.org/0000-0002-8812-5195		8. Performing Organization Report No. CAIT-UTC-REG55	
9. Performing Organization Name and Address Cayuga Partners, LLC 5950 Cleary Road, Livonia, NY 14487 Rutgers Center for Advanced Infrastructure and Transportation 100 Brett Road, Piscataway, NJ 08854		10. Work Unit No. 11. Contract or Grant No. 69A3551847102	
12. Sponsoring Agency Name and Address Center for Advanced Infrastructure and Transportation Rutgers, The State University of New Jersey 100 Brett Road, Piscataway, NJ 08854		13. Type of Report and Period Covered Final Report 3/1/2021 – 12/31/2021 14. Sponsoring Agency Code	
15. Supplementary Notes U.S. Department of Transportation/OST-R 1200 New Jersey Avenue, SE, Washington, DC 20590-0001			
16. Abstract This study was conducted by the project team from March 2021 to December, 2021. GatewayJFK and the Center for Advanced Infrastructure and Transportation (CAIT) at Rutgers University jointly funded this study. During the study period, several site visits and interviews of stakeholder were conducted by project team members in the off-airport GatewayJFK district and JFK Airport facilities to obtain input from stakeholders and observe operations. These include on-airport cargo ground handlers, off-airport transportation companies (including their truck drivers), and residents. In addition, several visits were made to the district to observe truck movement and business activity in the area, and residential uses impacted by the adjacent warehouse and logistics properties. Online and in-person surveys were conducted to gauge stakeholder satisfaction and insights as well the difficulty of getting to JFK Airport Area, level of congestion experienced, and delays related to the loading/unloading of cargo on-airport, and the challenges inherent within the off-airport GatewayJFK district. The preliminary results of this Phase I study are a compelling business case for an airport wide Truck Flow Management System (TFMS) and a list of future investments to retain and grow air cargo business at JFK Airport, and to enhance and support the on- and -off-airport synergy vital to the world's supply chain.			
17. Key Words Air cargo, congestion, truck flow, diesel emissions, dock scheduling, logistics		18. Distribution Statement	
19. Security Classification (of this report) Unclassified	20. Security Classification (of this page) Unclassified	21. No. of Pages 207	22. Price

Form DOT F 1700.7 (8-69)

The study team would like to thank Dr. Ali Maher, Professor and Director of the Center for Advanced Infrastructure and Transportation (CAIT) at Rutgers University for his guidance provided throughout the study period.

Efforts of the staff at CAIT for supporting this study is highly appreciated.

The study team would also like to thank Frank Liggio, GatewayJFK Chair, along with Scott Grimm-Lyon, former Director of GatewayJFK for their leadership, participation, guidance, and financial support of our study.

Rutgers Center for Advanced Infrastructure and Transportation® (CAIT) tackles some of the country's most pressing infrastructure challenges, especially those that are endemic in high-volume multimodal corridors like the Northeast.

The bulk of our efforts fall within several broad areas: assessing and monitoring the health of bridges, roads, and pipelines; creating revolutionary technologies, materials, and tools; formulating strategies to prolong the service life of infrastructure; and training the current and future workforce.

CAIT develops practical tools and processes that can be applied—not in theory, not on paper, not five years in the future—but as mainstream tools in the hands of transportation professionals solving real-world problems right now.

Since 1998, CAIT has been a University Transportation Center (UTC)—an elite group of academic research institutions sanctioned and supported by the U.S. Department of Transportation. It was named one of only five National UTCs in 2013 and selected to lead the Region 2 UTC in 2018.

GatewayJFK – Off Airport. On the Move. GatewayJFK is the off-airport cargo community that is a vital link in the global supply chain. It provides logistical support to the tons of goods that flow through JFK Airport and major ocean ports of call each year and is essential to the daily lives of New Yorkers, the nation and the world.

Accessed from Rockaway Boulevard, GatewayJFK is home to over 600 businesses and almost 8,000 workers and occupying approximately 4.1 million square feet of industrial and commercial buildings. The cargo related businesses exist alongside other light industrial and retail uses, hotels, community service and government facilities as well as 154 single family homes. Without question, GatewayJFK represents a distinct, unique New York City neighborhood.

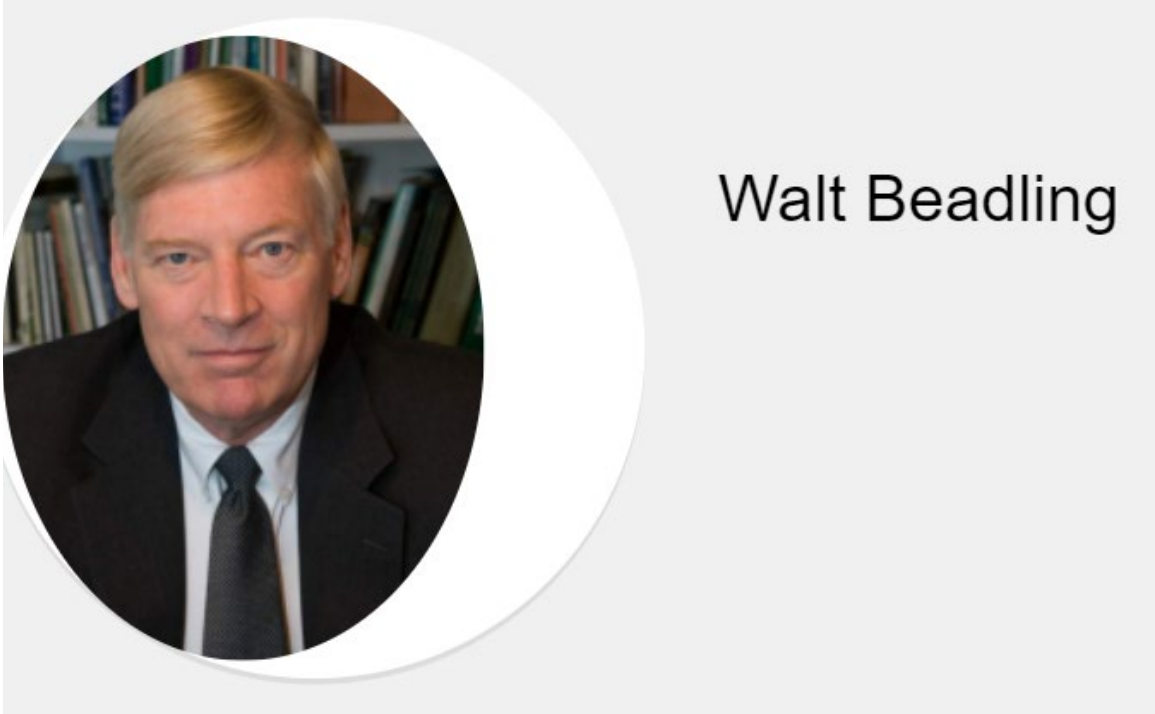
RUTGERS
Center for Advanced Infrastructure and Transportation

GatewayJFK
Off airport. On the move.

Dedication

This project is dedicated to our friend and colleague Walter H. Beadling III. For many years Walt was involved with the air cargo community at JFK airport. As he learned about the ongoing and increasing problems caused by truck congestion and the declining air cargo market share, he decided something needed to be done. For nearly a decade he doggedly pursued the idea of exploring whether a system could be put in place to alleviate truck congestion.

Our friend suffered a fatal heart attack in the middle of this Phase I Feasibility Study, just as he was preparing for our weekly team meeting. The entire team decided we should continue the project and try to complete it the way Walt would have wanted. We hope he would have been pleased with our work.



Executive Summary

From May 2021 – December 2021 we conducted a feasibility study for a Truck Flow Management System (TFMS) for air cargo supply chain participants in and around JFK International Airport. The project was sponsored by the Center for Advanced Infrastructure & Transportation (CAIT) at Rutgers University and GatewayJFK[i]. The study team included researchers from Rutgers University, Farmingdale State College (SUNY), Cayuga Partners, and Econsult Solutions Inc. (ESI).

The primary objective of a Truck Flow Management System is to reduce truck wait times and congestion at JFK airport. The project was envisioned to have four phases:

1. Establish Business Case and Plan
2. Acquire TFMS (Make and/or Buy)
3. Develop and Deploy
4. Operate and Maintain

Our conclusions from Phase 1 are:

1. Based on the results obtained from an online survey, interviews with truck drivers, shipment data from Alliance Ground International, our prototype simulation, and truck telematics data, we have confirmed that:
   a. Truck wait times at the airport are excessively long.
   b. Truck congestion is significant both on and off the airport.
   c. Waiting trucks can produce excessive diesel emissions, known to cause serious health issues.
2. There is an overwhelmingly positive business case for a TFMS based on the potential savings related to reducing truck wait times.
3. Commercially viable TFMS solutions are available.
4. An airport wide TFMS is required to maximize achievable benefits.
5. There are other more serious deficiencies in air cargo operations at JFK airport. Significant financial investments must be made to prevent continuing decline in air cargo business at JFK.

A common airport wide TFMS would provide a single process for all freight forwarders, ground handlers and truckers. For imported cargo, the TFMS would report when cargo has been broken down and ready for pickup, when the trucker is scheduled to pick up the cargo, and when the cargo has been loaded onto a truck. Based on our surveys, forwarders, truckers, and customers are frustrated by the inability to track cargo shipment status in a timely manner.

To stem the decline in air cargo business at JFK, the following are imperative:

- Adopt and integrate information technology solutions across organizations.
- Reengineer road access into and within JFK including a truck marshalling yard.
- Construct modern cargo handling facilities with ready access to flights.
- Recruit, train, and increase pay to retain cargo-related employees.
- Automate ground handling operations to move cargo faster and with less labor.

The recommendations listed above are long-term and require significant expenditures. A Truck Flow Management System however is not that costly and can bring shorter term improvements to the airport.

Contents

Introduction

In this document we report the team's observations and findings concerning the feasibility of deploying a Truck Flow Management System (TFMS) at John F. Kennedy International Airport (JFK) for the purpose of reducing truck wait times and congestion.

The first section contains background information and project objectives. We also describe the operational cargo environment at JFK Airport, the current state of cargo operations at the airport, and the need for improved information technology needed to manage the flow of air cargo.

The second section begins with an overview of the "Five Principles of Supply Chain Management" upon which the consulting practice of Cayuga Partners is based. It has been our experience that these Principles, as identified by our founder, Dr. Jack Muckstadt, have wide applicability to supply chain challenges in a variety of industries. In this section we describe how the Five Principles apply to air cargo operations and must be considered if we are to deploy a Truck Flow Management System (TFMS) that will have the desired effect of reducing wait times and congestion at JFK.

Key findings from an online survey we conducted with a sampling of JFK air cargo participants are presented in Section 3. The responses and comments made by survey participants provide insight to significant levels of dissatisfaction and guidance on addressing concerns. Their responses indicate that a TFMS will address some, but not all, causes of dissatisfaction.

Summaries of a small sample of trucker's interviews are presented in Section 4. Trucker comments are consistent with those from the online survey.

The fifth section profiles GatewayJFK, the off-airport cargo community located directly east of JFK airport. It also contains observations of cargo activities within the airport as well. These observations and overview are based on a tour of the area given to Kazem Oryani by former GatewayJFK Executive Director Scott Grimm-Lyon.

Section 6 contains a report on the Prototype Simulation developed by Peter Jin and his PhD Students. The purpose and functionality of the simulation as well as preliminary results are presented. The simulation is a valuable tool for quickly and inexpensively evaluating changes in operating conditions and practices.

Section 7 is a summary of reports by Michael Shenoda and Nazril Islam about the road network and conditions within the GatewayJFK district, the usability of GPS navigation on the airport, and a proposal for a secure cargo truck monitoring system at the airport. The complete reports can be found in Appendices C and D.

In the eighth section, we present system requirements for an air cargo TFMS. We also discuss a quantitative model evaluating the applicability of commercially available solutions to the JFK environment. The detailed requirements are contained within the model itself, which is documented in

the Excel file *TFMS Software Requirements and Vendor Evaluations.xlsx.* The requirements identified are categorized by system components and prioritized to differentiate needs from wants. The model can serve as a basis for soliciting information and proposals from potential software suppliers for a Truck Flow Management System.

The ninth section contains overviews of the commercial applications, including several that we elected not to evaluate in detail. The findings provide guidance for vendor negotiations and final selection.

Section 10 presents a business case and ecological benefits for deploying a Truck Flow Management System. The business and ecological impacts were derived by Ethan Connor-Ross and are reported in Section 11.

Benefits of employing a TFMS to JFK air cargo community stakeholders are listed in Section 10. The business and ecological benefits are further defined and quantified by Ethan Connor-Ross in Section 11.

In Section 12 we introduce important implementation considerations for future phases to deploy a TFMS. The considerations represent keys to success of IT-driven supply chain transformations that must not be ignored.

We end with a summary and conclusions.

1. Background and Project Objectives

Our project findings are based on observations made from April to December 2021.

During 2013, an ad hoc committee of JFK air cargo community members was formed to examine a variety of air cargo issues at the airport. The committee was specifically concerned about these challenges:

- Security
- Motor freight congestion
- Truck wait times
- Cargo theft
- Terrorism

The committee consisted of the following members:

- Walt Beadling, Cargo Security Alliance; Cayuga Partners LLC
- Bob Caton, President, JFK Airport Chamber of Commerce; Prologis Inc.
- Joe Clabby, KAAMCO Security Team Leader; CEO, Corporate Loss Prevention Associates
- Peter Debenigno, KAAMCO Trucking Industry Team Leader; Mobile Air Transport
- Joel Ditkowsky, JFK Customs Brokers & Freight Forwarders Association
- Stefano Pascucci, Executive VP, Business Development, Airport Plazas Inc.
- Joe Pesce, Chairman, KAAMCO Cargo Operations Committee; Air France
- Don Rivas, Port Authority NY & NJ
- Vida Shaver, IT Manager Cargo Airport Services (CAS)

The committee's concerns were supported by a study conducted by the New York City Economic Development Corporation and the Port Authority of New York and New Jersey that was reported in the Wall Street Journal[1]. That study found that:

1. Rising costs, traffic congestion and truck wait times are driving air cargo business away from JFK.
2. From 2004 to 2009, JFK air cargo related jobs fell from 50,000 to 30,000; wages from $3 billion to $1.75 billion; and sales from $8.5 billion to $5.2 billion.
3. Trucking, logistics companies and drivers try to avoid JFK when they can; ". . . one of the most costly places to conduct business in the ground transportation industry."

[1] JFK Declines as Air Cargo Destination, Wall Street Journal, February 24, 2013

Since 2013, the air cargo business environment at JFK has changed substantially:

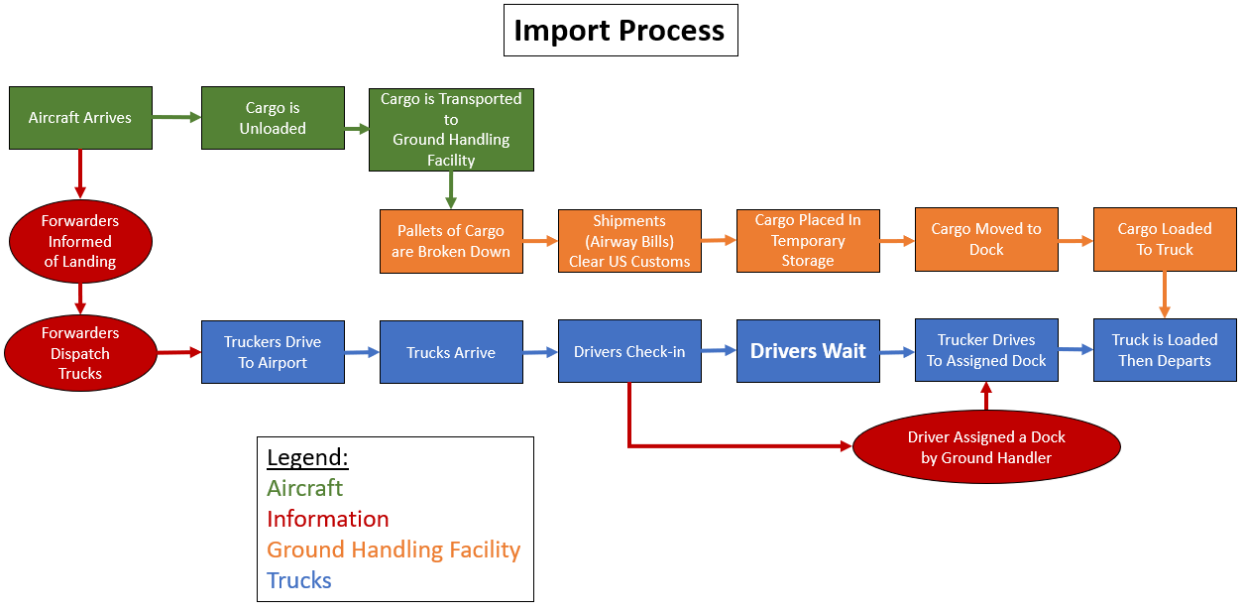
- The COVID-19 pandemic demonstrated the importance and value of air cargo to air carriers and the NYC Region.
- New Federal Motor Carrier Safety Administration Hours of Service (HOS) Regulations have constrained truck capacity, impacting the amount of time a driver can wait to pick up or drop off cargo.
- Mandatory 100% inspection regulations from the Transportation Security Administration have added to processing times in moving cargo through ground handling operations.

These events and the issues raised by the ad-hoc committee in 2013 must be addressed. The present environment has both detrimental economic and environmental consequences.

The Air Cargo Environment at JFK

The diagram below depicts a high-level flow of how cargo *currently* moves from aircraft at the airport. As the Legend indicates, the green boxes represent activities at the aircraft, orange represent ground handling activities, and blue represent truck activities. The red ovals represent the flow of information that trigger the movement of cargo.

After an arriving flight lands, the ground handler sends a dolly train to the aircraft where the cargo is unloaded from the aircraft and onto the dollies. The cargo is then trailered to the ground handling facility where it is unloaded from the dollies and broken down into individual packages for customs clearance. The cargo is then typically placed in temporary storage awaiting pickup. Once a truck arrives, they must check in and pass security checks. The trucker must then wait until the cargo is available, and a forklift, forklift operator and loading dock are available. The cargo is then removed from temporary storage and loaded onto the truck.



Dolly trains at a landing site

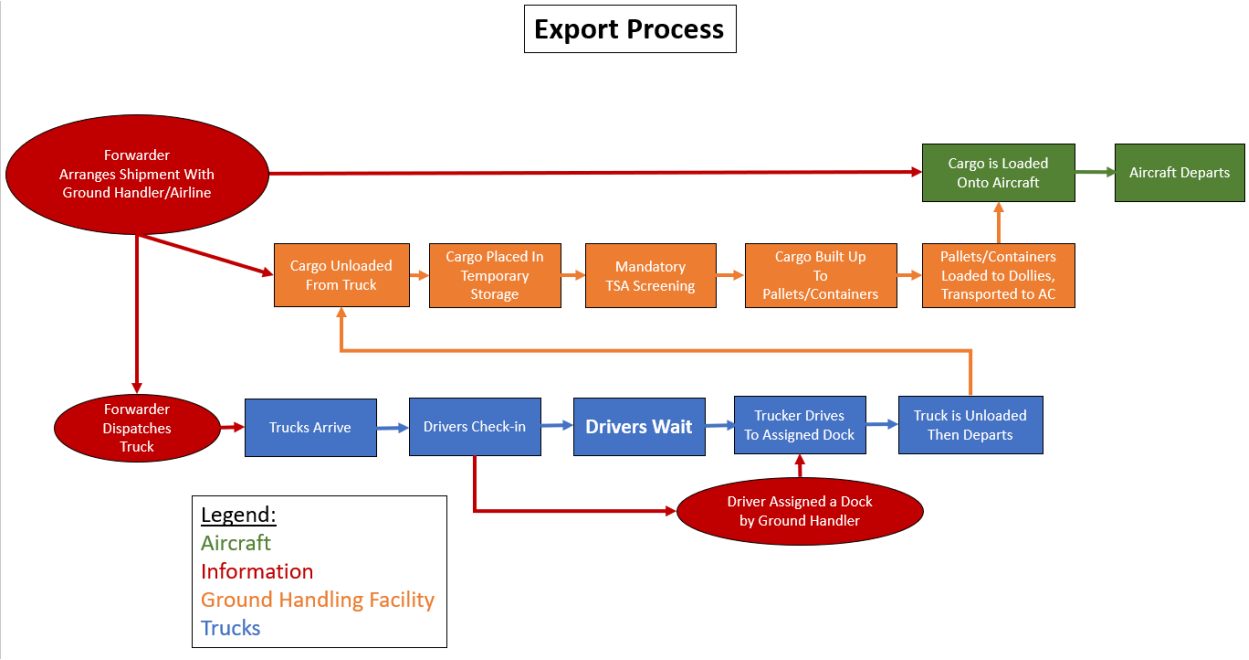
Airlines have information systems that track the flow of cargo from the departing airport to the arriving airport. Typically, freight forwarders, customs brokers and their customers can go to the airline's website to track flights by cargo airway bill number. Thus, they can be notified when the flight containing the cargo has landed. Fully integrated carriers like Amazon, FedEx, UPS and DHL have information systems that track the flow of cargo all the way to the end customer.

For other airlines however, there are no information systems to indicate when the cargo is ready at the ground handling facility for pickup. The only way a forwarder or trucker can find out if the cargo is ready is by calling the ground handler on the phone or by going to the airport and checking in at the ground handler facility. Our survey results indicated that ground handlers are often short-staffed and not able to answer the phone. Ideally, trucks would arrive when the cargo, a forklift and operator and dock are all available so that wait times would be minimized. However, without an information system to notify the truckers when the cargo can be loaded, they can only try calling or go to the airport after the flight has landed. This generally results in trucks arriving at the airport after the cargo has landed but not knowing if the cargo is yet available for pickup. As a result, drivers often must wait for hours before the cargo can be loaded onto their trucks.

A Truck Flow Management System would provide this important missing information. Forwarders and Truckers would be notified when the cargo is available for pickup, and they would be given the opportunity to reserve a dock and time slot. The trucker could then arrive at the scheduled time with little to no wait time.

Similarly, the next diagram depicts a high-level flow of how cargo moves from trucks to aircraft. The process is initiated by forwarders or customs brokers who arrange to have cargo transported for a customer. Ground handlers require cargo to arrive with enough time for them to prepare the cargo for its scheduled flight. Trucks then transport the cargo from the customers to the ground handling facility.

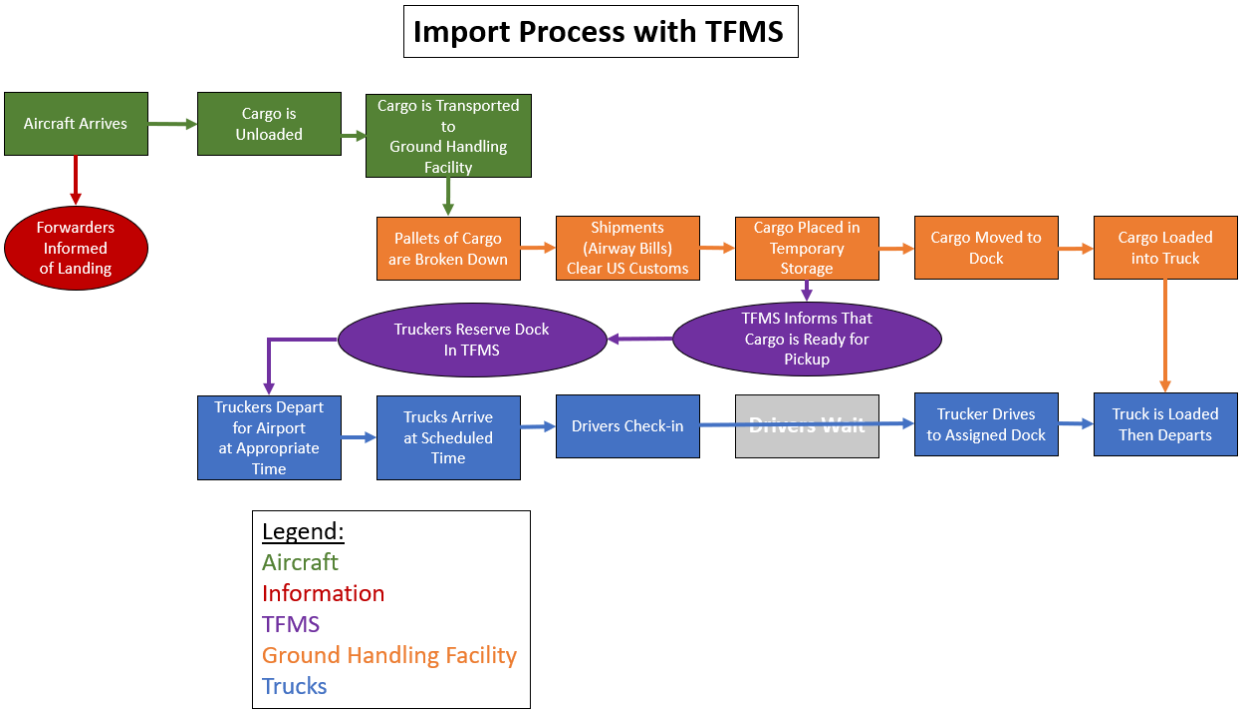
After arriving, drivers check in as they do for picking up cargo. The ground handling agent then assigns a dock for unloading when a dock, forklift, and forklift driver are available to receive the cargo. The cargo is then received and stored temporarily until mandatory TSA scanning can be performed. Scanned cargo is stored separately from cargo awaiting scanning. Cargo is then built up on pallets or loaded into containers prior to being transported to an awaiting aircraft on dolly trains.

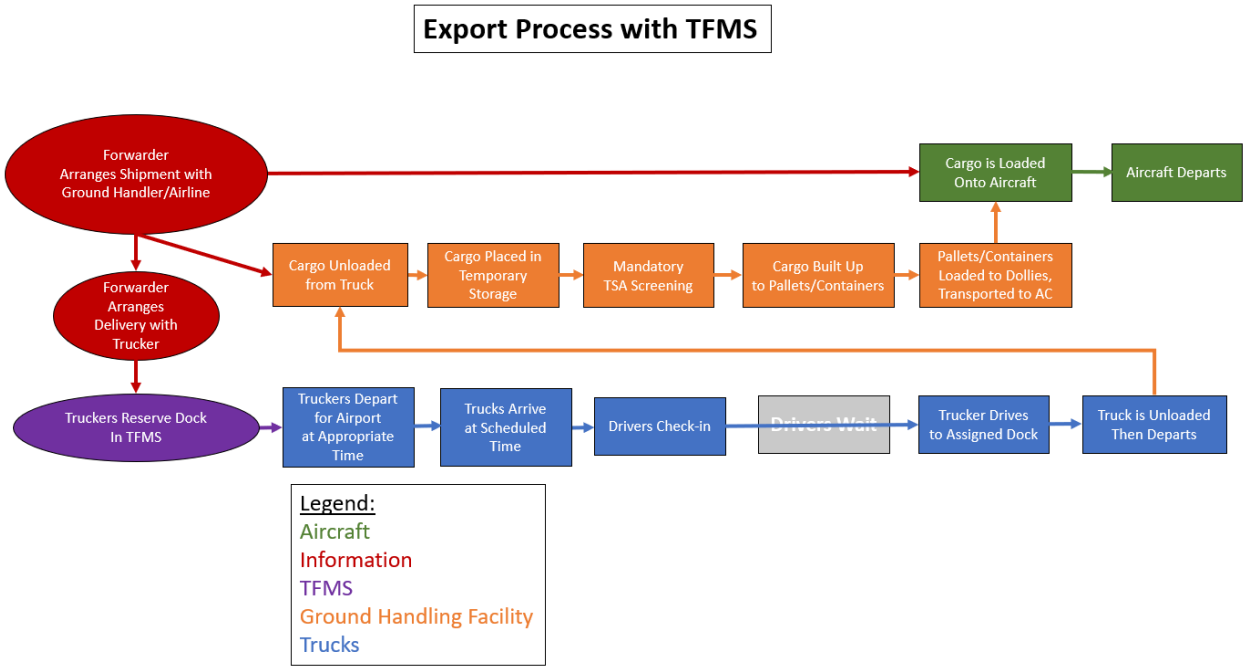


As with the import process, truckers currently experience long wait times with the export process. When the trucks arrive at the airport, the truckers do not know whether the ground handling facility has a dock, forklift, and forklift driver available to unload the cargo. If those resources are being consumed by other cargo, the driver must wait. Cargo drop-offs for export are given priority over pickups for import to ensure that shipments do not miss their flights. This prioritization can increase wait times for pickups.

A Truck Flow Management System we envision would reduce wait times for both import and export. By scheduling dock reservations prior to transporting cargo to the airport, truckers would be assured that a dock, forklift, and forklift driver will be available, thereby reducing or eliminating wait time. The proposed process changes with a TFMS are depicted on the following page for both the import and export processes.

Note the important changes. For import, drivers schedule a dock time following notification that the cargo is ready for pickup. Furthermore, the scheduled time of arrival ensures that a dock is available for the pickup activity to occur. Similarly for export, drivers would not need to wait at the airport for a dock assignment. They would schedule a time to arrive when a dock would be available. Thus, with a TFMS system, wait times are significantly reduced or eliminated for both import and export, greatly reducing truck congestion at the airport and lessening the environmental impact of idling trucks.





Our Project Objectives

Our project was initiated in 2021 to further study the congestion problem and to outline recommendations for community action. The project was sponsored by the Center for Advanced Infrastructure & Transportation (CAIT) at Rutgers University and GatewayJFK .

The high-level project objectives are to study how to:

- Minimize cargo truck wait times and traffic congestion at JFK Airport.
- Ensure a secure, traceable, verifiable chain of custody for JFK air cargo to prevent cargo theft and counter terrorism.
- Reduce logistics costs, make JFK airport more competitive as an international air cargo hub, attract new business, create jobs, and deliver economic benefit and growth to the communities surrounding JFK airport in particular NYC, and the region.

While many initiatives must ultimately be undertaken to improve daily operations and economic activity, a first, and essential, step is to deploy an airport wide Truck Flow Management System (TFMS). This system would:

1. Provide a mobile app for truckers.
2. Integrate with other critical air cargo applications with Electronic Data Interchange (EDI) messaging.
3. Schedule truck arrivals collaboratively.
4. Facilitate truck staging and temporary parking during peak times and when multiple Less-Than-Load (LTL) drop-offs and pick-ups occur.

Since we began this project, the urgency to improve air cargo operations has increased, as evidenced by:

- Air cargo volumes at JFK having increased 30% over 2020[2]
- Historic staffing shortages
- Existing Infrastructure not being able to process cargo volumes in a timely manner
- TSA's introduction of 100% Freighter Screening on July 1, 2021

Nearly 90% of the JFK Air Cargo Survey participants rated wait times at JFK as being worse or much worse than other airports[3]. When asked to rank potential solutions to improving wait times at JFK, "Improve Information Technology" was the 2nd ranked solution behind "Increase cargo handling capacity".

This section authored by:
Andrew J. Huber
John A. Muckstadt
Cayuga Partners

[2] Improving Air Cargo Throughput: The Challenge for Handlers, Airports and Their Stakeholders, Air Forwarders Association Webinar, 2021.

[3] 2 See Appendix A: FK Air Cargo Management Stakeholder Survey Results

2. Principles of Supply Chain Management: Implications for Airport Cargo Operations

The performance of a supply chain is influenced by the structure of business processes, information systems, and decision support rules as well as the nature of collaboration between supply chain partners. When designed poorly, as measured by managerial and physical attributes, incremental improvements will have little impact. A competitive advantage will exist only if several key elements exist in a supply chain. Our many years of consulting experience have consistently revealed five principles that must guide the development of an effective supply chain.

These Principles have been found to be required for maximum supply chain effectiveness in a wide variety of industries including manufacturing, retail, service operations, petroleum, transportation, the military and most recently in health-related systems They are equally as applicable to air cargo operations and must be considered if we are to reduce wait times and congestion at JFK airport significantly.

1. Know the customer.

First and foremost, without a clear understanding and definition of customer needs and desires, a supply chain cannot be effectively constructed. To gain this understanding, the project team has undertaken several activities to gain an understanding of the needs of air cargo community stakeholders. We

- Conducted a survey of air cargo stakeholders.
- Interviewed truck drivers at JFK airport.
- Developed a prototype simulation for evaluating the potential impacts of conditions and operational processes
- Participated in face-to-face and online meetings with experienced air cargo managers in airlines, ground handlers, freight forwarders, trucking and KAAMCO members.
- Interviewed trucking companies including Mobile Air Transport, K & N Trucking and Courier Service, and Uniglobe Worldwide.
- Tested and evaluated trucker claims about GPS navigation at the airport.
- Observed truck movement in and around the airport and conducted a road network geometric deficiency analysis.
- Toured cargo handling operations at American Airlines, Alliance Ground International, Mobile Air Transport.
- Reviewed cargo-related survey findings of the Air Forwarder Association.
- Attended webinars.
- Reviewed capabilities of cargo-related software applications.

To date the following priorities have become clear:

- Air cargo represents an important revenue source to passenger airlines. When passenger demand falls as it did during Covid-19, airlines are willing to transform and use passenger aircraft for cargo only.
- Airlines desire to maximize use of belly capacity to carry cargo. Every panelist on a recent Air Forwarder Association panel discussion confirmed that delays at shipping ports in the US has increased demand for air cargo.
- Trucking companies' capacities have been strained both by the Hours of Service (HOS) regulations and inability to recruit and employ enough truckers—a recognized nationwide problem.
- Ground handling operators have similarly been constrained by an inability to hire, screen, qualify and retain enough qualified employees.
- JFK facility investments have been focused on passenger traffic, but not for cargo related facilities. Insufficient capacity exists for warehousing and truck parking, particularly for 53' trailers.
- Brokers and freight forwarders have had to redirect cargo from JFK to other airports due to its capacity constraints.

2. Construct a lean supply chain organization that eliminates waste, variability, and uncertainty.

In general, for a supply chain to be efficient and effective, all partners must engineer, align, and execute their processes so that the entire chain can deliver short, predictable lead times. Even if the supply chain does have these attributes, it may not have a competitive advantage because variability and uncertainty will erode its efficiency and profitability. Lean supply chains must also be designed as a system that can respond to fluctuations in demand quickly and profitably. Simply contracting for a component or material will not result in a responsive supply base. Lean thinking must be extended beyond a firm's operations to the operations of an entire supply chain. To do so requires all participants to work together to ensure that deliveries of components occur with short, predictable, and repeatable lead times.

Most airlines at JFK airport have chosen to not manage their own cargo operations and consequently have outsourced ground handling to others. The integration between airlines and ground handlers is not well coordinated. Up-to-date information technology is not present across organizational boundaries. The onloading and offloading of aircraft and distribution of cargo to trucks generates a thick stack of paper documentation contained in a manila folder. Air cargo customers can only track the movement of their cargo while on its flight, but not once it is on the ground. By comparison, a consumer who orders an item online from Amazon can track the flow of her purchase from the point of shipment to the arrival at her/his doorstep.

Truckers do not know when a dock will be available and when cargo will be at which dock at what time for pickup. Complicating matters, ground handlers do not know when each truck will arrive. Thus, cargo movement is largely reactionary rather than planned and effectively communicated. This results in longer wait times to receive cargo both by the handlers and the truckers and causes in process inventory to build, further straining the capacity of ground handling facilities. Capacity is needed to respond to daily and hourly fluctuations in the arrival of cargo in a timely manner. Processes are required to coordinate what activities should occur in what order and to ensure information flows occur that direct all parties to perform activities in a coordinated manner.

3. Build a tightly coordinated information infrastructure.

A necessary condition for a supply chain to achieve a competitive advantage is the presence of an effective information infrastructure, both intra- and inter-organizationally. True supply chain collaboration requires partners to share up-to-date demand information, inventory status, requirements for daily capacity usage, evolving marketing plans, changes to product and process design, and logistics requirements to mention but a few. True collaboration requires more than the passing of data between successive supply chain members. How capacity is used daily must be considered from a systems perspective and not just from a local viewpoint. Simply passing data among partners only results in communication or coordination. It does not result in true collaboration.

While significant strides have been made in the flow of passengers, aircraft and flight schedules, data flows associated with cargo have not yet evolved to enable tight coordination and accurate, real-time flows of relevant data. The International Air Transport Association (IATA) has established standards for Extensible Markup Language (XML)-based Cargo Electronic Data Interchange (EDI); however, adoption has been slow. Nevertheless, these standards represent opportunities at JFK and elsewhere to build applications for cargo that can create more tightly coordinated flows of information.

A Truck Flow Management System (TFMS) is clearly needed to improve truck flow, but it alone cannot be expected to achieve the maximum levels of effectiveness that are possible. For maximum effectiveness, a tightly coordinated information infrastructure would be an airport-wide Cargo Management System, spanning across organizational boundaries of forwarders and brokers, airlines, ground handlers and truckers. By notifying a trucker when a dock will be available and when to pick up and drop off cargo, uncertainty would be reduced and would thereby reduce wait times and congestion.

4. Build tightly coupled business processes.

Business processes must be established both intra- and inter-organizationally to support the supply chain's strategic and tactical objectives. These processes, coupled with the information infrastructure, support the efficient flow of material through the supply chain. While much attention has been placed on understanding business processes within organizations, it is essential to understand what processes must be built inter-organizationally to leverage and enhance the capabilities of the chain's partners. These inter-organizational processes must be designed to take advantage of the increased information availability and technological advances, such as blockchain, in driving daily supply chain activities. Well employed business processes ensure the efficient and rapid flow of material throughout the entire supply chain.

The disintegration of cargo operations from airlines by outsourcing have certainly not resulted in tightly coupled business processes. Lowering wages with accompanying high workforce turnover and low worker morale is counterproductive. Compare the effectiveness of cargo handling at most passenger airlines to those of integrated cargo operations of FedEx, UPS, DHL, and Amazon. The differences are significant. We do not believe, however, that it is necessary for airlines to integrate vertically to improve business processes.

5. Construct tightly coupled decision support systems.

Over the past forty years, academics and software providers have concentrated on designing and building decision support systems (DSS) for individual firms and supply chains. These environments are based on different models of how supply chains operate. These systems and the rules embedded within them drive many of the day-to-day supply chain activities. Therefore, they have a substantial impact on the operating behavior, and consequently on the overall performance of a supply chain. How much they enhance this performance depends both on the accuracy of their input data and on the modeling approaches employed. Specifically, these decision support systems need to explicitly address uncertainty. If uncertainty is not properly considered, achieving operational and financial targets is not possible.

Airlines have deployed optimization models to manage the scheduling of flights and pricing of passenger tickets. One can see the effect of these models in tracking daily price fluctuations in ticket prices. These models guide the behavior of passengers, gate agents, baggage handlers and ticket reservation web sites. For air cargo however, these airlines have limited the delivery of cargo only to the point of hand-off to ground handlers. Systematic assignment of resources at ground handler operations is largely manually driven, not by any decision support systems that consider all arriving cargo and the human and equipment resources needed to move cargo to the end customer.

We envision an environment where the known cargo contents of aircraft on incoming flights would be assigned cargo-moving resources in a decision support system. This information would be communicated in real time to ground handler and trucking personnel via integrated applications for both ground handling personnel and the truckers.

The creation and deployment of the decision support system we envision is beyond the scope of just a Truck Flow Management System (TFMS). This would require incorporation into both the ground handler's systems and the TFMS. It would be based on a mathematical model that considers the capacities of each organization and the priorities of every shipment, taking into account real-time conditions from truck telematics data. Such a model would result in a more effective movement of cargo related resources which would provide better service at lower cost.

This section authored by:
Andrew J. Huber
John A. Muckstadt
Cayuga Partners

3. Online Stakeholder Survey Findings

As part of the JFK Truck Flow Management System (TFMS) Phase I Business Plan Project, a survey was conducted of air cargo business stakeholders at the JFK airport. The purpose of the survey was to:

1. Obtain feedback on wants, needs and business requirements from key stakeholders, potential users, and beneficiaries.
2. Gage the need and desire among stakeholders for the implementation of a TFMS at JFK.
3. Understand JFK airport's competitiveness with other airports as seen by air cargo industry participants.

Most of the responders were freight forwarders and customs brokers, which have the advantage of insights from end customer needs and wants as well as the barriers that long wait times have in meeting their needs. Responders express high levels of frustration with cargo handling at JFK.

We believe that a TFMS that includes electronic data interfaces, paperless truck check-in and ground handler dock scheduling could improve operational efficiency and effectiveness. However, a TFMS by itself will not fully alleviate most of the problems articulated by the survey's responders.

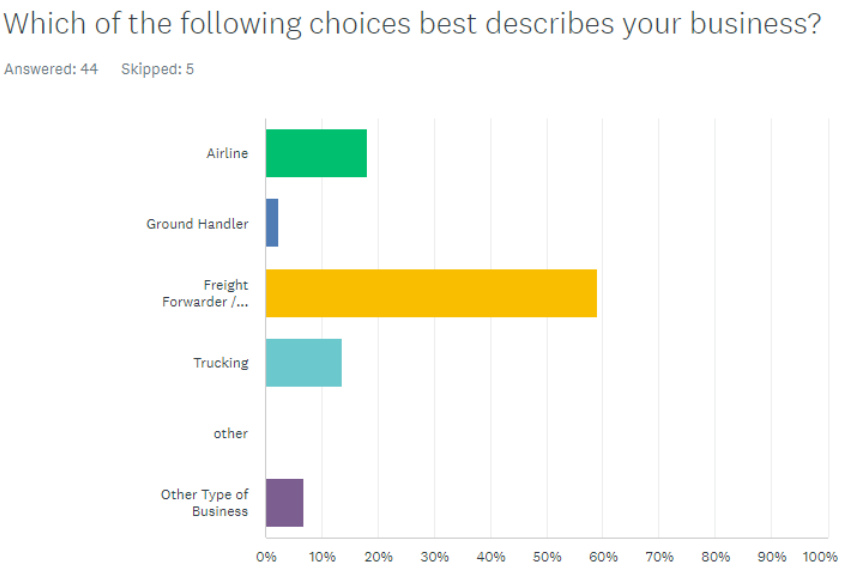
Responder Demographics

We received forty-nine completed surveys of which twenty-eight came from members of the JFK Customs Brokers and Forwarders Association (JFKBROKERS), ten from an advertisement in the GatewayJFK newsletter, seven from members of the Kennedy Airport Airlines Management Council (KAAMCO), and four from personal email invitations to our project Advisory Board members[4]. We also interviewed twenty-seven truckers, the results of which are presented in the next section.

As one would expect, 60% of the responses came from freight forwarder /customs brokers followed by airlines, trucking and other.

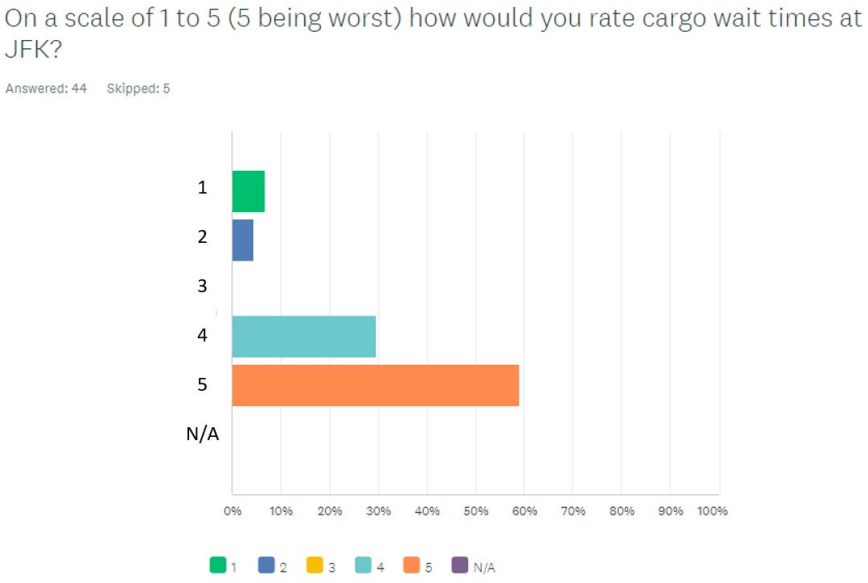
On the following pages we present some of the questions asked and the responses obtained.

[4] Project Advisory Board Members consisted of Brian Cooley of American Airlines, Peter Debenigno of Mobile Air Freight, Joe Clabby of Corporate Loss Prevention Associates, Tom Marzano of Alba Wheels Up and Steve Caulo of Alliance Ground International.

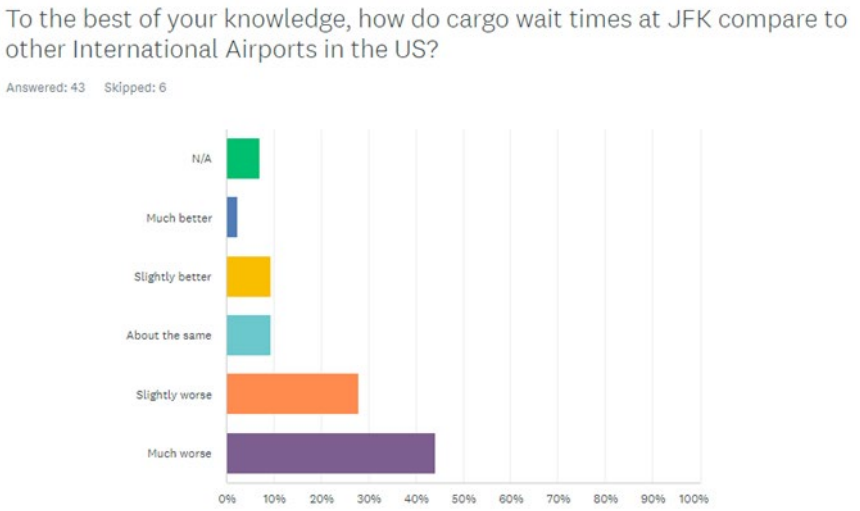


Stakeholder Satisfaction Levels

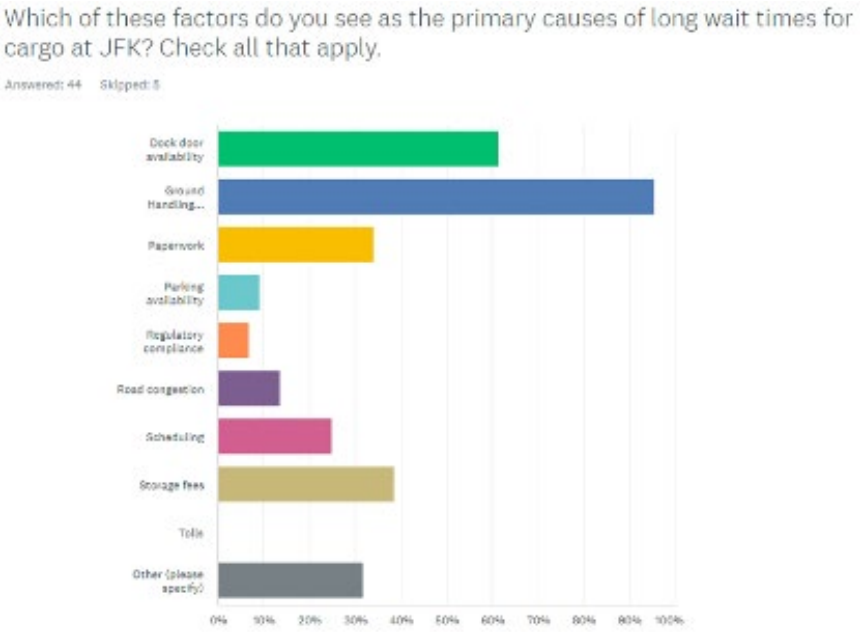
As expected, there is a high level of dissatisfaction with cargo wait times at JFK. 60% of responders gave wait times a “5” which is the worst rating, followed by a “4”. The three responders who rated wait times a “1” were confused about the scale. We know this because those three responders rated wait times at JFK worse or much worse than other airports.



Similarly, when asked how wait times at JFK compare to other International Airports in the US, most responders rated JFK “Much worse” or “Slightly worse”. It is surprising that a single responder felt that wait times were much better.



When asked to indicate the primary causes of long wait times, ground handling capacity and dock door availability were listed as primary.



Responders who indicate “Other” mentioned the following as causes:

- Airlines' short of manpower
- Cargo taking days to be broken down
- Communications
- Handling agents lack discipline and work ethic
- Incompetency of ground handling personal
- Lack of caring employees
- Lack of staffing, lack of training, lack of oversight
- Lack of workers and supervision
- Manpower, no locate, missing cargo
- No accountability
- No priority for Special Shipments & BUPs (Bulk Utilization Programs)
- Staff training, low wages with no experience
- Staff at the warehouses do not seem to be properly trained.

Given the mention of words like discipline, ethics, incompetency, caring, training, oversight, accountability, and experience, the stakeholders clearly and forcefully say that labor *capacity* is not the sole issue. They are frustrated by the low *quality* and *motivation* of employees.

In our experience, more efficient scheduling could in part help to alleviate capacity shortages by making best use of existing capacities. However, it is well known that severe labor shortages exist throughout the US and other countries as economies emerge from the Covid 19 pandemic. Additionally, the onboarding processes for cargo related jobs can take months before an employee is available with enough training and experience to be competent to perform the required tasks.

Nearly all the responders wrote about the impact of wait times on their business. Here is a summary of the topics mentioned in response to the question “Please describe any problems that excessive wait times have caused for you or your business. Be as specific as possible”. Verbatim individual responses can be found in Appendix B.

Problem mentioned	# Responses
Delivery delays	14
Excessive fees	12
Truck and driver utilization, congestion, trucker wait times	9
Unable to contact agents or excessive communication needed	6
Cost increases	5
Return trips required	5
Labor shortage	4
Too many problems to list	3
Customer complaints	3
Poor infrastructure	3
Loss of customers	2
Employee quality	2
Excessive paperwork	1
Dock availability	1
Revenue loss	1
Screening delays	1

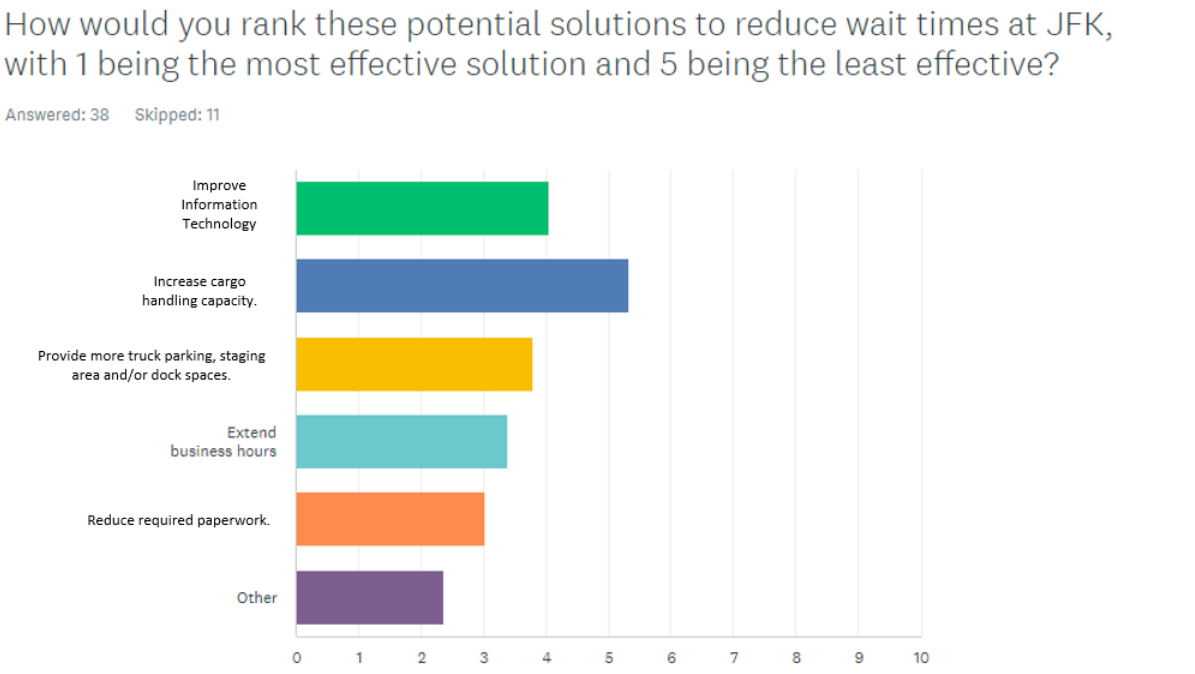
Sample sizes from Truckers, Airlines and Ground Handlers were too small to be reliable. However, challenges identified by Freight Forwarders and Customs Brokers are of interest.

From a forwarder/broker perspective, what would you say are some of the biggest challenges doing business at JFK? (These are the actual wording of responses.)

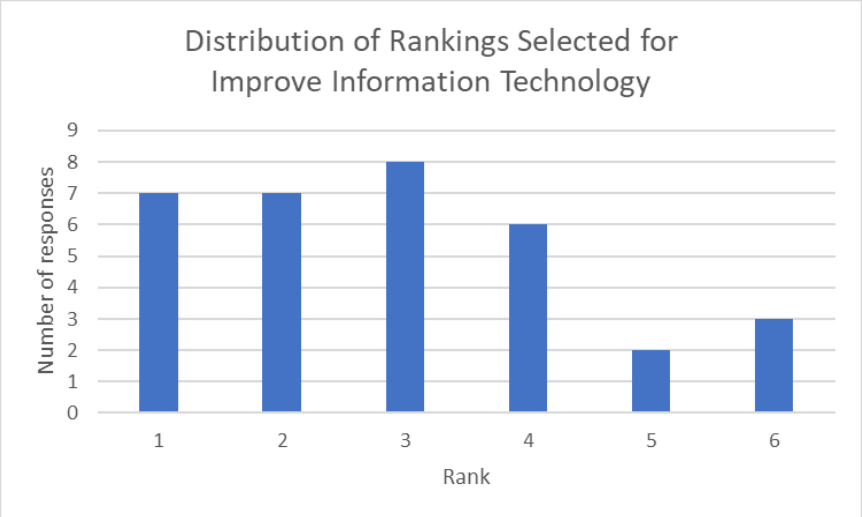
- Arranging Pick up within free time. Especially over the weekend.
- Because of the long waiting time, Trucking companies hesitate to deliver or pick-up freights at JFK, or limit the time waiting at the terminal, charge extra for the long waiting charges.
- Cargo breakdown times and long delays for pick up once freight is available
- Congestion, ground handling facilities.
- Delays, expense, aggravation.
- diminished free-time, onerous storage charges, lack of affordable warehouse and truckyard space in the surrounding areas
- Efficiency of airport operation
- excessive waiting time for airline pickup, not much trucker would like to pick up directly from JFK
- finding correct handling agent for minor airlines
- Getting freight picked up
- Ground handling agents not being held accountable for their lack of service. Storage fees being charged within 48 hours of arrival, regardless of the arrival date, including weekends and holidays.
- having to pick up freight on the weekend when it arrives on Friday and Sunday is the last free day. Monday storage starts at $1 per kilo per day or like thousands of dollars per day.
- incompetence, not enough employees to handle workload

- lack of communication, lack of staffing, lack of training, lack of knowledge, lack of oversight, lack of caring for the job
- no one answers the phone, and when they do have no training on how to verify AMS (Automated Manifest System), fees, LFD (Last Free Day)....
- On time Cargo delivery to Airlines by flight's cut off time
- There is no one to talk to in order to correct. Most airlines do not pick up the phone. Airline staff are often unskilled, rude, and not proficient enough to correct problems. Not enough understanding of AMS and AMS codes and too many errors arriving cargo in AMS.
- Third party handlers that have no care for the industry. Inadequate system and warehouse automation. Compare to European and Asian freight hubs, JFK is 30 years behind!!
- Though the challenges are not limited to JFK, but certainly the turnaround time of a shipments arrival to freight availability is the greatest issue.
- Trucking overtime charges
- Unable to contact import customer service
- We as brokers spend more time than needed calling and HOLDING (sometimes 45-75minutes) to have free time extended because cargo was not available. TOTAL WASTE OF OUR STAFFS TIME

Survey responders were asked to rank potential solutions to reducing air cargo wait times at JFK and were asked for further suggestions.



Improving information technology was ranked by 34 of the 38 respondents who answered this question. Here is the distribution of their rankings:



Twenty-eight of the responders provided suggestions in response to the question "Please specify any other suggestions you have to reduce wait times at JFK." Here is a ranking of the suggestions.

Suggestion	**# Responses**
Add employees	9
Increase dock capacity	5
More/better training	4
Allow more free time before charging storage fees	3
Prioritize build units, Unit Load Devices (ULDs), Special, small packages	2
Motivated agents	2
Increase pay	2
Dock scheduling	2
Rebuild infrastructure	1
Manage to Key Performance Indicators (KPIs)	1
More effective management	1
Reduce paperwork	1
Provide incentive pay	1
Fire slowest workers	1
Improve ground handler service quality	1
Have airlines hold ground handlers accountable	1
Use robots[5]	1

[5] See Freight Operators Plan to Deploy Thousands of Remote-Operated Forklifts, Wall Street Journal, January 19, 2022

Survey Conclusions

Based on the survey, we conclude that:

1. There is a high level of dissatisfaction and frustration with air cargo wait times by all participant groups. Specifically, responders are unhappy with:
    a. The length of the wait times,
    b. Having to make return trips,
    c. Communication challenges:
        i. Inaccurate data,
        ii. Manual flow of information,
        iii. Long hold times and agents not answering the phone,
    d. Paying storage fees when the cycle time is not the customer's fault,
    e. Lack of parking and turnaround space on the airport campus,
    f. Insufficient training of ground handling agents,
    g. Lack of courtesy by ground handling agents,
    h. Insufficient ground handling resources (docks, people, forklifts, etc.),
    i. Traffic congestion when picking up and dropping off cargo.
2. Introducing a Truck Flow Management System (TFMS) would help alleviate some, but not all excessive wait times.

More details from the online survey can be found in Appendix A: JFK Airport Truck JFK Air Cargo Truck Flow Management Stakeholder Survey Results.

This section authored by:
Andrew J. Huber
John A. Muckstadt
Cayuga Partners

4. Trucker Interview Findings

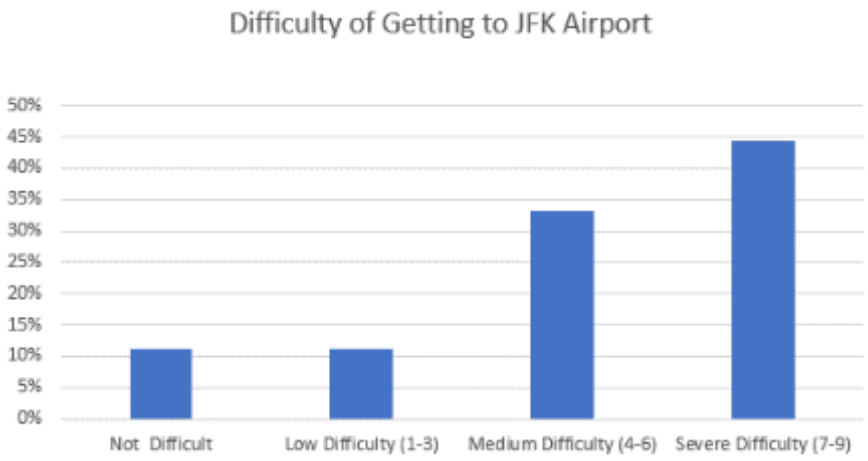
Principle Investigator Kazem Oryani and Student Intern Kwanita Williams interviewed 23 truck drivers in and around JFK Airport. While not a large sample size, the perspectives of the truckers are noted.

79% of the drivers reported full loads in their trucks.

Based on their reported times to get to the airport, most came from the New York City area:

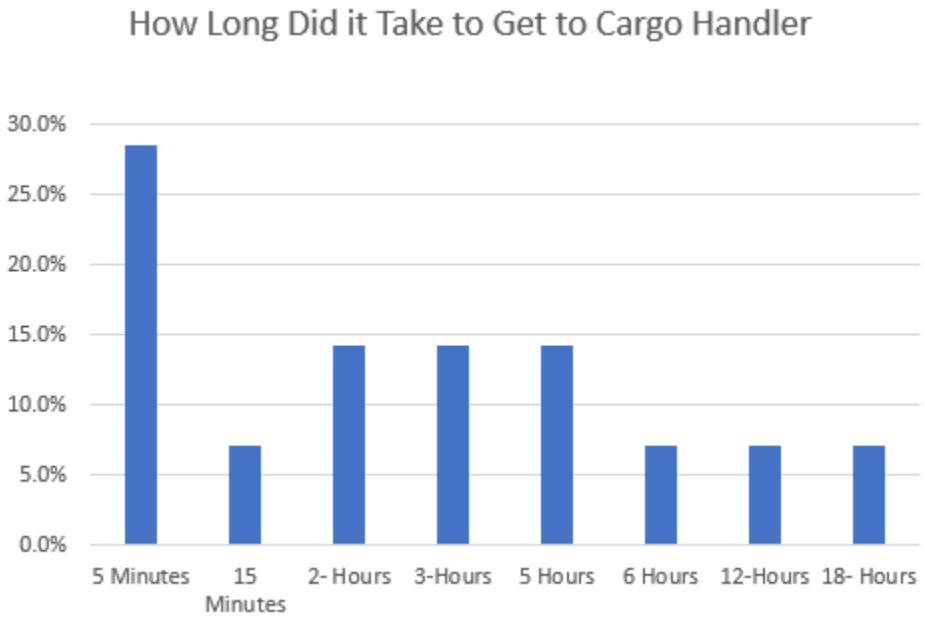
n=11

44% found it extremely difficult to get to the airport:



n=9

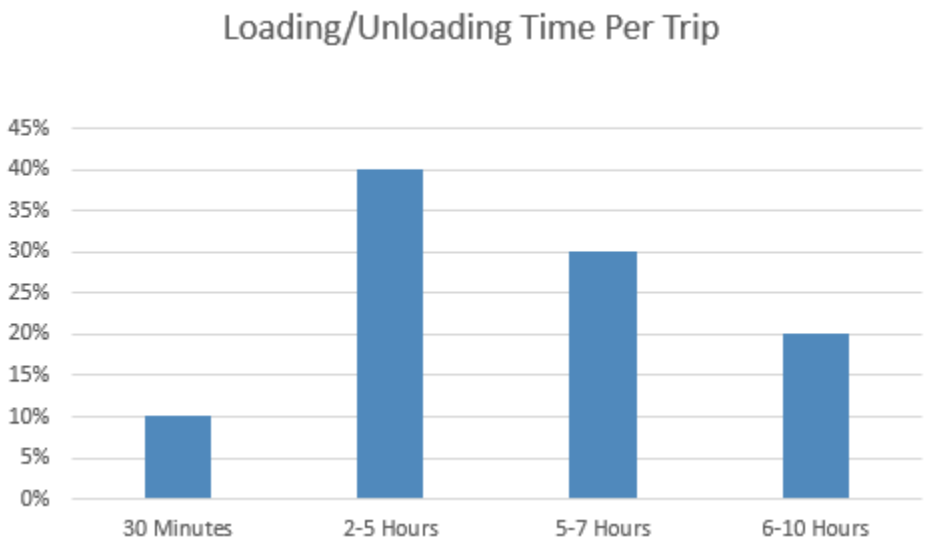
While most were able to get to the ground handler quickly, one driver reported 18 hours. We suspect this could be due to trucking Hours of Service regulations.[6]



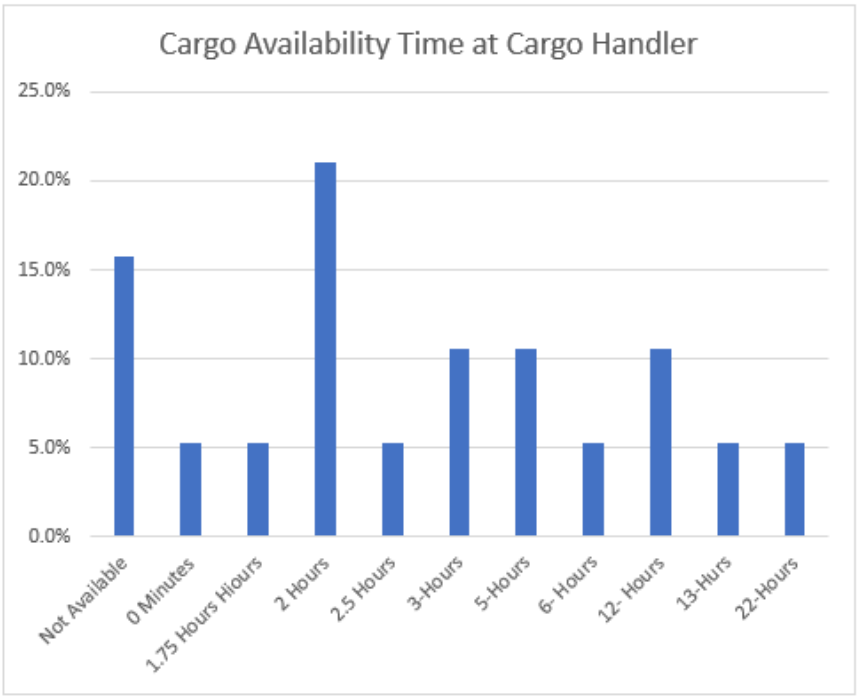
n=16

[6] https://www.fmcsa.dot.gov/regulations/hours-service/summary-hours-service-regulations

Of particular interest to our study are the long times reported by some of the truckers to load and unload cargo and the availability of cargo at the ground handler:

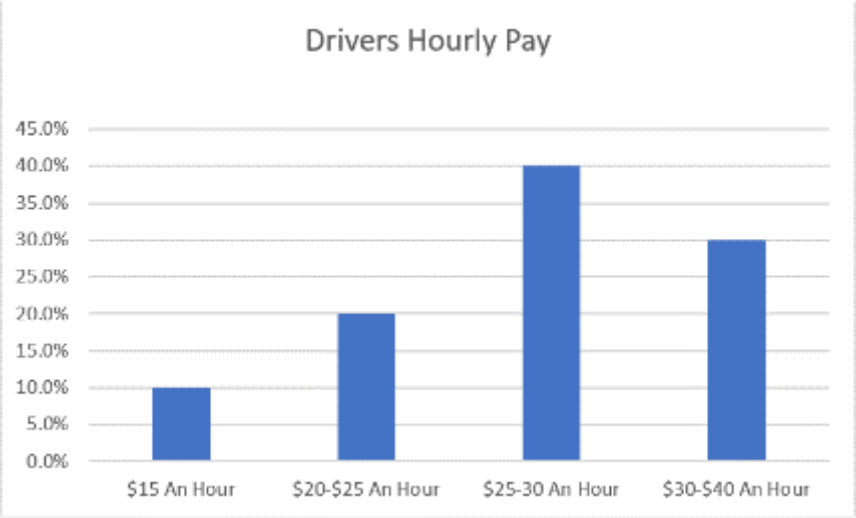


n=14



n-19

Only 10 of the truck drivers shared their hourly wage, but the ranges are consistent with the data found in the Business Case section:



n= 10

The interviews with the truckers are consistent with the responses to our online survey. Oftentimes truckers must wait many hours to pick up or drop off cargo. A few truckers commented that if they had a choice, they would prefer not to truck to JFK Airport.

The full trucker survey results are reported in Appendix B.

This section authored by:
Andrew J. Huber
John A. Muckstadt
Cayuga Partners

5. GatewayJFK and the Springfield Gardens Community

GatewayJFK is a not-for-profit 501(c)(3) public-private partnership, structured as a NYC Business Improvement District (BID), to provide technical and professional services, supplemental services and improvements, and advocacy for the District's off- airport cargo community, a vital link in the global supply chain, and for all of those who live, work or visit the area. Located in the Springfield Gardens neighborhood of southeast Queens, the GatewayJFK district is adjacent to the northern JFK Airport boundary separated by Rockaway Boulevard and Nassau Expressway.

GatewayJFK is home to over 600 businesses and almost 8,000 workers and occupying approximately 4.1 million square feet of industrial and commercial buildings. The cargo related businesses exist alongside other light industrial and retail uses, hotels, community service and government facilities as well as 154 single family homes. Several visits were made to the off-airport cargo district and other areas around JFK to become familiar with the community and to observe truck traffic flows, the road network layout, and the environment. We also wanted to gain a better understanding of the socio-economic profile of the Springfield Gardens neighborhood overall and the interactions between the residential and commercial activities of the district, as GatewayJFK encourages its members to work together to strike an appropriate balance between industrial, commercial, and residential interests. Within the GatewayJFK district, residents are represented by Spring Jam Block Association and United Neighbors Civic Association, both are represented on the GatewayJFK board of directors.

During one visit, Scott Grimm-Lyon, GatewayJFK's former Executive Director, provided Kazem Oryani with an overview of the off-airport GatewayJFK district's traffic, social, and economic conditions. During that visit, Scott and Kazem walked, observed, and drove through the district and videotaped the neighborhood and economic activities taking place there. They also visited JFK airport cargo areas A, B, C and D.

Figure 1: Map of the GatewayJFK business improvement district boundary[7]

[7] Map courtesy of www.gatewayjfk.org

GatewayJFK's land area comprises 215 acres consisting of 525 properties represented by local and major institutional owners such as Seagis, RREEF, LINK, and Terrano. The main thoroughfare of the GatewayJFK district is Rockaway Boulevard, and the complex assembly of properties within the District either front Rockaway Boulevard or are just to the east and west of Rockaway Boulevard from Baisley Boulevard South to 183rd Street. Although there are areas where the district boundary lines are irregular, generally, the major eastern boundary is 147th Avenue and the western boundary is defined partly by the Nassau Expressway. The existing character and configuration of the off-airport GatewayJFK district is a complex assembly of private- and public-sector owned properties, and are not part of the managed development of JFK International Airport itself, nor the Prologis JFK Logistics Center to the south on Rockaway Blvd[8].

Four governmental agencies are anchor employers in the district. These include the NYS DMV, MTA Bus Depot, DSNY sanitation garages and the Federal Aviation Administration-Eastern Regional Office. Major private employers include UPS, FedEx, FTN, DHL, Kuehne+Nagel, MRZ Trucking, Aramex International Couriers, Borenstein Caterers, Gabrielli Trucks, along with multiple hotels, and many others. Airgate Industrial Park, a four-building complex located at 132nd Avenue & Baisley Boulevard, just off Rockaway Boulevard, benefits from an internal driveway and courtyard, unlike many district properties where loading and unloading spills over to public streets, as 53-foot trucks exceed the maximum length for loading bays at aging logistics facilities. Currently under construction is the Bartlett Dairy distribution center on Rockaway Boulevard at 146th Avenue and Nassau Expressway. It replaces a damaged facility in North Jamaica.

GatewayJFK off-airport cargo community is home to more than 600 businesses and 8,000 workers providing logistical support to products and goods flowing through JFK airport and the region.

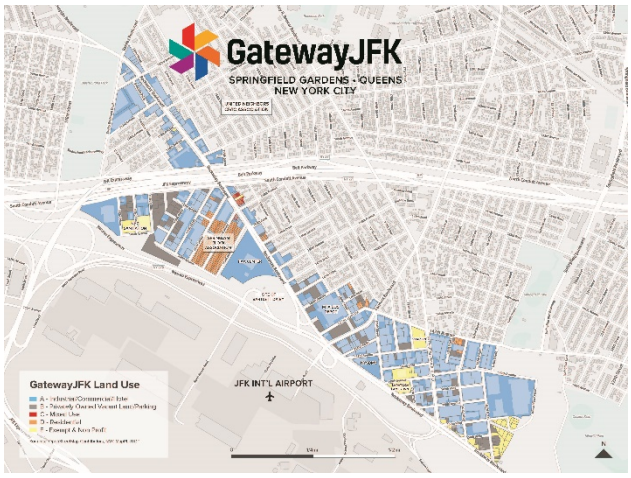


Figure 2: GatewayJFK Land Use

[8] This section's information provided courtesy of Barbara J. Cohen, Interim Executive Director, GatewayJFK.

Transportation and Social Services

A recent initiative, GatewayJFK in association with Dollaride (ride-sharing app) offers a shuttle service between the transportation hub in Downtown Jamaica to the GatewayJFK district, as public transport is limited to bus service.

Jamaica station is the fourth busiest train station in North America, with over one thousand trains and over 200,000 passengers passing through each business day. The station consists of the Long Island Railroad (LIRR), four subway lines (A, E, J, Z), public buses, and AirTrain. AirTrain connects Jamaica Station to JFK terminals via a Van Wyck Expressway overpass. The Gateway JFK shuttle service runs on Sutphin Boulevard and Rockaway Boulevard and ends at the district. While there is MTA bus service in the district, workers both within the district and at the airport have welcomed fast and more reliable transit service for the area.

Figure 2: Connection Service[9]

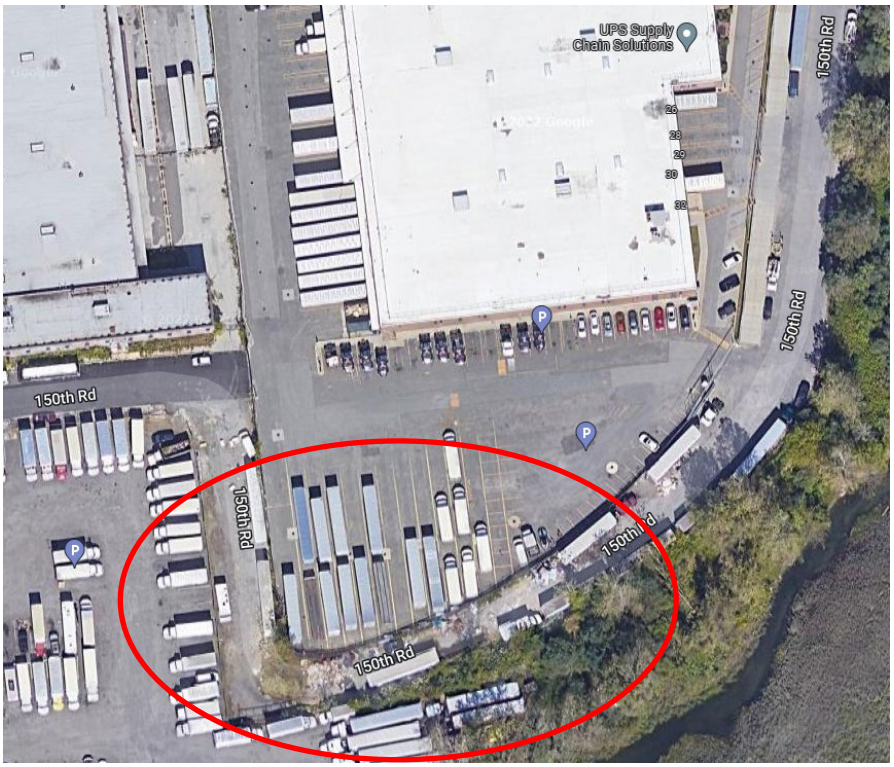
District Traffic and Transportation Challenges

The legacy roads around JFK Airport were not designed for the common 53-foot trailers that, when attached to a tractor, average 72 feet in length. Within the GatewayJFK off-airport district, the roadway uses have clearly grown without a master plan. Street layouts are narrow and cargo bays are mostly short in length and cannot accommodate tractor trailers.

At 148th avenue we observed a trailer blocking the street in its attempt to get to a bay. This required several attempts by the driver to place the trailer in the bay, resulting in stopped traffic. The problem is not as severe with vans and smaller four axle and six axle (Single unit box) trucks that also operate in the area.

[9] Map courtesy of www.gatewayjfk.org

There are discontinuities reflected in the GatewayJFK district. For example, there is an abutted roadway adjacent to the UPS Operations Center at 150th Road and 183rd Street that is a dead end and not connected to other streets.



The loading dock aprons on most of the older buildings take up most of the space around them. These older buildings were only built to accommodate box trucks, not tractor-trailers. Newer buildings under development in the area are multi-story for both office and warehouses and will be able to accommodate the longer trailers.

Some truck drivers told us that they prefer to avoid New York City and JFK Airport due to congestion, lack of space and parking. The area requires advanced skill in backing up and making turns in such restricted areas. Modern facilities are more forgiving. This is notable because of current driver shortages and attempts by trucking companies to recruit younger and newly trained Commercial Driver's License (CDL) operators.

Navigating larger trucks around telephone and electric power poles is another challenge. We observed a truck blocking a two-way street while approaching a loading dock. Several moves forward and backward were required to position the trailer at the dock. The tractor itself was parked in the narrow street in front of a Skyline Logistics facility. Drivers have no choice but to use public streets as driveways for the freight handling facilities. This creates congestion as illustrated in Figures 4 and 5.
Figures 6 and 7 are examples of trucks parking on public streets.

Figure 4: Truck blocking road.

Figure 5: Truck blocking road.

Figure 6: Truck Parked on Street

Figure 7: Truck Parked on Street

While we did see tractor-trailers blocking streets, we also did see some trailers unhooked from their trucks, occupying badly needed parking spaces. Drivers are supposed to do this to prevent blocked traffic, but this is rarely done due to the level of effort to unhook and reattach trailers. Truckers told us that they often receive parking tickets. Independent drivers must bear the cost and most consider tickets a cost of doing business around JFK.

Figure 8 shows the truck types seen at the airport.

Figure 8: A Box Truck and Tractor-Trailer

Figure 9: Entry Points to JFK Airport for Trucks

Entry points to JFK Airport for trucks are limited. Farmers Boulevard is a hub for cargo-related businesses. Another entry point for trucks is Guy. R. Brewer Boulevard.

Trucks drive down Rockaway Boulevard and then via Farmers Boulevard or Guy R Brewer Boulevard to enter airport property, as seen in Figure 9.

Employee parking is limited. Signs indicating "No Parking, Car Will Be Towed Guaranteed" can be seen.

Parking spaces for trucks and cars in the cargo areas are limited, although there is a parking lot for cars and trucks within the airport.

Some private bus operators use the parking areas that were not highly utilized during our visit, presumably due to the high prices, as indicated in Figure 10, where the daily rate for cars is $35 and $59 for trucks.

Figure 10: Parking Rates at the Airport

Transferring cargo from aircraft to ground handling facilities on the airport is accomplished by means of dolly trains and, at some buildings, by taxiing the aircraft. Figure 11 shows direct loading and unloading of a Saudi Arabia cargo plane at the Delta cargo area.

Figure 11: Cargo Loading at the Delta Facility

There is demand for larger and more modern cargo facilities with adequate parking. While some businesses have their own fleets and parking areas, many freight forwarders work with independent truckers that park on residential streets. This is a source of conflict between the residents and the business community. Because trucks had been parking on Springfield Boulevard, GatewayJFK worked with community representatives to add signs indicating truck parking is prohibited. There is limited legal on-street parking for trucks away from residential areas.

On the east side of the district, Prologis has a large-scale freight facility. It borders the Idlewild Park wetland and nature preserve bordering Nassau County. Four miles from the district in an area known as Five Towns, Amazon is building a new facility adjacent to the Nassau Expressway. There are other trucking facilities around Five Towns.

On the north side of the district there are trucking facilities on South Conduit Avenue. South Conduit Avenue runs parallel to the Belt Parkway where trucks are prohibited.

After walking around the district, we drove on Farmers Boulevard and 147th Avenue where we noticed a tractor-trailer blocking the street due to inadequate docking space at a warehouse. We also saw a former car repair shop that is being taken over by a Chinese freight forwarding company.

Other facilities in the district include a seafood distribution center, Verizon truck parking, and a Salvation Army shelter and other homeless shelters, and auto repair shops where vehicles often block sidewalks.

Within the cargo areas of the airport, some trucks use warehouse bays for parking where docks are not used for loading and unloading.

Trucks access on-airport ground handling facilities via Boundary Road, which runs parallel to the Nassau Expressway. As the name implies, Boundary Road marks the border of the JFK Airport property and connects with Rockaway Boulevard and the Nassau Expressway via Guy Brewer and Farmers Boulevards. The American Airline on-airport cargo facility is directly across from Farmers Boulevard. From there we

could see the NYS DMV office building, which is next to GatewayJFK's office.

Consolidation of On-Airport Cargo Terminals

The Port Authority and New York and New Jersey (PANYNJ) intends to consolidate all the cargo facilities into Cargo Area D due to its larger space. However, due to long lease contracts in Cargo Areas A, B, and C, that could take years to accomplish.

Summary of Findings

Observations made from various site visits to the off-airport GatewayJFK district are summarized below.

1. The road network within the off-airport GatewayJFK area has grown without a master plan. Streets are too narrow and cargo bays insufficient to accommodate 53-foot trailers.
2. Trucks often block traffic in the roadways in warehouse areas, and when trailers are unhitched and stored on the street, badly needed parking spaces are lost.
3. There is an abutted dead-end roadway adjacent to the UPS Operations Center contributing to congestion and a back-alley area for illegal dumping
4. Telephone and power lines are obstructions that trucks must navigate around, contributing to blocked streets.
5. There is inadequate parking for trucks, buses and cars, and parking prices are high.
6. Illegal dumping frequently occurs, particularly near the UPS operations center at 150th Road
7. Trucks parked on residential streets create an annoyance for residents in the area.
8. There is no buffer zone between houses and warehouses.
9. Older warehouses cannot accommodate 53-foot trailers, resulting in streets being blocked.
10. Drivers told us they prefer to avoid driving to the airport due to congestion and the lack of parking and space to maneuver.
11. Despite the congestion, some residents told us they generally feel safe living and working in the area.

This section authored by:
Kazem Oryani
Center for Advanced Infrastructure and Transportation (CAIT), Rutgers University

6. A Prototype Simulation for Air Cargo Operations

Purpose of the Simulation Model

A simulation model imitates the operation of a real-world process or system over time. Our simulation represents the ground handling activities and their interaction with trucks and aircraft at the JFK airport. In addition, the simulation model provides us with a tool to evaluate the operational performance and to identify bottlenecks. We designed simulation scenarios to determine how performance measures, such as truck wait times, vary as consequence of implementing a TFMS at JFK. In general, by using simulation modeling, we may determine the efficacy of implementing proposed changes to managing cargo operations in the real world.

In this project, we chose Anylogic simulation software to construct a prototype simulation model of a sample ground handling facility in JFK airport. We illustrate, using this prototype, how changes in resource levels and the presence of a TFMS impact performance measures. This illustration is based on observations of actual operations at JFK and on a set of reasonable assumptions.

Simulation Framework/Modules

In Anylogic, our prototype simulation model construction framework and modules are mainly composed of the following parts. In the further development of the simulation model, we can use similar frameworks and modules.

- Agents: All individuals and group units used in the model are established as agents in Anylogic, which are the main building blocks of our simulation model. An agent is a unit of model design that can have behavior, action, timing, etc. Within an agent, we can define variables, events, state charts, and flow diagrams, embed other agents and add process flowcharts. In Figure 1 we show examples of agent types used in our Anylogic prototype simulation model. A Main agent contains all other agents in the list and each agent is the object of various discrete events in the simulation model.

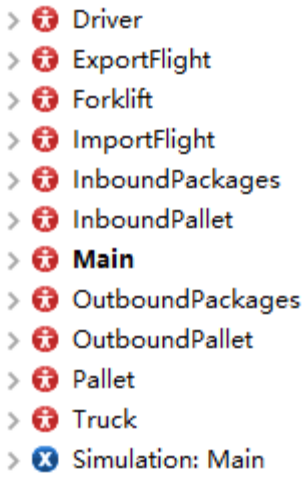


Figure 1. Examples of agents in Anylogic simulation model

- Flowcharts: All agent behaviors, time spent, and interactions with other agents can be created by AnyLogic Process Modeling Library. The Process Modeling Library supports building the discrete event by using different blocks representing real-world system processes (sequences of operations typically involving queues, delays, service, and resource utilization). The processes are specified in the form of flowcharts to indicate the defining process of each agent. The Process Modeling Library also works closely with the AnyLogic presentation/animation framework. This enables us to develop sophisticated process animations.

  In addition, other libraries can establish processes and behaviors for specific agent objects. These libraries have similar functions but can highlight the behavioral characteristics of specific agents. For example, for human resources in the model, a pedestrian library characterizes the queue in the service; for material handling items, such as conveyors, there is a material handling attribute that can define their length, operating speed, and other characteristics.

  The flowchart in the Figure 2a shows the basic process for each aircraft. The first two blocks represent an aircraft arrival and the start of movement to the ground handling facility. The 'MoveToLot' means the aircraft moves to the aircraft load/unload lot. All the facility activities happen in the 'FacilityActivity' block and, when it finishes, the 'LeaveLot' block lets the aircraft leave the facility.

  All discrete events that flow in our Anylogic simulation model, such as truck process, truck driver checking-in process, and facility activities, have flowcharts with similar structure. In combination, these flowcharts constitute the whole simulation model.

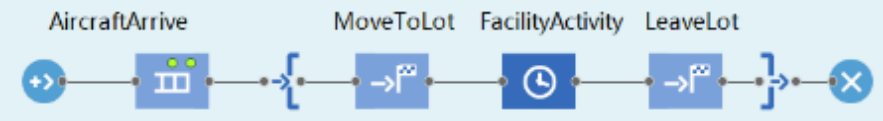


Figure 2a. Example of flowchart for aircraft in simulation model

- Data Table: Each simulation model has a database for storing real-world input data and recording output data during the simulation process. In the entire simulation process, a dynamically updated array list and data statistics table can also be established to record dynamically changing resource levels or states during the simulation process, such as the number of packages in a truck and timestamp information.

Simulation Inputs/Outputs

In our prototype simulation model, the simulation inputs are divided into three categories: data collection samples based on site visits, simulation preset parameters based on collected data, and agents' parameters based on objective facts. All these input data in the database can be used when the corresponding discrete event occurs at a specific timestamp. For example, when the flowchart of the truck in the simulation model runs the unloading blocks, the number of packages carried by this truck in the database will be called, and the model will generate this number of packages and pass these data to the statistical table, which is used as a part of the output or may be called by other flowcharts. When the entire data flow in the database is processed, the simulation ends, and we may observe the final output results.

The prototype simulation model provides various precise outputs based on simulation input data. The wait time of trucks in each process of ground handling facilities is the main output indicator. First, we use a sample information system to show an improvement of reducing the wait time. Also, we use it to illustrate the possible advantages of employing a TFMS over the sample baseline scenario.

Initial findings from prototype simulation model

The prototype simulation model validates that the simulation method is feasible. Based on sample input data and reasonable sample parameter settings, the prototype outputs reasonable sample wait time indicators for trucks. We believe that these indicators can reflect the actual wait times when a sufficient amount of real-world input data are available. Importantly, after running a sample simulation scenario in which some operational improvements are assumed, wait times are reduced, which will be explained in greater detail later. We can also design a simulation scenario in which a fully operational TFMS is present and then make a preliminary evaluation of its operational value.

Data Collection for the Simulation Model

Three site visits were made to the air cargo ground handling facilities at the JFK airport. The goal was to obtain data and to observe workflow in a facility that would provide the basis for developing a simulation prototype. Additionally, we also analyzed truck operating data provided by The American

Transportation Research Institute (ATRI). These data show detailed minute-by-minute truck movements for each arriving and departing truck.

Site Visit Summary of Alliance Ground International (AGI)

We visited Alliance Ground International (AGI), Cargo Building 77A Eastern Road, Jamaica, NY 11430 on August 27th, 2021. AGI provides airline cargo handling service for 55 airlines at 13 airports in the United States. AGI has four buildings for operations in the JFK airport area, and we visited the building 77. During the site visit, we:

- Obtained ground handling operational flowchart data and discussed with AGI management team what their critical issues and challenges are.
- Toured the facility and obtained an understanding of the general layout/functional areas.
- Collected sample data, which include:
    - The flight schedules for August 2021. These data include the flight ID, scheduled arrival and departure times, and origin and destination information as shown in Figure 2b.

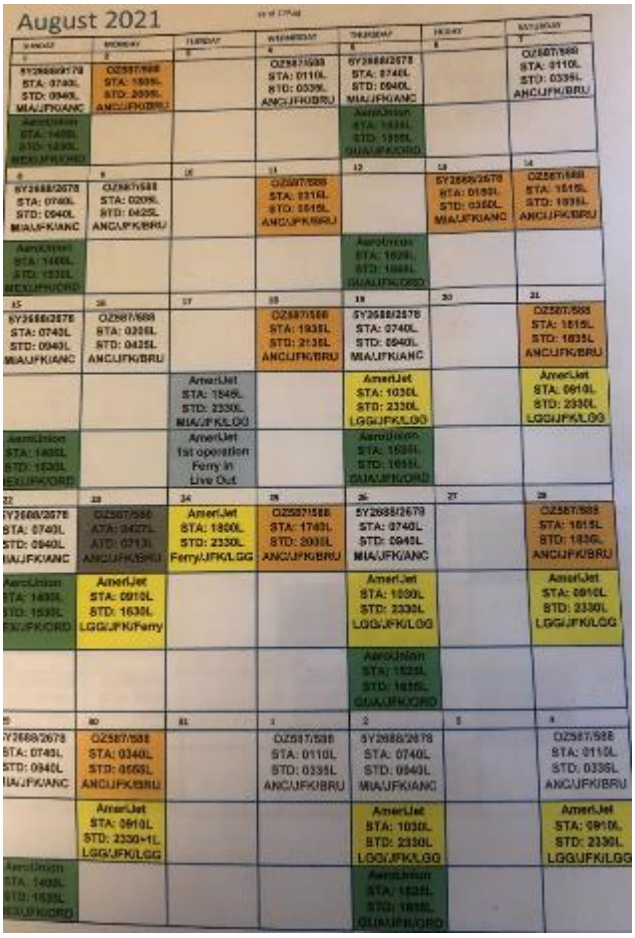


Figure 2b. Flights schedule in August 2021 of AGI

    - Hard copies of Airway Bill data and corresponding cargos and pallet processing information. We obtained Airway bill data for some flights from August 21st to 26th

including manifest data and timestamps and the timestamps of part of the pallet building up processing. However, all Asiana airline information is not authorized to share, and other data are not complete. Therefore, when constructing the simulation model, we also estimated certain parameters values.

- An electronic version of the annual tonnage report data for different airlines. These data indicate the monthly import and export tonnage for each airline served by AGI in 2019 and 2020. These data help us to determine the cargo throughput capacity of different airlines.

○ Customer	○ 20-Aug
○ BUILDING 77	○ Kilos
○ BUILDING 77-B TOTAL:	○ 4.9 million
○ ASIANA AIRLINES	○ 4.1 million
○ Other Flights	○ 0.9 million
○ Tonnage Ratio (Asiana/Others)	○ 4.6 times

- Table 1. Sample AGI cargo volume report in August 2020

- Facility layouts, equipment (e.g., forklifts, screening belt, weighing station, staff, area functions) data.
- Sample surveys for truck drivers at Building 77.

Site Visit Summary of Mobile Air Transport

We visited Mobile Air Transport, 144-30 157th ST, Jamaica NY 11433 on September 22nd, 2021. Mobile Air is the Northeast's service partner, and they have a daily seamless line haul system connecting 9 hubs to 4,200 cities across NY state and beyond.

During the site visit, we:

- Obtained ground handling operational flowchart data and discussed with the management team about what the critical issues and challenges are
- Toured the facility and obtained an understanding of the general layout/functional areas.
- Collected sample data, which includes:
  - Sample truck data with corresponding Airway bill information.
  - Warehouse layout, equipment (e.g., forklifts, screening belt, weighing station, staff, area functions) data.
  - Sample truck driver interviews at Mobile Air location.

Site Visit Summary of American Airlines (AA) Cargo

We visited to American Airlines Cargo, 79 N Boundary Rd, Queens, NY 11430 on November 3rd, 2021. AA Cargo operation building in JFK is Building 79. AA moves cargo on its passenger aircraft throughout the

world. According to Port Authority reports, AA was the 3rd-ranked airline for cargo tons at JFK in the pre-pandemic year 2019 and is currently running 10th as of Aug 2021.

During the site visit, we:

- Obtained ground handling operational flowchart data and discussed with AA management team what the critical issues and challenges are
- Toured the facility and obtained an understanding of the general layout/functional areas.
- Obtained sample data, including:
    - Flights and delivery trucking schedules in the recent month from the official website. We are working with the AA Cargo management team to obtain additional data.

NEW YORK CITY (JFK)											
Flight	Flight #	M	T	W	Th	F	S	S	Departs	Arrives	Aircraft	Notes
JFK-DEL	AA292	✈	✈	✈	✈	✈	✈	✈	20:05	20:30+1	777-300	Dec 1-31
JFK-TLV	AA146	✈	✈	✈	✈	✈	✈	✈	23:55	17:15+1	777-200	Dec 1-15
JFK-TLV	AA146	✈	✈	✈	✈	✈	✈	✈	00:05	17:15	777-200	Dec 17-31
JFK-TLV	AA148					✈			23:59	17:15+1	777-200	Dec 31

    - Figure 3. Flights schedule in December 2021 of AA Cargo
    - Warehouse layout, equipment (e.g., forklifts, screening belt, weighing station, staff, area functions) data.

American Transportation Research Institute (ATRI) Dataset

Based on the site visits to the ground handling facilities located within the JFK airport, we obtained the ATRI truck operation data samples, which contains the truck GPS location information and speed for each recorded truck at the recorded timestamp. The date range is one to two weeks for ATRI data around the site visit date. Connecting ATRI data to the visited ground handling facilities, we first defined the geo boundary of each ground handling facility and selected all the ATRI data points for trucks within the defined area based on the GPS information. In Figure 4 we show the AA cargo geo boundary (red color) and the ATRI trucks points (blue color) within it. The geo boundary includes the entrance/exit of the ground handling facility and the connecting roads. The data indicate that the truck has entered or left the warehouse. Next, we calculated each truck's dwell time inside the area near the ground handling facility. These data provide us with a sample of truck wait times. These data are used to generate truck wait times in our prototype simulation.

Figure 4. Example of ATRI data within defined AA Cargo warehouse area

For AGI, the ATRI data are for August 17th to August 31st, 2021. By defining the geo boundary of the AGI facility, we selected data pertaining to seven trucks. The dwell time within the area ranges from several minutes to 8 hours.

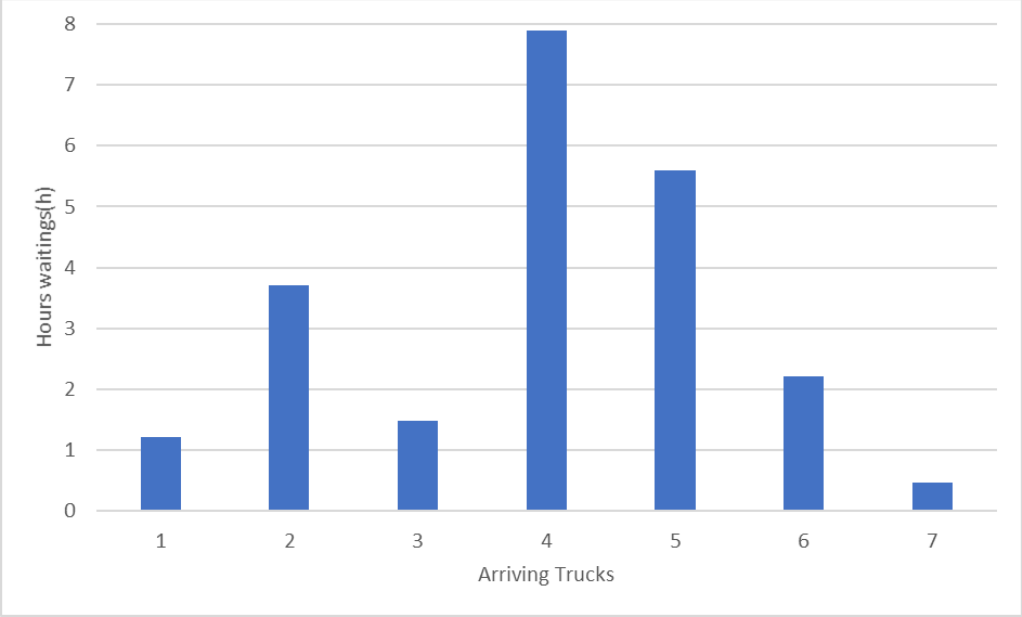


Figure 5. Trucks wait time in AGI warehouse area by ATRI data

The ATRI data for Mobile Air are for September 20th to September 27th, 2021. By defining its geo boundary, we selected data pertaining to ten trucks. The dwell time within the area is from several minutes to 5 hours.

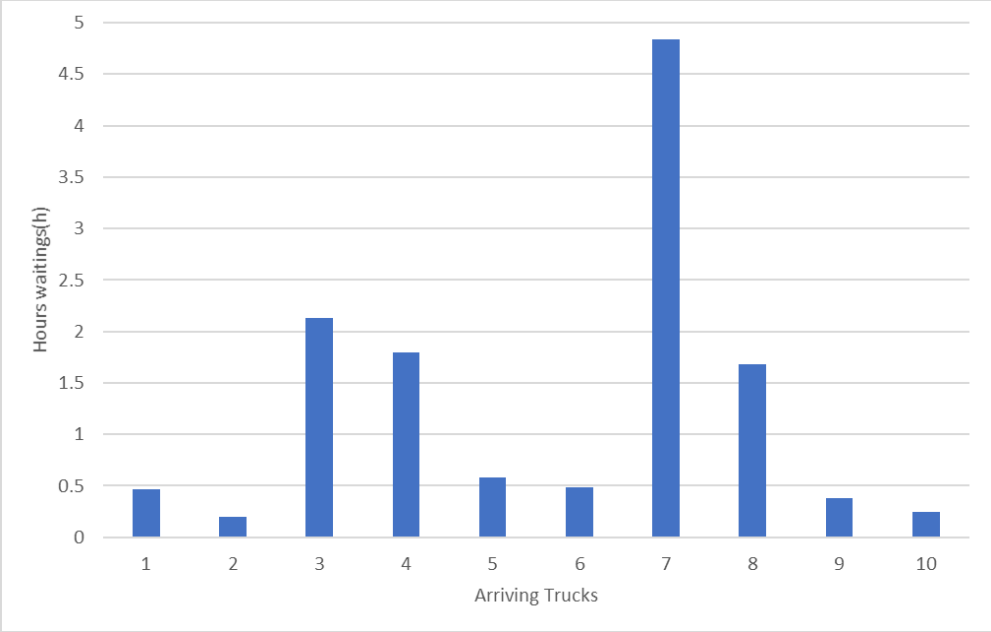


Figure 6. Trucks wait time in Mobile Air warehouse area by ATRI data

The ATRI data for the AA Cargo warehouse are for November 1st to November 8th, 2021. By defining its geo boundary, we selected data pertaining to 14 trucks. The dwell time within the area ranges from several minutes to 11 hours. Two trucks came to the AA Cargo area twice, and one came to the AA Cargo three times on different days in the date range.

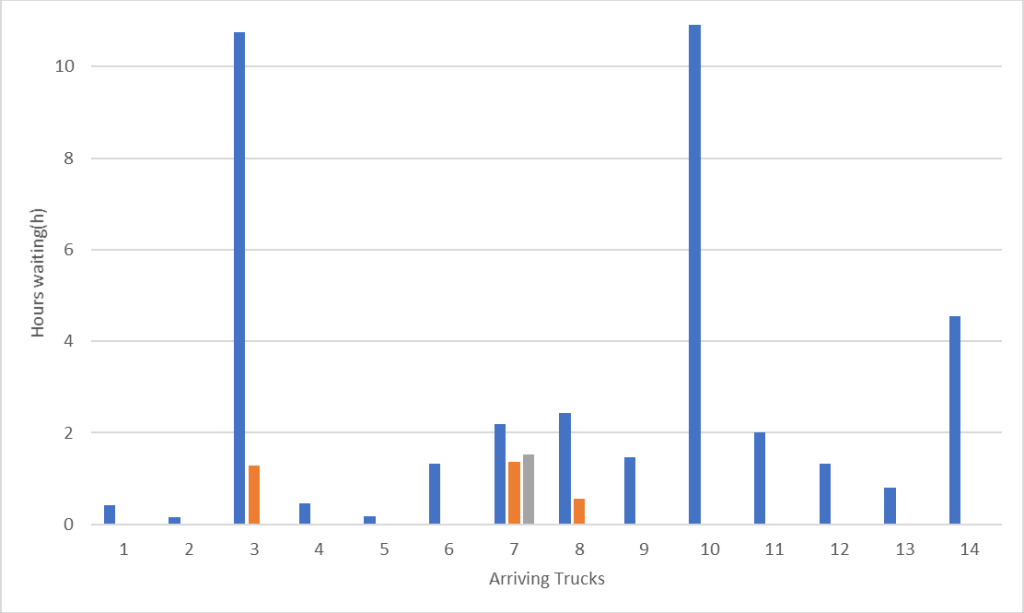


Figure 7. Trucks wait time in AA Cargo warehouse area by ATRI data

Simulation Scenarios and Settings

Based on the available data and observations from our site visits, we represented a ground handling facility in JFK in our prototype simulation model written in Anylogic software. For the privacy protection, we call it Cargo Handling Facility A. The input data are on the collected data from Cargo Handling Facility A and reasonable estimates of certain parameter values. Also, we use some pronouns to represent the airline names and flight ID. Airline A is the main airline operated by Cargo Handling Facility A, which has the most tonnage of cargo and corresponding trucks, followed by other airlines, Airline B, Airline C, and so on. The flight ID is combined by the date of the flight and the airline name, for example, 0822AirlineA. Our prototype simulation model represents the handling operations, truck activity, and aircraft activity at this facility. Truck wait times are outcomes of the execution of the simulation. We designed two scenarios to analyze the impact of information flow on reducing truck waiting times. The details of the entire prototype simulation model are as follows.

The Layout of Cargo Handling Facility A

In the prototype simulation model, we first sketched the layouts of Cargo Handling Facility A. For the privacy protection, we remove the satellite image of Cargo Handling Facility A and use geometries to represent the building areas. The yellow polygon means the Cargo Handling Facility A building, and the blue rectangles correspond to the truck parking lot, which is connected to the loading and unloading dock, the aircraft load and unload lot, and the parking lot for other vehicles, respectively. All areas are in line with the actual situation observed during the site visit.

Figure 8. Layouts of Cargo Handling Facility A building area

Based on the facility's internal structure obtained during the site visit, we defined the facility's internal functional areas in detail as shown in the figure below. All areas are in line with the actual situation observed by the site visit. The yellow polygon means the building of Cargo Handling Facility A, and the blue rectangles correspond to the functional areas in the Cargo Handling Facility A.

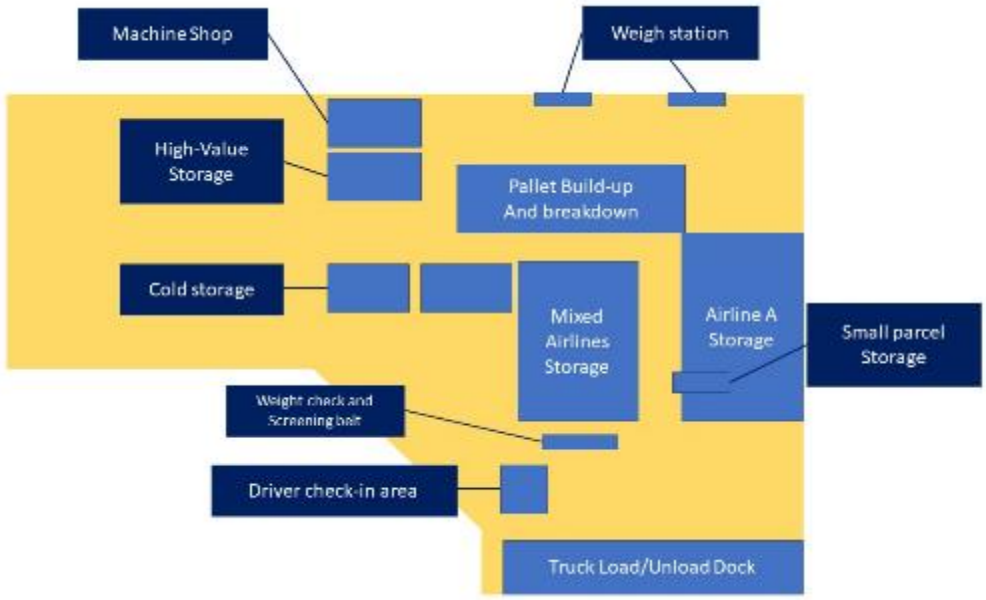


Figure 9. Functional areas in Cargo Handling Facility A

Discrete Event Processing in the Simulation Model

As mentioned in the project background section, the operational processes related to ground handling facilities are mainly divided into two parts, inbound processes and outbound processes. In our model, a series of discrete events occur through time. The simulation represents these events as activities of the ground handling facility and both trucks and aircraft. In Figure 10 and Figure 11 we show the complete import process and export process. Among them, the blocks circled in the red oval shapes represent information flows, green boxes represent aircraft activities, orange boxes represent activities within ground handling facilities, and blue boxes represent truck activities. The details of discrete events in the prototype simulation model are as follows:

- Inbound processing

  In our prototype simulation model, an aircraft arrives and unloads its cargo. Then, the ground handing facility starts to transport the cargo into the ground handling facility, where the staff/forklift moves cargo to the pallet break down area and breaks down the pallets. Once Customs is cleared, the broken down cargo is moved to the temporary storage area. When the truck comes to pick up cargo, the driver first completes the checking-in process, and then goes to the loading dock. At the same time, the staff/forklift will find the corresponding goods from the storage area and move them to the dock area. After the loading is completed, the truck departs the airport.

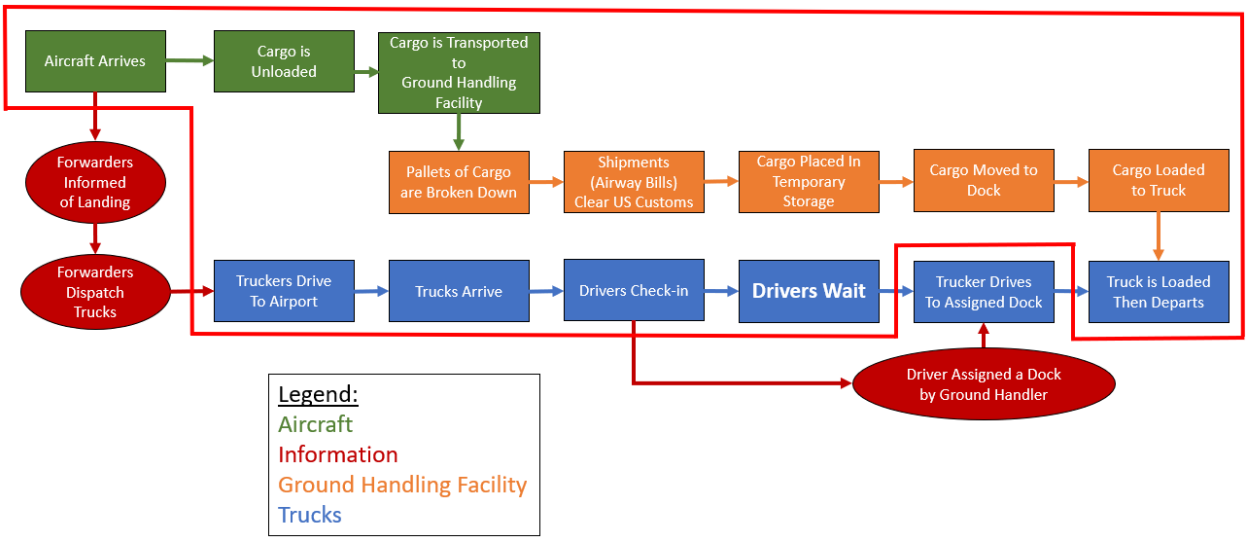


Figure 10. Inbound process in simulation model

- Outbound processing

  From the data collected from Cargo Handling Facility A, we know that each aircraft has a set of inbound processes and outbound processes. After the inbound cargo is unloaded from an aircraft, the outbound cargo is moved to the same aircraft by ground handling facility processes. In the prototype simulation model, we represented this operation as it occurs in practice. In addition, if an aircraft is required to move to accommodate another aircraft, it will leave after its unloading process is completed and will later return for loading. When the truck comes to drop off cargo, the driver also completes the checking-in first, and then the truck goes to the dock to begin the unloading process. Then available staff/forklift go to the dock to unload the cargo. This cargo first needs to be scanned and weighed, which increases dock wait time. Finally, when the unloading step is completed, the truck can leave, and the ground handling facility will then transport the cargo to the corresponding storage area. When the aircraft is ready to load cargo, the cargo is moved to the pallet buildup area and placed onto/into pallets/containers. Finally, the pallets/containers are moved to the aircraft.

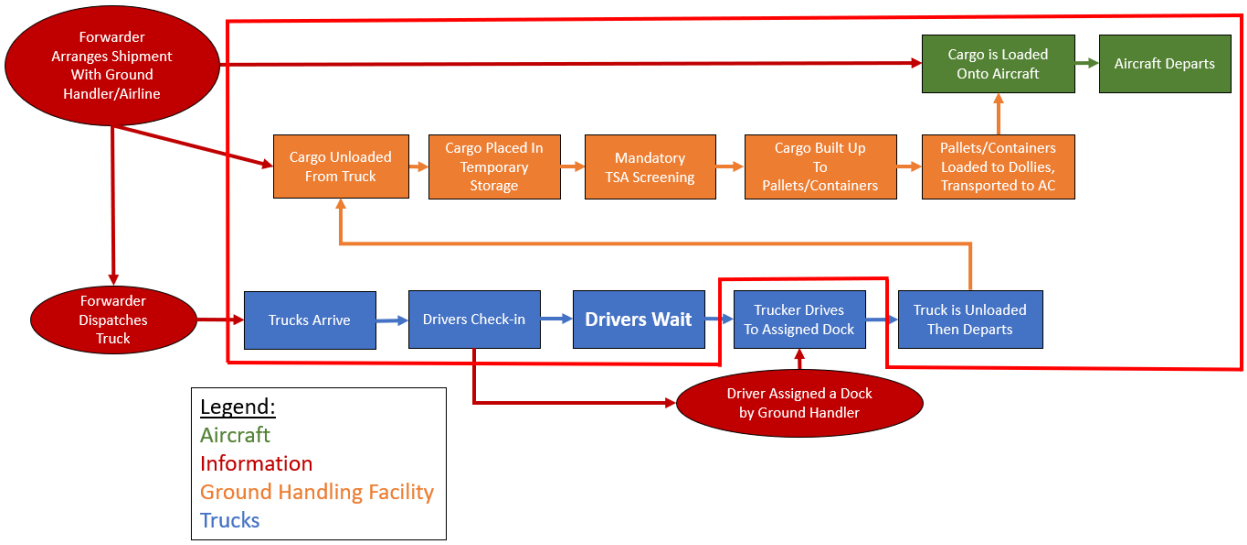


Figure 11. Outbound process in simulation model

In our prototype model, we assume forwarders have perfect information, and will arrange shipments with truckers. At present, the prototype simulation model cannot allow the truck to go to a specific assigned dock gate. The truck will randomly go to any available idle dock gate to complete the load/unload process. These issues will be dealt with in future models.

The moving of cargo to final customers is not shown in the prototype simulation model.

Simulation Sample Parameters and Input

Based on our on-site observations and flight schedule data, we first simulated operations for August 20th, 2021, to August 27th, 2021. After defining the framework and flowchart of the prototype simulation model, parameters need to be set. Some parameters are obtained directly from the collected data. However, due to missing data, we set parameter values based on sample data, statistical principles, and real-world conditions to run the simulation.

Parameters	Setting
Simulation period	August 20th, 2021, to August 27th, 2021
Number of aircrafts	11 from flights schedule
Operation hours	24/7
Aircraft arrival/departure date/time	Collected Flights schedule
Inbound Trucks arrival time	Random arrival in four types: as soon as possible, Same day, second day, third day based on sample AWB data
Outbound Trucks arrival time	-24 to -12 hours before the corresponding aircraft departs Based on pallet/manifest data
Number of trucks per aircraft	9 – 22 trucks per Airline A aircraft 2 - 5 trucks per all other aircrafts Based on tonnage report data
Aircraft capacity	23-45 pallets per Airline A aircraft 5-10 pallets per all other aircrafts 5-10 cargos per pallet Based on sample manifest data/tonnage report data
Truck capacity	20-50 cargos per truck
Driver Checking-in time	Continuous uniform distribution from 10 - 20 min per driver
Pallet build up/break down time	Continuous uniform distribution from 10 – 30 min per pallet based on sample manifest data
Number of forklifts	8 from collected data
Number of screening belt	1 from collected data

Table 2. Simulation Sample Parameters

One truck table and one aircraft table provide the input data. The aircraft table is based on the collected data. The truck table is generated based on the sample data and parameter settings. There are 141 trucks in the simulation period, including 67 inbound trucks and 74 outbound trucks.

Truck_id	arrivetime	numberofparcel	type	for_flight
29322	2021/8/20 11:29	22	outbound	0821AirlineA
54685	2021/8/20 20:40	24	outbound	0823AirlineA
23081	2021/8/21 23:54	43	outbound	0822AirlineB
49557	2021/8/22 12:24	25	outbound	0823AirlineA
30265	2021/8/22 18:27	34	inbound	0821AirlineA
38927	2021/8/22 20:55	38	inbound	0821AirlineA
69664	2021/8/22 21:56	39	inbound	0821AirlineA

Table 3. Sample Input truck data

Flight	STA	STD	TYPE	Pallets
0821AirlineA	2021/8/21 16:15	2021/8/21 18:35	Airline A	18
0822AirlineC	2021/8/22 14:00	2021/8/22 15:30	Airline C	6
0825AirlineA	2021/8/25 17:40	2021/8/25 20:00	Airline A	14
0826AirlineB	2021/8/26 7:40	2021/8/26 9:40	Airline B	9

Table 4. Sample Input flight data

Baseline Scenario

The purpose of this prototype simulation model is to focus on truck wait times and to determine if it is possible to employ simulation tools to determine how to reduce the wait times, improve the efficiency of the operation, and reduce the related costs. Therefore, we first designed a baseline environment and simulated it to get the truck's wait time in each process.

Many customers currently inform truckers to go to pick up the goods when they learn that the aircraft has landed. However, the cargo still needs to go through Customs and the breakdown process. Therefore, even if the truck arrives at the facility, it still may not be able to load the cargo onto the truck since it may not have completed these process steps. Therefore, in the baseline scenario, those who arrive to pick up goods immediately following an aircraft's arrival will have to wait until the corresponding cargo has been processed.

Truck Flow Information System (TFIS) Scenario

We created a second scenario that included a Truck Flow Information System (TFIS), which contains some elements of the proposed Truck Flow Management System (TFMS). In this new environment, truckers know when cargo is ready to be picked up. We designed a staging area for trucks in the prototype simulation model. Since truckers will not arrive until cargo is ready to be picked up, we

assume the truck did not accumulate any wait time in the staging area. Under this TFIS scenario, the wait time incurred during the breakdown process in the baseline scenario is eliminated.

Simulation Outcome and Result Analysis

Simulation Outcomes

To compare the two proposed scenarios, the prototype simulation model outputs the time consumed by the truck in each process. These processes are used in each scenario: the driver's checking-in time (from the driver's queuing at the service counter to the end of the checking-in process) and the truck waiting for available resources inside the warehouse (forklift, screening belt, weighing station) at the dock, and truck loading and unloading time. For comparison, there is another wait time in the baseline scenario. Trucks wait for the corresponding cargo to complete the breakdown process at the dock in this scenario. In contrast, in the TFIS scenario, all inbound trucks arrive only after the breakdown process is completed.

Simulation Result Analysis

After completing the simulation experiments, we determined the impact of having a TFIS on performance measures. First we measured the effect on the average total wait time of the inbound trucks corresponding to each arriving flight. By using the TFIS, the average wait time was reduced, although some of the reductions are small. In the baseline scenario the aircraft based inbound trucks' average wait time is 2.4 hours and is reduced to 1.5 hours in the TFIS scenario. An average reduction of 0.9 hours is equivalent to 38% of the average wait time in the baseline scenario.

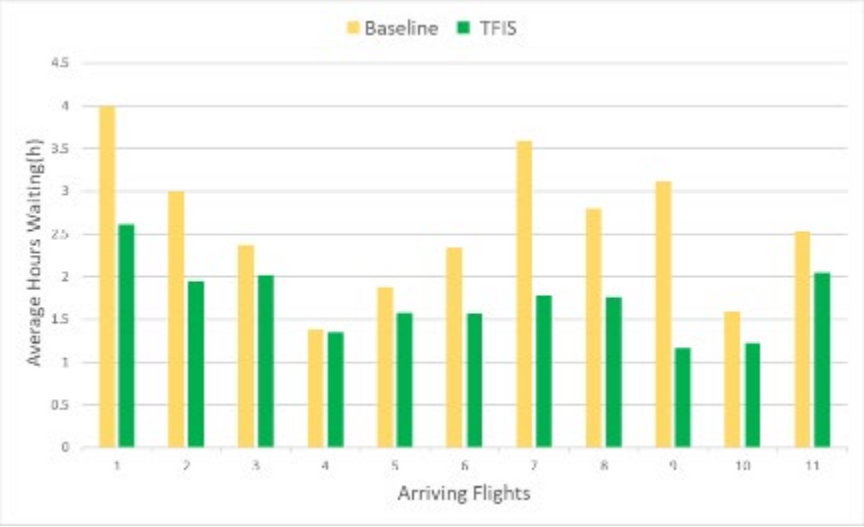


Figure 12. Simulated average inbound truck wait times

For all trucks, the average wait time has been reduced from 2.3 hours in the baseline scenario to 2.0 hours in the TFIS scenario. It is reduced by 0.3 hours, or 13% of the average wait time incurred in the

baseline scenario. In the baseline scenario, if the truck needs to wait for breakdown processing, this wait time will dominate the wait time bars. In addition, in the two scenarios, some truck wait time is mainly caused by waiting for available resources inside the ground handling facility. The data displayed in the figures below show wait times and what caused them.

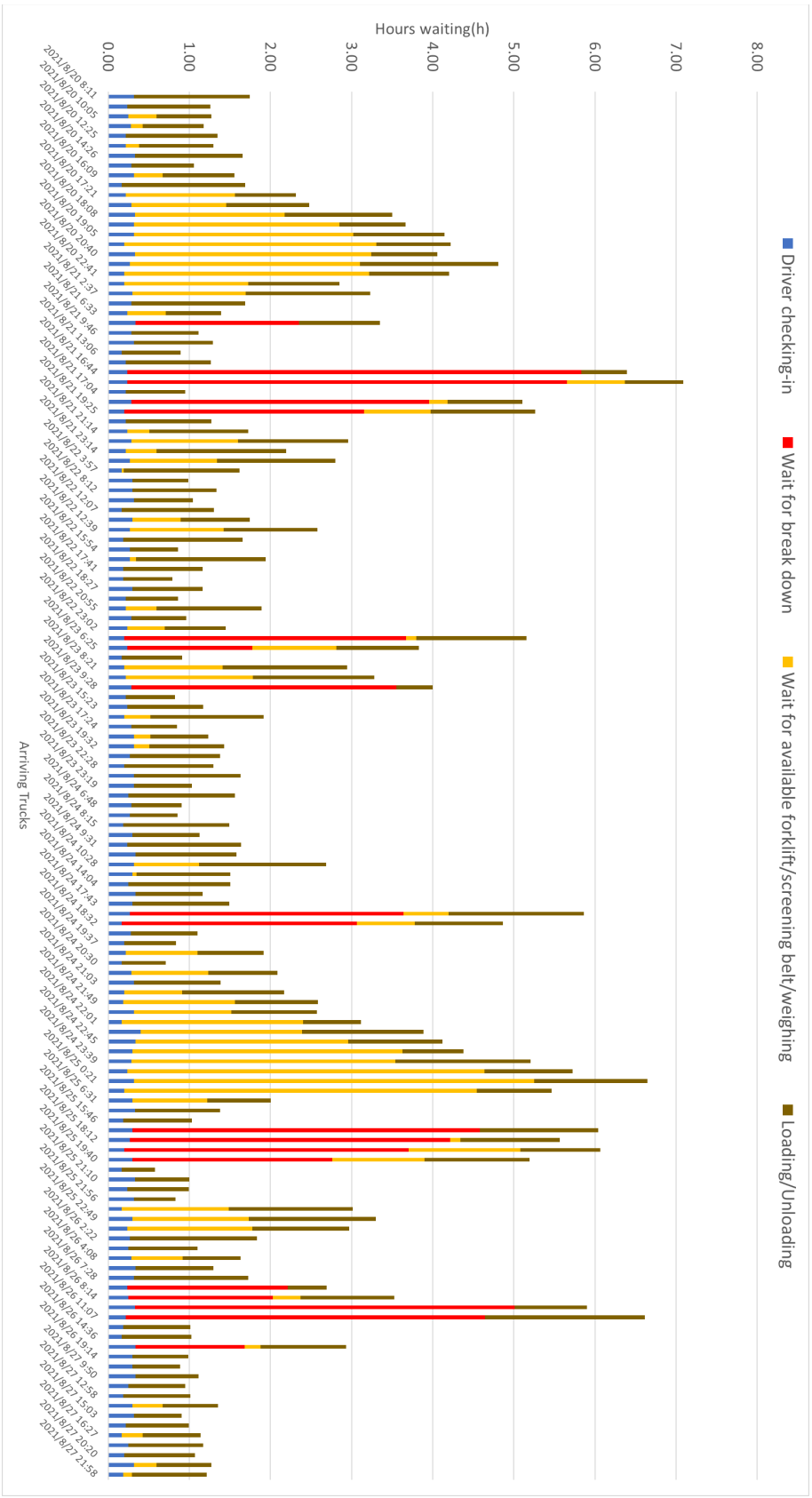


Figure 13. Simulated stacked wait times for all trucks in Baseline

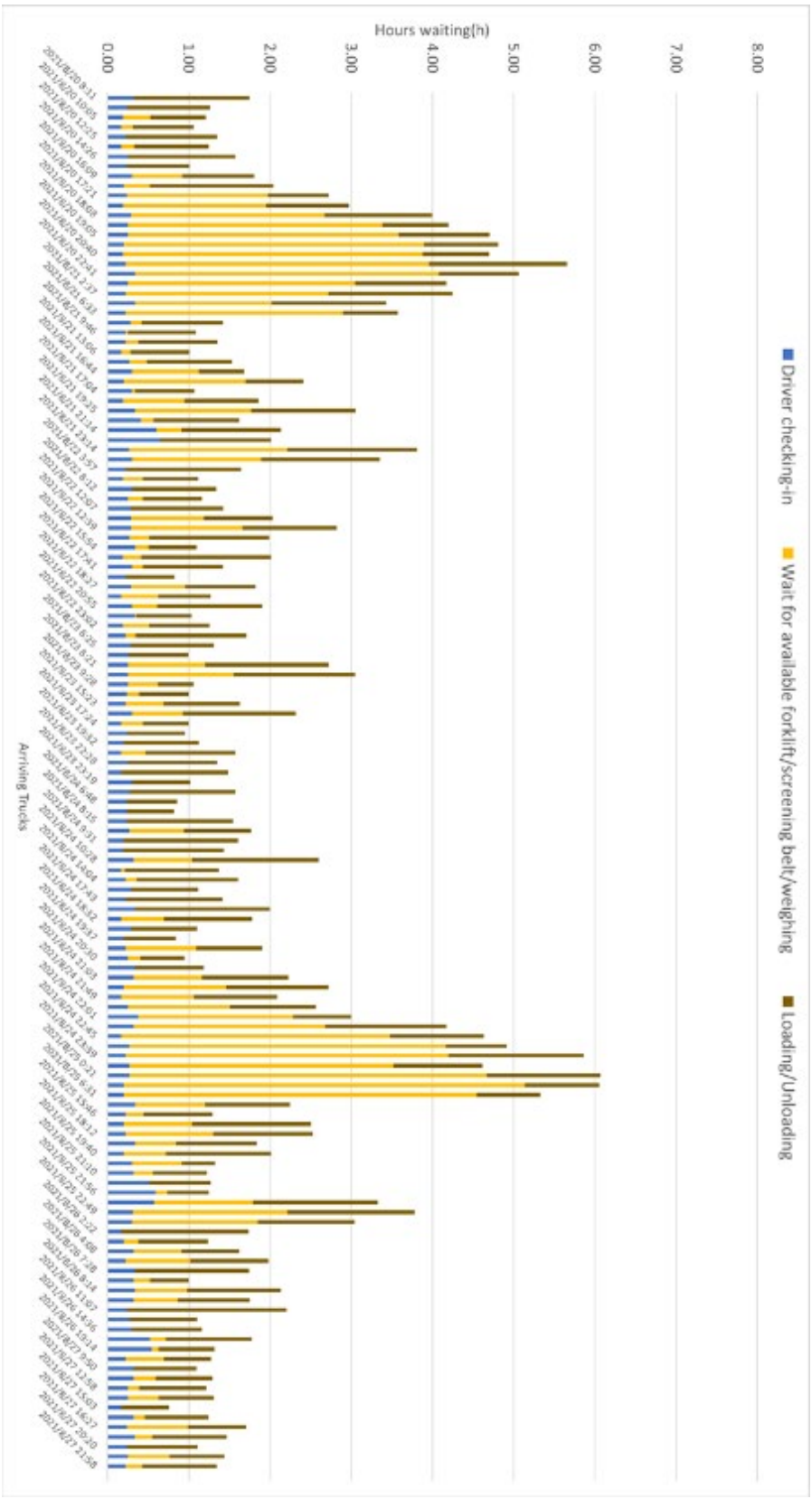


Figure 14. Simulated stacked wait times for all trucks with TFIS

We also separately analyzed the characteristics of the wait time of each process of all inbound trucks and outbound trucks in the two scenarios. In the baseline scenario, 19 inbound trucks were directly affected by breakdown processing and generated a considerable amount of dock wait time. This kind of wait time reaches 4-6 hours at its worst, which completely dominates the waiting time of each truck processing.

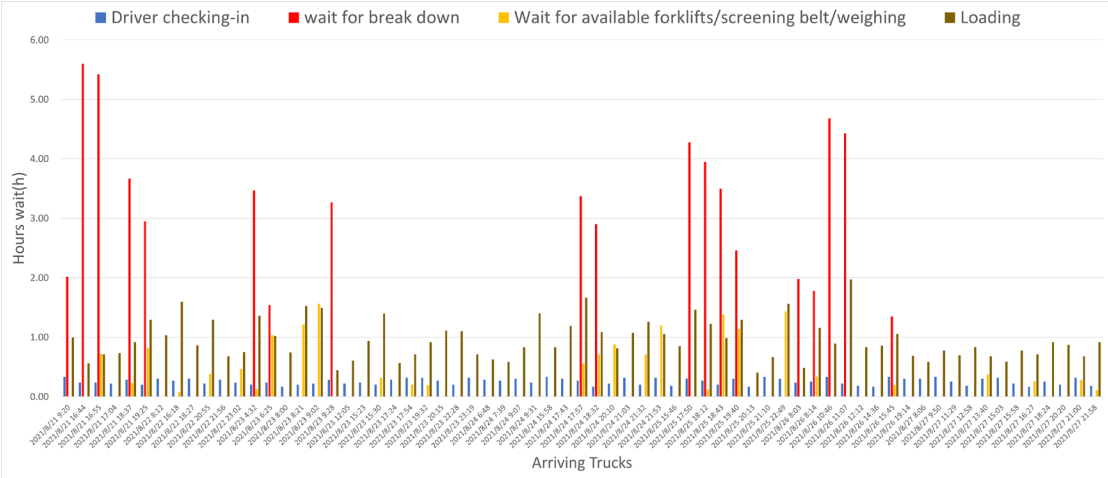


Figure 15. Different types of wait time for inbound trucks in Baseline

In the TFIS scenario, these high wait times were eliminated for inbound trucks, and all process wait times were reduced to less than 2.5 hours. When there is no need to wait for the breakdown process to be completed, most wait time occur due to the lack of the human or equipment resources in the facility.

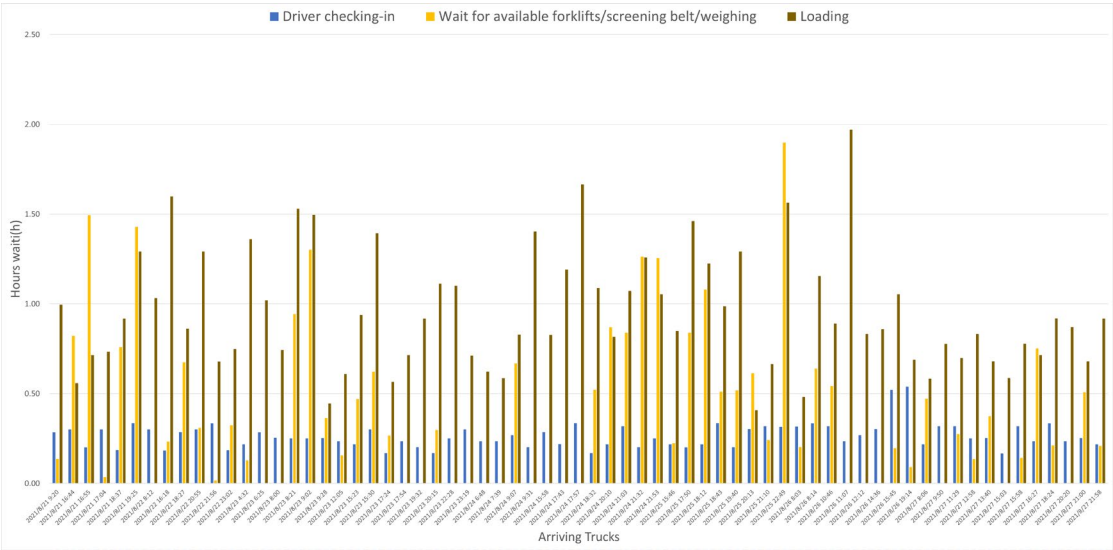


Figure 16. Different types of wait time for inbound trucks with TFIS

For outbound trucks in the TFIS scenario, the timing of truck arrivals is changed. Therefore, it is also meaningful to compare and analyze the wait time of the outbound trucks in the two scenarios.

For the baseline scenario, the highest wait time of outbound trucks is still the wait time for available forklift/screening belt/weighing station. And the wait time of outbound trucks is higher than for inbound trucks. This occurs because there is additional scanning, weighing procedures for dropped cargo, all of which are limited by the number and capacity of available resources. Two peaks are evident in the graphs displayed in Figure 17. Combined with the flight schedule, these two peaks correspond to outbound trucks dropping off Asiana Airline cargo. Based on the tonnage report, Asiana Airline carries more cargo than other airlines do. Therefore, more outbound trucks and more cargo is handled for this airline, which leads to increased wait times.

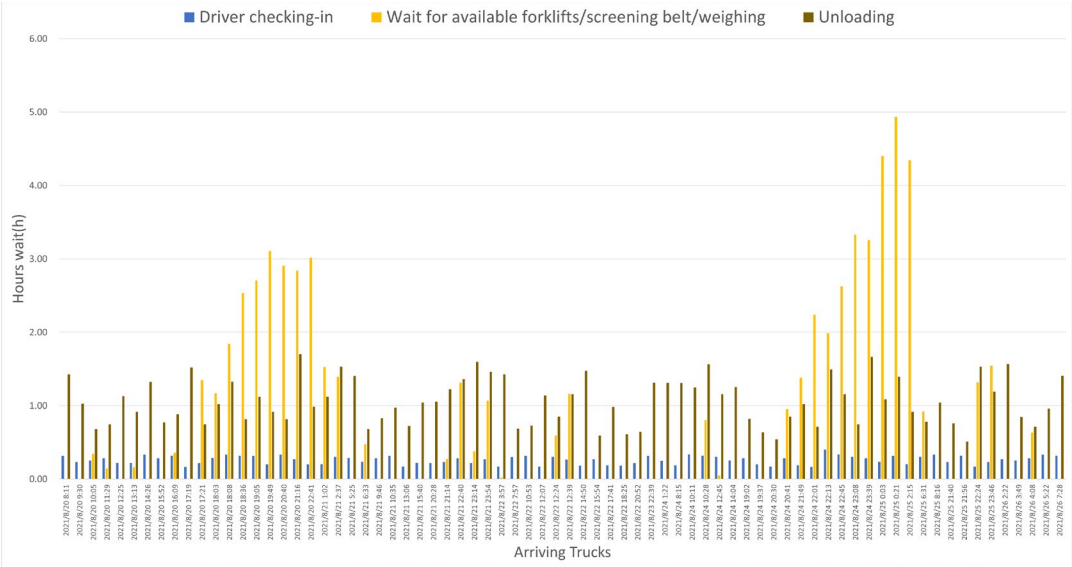


Figure 17. Different types of wait time for outbound trucks in Baseline

In the TFIS scenario, the characteristics and distribution of various wait times do not change much, indicating that a slight change in the truck's arrival time will not cause significant fluctuations in wait time. However, the wait time for resources in the warehouse is still very high, which is related to the problem mentioned for outbound trucks in the baseline scenario.

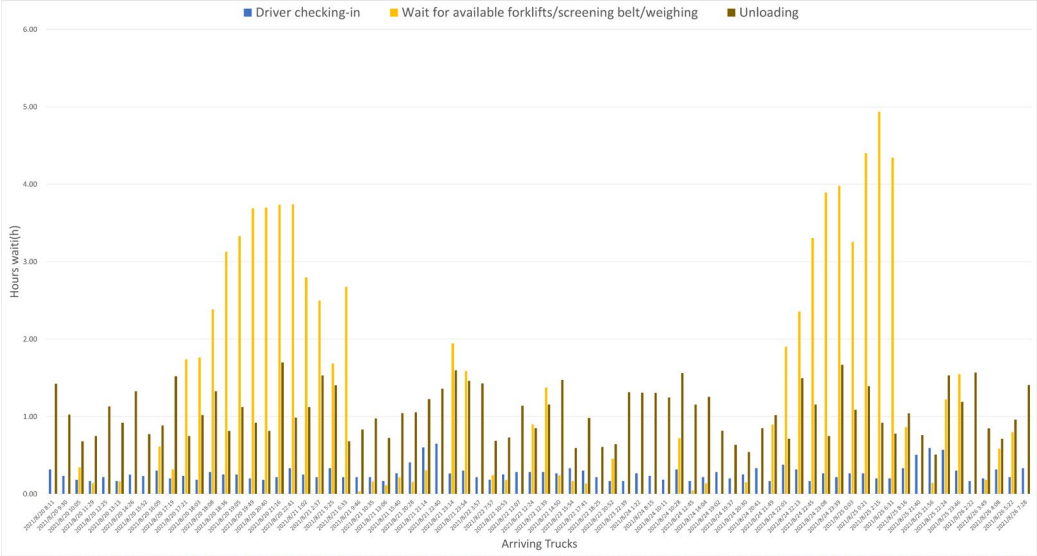


Figure 18. Different types of wait times for outbound trucks with TFIS

Empirical Implications and Analysis

Based on preliminary results obtained using the sample input, wait times are related to the lack of information sharing, truck arrival schedules and facility processing capabilities. There are two primary bottlenecks. First, if trucks arrive to pick up cargo from an inbound flight and need to wait for the breakdown of the cargo, substantial wait times can occur. Because the driver lacks information about the true status of the cargo, breakdown waiting times occur in the baseline scenario. Second, when many trucks arrive within a short span of time, waiting time will occur due to the lack of available operational resources in the ground handling facility. If there are no human resources available to operate equipment or there no available forklifts to move cargo, trucks must wait. This bottleneck is even more severe for trucks that drop off cargo for outbound flights. They also need additional security screening and weighing processes. These preliminary simulation results have empirical significance not only for Cargo Handling Facility A but also for a more extensive range of applications in the future.

The second sample simulation scenario, in which a TFIS exists, the first bottleneck problem is largely mitigated. Regardless of other factors, in the TFIS scenario this waiting time for cargo breakdown is eliminated, thus saving time even if other limitations and bottlenecks have not been considered. We conclude that improving the information flow alone can significantly reduce truck wait time. In addition, many potential operational improvements are not presently implemented in the simulation model such as increasing the number of human and other resources. By using our simulation model, we can easily demonstrate the extent to which wait times can be reduced when resource levels are increased. More importantly, it is possible to identify a plan that optimizes the value of information so that wait times could be minimized or controlled within a design range.

In future simulation models, the proposed TFMS can be fully implemented. For the inbound process, as is the case in the TFIS, the TFMS would inform that cargo is ready for pickup. In the TFMS environment, truckers can reserve a dock service time and service resources, which is not the case in the TFIS. Therefore, when they arrive at the ground handling facility, every process can start on time, and they do not incur any additional wait time. The whole inbound process associated with the TFMS is shown in Figure 19.

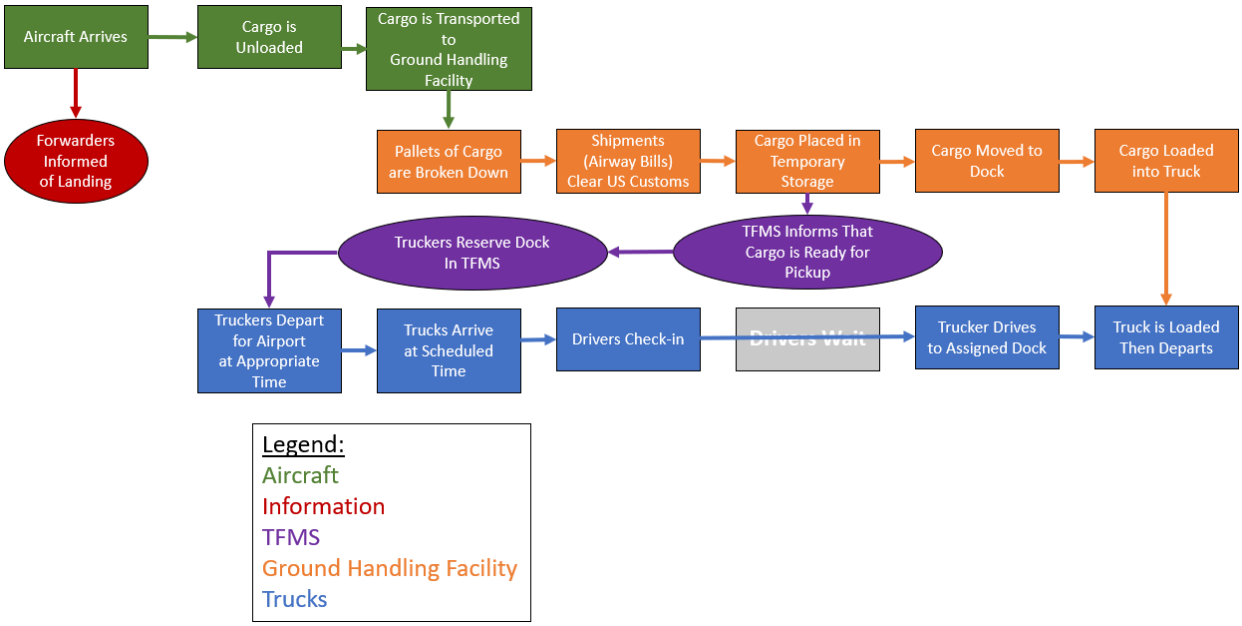


Figure 19. Completed inbound process with TFMS

For the outbound process, dock scheduling is not considered in the prototype simulation model. However, the TFMS will have an appointment scheduling service for truckers so they will not have extra wait time when they arrive at the dock. A TFMS will ensure that cargo arrives at the facility on time and is loaded onto the appropriate aircraft in a timely manner. The whole outbound process when the TFMS is in operation is shown in Figure 20.

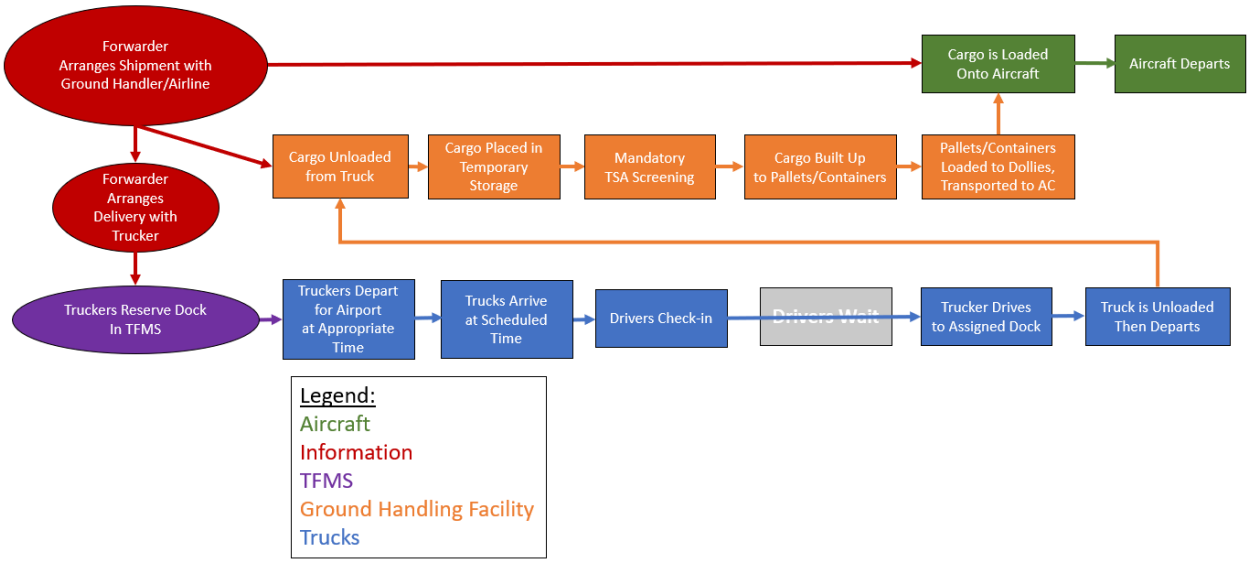


Figure 20. Completed outbound process with TFMS

By using the framework of the prototype simulation model, we can build the complete process model for a TFMS by adding a few missing functions. Employing this enhanced model with real world data will permit us to determine the effect of using a TFMS on operational performance.

Conclusion and future work

Based on the existing sample input and the proposed two scenarios, we preliminarily conclude that

- Wait times were reduced by 0.9 hours for inbound trucks (from 2.4 hours in the baseline scenario to 1.5 hours in the TFIS scenario, a 38% reduction)
- Demand spikes from Asiana Airlines flights overwhelmed the capacity
- Screening belt and forklifts are the primary constraining resources. Without increased capacity, further wait time reductions were not possible.

The simulation model we discussed is only a prototype. Many additional types of studies can be undertaken in the future, including but not limited to:

- Designing more scenarios to evaluate the impact of various policy and resource levels on truck wait time.
- Evaluating the impact of these possible operational changes on more performance measures, such as fuel consumption, operating costs, air quality, etc.
- Creating simulation models for other ground handling facilities, collecting, and analyzing more operational data, and validating the results of our simulation experiments in the real world.

Airport Traffic Report (2019). Available from: https://www.panynj.gov/content/dam/airports/statistics/statistics-general-info/annual-atr/ATR2019.pdf

JFK August 2021 Traffic Report (2021). Available from: https://www.panynj.gov/content/dam/airports/statistics/statistics-general-info/monthly-2021/JFK_AUG_2021.pdf

Anylogic (2021). Available from: https://www.anylogic.com/

This section authored by:
Anjiang Chen,
PhD Candidate and Graduate Assistant
Jing (Peter) Jin, PhD
Associate Professor of Civil and Environmental Engineering
Rutgers University

7. Improving Navigation and Cargo Security in and Around the Airport

Farmingdale State College Civil Engineering Technology Assistant Professor Michael Shenoda and graduate student Irfan Siddiqui performed an analysis of the airport network geometry deficiencies. Their findings can be found in Appendix C.

Twenty-eight roads were observed and reported on with street-level and satellite photos. Traffic backups occur on virtually all of them to varying degrees due mostly to:

1. Two-lane roads without dedicated lanes for turning.
2. Cars parked on both sides of roads.
3. Large trucks blocking streets while backing into docks with inadequate space.
4. Trailers parked on roads near freight facilities.
5. Trash in the streets.

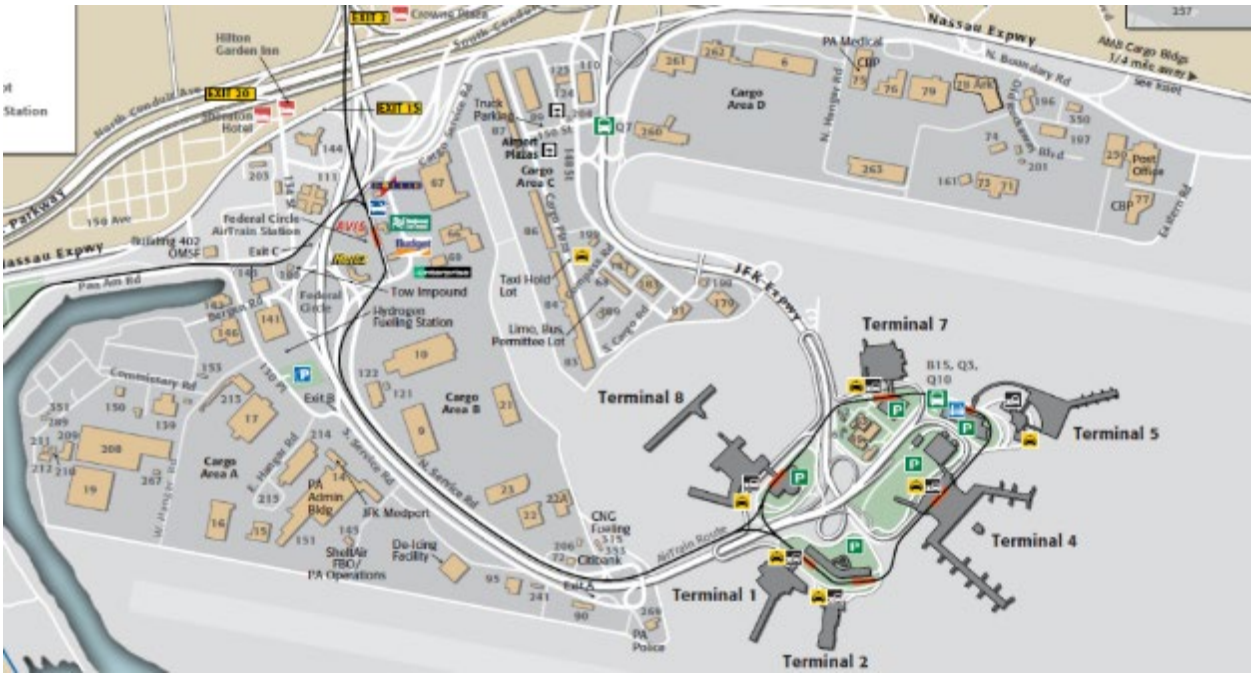
Based on the observations it was suggested that parking be restricted or prohibited on roads frequented by truck traffic. This conclusion agrees with the same point made in a 2019 Technical Memorandum by Engineering and Planning firm Phillip Habib & Associates[10]. That memorandum contains fifteen specific recommendations that we feel should be revisited and considered to improve traffic flow within the GatewayJFK district.

Farmingdale State College Professor and Computer Security Department Chair M. Nazrul Islam conducted a study of cargo monitoring and security at the airport. He also evaluated and reported on the use of GPS by truck drivers at the airport. His report can be found in Appendix D.

Truck drivers sometimes complain that GPS does not help them locate ground handling facilities on airport property. This was confirmed by Joe Clabby who told us he has personally helped drivers who were lost.[11] We also found during our visits to the airport that signage alone was inadequate to direct drivers to specific buildings. The inability to locate cargo facilities is further compounded by the fact that building numbers do not represent their relative location at the airport. For example, Building 77 is located next to Building 250 which is next to Building 350 and across the street from Building 197.

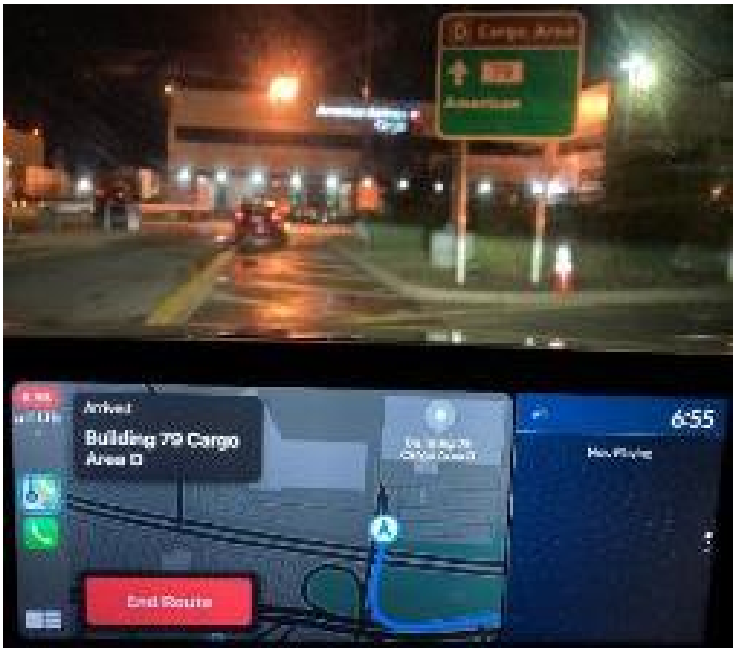
[10] GatewayJFK Traffic Study Phase 1 Conclusion.pdf, Phillip Habib & Associates memo to Scott Grimm-Lyon, PHA #18-114, 2019

[11] See Appendix H: Interview Notes: Joe Clabby, CEO, Corporate Loss Prevention Associates



Cargo Building Numbers and Locations

Nazril Islam experimented with GPS at the airport and found that he was able to navigate to Building 79 without loss of signal and provided with driving directions on airport. However, he noted that although he experienced excellent reception, it could be possible aviation signals could interfere with navigation signals and satellite signals could be compromised during busy hours. Here is a view of Nazril's experiment navigating to Building 79:

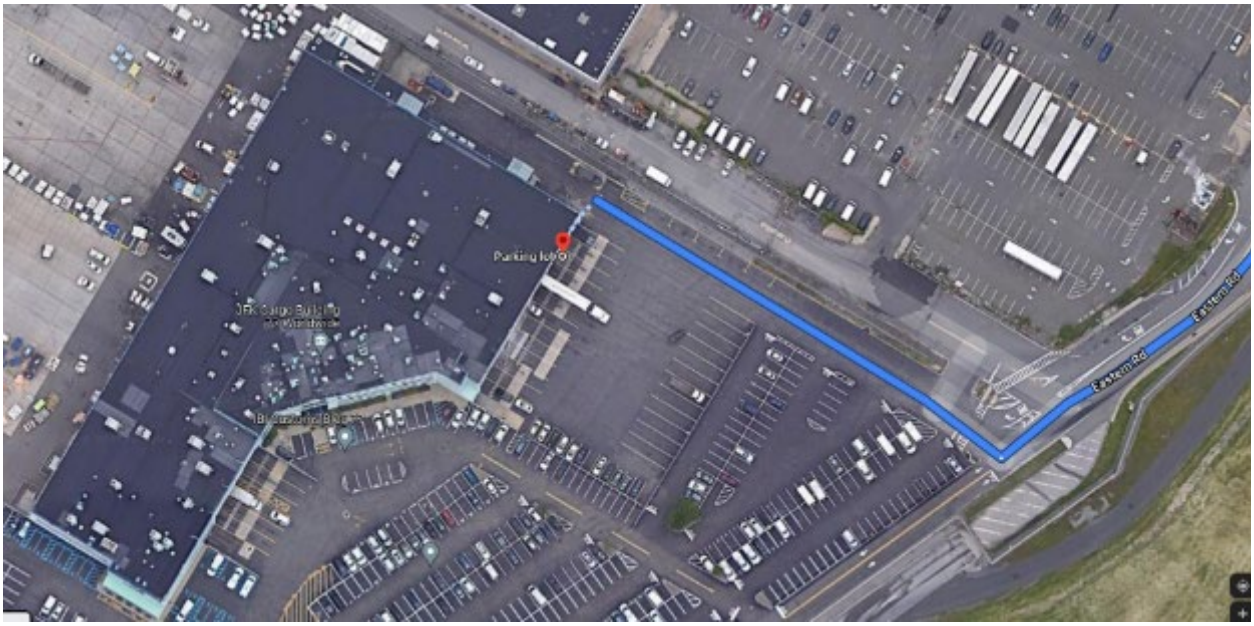


Navigating to Building 79

One of the problems with GPS navigation is the lack of street addresses on airport. Some applications like Google maps can find a building by entering search terms. For example, Google maps will provide directions to the American Airlines facility by searching on "jfk airport building 79". However, Nazril tested some navigation devices that did not recognize Building 79.

I tested the use of latitude and longitude coordinates for navigation in both Google Maps and the popular Hammer navigation app that avoids truck-restricted roads and bridges. Both applications were able to direct me to specific parking spots and even specific loading docks at AGI's facility in Building 77.

We recommend that the airport, ground handlers and forwarders publish and communicate road addresses and latitude and longitude coordinates of all ground handling facilities at the airport. We would also recommend to TFMS and ground handling operating system vendors to communicate latitude and longitude coordinates in real time when notifying truckers when and where to pick up or drop off cargo. These coordinates could be easily established during the installation phase of software that could accommodate them. Here is an example of Google maps directions to a specific dock at Building 77:



Google Maps Driving Directions to a Building 77 Loading Dock

Nazril also noted the absence of a secure and automated cargo monitoring system at the airport and proposed a system that would include a central control system that would monitor and communicate with trucks in and around the airport. Nazril proposed the following capabilities:

1. Each truck will be equipped with a special transmitter. When a truck approaches the airport, it will request connection with the control system.
2. The control system will verify the identity of the truck using an authentication protocol.
3. Once authenticated, the control system will connect with the truck and guide it to its destination.
4. The control system will also record the status of each authorized truck, including arrival, departure, station.

The capabilities suggested by Professor Islam were not found to be in any of the software products that we evaluated. However, we feel that the system he proposed would be worthwhile extensions to a TFMS system. If integrated with airlines and ground handling systems, the proposed secure and automated cargo monitoring system could enable more efficient, effective, and secure movement of air cargo as a longer-term effort.

This section authored by:
Andrew J. Huber
Cayuga Partners

Based on reports from:
Michael Shenoda,
Assistant Professor
Farmingdale State College
and
M. Nazril Islam
Professor
Farmingdale State College

8. Requirements for a Truck Flow Management System

Two primary applications would comprise a TFMS:

1. A **Collaborative Scheduling** application, ideally driven by a mathematical optimization engine that would recommend the best times to allocate trucks to docks for drop offs and for pickups. The scheduling application would be accessible by brokers and freight forwarders, ground handlers and truckers. Trucking companies and/or freight forwarders could use the application to collaborate with ground handlers for the allocation of docks and would drive the activities of ground handling operations to receive, process and move cargo to and from the docks.
2. A **Trucker App** would notify truckers when cargo is ready for pickup, where to go upon arrival, and when to move each truck to a dock for pickup and delivery. It would be kept up to date in real time with the status of dock availability and cargo readiness for pickup. Drivers who do not have a smart phone could receive notices on a flip phone or could access the information via a walk-up kiosk or from a ground handling agent.

In addition to the functionality required or desired in each of those two applications, we have identified vendor requirements in the following categories:

- Air Cargo Industry Experience
- Collaborative Scheduling
- Cost Model
- Reporting
- Information Security
- Support
- Technology
- Trucker App Functionality

To prioritize the needs and the wants for both software applications, we have assigned one of three levels of priority to each stated requirement. The three priority levels are defined as follows:

1. **Must** (most critical requirements)

These requirements are critical to the successful use of the platform. Potential vendors will need to provide a suitable response to all these requirements.

2. **Should** (important features)

These items are important to the success of the use of the platform.

3. **Could** (desirable features)

These items are desirable but not necessary within the scope of the TFMS objectives.

While it is not within the scope of Phase I of the TFMS project to make the final selection of software vendors, we have analyzed the offerings of the most likely vendors, using an Excel-based scoring model that we developed. The model enables assigning a numerical importance weight assignments to score and compare competing solutions. The weights can be adjusted as needs evolve and priorities are adjusted. The importance weights we applied are illustrated below.

Overall Category Weights	Weight
Air Cargo Industry Experience	15
Collaborative Scheduling	20
Cost Model	8
Reporting	7
Security	10
Support	10
Technology	15
Trucker App Functionality	15
	100

Priority Weights	Weight
1 Must	70
2 Should	20
3 Could	10
	100

When soliciting formal responses and product demonstrations from potential venders, their capabilities relative to the requirements can be categorized as having one of the following attributes:

- Yes (Out-of-box)
  - This indicates that feature is standard part of the offering.
- Yes (Configure)
  - This indicates that the feature could be configured using the current capabilities.
- 3rd Party
  - This indicates that the vendor would enlist a 3rd party to provide that feature.
- Yes (Programming)
  - This indicates that the feature could be made available via custom programming.
- Yes (Roadmap)
  - This indicates that the vendor plans to provide the capability in a future release.
- Not available.

To calculate a relative score of each potential offering, a point system is assigned to the above categories. An example point system is provided below. While these points are used to calculate the initial scoring, they can easily be changed in the Excel model.

Vendor Response	Points
3rd Party	10
Not available	0
Yes (Configure)	25
Yes (Out-of-box)	35
Yes (Programming)	20
Yes (Roadmap)	10
	100

All the requirements have been documented in the Excel file *TFMS Software Requirements and Vendor Evaluations.xlsx.* It also contains evaluations of vendors and automatically updates the scores as weights or capability evaluations change. If new vendors are evaluated or new requirements are added, they can easily be added to the model.

9. Software Vendor Evaluations

As mentioned previously, all the requirements have been documented in the Excel file *TFMS Software Requirements and Vendor Evaluations.xlsx.* In this section we provide high-level descriptions of the vendors considered and those that were evaluated. It is not within the scope of Phase I to select a vendor. However, two vendors, Nallian BRUCloud and Kale Logistics provided enough information in their product literature and demonstrations to us that we can confidently report that both have offerings that meet JFK Airport's primary needs for a Truck Flow Management System.

Vendors Considered

Fifteen software vendors were evaluated. Here are our assessments.

1. **Kale Logistics**

   Kale Logistics is a 10-year-old software company based in India providing solutions for Air, Ocean, 3rd Party Logistics and Trade Facilitation. Their Air Cargo Community System (ACCS) truck slot management capabilities are live at the Atlanta (ATL) Airport. Reference customers in ATL include Swissport ground handling and Southeastern Freight Lines. However, Kale has not yet been adopted by Delta Airlines, which operates the largest ground handling operation at ATL.

   Notably, Kale's solution is being piloted at Worldwide Freight Services (WFS) Building 9 handling operations. WFS has been promoting the pilot to trucking companies via a "Time is Money" poster they have been circulating to the cargo community.

   We attended a product overview, demonstration and training for freight forwarders and truckers at JFK. Kale USA Vice President Donna Mullins, a 38-year air cargo veteran joined the company in 2020. Donna conducted the demos, training and answered many of our questions.

   While the training sessions were brief (45 minutes) and straightforward, we are concerned that there was no hands-on training for users and observed no evidence of extensive change management involvement with WFS by forwarders and truckers. Kale's solution has been integrated into WFS's internal warehouse system.

   The capabilities demonstrated represent a good fit for our proposed TFMS requirements. Kale's software scored a 92 in our Excel model.

2. **Nallian BRUCloud**

   Nallian is a small software company based in Brussels, Belgium. It is a spin-off company from the Brussel's Airport team that first developed and deployed the BRUCloud solution for air cargo landside management. Realizing the potential to sell the software to other airports around the world, Nallian was formed.

   In North America, BRUCloud has been deployed at Dallas Fort Worth (DFW) airport and at ground handler Menzes at Los Angeles international airport. Longtime air cargo industry consultant Dan Muscatello shared with us that adoption by truckers at DFW has been slow, and that the airport will apply incentives to drive adoption there.

   We first met with Stephen Polmans, Nallian's Chief Customer Officer. At our initial meeting Stephen described the challenges of landside management and how their software meets those challenges. He acknowledged that the most difficult part in deploying their software is the challenge of change management and adoption. This is consistent with our experience.

   After reviewing Nallian's product literature, we invited them to do a full product demonstration. The demo was performed by Sara Van Gelder who was supplemented by Polmans as well as Product Manager Joke Aerts. A recording of that demo is available.

   After reviewing the product literature provided and the software demonstration, BRUCloud was evaluated in the Excel model using the weightings described in the previous section. The model yielded a weighted score of 88% of JFK's prioritized requirements. We do not see any of the lower rated requirements as being a major stumbling block for implementation at JFK. Therefore, they could be considered to be a provider of a TFMS.

3. **AEB**

   Based in Stuttgart, Germany, AEB has extensive capabilities for international trade. A review of their offerings in their website did not reveal any capabilities for dock reservations for air cargo shipments.

4. **Capterra Dock Scheduling Software Evaluations**

   Capterra provides free software reviews on the web. They do not sell software. Their reviews are funded by some of the vendors they review. We explored their reviews of dock scheduling software applications in search of potential candidates for a TFMS.

   Of the applications evaluated by Capterra, GoRamp was the highest rated, scoring a 5 stars out of five. After reviewing product and company information from GoRamp's web site, we compared its capabilities to the requirements in our Excel model.

GoRamp's lack of air cargo experience as well as its not meeting other requirements have excluded it from consideration.

The other vendors evaluated by Capterra were also excluded due to lack of air cargo experience.

5. **GoRamp**

   GoRamp is a small software company founded in 2016 that is based in Lithuania. They describe their product as "…is a tool that lets carriers and suppliers book the most reasonable time slot at the warehouse in advance avoiding manual calls/emails. The software helps (1) warehouse people to plan their workday in advance for distributing the trucks throughout the day, (2) eliminate queues, and gives the possibility for the head of logistics to track different warehouse KPIs."

   Our review of GoRamp's product literature scored a 47% against the weighted TFMS requirements in our model and therefore it is excluded from consideration.

6. **CargoSprint SprintPass**

   CargoSprint is a small software company based in Atlanta, GA with two products focused entirely on air cargo. SprintPay is a digital solution designed to simplify the payment process between freight forwarders and cargo facilities. SprintPass connects freight forwarders, cargo facilities and trucking companies during the pickup & drop-off process. Of the two, SprintPay has been more widely adopted.

   SprintPass has been deployed at several airports in the US and is managed by Product Manager Jack Fiol, an air cargo industry veteran who resides in Brooklyn. We invited Jack to demonstrate SprintPass to us during one of our visits. Jack gave us a product demo and showed us the application in use at Alliance Ground International's ground handling operations in Building 77.

   While we were impressed with SprintPass's capabilities to help streamline the trucker check-in process at ground handler facilities, it does not currently support scheduling of docks, nor does it have a trucker app. SprintPass scored a 46% in our Excel model.

7. **CHAMP Cargosystems CargoSpot**

   CHAMP Cargosystems is a software company serving the air cargo industry exclusively. Headquartered in Luxembourg, they have worldwide presence.

   We reviewed CHAMP's CargoSpot Handling capabilities from their product literature. It provides a rich set of capabilities for ground handlers. CargoSprot supports Application Protocol Interfaces (APIs) to enable integration to other applications. It has a mobile app for warehouse personnel but not for truckers. In our view, CargoSpot could be a good fit for ground handlers integrated with a custom trucker app using data from the

CargoSpot handling app. If CHAMP were to extend CargoSpot's capabilities to dock scheduling, it would be worthy of consideration. Without those capabilities, CargoSpot scored a 69% in our Excel model.

It is interesting to note that Worldwide Freight Services (WFS) has announced that they are committed to use CargoSpot Handling outside North America.

8. **Chain.io**

   Chain.io was founded in 2017 by Brian Glick to provide cloud-based integration solutions to freight forwarders, shippers, and software companies. Brian has extensive experience in the Air Freight Forwarding industry and related information systems. Brian attempted to lead a project addressing cargo handling challenges at DFW and was stymied by lack of support from cargo handling participants.

   We met with Brian, and he offered to share his experience. While Chain.io does not currently offer dock scheduling and a trucker app, Brian's experience is worth mentioning.

   Brian has been involved in the implementation of Nallian's BRUCloud system at Dallas/Ft. Worth airport (DFW). Getting alignment among different businesses has been difficult and has prevented complete success of the project so far. The primary roadblock is that the airlines and ground handling agents fail to understand the benefits from the system. Brian feels that the project got stuck in pointless conversations and as a startup company he could not wait years to get traction on the effort before seeing a return. (In a subsequent conversation with Dan Muscatello, he shared that DFW has offered incentives for participation and is considering penalties for non-conformance.)

9. **Descartes**

   Descartes is a large company with over 1,500 employees offering cloud-based logistics and supply chain solutions globally. They are based in Waterloo, Ontario Canada.

   Although Descartes serves air carriers, forwarders, brokers, and truckers, they do not offer dock scheduling software for air cargo. Their offerings are more targeted to distribution centers and warehouses.

10. **DLT Labs DL Freight**

    DLT Labs is a startup company based in Toronto, Canada. They provide workflow, supply chain, payment, records management, and data privacy applications. Their deployment of their DL Freight software at Walmart Canada is claimed to be the world's biggest blockchain application.

    DL Freight focuses on invoicing, proof of delivery, dispute resolution and network visibility. DLT Labs does not offer dock scheduling or a trucker app for air cargo.

11. **IBS Software iCargo**

IBS Software is a large India-based company offering software for airlines, airports, hotels, and the cruise industry. They have over 3,400 employees with a global presence. Their iCargo application is a cloud-based platform for air cargo management and stakeholder collaboration.

Notably, iCargo has been deployed worldwide by American Airlines (AA) and is live at AA's cargo operations in Building 79 at JFK. AA is a reference customer to IBS featuring a case study and interview with AA VP Jessica Tyler on IBS's web site. There is a large poster displayed in the lobby of Building 79 identifying the benefits to AA employees from iCargo[12]

Two characteristics of IBS that we like include:

1. Their functionality is developed collaboratively with their customers. This is mentioned on their website and was confirmed by AA's Brian Cooley[13] during our visit.
2. They offer complimentary air cargo consulting services to assist customers with operational assessment and deployment.

There is nothing in IBS iCargo product literature mentioning dock scheduling. However, Brian Cooley informed us that they have a module currently in development. Because that module is not yet available nor successfully deployed, iCargo scored a 76 in our Excel model.

12. **INFORM Software Syncrosupply**

INFORM is a software company based in Aachen, Germany with over 850 employees. They provide solutions for Aviation, Automotive, Banking & Insurance, Fraud Prevention, Inventory & Supply Chain, Logistics, Manufacturing, Materials Handling, Production, Transportation, and Workforce Management. We like INFORM's application of Operations Research (OR) and Artificial Intelligence (AI) within their applications. The use of OR models support the importance of tightly coupled decision support systems as we discussed in Section 2.

INFORM offers an air cargo decision platform solution for the movement of cargo on dolly trains to ground handlers using telematic data and incorporates cargo type and urgency in optimizing the flow of vehicles and drivers between aircraft and ground handling facilities.

[12] See Appendix F: American Airlines JFK Cargo Handling Observations
[13] Ibid.

Although INFORM's air cargo solution does not address dock reservations for truckers, the company urged us to consider their Syncrosupply product and gave us a live demonstration. We were impressed with the capabilities we observed. Syncrosupply scored an 87 in our Excel model. Although that is a high score, the application is not yet live at a major airport therefore we would not consider them at this time. .

13. **Spotworx SPOT**

    Spotworx is a Vienna, Austria-based company that provides cloud-based logistics, transportation, and supply chain capabilities to the automotive, wholesale, retail, electronics, and clothing industries. Its capabilities include Purchase Order Management, Transport Management, Time Slot Management, eWarehouse, Parcel, all with reporting and analytics.

    Spotworx was considered because of their extensive time slot management capabilities to reduce truck wait times and congestion in yards awaiting docks. Their graphical calendar-based user interface appears to be easy to use.

    Spotworx website shows no evidence of any presence in the air cargo industry. We did not evaluate SPOT in our Excel model.

14. **Transporeon Time Slot Management**

    Transporeon is an Ulm, Germany-based 20-year-old cloud-based software provider with over 1,000 employees and a global presence.

    Like other software providers who provide dock scheduling, Transporeon advertises that their software reduces overcrowded parking areas and costs for waiting times.

    Beyond just docks, Transporeon matches forklifts and other resources to each shipment. The system predicts the loading time based on the specifics and transport data of the shipment and available resources at the warehouse. The loading or unloading status of each truck can be viewed and updated in real time.

    Since we saw no evidence of air cargo experience, we did not evaluate Transporeon's software in our Excel model.

15. **CargoHub Trucking CDM** (Collaborative Decision Making)

    CargoHub is a software provider specific to the air cargo industry. It has evolved from developing software specifically for Schipol Airport in Amsterdam, Netherlands. Their Trucking CDM platform was developed in collaboration with InHolland University of Applied Sciences. CargoHub's web site contains a quote from Research Fellow and Project Manager Giovanni Douve that supports our our 3rd Principle of Supply Chain Management:

"We believe that all players in the air cargo industry should be connected in the cloud, where each player should share relevant data with other parties involved."

Trucking CDM is an app for truckers that matches many of our requirements for a TFMS. However, we see no evidence of deployment outside of airports owned by Schipol. Also, because Trucking CDM is fully integrated with Schipol's mature legacy CargoNaut air cargo system, we question its flexibility for integration into other air cargo systems. CargoHub's website indicates that they are seeking worldwide distribution capabilities.

Trucking CDM scored a 71 in our Excel model.

Given the presence of many truck slot management software offerings supporting wholesale distribution operations, it appears that they are ahead of the air cargo industry in solving the challenges of truck congestion in yards outside warehouses. Both Nallian and Kale Logistics where we did find capabilities that closely match our TFMS requirements are relatively new offerings. Given that they have been successfully deployed at Brussels and Atlanta give us confidence that both could help address truck congestion at JFK airport.

However, our experience with software companies is that most deployments of commercial software offerings will require some degree of modification or enhancement to maximize success. This is especially true for software offerings in their infancy like Nallian and Kale Logistics. Integration of best-of-breed niche products like dock scheduling into other air cargo applications is required to be successful. (See Principle 3 in the Principles of Supply Chain Management section.) Although we see no need to develop new TFMS software for JFK, we also expect that significant IT work will be required both in the integration with ground handlers and potentially with needed software enhancements. Our findings agree with Brian Glick's (Chain.io) statement to us that existing COTS cargo handling software would need 20% modification.

Software Vendor Evaluation Summary

Eight software provider products were evaluated in our Excel model. Given the importance weights presented in the Requirements section, their summary scores are:

Weighted Scores							
45	46	62	68	91	94	72	78
GoRamp	SprintPass	CargoSpot	Trucking CDM	BRUCloud	Kale	iCargo	SyncroSupply

Although useful for determining a make/buy decision for TFMS, we caution that these results are preliminary for three reasons:

1. We have not fully verified every product's ability to meet each requirement, especially those that were derived only from product literature without having seen live demonstrations.
2. Adjustments to the importance weights discussed in the Requirements section will change the scores. There are typically tradeoffs in capabilities that must be made when choosing vendors as some products are stronger in some areas and weaker in others. Our model helps determine which products have the highest potential based on the importance of the various requirements being considered.
3. While we did receive a formal proposal from Kale Logistics, we did not initiate any negotiations with potential vendors.

More thorough reviews of these and other emerging vendors could be conducted during Phase 2.

This section authored by:
Andrew J. Huber
John A. Muckstadt
Cayuga Partners

10. Benefits to JFK Air Cargo Community Stakeholders

There are six important benefits will result from a TFMS.

1. Financial Savings
2. Improved Customer Service
3. Reduced Diesel Emissions
4. Reduced Congestion
5. Improved Quality of Work Experience
6. Business Growth and Jobs

1. Financial Savings

As stated previously, truckers do not know when a dock will be available and ground handlers do not know when each truck will arrive, resulting in longer wait and straining the capacity of ground handling facility facilities. A TFMS with collaborative scheduling capabilities can alleviate much of this uncertainty thereby reducing wait times. By providing a schedule of drop-offs and pickups, ground handlers can better plan their resources with known appointments and fewer workload peaks.

Every hour a trucker is waiting to drop off or pick up cargo is an hour that could be better spent transporting freight. Trucking companies understand their trucker labor costs per hour and the cost of operating their trucks.

By having a known schedule, the need for telephone calls to find out the status of arriving cargo is reduced, thereby lowering ground handling agent labor costs. It also enables ground handling facility staff to deliver outgoing cargo in the order that they are scheduled to be picked up by truckers.

The financial benefits are quantified in the Business Case articulated by Ethan Connor-Ross of Econsult Solutions.

2. Improved Customer Service

By reducing wait times for pickups, customers can receive their cargo faster. There would also be more certainty of when the cargo will be picked up, enabling truckers and freight forwarders to quote expected times of arrival more accurately.

Because cargo availability and pickup times would be known, the need to contact agents to inquire about the cargo status would be reduced or eliminated. Survey responses indicate that these phone calls are a source of frustration for freight forwarders and their customers[14].

3. Reduced Diesel Emissions

[14] See Appendix a: JFK Air Cargo Management Stakeholder Survey Responses

Every hour a truck idles, .6 gallons of fuel are burned[15] releasing over 6,000 grams of CO2 and other noxious pollutants including hydrocarbons, nitrogen oxides, sulfur dioxide and diesel particulate matter (soot)[16].

While New York State has an anti-idling law, it is not known the degree to which the law is enforced or complied with at JFK airport. The law does not apply when the temperature is less than 25 degrees F, and the vehicle is stopped for 2 hours. During hot summer temperatures, drivers forced to wait in their trucks may idle to run cab air conditioners.

A 2012 New York Community Air Survey reported that "Soot pollution alone causes more than 3,000 deaths, 2,000 hospital admissions for lung and heart conditions, and roughly 6,000 emergency room visits for asthma among children and adults in New York City every year."[17]. Area residents would certainly appreciate reduced emissions.

Anticipated diesel emission reductions are quantified in the Business Case articulated by Ethan Connor-Ross of Econsult Solutions.

4. Reduced Congestion

Long truck wait times result in more trucks at the airport, filling parking lots and looking for limited parking during peak times. During one of our visits to JFK, a trucking company manager told us that airport security officers have forced truckers to leave because their trucks were blocking road access.[18]

A TFMS can help relieve congestion both by reducing wait times, by limiting the number of appointments at any point in time, and by reducing the number of arriving trucks at peak times.

Other causes of congestion and wait times include insufficient ground handler labor and dock spaces, poor and insufficient communication between supply chain participants, undersized truck aprons, lack of queuing availability, constrained maneuvering space, limited truck bays, and limited capacity of Customs and Border Protection to clear cargo*[19]. Although a TFMS would not alleviate those causes[20], it is a relatively low cost and easy first step in alleviating truck congestion at JFK.

5. Improved Quality of Work Experience

The overreliance of telephone for communication between supply chain participants about the status of air cargo shipments coupled with labor shortages is a major source of frustration for

---

[15] https://afdc.energy.gov/files/u/publication/hdv_idling_2015.pdf

[16] https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle

[17] https://www1.nyc.gov/html/dep/html/press_releases/12-32pr.shtml

[18] See Appendix B: Truckers Survey Report.

[19] Air Cargo: Addressing Airport Throughput Challenges, 2021, An Initiative of: The Airforwarders Association, the National Customs Brokers and Forwarders Association of America, and the Airports Council International-North America, 2021, pp 6, 9-10.

[20] See the Executive Summary and Section 13 on other critical actions needed to alleviate causes of congestion.

employees, particularly those who communicate with customers. Survey respondents complained about lack of caring, motivation and poor supervisory oversight of handling agents. Imagine the impact on one's workday when dealing with so many dissatisfied and frustrated customers. A constant barrage of demanding and critical communication makes for a frustrating workday.

Much of the need for phone calls can be eliminated by data integration between supply chain participants. A TFMS can relieve some phone traffic; however, significant investment in Electronic Data Integration (EDI) will be needed to further reduce the need for phone calls. Even with full EDI integration, there will remain some desire for human-to-human communication.

6. Business Growth and Jobs

Every passenger flight in and out of JFK represents an opportunity for shipping cargo. For example, the Boeing 767 contains 3,840 cubic feet of space in its lower hold that are used for cargo and baggage[21].

Increasing customer and freight forwarder satisfaction with cargo operations at JFK can make the airport a more attractive place to do business. By implementing a TFMS and other needed air cargo investments, the region around JFK could see a growth in job opportunities. In 2013 the Port Authority and NY Economic Development Corporation reported that every thousand tons of cargo supports 35 jobs in the New York Region[22].

This section authored by:
Andrew J. Huber
John A. Muckstadt
Cayuga Partners

[21] www.atlasair.com/wp-content/uploads/2018/01/767-300-BCF-One-Sheet_012418.pdf

[22] JFK International Airport Air Cargo Action Agenda, The Port Authority of NY & NJ and New York City Economic Development Corporation, 2013, p19.

11. The Business Case for Improved Truck Flow

Problem Statement

As reviewed through this report, inefficiencies in the cargo management systems at JFK Airport are creating delays in the movement of cargo through the airport. These delays create costs or losses for a range of stakeholders both within and beyond the logistics system.

Some of the losses from time delays are borne by the private sector, including the direct costs for "wasted" time and the economic losses from reduced competitiveness. Other losses are publicly shared, including additional emissions and road congestion, and foregone public revenues that additional economic activity would create.

From a business standpoint, time losses function like a tax, increasing costs and therefore reducing the competitiveness of a location and the amount of economic activity that will take place there through the basic functioning of supply and demand. Unnecessary time losses are in a sense worse than a tax in that they do not generate any revenue available for positive uses but are instead purely "deadweight" losses.

From a forward-looking perspective, these existing inefficiencies present an opportunity to improve performance and economic activity. Interventions that reduce losses will have positive financial and social value. Analysis below shows the potential to generate significant surplus economic value from improved truck flow, which would make a sustainable business model viable. This represents the private and public return on investment from improving the flow of cargo at JFK. Sustainability also requires an organizational and governance structure that aligns with the revenue streams and accounts for the interests of direct and indirect beneficiaries of truck flow improvements.

This section outlines the business case for investment in the development and operations of a Truck Flow Management System (TFMS) at JFK Airport. To do so, in this section we:

- Describe the private and public losses from inefficient cargo management
- Present scenarios illustrating the potential benefits from improvements
- Describe potential operating and governance models to sustain a Truck Flow Management System

Private and Public Losses from Inefficiencies

The potential costs from time losses associated with inefficient truck flow are varied in both their type and incidence.

Economic losses can be considered both “direct” and “indirect”:

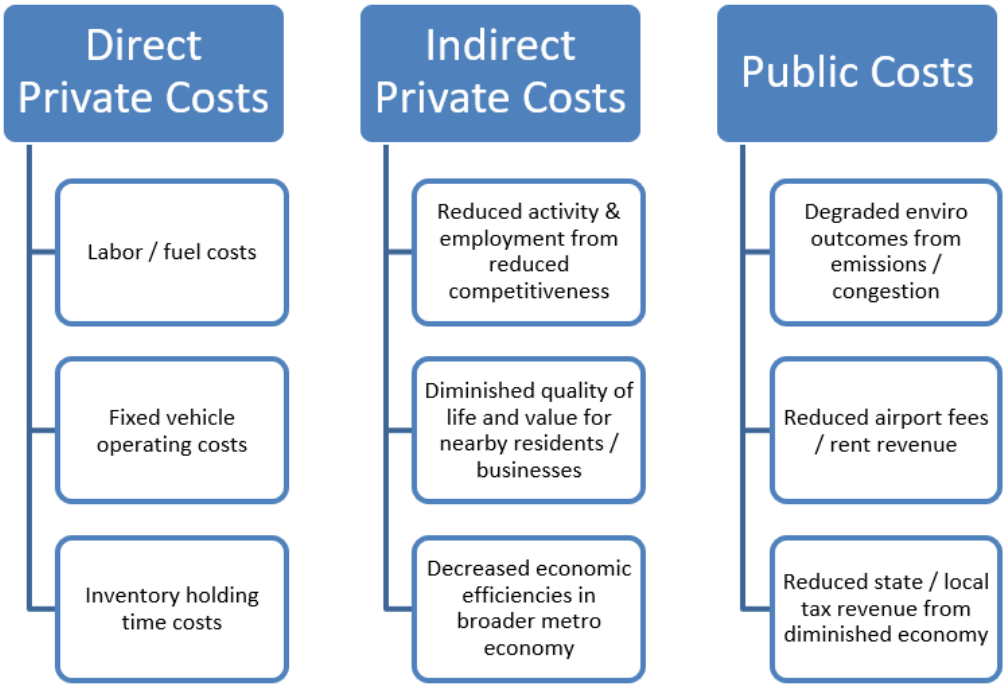
- Direct losses come from the straightforward financial costs associated with each hour of time loss when trucks are waiting for cargo.
- Indirect losses are economic effects that flow out of the diminished attractiveness caused by this inefficiency, time loss, and congestion in accessing the airport.

These losses are also incident on both private actors and on the public more broadly:

- Private costs fall on the businesses, employees, and landholders throughout the private sector, including those directly involved in JFK cargo activity and those are tied more broadly to efficiency of the logistics sector.
- Public costs relate to reduced government revenues or increased public costs tied to reduced private activity, as well as broader social costs.

The figure shows the major categories of costs stemming from time losses due to inefficient cargo management at JFK, which are discussed in turn below.

Costs from Time Losses due to Inefficient Cargo Management



Direct Private Costs

Direct private costs are borne primarily by the entities directly involved in the logistics activities. Delays in truck flow mean that truckers spend a greater amount of time than otherwise needed waiting to pick up cargo.

Since truckers are "on the clock" during these delays, each additional hour comes with a labor cost. To the extent that trucks are idling during these delays, they also generate fuel costs (as well as emissions, which are discussed as a public cost).

In addition to labor and fuel, there are a number of additional vehicle operating costs for a truck, some of which are fixed regardless of whether the truck is on the road or is waiting to receive cargo. These costs, including lease / financing payments, insurance, and permits, can also be regarded as reflecting the opportunity costs of time delay. Absent the delays, these fixed costs could either be reduced (through a reduction in the number of trucks needed), or they could be put to more productive use in another capacity, rather than waiting.

Beyond truckers, there are a number of other actors in the logistics chain (airlines, forwarders, brokers, ground handlers) that are all impacted by time delays and inefficiencies. For these actors, delays cause additional inventory costs that accumulate throughout this supply chain which could be reduced if inventory was moved more efficiently. Shorter turnaround times could also reduce the incidence of shrinkage of inventory.

Indirect Private Costs

Direct costs from delays make the JFK Airport a less efficient location for cargo activity than it would otherwise be. This translates to a lower market share of cargo activity at JFK than it could otherwise achieve. Inefficiencies are one cause of the long-term declines in JFK's market position, which has fallen from the #3 US airport by landed cargo weight in 2000 to #8 in 2020, according to data from the Airports Council International (ACI) tracked annually by the Port Authority of New York and New Jersey (PANYNJ).

Reducing the volume of truck flowing through JFK in turn reduces the amount of economic activity and the potential employment level associated with this logistics activity. PANYNJ's annual report indicates that cargo activity supported about 73,000 direct and indirect full time equivalent (FTE) jobs in 2019, or about 46 jobs for every 1,000 tons of cargo.[23] Losses or failure to grow market share are foregone opportunities to increase this activity and employment footprint.

Inefficiencies in truck flow also make the surrounding area less attractive as a business location. Nearby businesses have a lessened ability to take advantage of the potential logistical efficiencies from airport proximity. Inefficiencies in truck timing and routing create local congestion issues and associated negative externalities like parking and air quality issues that fall disproportionately on nearby households and businesses. These effects reduce the quality of life for residents and the potential attractiveness and property value for nearby businesses and property holders.

More broadly, the efficiency of logistics activity, like the efficiency of the broader transportation network, is one of the inputs to the attractiveness of business activity in a metropolitan area. The New York metro will of course remain an attractive business location for numerous reasons and will also continue to have numerous other cost challenges outside truck flow at JFK. Nonetheless, on the margin,

[23] Port Authority annual traffic reports, reflecting both market share and economic impact data, are available at: https://www.panynj.gov/airports/en/statistics-general-info.html

shipping delays, increased costs and a negative customer experience makes businesses in the city and region slightly less productive, constraining localized economic growth over time.

Public Costs

The direct and indirect private losses outlined above in turn have consequences for the public at large and for a variety of public entities.

Narrowly, the Port Authority of New York and New Jersey is a public entity, and its revenue streams are therefore of public interest. The attractiveness and market share of cargo activity at JFK Airport bears on direct revenues like landing fees and rents that PANYNJ is able to collect from cargo activity.

Expanding the lens, governments at a variety of levels (local, state, federal) see revenue effects from the level of economy activity and value within their jurisdictions. Government tax bases vary, but in general are broadly tied to private economic activity, property value, and earnings levels. Delays at JFK that reduce the economic potential and degrade its attractiveness relative to regional, national, or international competitors, and the reduced business attractiveness in the surrounding area and broader region both constrain government revenues.

Most broadly, social losses are generated from congestion and emissions associated with inefficient truck flow. These negative externalities undermine goals related to climate and to local health outcomes. These are relevant considerations for governments given their societal function.

Potential Benefits from Improved Truck Flow

The multiple categories of losses from time delays in truck flow described above imply potential benefits from improved time efficiency associated with a Truck Flow Management System (TFMS). Many of the indirect and government benefits flowing from these improvements occur “downstream” of the direct time savings and are not quantified within the scope of this study. However, it is possible to develop quantitative scenarios on the potential trucker time savings from improved truck flow, and the potential direct cost savings and reduced emissions associated with these scenarios.

Government and industry data sources provide information on the direct costs associated with the trucking industry on an hourly basis. This information can be used to understand the potential cost savings associated with each hour of time savings from improved truck flow.

From this hourly cost estimate, the analysis presumes different scenarios of potential per truck and annual time savings from a TFMS at JFK. Combining per hour benefits with hours saved yields scenarios of potential annual benefits.

While these scenarios are grounded in existing information and analysis, no single annual time savings estimate for a TFMS has been developed in this phase of analysis, and these scenarios should be understood as illustrative rather than as projections.

Hourly Labor Costs

The most direct cost associated with time delays is represented by the hourly earnings (wages and benefits) of truckers. The American Transportation Research Institute (ATRI) prepares an annual analysis of the operational costs of trucking, including hourly labor and non-labor costs. The most recent update contains data for 2019, which indicates an average cost per hour nationally of $21.01 in driver wages and $6.31 in driver benefits.[24]

Local labor costs in the New York metropolitan area are higher than this national benchmark. Data from most recent Bureau of Labor Statistics (BLS) Occupational Employment Survey indicates an average wage for "Heavy and Tractor Trailor Truck Drivers" in the New York metro of $27.38, equivalent to an annual wage of about $57,000.[25] This hourly wage in the New York metro is 17% higher than the national average of $23.42 reported by the BLS (which is broadly in line with the industry data reported by ATRI).

ATRI's national data implies that for every dollar in direct driver wages, another $0.30 in employee compensation is earned in the form of benefits. Applying this ratio to the BLS wage estimate for the New York metro yields average hourly benefits of $8.22. In practice, this estimate is likely conservative, since the New York region features higher levels of unionization and worker bargaining power than the national average.

Combining these wage and benefit components, the driver costs per hour in the New York metro are estimated at $35.60.

Hourly Fixed Costs

In addition to driver costs, ATRI data provide information on average vehicle-based costs per hour for trucking, broken into several components. This analysis is focused on costs relevant to truck delays, rather than all vehicle operating costs. Therefore, these line items are categorized as either "fixed costs," which accumulate whether or not the vehicle is in motion, and "variable costs" which occur primarily when the vehicle is being driven. Repair and maintenance, tolls and tires are classified as variable costs and are excluded, while fuel costs are excluded from this step and analyzed separately below.

Fixed hourly costs of truck ownership and operations include lease and purchase payments, insurance premiums, and permits and licenses. Each of these categories are allocated by ATRI on an hourly basis across the lifespan of truck operations and accrue whether the truck is on the road or whether it is waiting to receive cargo. Together, these categories account for $13.79 in fixed costs per hour.

[24] American Transportation Research institute, "An Analysis of the Operational Costs of Trucking: 2020 Update", pg. 20

[25] Data is drawn from the metro area data sets available within the BLS Occupational Employment and Wage Statistics program. Data is used for NAICS code 53-3032, "Heavy and Tractor-Trailor Truck Drivers" https://www.bls.gov/oes/current/oes533032.htm

Table 1: Fixed Vehicle Costs of Truck Operations per Hour

Cost Category	Cost per Hour 2019
Fixed Costs	
Lease & Purchase Payments	$10.21
Insurance Premiums	$2.68
Permits and Licenses	$0.90
Total Fixed Costs	**$13.79**
Variable Costs (Excluded)	
Fuel	$15.62
Repair & Maintenance	$5.62
Tires	$1.42
Tolls	$1.34
Total Variable Costs (excluded)	$24.00

Idling Costs

While trucks experiencing delays waiting for cargo to be available are generally stationary, some variable costs will apply for trucks that are idling. This analysis focuses on fuel usage from idling, both in terms of costs and emissions impacts, though in practice a running vehicle contributes to the accumulation of repair and maintenance costs shown above.

New York State has a maximum fifteen-minute idling law, though the law provides for exception based on the weather conditions. The degree of enforcement of the law is also unclear.

For a short delay, it is possible that a truck would be idling for the full extent of the delay. For a longer delay, idling may represent a smaller share of time, with variation to be expected based on the conditions. For illustrative purposes, it is presumed that for each hour of truck delay due to cargo inefficiencies, 15 minutes are spent idling.

Research on vehicle idling from the Argonne National Lab published by the federal Department of Energy indicates that fuel use for an idling “Tractor-Semitrailer” is estimated at 0.64 gallons per hour for

a truck with no load (and 1.15 gallons per hour for a full load). [26] Presuming 15 minutes of idling, this would indicate fuel usage of 0.16 gallons for each hour of delay. At the current diesel fuel cost of around $3.75 per gallon, this fuel usage would translate to $2.40 in cost for each hour of idling, or $0.60 for the presumed 15 minutes. [27]

There is also an emissions footprint associated with this delay. Research from the Department of Energy reported by the Environmental Protection Agency indicates that each gallon of diesel fuel is associated with more than 10,000 grams (22 pounds) of CO2 (carbon dioxide) emissions. [28] Based on the ratios above, each 15 minutes of idling would be associated with about 1,600 grams (3.3 pounds) of CO2 emissions.

Benefit Scenarios

Prototype Simulation Model estimates for cost of delay at a warehouse developed by the Rutgers research team have illustrated the potential for significant time savings in delay reduction. This analysis develops scenarios presuming 1, 2 and 4 hours of average time savings per truck associated with a TFMS. These scenarios should be understood as illustrative of potential benefits, rather than as a specific projection at this stage.

Scenario development requires an input of the annual number of trucks in order to translate the potential benefits per truck into aggregate terms. As a starting point, the 2019 volume of cargo at JFK is reported by the FAA at 3.18 billion pounds, which translates to about 1.6 million tons. [29] A TFMS system could be implemented on an airport-wide basis or may be utilized by a subset of participating handlers. For illustrative purposes, the scenarios presume 1 million tons of cargo under management of the TFMS annually.

The average loaded weight per truck implies the number of trucks that would be needed to haul 1 million tons of cargo. The maximum allowable tractor-trailer weight based on federal standards is 80,000 pounds, while a typical unloaded weight for a 53-foot tractor trailer is about 35,000 pounds, implying a maximum loaded weight of 45,000 pounds. [30] However, this maximum is unlikely to be achieved by every truck.

---

[26] Argonne National Laboratory, "Vehicle Idle Reduction Savings Worksheet." https://www.anl.gov/es/reference/vehicle-idle-reduction-savings-worksheet-excel

[27] Diesel fuel prices are based on national data from AAA, accessed November 2021. Fuel prices will naturally vary over time due to market forces. https://gasprices.aaa.com/

[28] US Environmental Protection Agency. "Greenhouse Gas Emissions from a Typical Passenger Vehicle." https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle#burning

[29] Federal Aviation Administration based on Air Carrier Activity Information System (ACAIS), "CY 2019 Final All-Cargo Landed Weights." https://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/media/cy19-cargo-airports.pdf

[30] JD Power and Associates, "How Much Does a Semi Truck Weigh." https://www.jdpower.com/cars/shopping-guides/how-much-does-a-semi-truck-weigh

To provide an illustrative range of values, the scenarios developed presume an average weight of 40,000 pounds per truck, which implies 50,000 trucks annually for 1 million tons of cargo, or an average weight of 25,000 pounds per trick, which implies 80,000 trucks needed annually to haul 1 million tons.

These annual volumes of trucks are then combined with the presumed average wait time reductions of one, two or four hours per truck to yield aggregate annual hours saved under each of six scenarios.

Table 2: Annual Time Savings Scenarios

	Aggregate Annual Time Savings	
Time Savings per Truck	**50,000 trucks**	**80,000 trucks**
1 hour	50,000 hours	80,000 hours
2 hours	100,000 hours	160,000 hours
4 hours	200,000 hours	320,000 hours

For each scenario, the aggregate hours saved can be multiplied by the hourly costs savings outlined above to yield aggregate direct cost savings. Direct cost savings for each hour of delay reduction are estimated at nearly $50. This is comprised of $35.60 in labor cost savings (wages and benefits), $13.79 in fixed vehicle costs, and $0.60 in fuel costs (presuming 15 minutes of idling for each hour of delay).

Table 3: Direct Trucking Cost Savings per Hour of Delay Saved

Direct Cost Category	**Hourly Savings**
Labor	$35.60
Fixed Vehicle	$13.79
Fuel	$0.60
Total	**$49.99**

Combining these per hour savings with the annual time savings scenarios presented above generates scenarios for the potential aggregate annual cost savings. These scenarios represent a potential annual savings of $2.5 - $16.0 million in direct trucking costs, depending on the number of trucks and average time savings per truck presumed.

Table 4: Annual Potential Direct Trucking Cost Savings by Scenario

	Aggregate Annual Direct Cost Savings ($M)	
Time Savings per Truck	**50,000 trucks**	**80,000 trucks**
1 hour	$2.5 M	$4.0 M
2 hours	$5.0 M	$8.0 M
4 hours	$10.0 M	$16.0 M

This direct cost calculation is based on trucking costs only, excluding direct savings from reduced inventory holding times to all other logistics stakeholders, as well as the range of indirect benefits to the private sector and government that would result from reduced costs and improved truck flow.

One social benefit that can be estimated directly within this framework is the emissions savings from the reduced level of diesel fuel usage associated with each scenario. As discussed above, fuel usage is estimate by presuming 15 minutes of idling time for each hour of time delay. Using per-hour and per-gallon estimates based on federal data, 1,600 grams of CO2 emissions are estimated for each 15 minutes of idling. From this benchmark, the time savings scenarios outlined above yield 80 – 512 metric tons in reduced CO2 emissions annually.

Table 5: Annual Potential CO2 Emissions Savings by Scenario

	Aggregate Annual CO2 Emissions Savings (Metric Tons)	
Time Savings per Truck	**50,000 trucks**	**80,000 trucks**
1 hour	80	128
2 hours	160	256
4 hours	320	512

Operating and Governance Models

The potential economic benefits outlined above form the basis for a sustainable financial model for a TFMS. Revenue from the development and operations of a TFMS can be justified on a return on investment framework from both private and public sources.

Private funding could be drawn from participant fees, which would be economically rational so long as fees were lower than the expected cost savings from the truck flow improvements associated with the system. These revenues would most likely take the form of a subscription or usage-based fee, creating a regular revenue stream based on activity levels.

Public funding would be justified based on the indirect benefits reviewed above. These include greater economic activity and employment at JFK, enhanced PANYNJ and government revenues, and social benefits through reduced emissions and congestion for the GatewayJFK area residents and warehouse workers in the area. Public contributions may be more valuable in the form of an upfront investment, helping to organize collective action in which an investment is needed in order to realize gains across a diffuse set of actors.

The discussion below outlines expected upfront and ongoing costs for a TFMS, and potential revenue models to address these costs. Next, potential organizational structures for operating and managing the system are reviewed.

Upfront Costs (One-Time)

Upfront investment will be required to develop TFMS software customized to the requirements of truck flow at JFK, to set up required systems, train users, and address implementation challenges. Through discussions with TFMS vendors and broader experience with the implementation of software systems, an illustrative estimate of potential costs for both software and staffing has been developed.

Software Costs: Based on their experience in other context, Kale Systems provided an implementation cost estimate for a TFMS of $100,000 across all handlers (in the case of full participation), or $15,000 per

handler in the case of deployment to specific handlers. This one-time fee covers the system configuration, set up, and user training provided by the software vendors.

This estimate is used as a proxy for potential software vendor costs and should not be understood as a determination of a recommended vendor or system as this stage. Notably, the potential software costs are informed by the existence of proven software and vendors from other locations. As a result, software can be adapted to the needs of JFK rather than generated "from scratch," reducing the potential software development costs considerably. However, the use of a low cost software vendor may leave additional functions to be fulfilled through project implementation and management, and upfront costs should be understood as a combination of these functions.

Project Implementation and Management: In addition to fees for services provided by the software vendor, additional support is expected to be needed for change management and project coordination in order for the system to be implemented and utilized successfully. One-time costs for staff or external vendors to execute these services are estimated at $500,000 - $1,500,000, based on experience with prior software implementation efforts.

Combining software and implementation costs, potential one-time upfront costs are anticipated to be in the range of $600,000 - $1,700,000.

Ongoing Costs

Once system development and implementation has taken place, ongoing costs requirements include software costs, and operating costs to manage the application and administrative tasks. These costs will be incurred on an ongoing or monthly basis, and are expressed on an annual basis below.

Software Costs: Based on their experience in other context, Kale Systems provided an ongoing cost of $1.50 per airway bill (in the case of full participation) or $3.00 per truck (in the case of deployment to specific handlers). These usage fees would be invoiced on a monthly basis. Based on the scenarios above presuming 50,000 or 80,000 trucks to address 1 million tons of cargo, a fee of $3.00 per truck would total $150,000 - $240,000 annually.

Operating Costs: It is anticipated that a small staff would be required in order to manage the TFMS application and administrative functions like billing on an ongoing basis. Based on prior experience with software management and implementation, these needs are preliminarily estimated at 3-5 FTE staff. Presuming an average compensation for this staff of $100,000 (inclusive of salary and benefits), staffing costs would total $300,000 – $500,000 annually.

Based on the scenarios outlined above, ongoing costs for the TFMS would range from $450,000 - $740,000. These costs also be expressed on a per truck basis, equating to $9.00 per truck in the 50,000 annual trucks scenario and $6.75 per truck in the 80,000 annual trucks scenario outlined above.

Table 6: Annual Potential Operating Costs by Scenario

Ongoing Cost	50,000 trucks	80,000 trucks
Software Costs	$150,000	$240,000
Staff (Management / Admin)	$300,000 - $500,000	$300,000 - $500,000
Total	$450,000 - $650,000	$540,000 - $740,000
Effective Cost per Truck	$9.00 - $13.00	$6.75 - $9.25

These effective costs per truck should be understood in light of the analysis of the potential direct cost savings per truck reviewed above. That analysis illustrated that each hour of time savings would result in a savings of approximately $50 in direct trucking costs (comprised on labor costs, vehicle costs, and fuel costs). This comparison indicates that significant surplus value is created if meaningful time savings can be achieved through the system. This surplus value means that private sector actors can absorb these costs, including ongoing staffing costs in addition to software subscription fees, into their operating models and still be better off than they would be absent the system.

Organizational Models

The organizational and governance model for implementing and maintain the TFMS must be structured to address the collective action and coordination challenges across the range of private sector and public sector actors with the potential to benefit from improved trucking flow. The conditions for collective actions are created because for any individual actor, the upfront costs and administrative burden may not justify developing and implementing their own software solution, but participation in a collectively funded and administered solution may yield significant benefits to each participant.

Multiple different organizational structures have the potential to provide appropriate management and oversight of a TFMS. Potential considerations for each are outlined below. These considerations generally relate to the funding mechanisms, staffing models, and governance oversight that are likely to be associated with each model.

Public Entity

Responsibility for the operation and management of a TFMS could be managed within the responsibilities of a public entity, such as a government jurisdiction or public authority. This approach envisions absorption of these functions into an existing public entity, since the size and scale of the program are unlikely to justify the creation of a new public agency.

From an operational standpoint, this approach would capitalize on an existing organizational infrastructure and governance model to absorb the program. If the program is managed by the PANYNJ, it would also be able to leverage the existing connections and interface with the various private sector stakeholders.

A public model does not imply that all costs are publicly absorbed. Under this model, it would be anticipated that revenue to cover the software, operating and staffing costs associated with the maintenance of the program would be generated through the user fee or subscription models outlined. A public entity or jurisdiction may have an interest in contributing funding or staff resources to the upfront costs, or potentially provide a partial subsidy on an ongoing basis, based on the collective benefits that could be achieved. As discussed above, these include increased economic activity and associated public revenues, and reduced congestion and emissions.

Private non-Profit

Operation and management of a TFMS could also be undertaken by a private non-profit organization. This could entail either an existing entity, with a related mission and suitable capabilities, or an entity newly formed for this purpose. Locating this organization within an existing entity would capitalize on existing organizational infrastructure, reducing the need for the administrative and logistical considerations (legal, locational, etc.) associated with a new entity. Like a public entity, a non-profit could be compensated for its role and contributions through the fee-based funding associated with the system and would likely be in a position to be recipient of public funding or contributions.

The entity would also be presumed to have a Board of Directors or similar oversight mechanism that could assume oversight of the program. However, it may be necessary to structure the board's composition to reflect the interests of the TFMS users and funders.

The creation of a new non-profit entity would likely ensure a mission more narrowly tailored to implement and maintain the TFMS. Such an entity could be created collectively by the companies utilizing and funding the system, and the governance oversight could be shared among these users accordingly. This model would likely require a greater on-ramp in terms of implementation and may have greater costs due to the absence of an existing administrative architecture.

Private for Profit

Development and management of the TFMS could also be situated within an existing or new private organization and managed on a for profit basis. Fundamentally, if significant value is generated for the private sector from the system, it is possible that a business model could be developed to justify private investment and operations. For instance, a software vendor could expand to a "full service" provider. Alternatively, a logistics company could invest in software and management capabilities with the intent of providing this service on a revenue generating basis across multiple potential purchasers.

Under a private for-profit model, the staffing and governance functions would be investor-driven and determined. Such an entity could be newly created or "spun off" and have dedicated staff or could be operated as a function within an existing company. Implicitly, cost to the user may be higher in this scenario, in order to generate a profit margin that would be sufficient to justify the investment and ongoing costs. It is possible that over time, private sector operations would yield greater incentives for innovation to improve quality or reduce costs.

Notably, this scenario is already available to any investor through normal market-based mechanisms but has not been implemented at scale absent a coordinated effort. This is likely due to the collective

coordination issues, which make successful implementation a challenge for a private actor in practice, even if profits to deliver this service would in principle be attractive. It is thus unlikely that the private sector will undertake this role on its own without any public coordination or investment. A more likely possibility would seem to be a vertically integrated private sector logistics companies using superior technology to serve as disruptors to existing networks.

Public Private Partnership (PPP)

In addition to fully private or public models, a hybrid entity, or public-private partnership (PPP) could be created for management and operations of the TFMS. PPP models are potentially attractive when benefits are shared between public and private entities (as in this case), and where public entities seek to retain some control of governance and oversight.

PPPs are a broad category that may encompass a variety of organizational and contractual relationships. Broadly, PPPs are generally able to receive public funding and have a mission to achieve a public purpose but may also have private sector profit incentives built into their structure. In this instance, a TFMS would most logically be shared between a public sector entity with an interest in its success but without the desire to operate it directly, and private sector stakeholders (users).

Creation of a new PPP for the purpose of operating a TFMS would require a material on-ramp in determining the structure or contractual relationships and oversight mechanisms, as well as a new administrative architecture. Since the interest of private sector actors in implementing a TFMS are generally aligned with public interests and benefits, it is unclear that the administrative complications of this approach would justify the potential shared governance benefits of this model.

Leadership and Coordination

In addition to the structural considerations associated with this model, considerations around leadership and coordination cut across each of the models. Within any structure, successful investment, implementation, and operations of the TFMS requires collective action across a range of stakeholders and potential beneficiaries. Regardless of the financial and economic merits of a TFMS, dedicated leadership to help focus attention and efforts on this issue is an essential ingredient to success. The connection between potential leadership and organizational structure is therefore another important practical consideration.

Summary

The analysis above describes the potential direct, indirect and public benefits of improved trucker flow at JFK airport. Preliminary analysis shows that the direct private benefits, in the form of savings on labor, vehicle and fuel costs, would provide a sufficient return on investment if time savings from the system are material. These direct benefits would trigger further indirect benefits to nearby and regional residents and businesses, and public benefits to government entities. This range of beneficiaries make a range of organizational structures (private, public or mixed) potentially viable for administration of the system on an ongoing basis.

While the above analysis shows that estimated benefits are a multiple of estimated costs and justify continuation of this project to Phase II, the above estimates of benefits and costs are based on a preliminary basis. In Phase II of this project with utilization of an enhanced Truck Movement Model and revisit of estimation of delay time, the above benefits and costs will be further deepened.

This section authored by:
Ethan Connor-Ross
Econsult Solutions

12. TFMS Implementation Planning Recommendations

Successful deployments of newly introduced information technologies require effective leadership and change management. It is often said by practitioners that technology is the easy part. We cannot overemphasize the importance of change management. Most major information technology transformations in large organizations either fail to get fully deployed or fail to fully realize their anticipated benefits. Project failures can be caused by technology problems, failure to manage change, or both. Usually, technology problems if identified quickly and before full implementation can be fixed in time for success. Conversely, change management failures can be difficult to overcome.

Introduce change gradually.

Some process-change initiatives fail because they take on too many changes simultaneously and are overly disruptive. Fortunately, a TFMS represents a limited degree of change for ground handlers and truckers. The degree of change can be further limited by timing other systems and process changes around the implementation of a TFMS. For example, it would be a mistake to deploy a new management system or upgrade at the same time as a TFMS.

WIIFM: What's In It For Me?

Implementation of new systems and processes require cooperation, effort, and *time* by people who must participate in the process. Simply conducting a one-time training session is usually insufficient to get people to understand and follow new procedures.

One step in applying effective change management is for the process designers and implementers to identify what consequences will result for each participant's role. Compare those consequences to the consequences of not bothering to follow the new process. If the difference in consequences between following versus not adopting the change is not enough to convince people to make the effort, then there is insufficient WIIFM to ensure success.

Carrots and Sticks

Ideally, there will be positive consequences from adherence to the process change. Positive consequences are carrots. There is a behavior management principle that positive consequences incent people to embrace changes more fully and often do more than what is expected. People who "go above and beyond" often see positive benefits either for themselves or for others that they care about.

As an example, the Brussels airport established "fast lanes" and "slow lanes" for trucks entering airport cargo areas. The fast lanes provide faster access to docks from using the dock scheduling application. By using the new software and reserving a dock, those truckers get faster service.

Fast and Slow Lanes at Brussels Airport

Negative consequences are sticks. There is a corresponding behavior management principle that negative consequences incent people to do the minimum required, and no more.

At airports with dock scheduling systems coupled with fast and slow lanes, drivers without dock reservations are forced to use the slow lanes. They won't know how long they will be at the airport, won't be able to quote expected delivery times to their customers, and will wait at the airport longer.

Everyone must benefit.

If all the benefits of the new process accrue to just *one set* of stakeholders yet cooperation is required by *all* participants, there will be high risk of failure. Success can be better assured if process designers arrange to have all participants share in the benefits, or at least share in the pain if the process is not followed.

A challenge for a TFMS is for ground handlers to understand and realize immediate benefits. On the surface, much of the initial benefits accrue to truckers in reduced wait times. Ground handlers can achieve immediate labor savings by reducing driver check-in times at their front desks. Some of that time savings could be offset at first as the agents learn to work with the dock reservation system. Ground handlers can increase those labor savings if they can eliminate or automate any part of their check-in processes, for example driver security checks. Furthermore, having the knowledge of when each truck is scheduled to arrive should help ground handling facility personnel better plan the pickup and delivery of shipments to each dock, enabling labor savings in the ground handling facility as well.

Freight forwarders and brokers are more likely to fully embrace and understand the benefits of dock scheduling. Many forwarders are already quite frustrated with the inability to accurately quote delivery times to customers and the dependence on telephone communication with short-staffed ground handlers. A user-friendly TFMS with real-time notification of cargo availability and dock availability should be a welcome relief to forwarders and brokers.

It is important not to assume everyone will understand TFMS advantages. Education and not just training is important in the implementation process. That education must demonstrate knowledge of the current processes, the challenges with current processes, and how those

challenges can be met by the new process. The education component of change management should provide for two-way interaction between the educators and the participants.

For example, before deploying iCargo, American Airlines had their internal change management team conduct workshops where participants were asked to write challenges and priorities on post-it notes.[31] In change management workshops, team inputs are collected and often help identify and overcome potential problems before they occur.

Involve all levels of management.

It is important to obtain the buy-in, support and engagement of all levels of management particularly in ground handling and trucking companies. This not only means agreement, but time spent to monitor the compliance and success of the new process.

Employees generally look to their immediate supervisors for direction. Supervisors must establish clear expectations that the new process be followed. They should listen and respond to employee concerns and follow up on challenges that employees encounter. They should also monitor compliance to the process, and the impact of the process on Key Performance Indicators (KPIs). They should provide feedback to the implementation team and their own management. Expectations must flow from the top managers to the first level supervisors for the project to be successful.

Managers should attend and participate in kick-off, change management, and training sessions. Stopping by and saying a word or two then leaving sets the expectation that managers have more important things to do. Managers should explain in their own terms why they feel the new process will help the company and the employees themselves. The implementation team should start with the managers first to establish their support. Skeptical managers may require proof of benefits from successful pilot programs before giving full support to the new process.

Another way managers should be involved is by learning and using dashboards and/or reports that come with the new system. If they only look at traditional internal reports and KPIs that are not directly reflective of new process measures, they may be implicitly sending a message to employees that the new process is not important.

Consider engaging change management specialists.

There are firms that specialize in or provide consulting engagements that include change management specialists who have experience in facilitating workshops to engage employees. Some companies have internal groups with this expertise. As previously stated, American Airlines used their own internal change management group when launching the rollout of their new iCargo system.

Organizations that are typically in a constant state of change may already be proficient in embracing and driving change. They may not require outside help if their employees are used to and have become adept at adopting frequent changes in ways of doing business. We do not believe this has been the case in the air cargo business. For example, Brian Ridley of American

[31] See Appendix F: American Airlines JFK Cargo Handling Observations

Airlines told us that he had only experienced one successful major new system launch in his 35-year career at AA.[32] This is not unique to AA. Many organizations in many industries remain reliant on operating systems that are decades old.

Communicate with all stakeholders.

It is important to inform all stakeholders involved with air cargo at JFK that the new capability is coming well before any pilot or airport-wide go live. There are a few reasons that this communication is critical:

1. It will demonstrate to stakeholders that the sponsor and funders of the project are committed to improving air cargo operations.

   Our survey results indicate dissatisfaction with air cargo operations at JFK. The Port Authority's own recent press release announcing the Aeroterm facility admits the lack of investment in air cargo facilities for over 20 years.[33] However, that project was previously announced four years earlier, yet demolition of older Buildings 260 and 261 and construction site preparations have only recently begun.[34] [35]

   The Aeroterm project is one step of many that will be necessary to retain and grow air cargo business. The announcement of a TFMS coupled with a compelling and believable long-term vision for air cargo could be a good 2nd step towards air cargo modernization.

2. It will educate people on the purpose of the change, how the change will affect them, and the expected benefits.

   When people learn about changes as they occur without being informed, they often develop their own theories on the purpose of the change. Those theories can often be negative, such as assuming they are only about cost-cutting without any concern for service.

3. It will help foster patience as the new process is adopted and make people more tolerant of any startup issues that must be overcome.

   It is not uncommon for new systems to have start-up challenges. If stakeholders first learn of a project by hearing people complain about it, those negative impressions can be extremely difficult to change.

   While live pilots help identify issues so that they can be corrected before go-live, some challenges may not fully manifest them until the system scales after go-live. It will then be important that problems be corrected quickly. If course corrections cannot be made immediately, stakeholders need to be given frequent updates on progress.

---

[32] See Appendix F: American Airlines JFK Cargo Handling Observations

[33] https://www.panynj.gov/port-authority/en/press-room/press-release-archives/2021-press-releases/port-authority-signs-long-term-ground-lease.html

[34] https://www.aircargonews.net/cargo-airport/new-york-jfk-to-revamp-cargo-area/

[35] Construction status obtained from a 1-17-2022 phone call between Kazem Oryani and Bob Caton, Aeroterm Regional Manager.

Establish an effective operating and governance model.

An airport wide TFMS would cross organizational boundaries to establish a common process to manage truck flow. The TFMS would require a centralized team that can manage the implementation, operation, and support for the system.

Operating and governance model alternatives are presented in the Business Case articulated by Ethan Connor-Ross of Econsult Solutions.

Find a leader who commands respect.

We propose that a project leader be selected from the air cargo community. The person should be one who commands respect of the effected TFMS stakeholder organizations. The leader needs to be passionate about the need for transformation in the air cargo business and must inspire others to join in the cause.

The leader should introduce the project, its goals and personal expectations for participation. Leadership must be demonstrated by participation throughout the implementation process.

The leader does not need to manage day-to-day implementation tasks. Those details can be left to project managers and process experts. However, when organizational hurdles occur, the leader must get personally involved to see that they are resolved. The leader needs to have the knowledge of the community and understand how to overcome barriers to change and clear the path to implementation.

Without a leader who can influence the participation to ensure success, any transformational effort will be doomed to failure.

Establish a project team with champions from every participating organization.

Successful implementation of a TFMS will require more than just Information Technology integrations and training sessions. It will be important that the solution is incorporated into each organization's work processes in a way that removes more work than it adds. The best people to help guide the implementation in that manner are those who actually do the work.

At a minimum, the project team should consist of:

- The project leader.
- A project manager.
- The individual who will ultimately be responsible for the application of the system airport wide. This should be a staff member of the sponsoring organization who is responsible for the budget, vendor relationship, stakeholder / airport relationships, system performance, and airport wide cargo Key Performance Indicators (KPIs).
- The implementation lead from the vendor.
- The trainer or training staff.
- IT leaders from each ground handler for which there will be integrations.
- The manager of Port Authority air cargo business development.

- Project “champions” from each participating organization, including forwarder/brokers, ground handlers, high volume trucking companies, airlines with significant cargo volumes, and perhaps even the residents who stand to benefit. These champions can include managers but more importantly should be people who fully understand work processes on the ground floor and have good working relationships with the employees in their organizations who do the work.

The project team will first be educated on the project goals, then assist the project manager with implementation planning. Most importantly, they will provide feedback at each project milestone whether the project can proceed to the next step. They will provide feedback on the system demonstrations, ask questions, and suggest enhancements. They will participate in conference room pilots and help launch live pilots within their organizations. They will collect feedback from employees on the floor and summarize their input to the project team. They will help craft pilot success criteria and vote on pass/fail readiness.

All of the activities of the project champions will be critical to a successful implementation that will reduce wait times and congestion without adding other forms of disruption.

Run pilots with clear success criteria.

Every effort should be taken to reduce the chances of technical problems after go-live.

Electronic Data Interchange (EDI) integrations should be made with ground handling operational systems so that the statuses of cargo are kept in sync between systems. Do not rely on double-keying data into both the ground handler system and the TFMS. Double-keying so-called “swivel seat integrations” result in systems being out of sync when a “single source of truth” is required to ensure accurate and timely communication. It also results in increased administrative costs.

Once the integrations are complete and pass IT quality assurance testing, conference room pilots with actual users and simulated data are a good way to verify both system functionality and ease of use. Users themselves can help to develop success criteria and to set quantitative thresholds to determine when the new system is deemed to be ready.

Once the conference room pilot participants agree that their success criteria have been met, small scale pilots with actual cargo operations are another way to identify problems that manifest themselves in actual operation. By limiting the scope of the first pilot, any problems can be limited to a small subset of cargo activity. It is also appropriate to expand pilots after the small-scale pilot success criteria have been met before going full scale airport wide.

WFS is conducting a pilot of the Kale Logistics Truck Slot Management capability in Building 9. The success or failure of that pilot is likely to provide valuable lessons learned for an airport wide TFMS.

This section authored by:
Andrew J. Huber
John A. Muckstadt
Cayuga Partners

13. Summary and Conclusions

The need to study the potential for an airport-wide system was identified by an ad hoc committee of JFK air cargo community members in 2013. Funding was finally obtained by The Rutgers Center for Advanced Infrastructure and Transportation (CAIT) and GatewayJFK in April 2021 and a team was assembled with University Transportation Center members, Cayuga Partners, and Econsult Solutions as consulting contractors.

JFK airport's market share for air cargo has been declining for two decades yet cargo-related congestion remains a problem. The causes of both congestion and market share decline are numerous and include labor shortages, high employee turnover, inadequate training, and insufficient airport infrastructure including roadways, buildings, and information technology.

Decades of supply chain consulting experience have revealed five important principles that equally apply to the business of air cargo:

1. Know the Customer
2. Construct a lean supply chain organization that eliminates waste, variability, and uncertainty.
3. Build a tightly coordinated information infrastructure.
4. Build tightly coupled business processes.
5. Construct tightly coupled decision support systems.

While by no means a complete solution to the air cargo related challenges, a TFMS is a low-cost first step at reducing wait times for truckers and improving cargo operations at the airport. It would provide a more automated information flow between freight forwarders, ground handlers and truckers enabling them to better coordinate the drop off and pick up of cargo. The investment would more than pay for itself financially and help reduce soot and health risks from diesel emissions in the area around the airport, benefitting residents and workers.

Modern cloud-based applications that include a trucker app and dock scheduling for air cargo are available. The Excel model we established with requirements, importance weights, vendor evaluations and capability scoring demonstrate that it would not be necessary to design, develop, and deploy a completely new system. However, each of the vendor's solutions we evaluated are still in relative infancy. Some enhancements or extensions would likely be required for the large-scale cargo operations at JFK. In addition, IT integrations would be required by both the maintainers of existing ground handling systems and by the selected vendor.

Beyond a TFMS, to stem the decline in air cargo business at JFK, the following actions are imperative:

- Adopt and integrate information technology solutions across organizations.
- Reengineer road access for 53' trailers into and within JFK including a truck marshalling yard.
- Construct modern cargo handling facilities with more storage, more dock space and ready access to flights.
- Recruit, train, and increase pay to retain cargo-related employees.[36]
- Automate ground handling facility operations to move cargo faster and with less labor.

Finally, although we have concluded that there is a clear and compelling opportunity to reduce truck congestion by deploying a TFMS, there are serious barriers that must be resolved:

1. Leadership from within the air cargo community with the influence to obtain a consensus from participating organizations that a TFMS has yet to occur. The most critical organizations that must support the effort are the freight forwarders, customs brokers, ground handlers, and trucking companies.
2. There is no committed source of funding to ensure full implementation and ongoing operation of a system.
3. Organizational priorities for information technologies need to be reconciled:
    a. An airport wide TFMS would best provide a consistent process and most effectively help reduce truck congestion.
    b. Airlines and ground handlers determine IT strategies for their companies independently. Airlines desire to have their own set of IT applications to manage their passenger and cargo flights worldwide. Ground handling companies similarly desire a consistent set of applications and processes at all their facilities.

We believe that all three barriers can be overcome; but, until leadership and funding emerge in support of an airport wide TFMS, it will be up to each ground handler to decide for themselves whether and what system to deploy.

This section authored by:
Andrew J. Huber
John A. Muckstadt
Cayuga Partners

[36] One interesting idea presented by Joe Clabby is to have an on-airport training and education center for cargo employees career development. This along with certification programs and adequate pay and benefits might help reduce employee turnover and increase productivity and effectiveness. Other ideas from Joe are presented in Appendix F.

Appendix A: JFK Air Cargo Management Stakeholder Survey Results

Andrew J. Huber
Associate and Senior Consultant
andy@cayugapartners.com

Introduction

As part of the JFK Truck Flow Management System (TFMS) Phase I Business Plan Project, a survey was conducted of air cargo business stakeholders at JFK airport. The purpose of the survey was to:

1. Obtain feedback on wants, needs and business requirements from key stakeholders, potential users, and beneficiaries.
2. Gauge the need and desire among stakeholders for the implementation of a TFMS at JFK.
3. Understand JFK airport's competitiveness with other airports as seen by air cargo industry participants.

Most of the responders were freight forwarders and customs brokers, which have the advantage of insights from end customer needs and wants as well as the barriers that long wait times have in meeting their needs. Responders express high levels of frustration with cargo handling at JFK.

We believe that a TFMS that includes electronic data interfaces, paperless truck check-in and ground handler dock scheduling could improve operational efficiency and effectiveness but will not fully alleviate the problems articulated by the survey's responders.

The report includes verbatim responses to open-ended questions with minimal editing on our part.

Most of the responses are presented as charts with some commentary containing our thoughts and reactions.

Responder Demographics

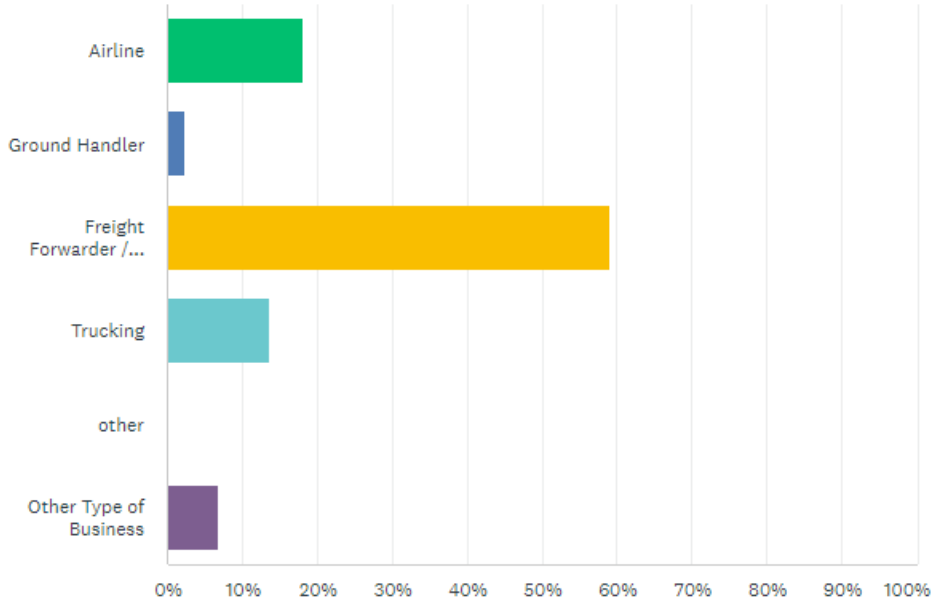
49 people responded to the survey of which 28 came from members of the JFK Customs Brokers and Forwarders Association (JFKBROKERS), 10 from an advertisement in the GatewayJFK newsletter, 7 from members of the Kennedy Airport Airlines Management Council (KAAMCO), and 4 from personal email invitations to our project Advisory Board members[37].

As one would expect, 60% of the responses came from Freight Forwarder /Customs Brokers followed by Airlines, Trucking and Other.

Below are the questions asked and the responses to them.

Which of the following choices best describes your business?

Answered: 44 Skipped: 5

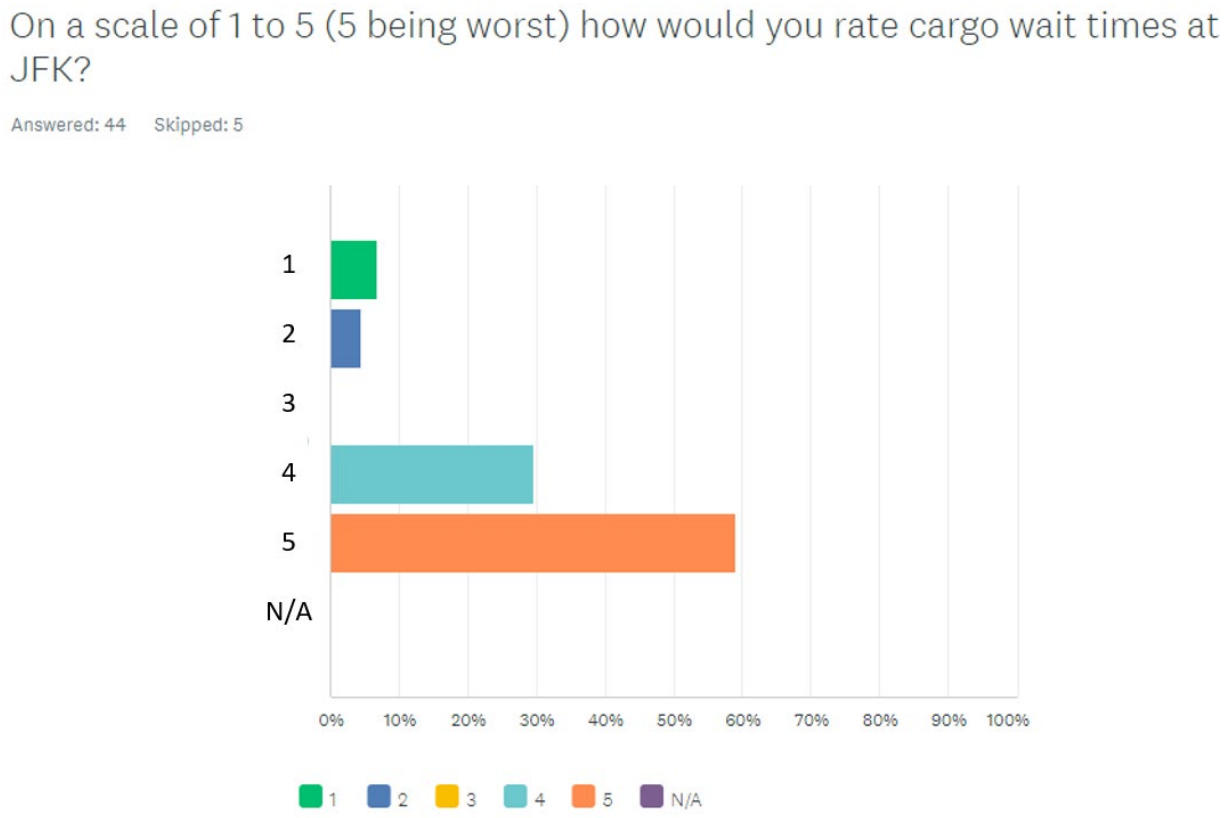


Toward the end of this appendix, we provide a complete listing of all responders with their companies, titles and contact information.

[37] Project Advisory Board Members consisted of Brian Cooley of American Airlines, Peter Debenigno of Mobile Air Freight, Joe Clabby of Corporate Loss Prevention Associates, Tom Marzano of Alba Wheels Up, and Steve Caulo of Alliance Ground International.

Stakeholder Satisfaction Levels with Cargo Wait Times

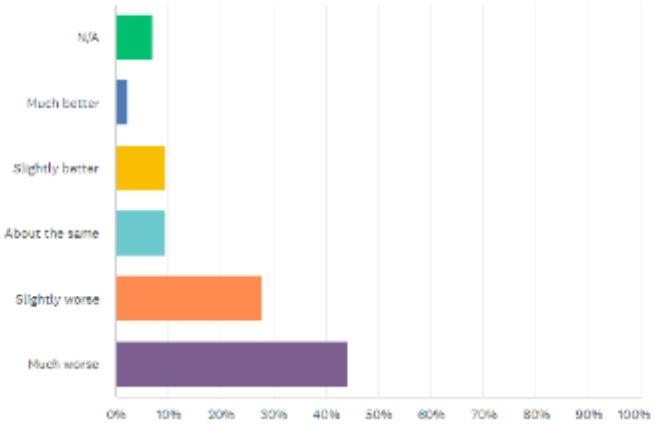
As expected, there is a high level of dissatisfaction with cargo wait times at JFK. 60% of responders gave wait times a “5” which is the worst rating, followed by a “4”. The three responders who rated wait times a “1” were confused about the scale. We know this because those three responders rated wait times at JFK worse or much worse than other airports.



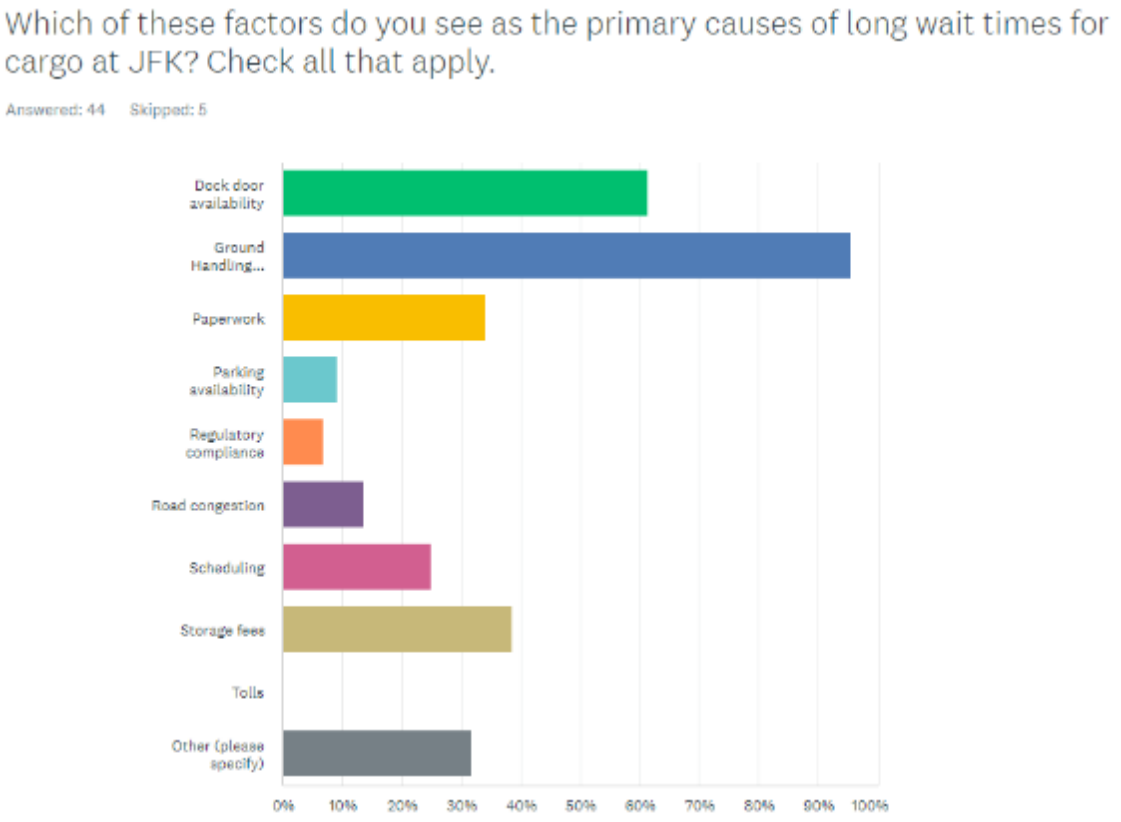
Similarly, when asked how wait times at JFK compare to other International Airports in the US, most responders rated JFK “Much worse” or “Slightly worse”. It is surprising that a single responder felt that wait times were much better.

To the best of your knowledge, how do cargo wait times at JFK compare to other International Airports in the US?

Answered: 43 Skipped: 6



When asked to indicate the primary causes of long wait times, ground handling capacity and dock door availability were listed as primary.



Responders who indicate “Other” mentioned the following as causes:

- airlines' short of manpower
- cargo taking days (to) be broken down
- communications
- handling agents lack discipline and working ethics.
- incompetency
- incompetency of ground handling personal
- lack of caring employees
- lack of staffing, lack of training, lack of oversight
- lack of workers and supervision
- manpower, no locate, missing cargo
- no accountability
- no priority for Special Shipments & BUPs (Bulk Utilization Programs)
- staff training, low wages with no experience
- Staff at the warehouses do not seem to be properly trained.

Given the mention of words like discipline, ethics, incompetency, caring, training, oversight, accountability, experience; stakeholders clearly and forcefully say that labor *capacity* is not the sole issue. They are frustrated by the low *quality* and *motivation* of employees.

In our experience, more efficient scheduling could in part help to alleviate capacity shortages by making best use of existing capacities. However, it is well known that severe labor shortages exist throughout the US and other countries as economies emerge from the Covid 19 pandemic. Additionally, the onboarding processes for cargo related jobs can take months before an employee is available with enough training and experience to be competent to perform the required tasks.

Nearly all the responders wrote about the impact of wait times on their business. Here is a summary of the topics mentioned in response to the question *"Please describe any problems that excessive wait times have caused for you or your business. Be as specific as possible".* Verbatim individual responses can be found in toward the end of this appendix.

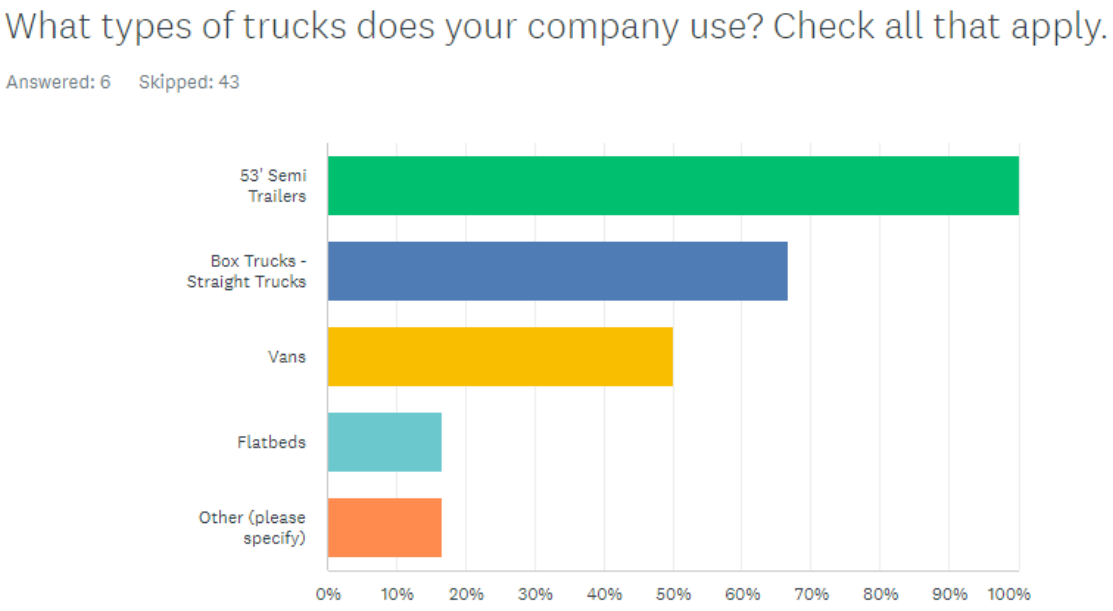
Problem mentioned	**# Responses**
Delivery delays	14
Excessive fees	12
Truck and driver utilization, congestion, trucker wait times	9
Unable to contact agents or excessive communication needed	6
Cost increases	5
Return trips required	5
Labor shortage	4
Too many problems to list	3
Customer complaints	3
Poor infrastructure	3
Loss of customers	2
Employee quality	2
Excessive paperwork	1
Dock availability	1
Revenue loss	1
Screening delays	1

Trucking Company Responses

Only 6 of the responders identified themselves as a trucking company so the results are not statistically significant. However, their responses may be of interest.

Approximately how many trucks does your company own?

- 200
- 100
- 11
- 10
- 8

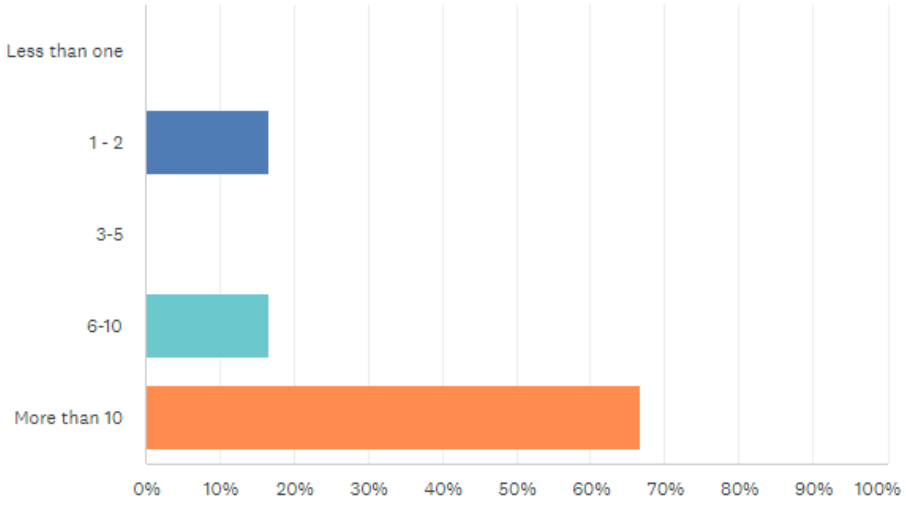


What problems do you currently experience in picking up and dropping off freight at JFK?

- Excessive wait times (mentioned be two responders)
- Extremely excessive waiting. limiting the amount of pick ups and deliveries to the airlines.
- IMPORT/EXPORT WAITING TIME
- lack of queuing space, poor communications, city traffic Small truck aprons Roadway geometry
- Paperwork processing times, capacity issues.

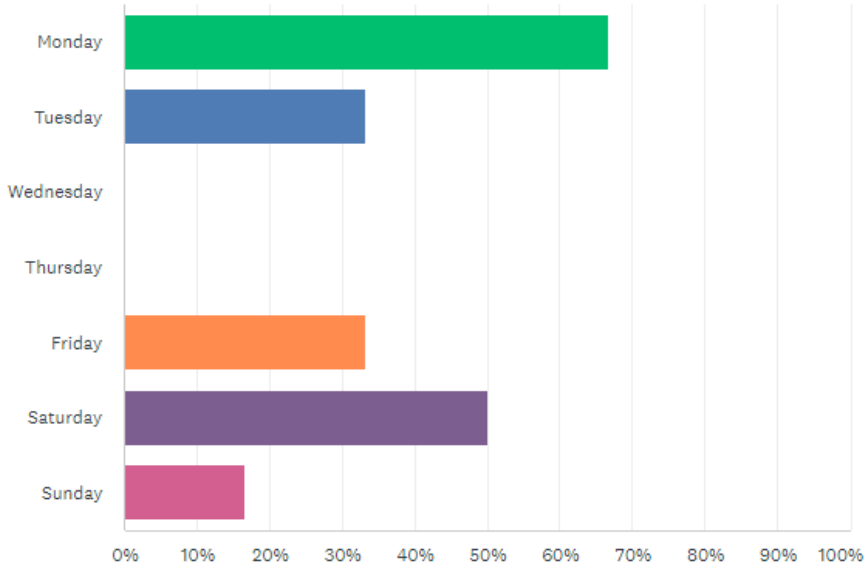
In a typical day, how many trips do your trucks make to JFK ?

Answered: 6 Skipped: 43



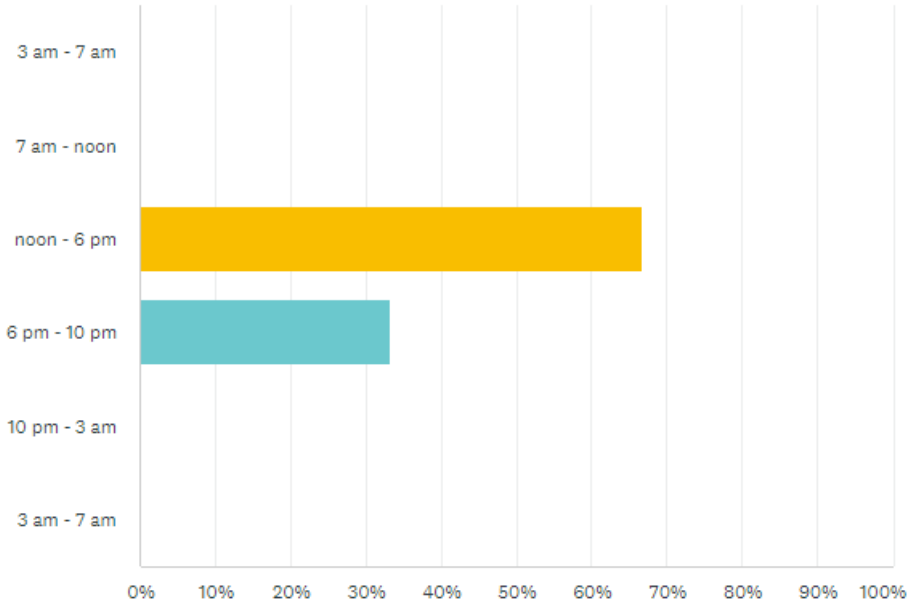
Which are your TOP TWO busiest days for truck runs to JFK?

Answered: 6 Skipped: 43



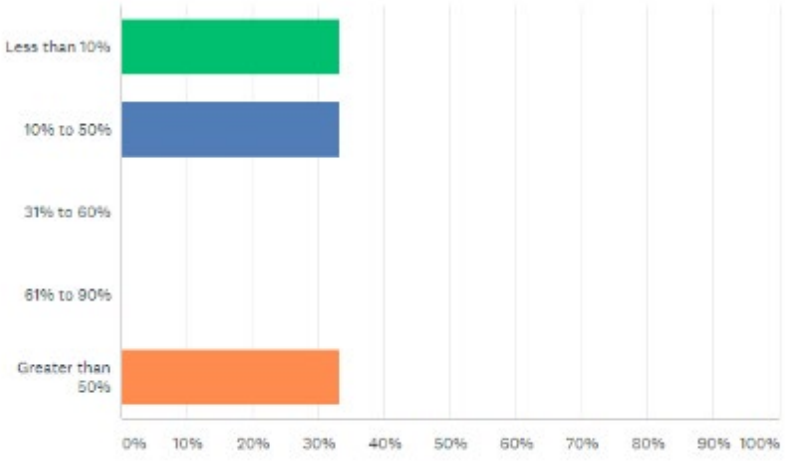
Which of the following is the busiest TIMES for truck runs to JFK?

Answered: 6 Skipped: 43



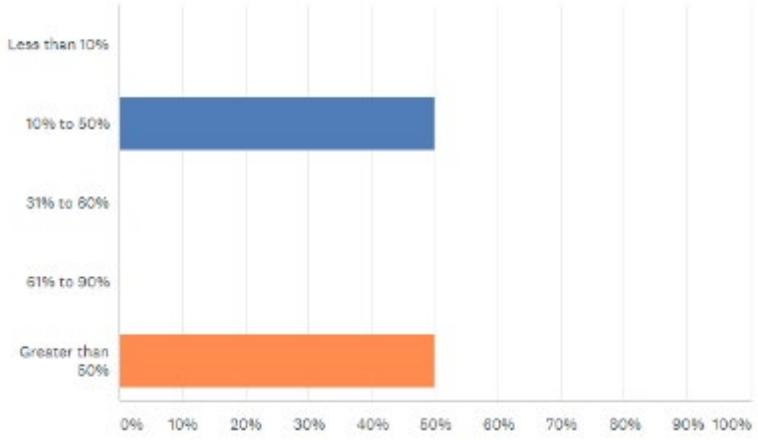
Which of the following best describes your company's percentage of truck runs to JFK that are Full Trailer Loads?

Answered: 6 Skipped: 41



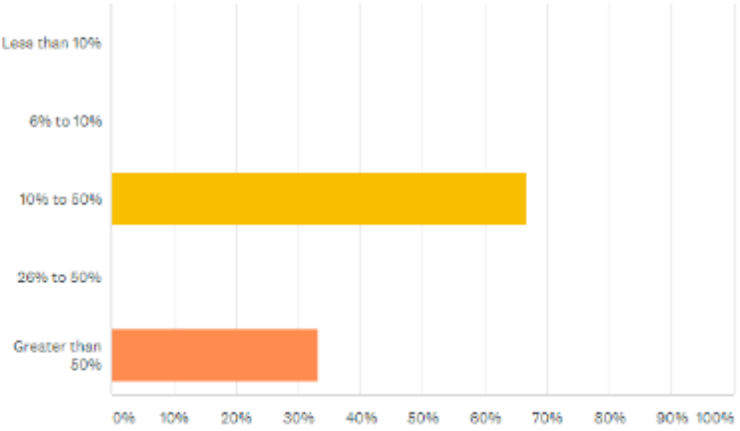
Which of the following best describes your company's percentage of truck runs to JFK that require multiple stops on the airport?

Answered: 6 Skipped: 41



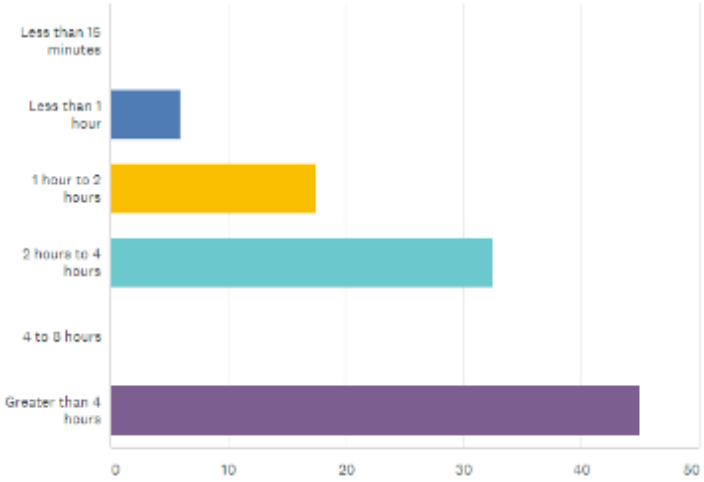
Which of the following best describes your company's percentage of truck runs to JFK that require drivers have to return to the airport because freight is not ready or dock space and handling capacity is not available for pick-up?

Answered: 6 Skipped: 41



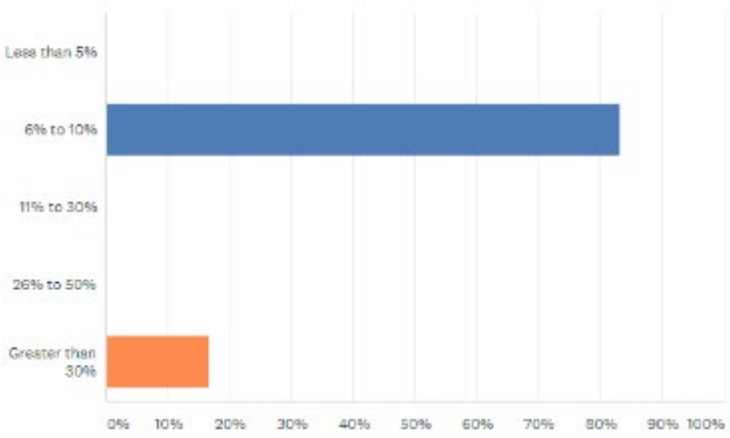
Approximately what percentage of truck runs to JFK does your company experience the following wait times to pick up or drop off cargo at JFK?

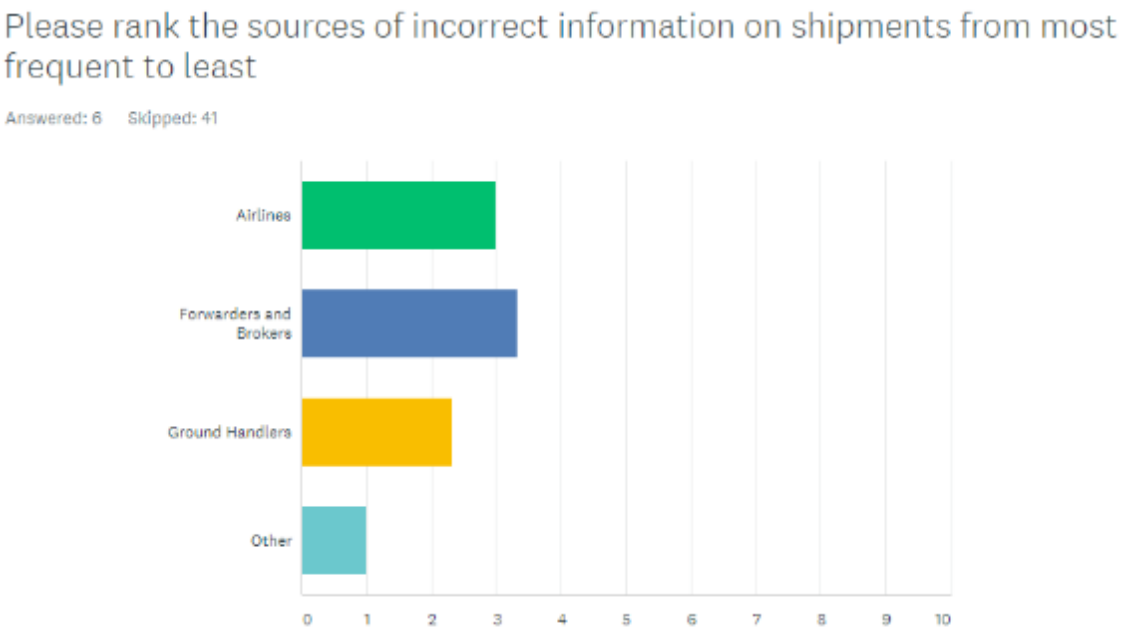
Answered: 6 Skipped: 41



Which of the following best describes the percentage of shipments (Airway bills) that contain incorrect information?

Answered: 6 Skipped: 41





Please list the most common errors that cause delays.

- Incorrect airway bill numbers
- incorrect flight arrivals. incorrect piece counts
- Lack of TSA LETTER
- money due
- No cargo locations. Cargo is not broken down when it should be. Etc.
- UNAVAILABILITY

Airline Responses

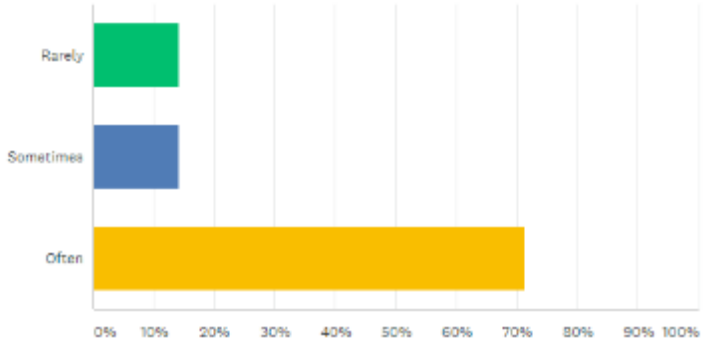
Only 7 of the responders identified themselves as an Airline so the results are not statistically significant. Their responses are listed here.

In a typical week, how many flights per week does your airline fly into JFK?

- 322
- 21
- 20
- 10
- 8
- 7
- 3

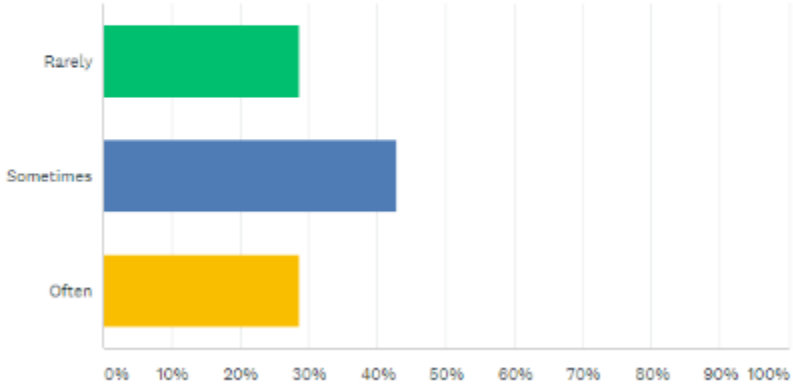
How often does your airline experience cargo-related delays at JFK due to ground handling operations on import flights?

Answered: 7 Skipped: 40



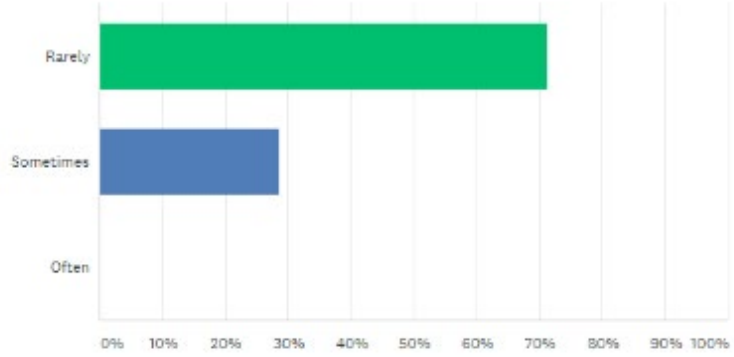
How often does your airline experience cargo-related delays at JFK due to ground handling operations on export flights?

Answered: 7 Skipped: 40



How frequently do you need to divert cargo destined for New York City region to other airports due to cargo-related delays at JFK?

Answered: 7 Skipped: 40



Approximately what percent of your flights into JFK are freighter aircraft?

- 100
- 50
- 45
- 40
- 30
- 0
- 0

Ground Handler Responses

Only one ground handler responded to the survey. Those responses are below.

How many airlines do you do business with at JFK?

- 10

Approximately what percentage of your cargo shipments at JFK arrive on freighter aircraft?

- 41-80%

How does your employee turnover at JFK compare to similar airports?

- Somewhat Lower

From a ground handler perspective, what would you say are some of the biggest challenges doing business at JFK?

- Facility Space

Freight Forwarder Responses

25 of the 49 survey responders identified themselves as Freight Forwarder / Customs Brokers. Their high level of frustration is expressed in their comments.

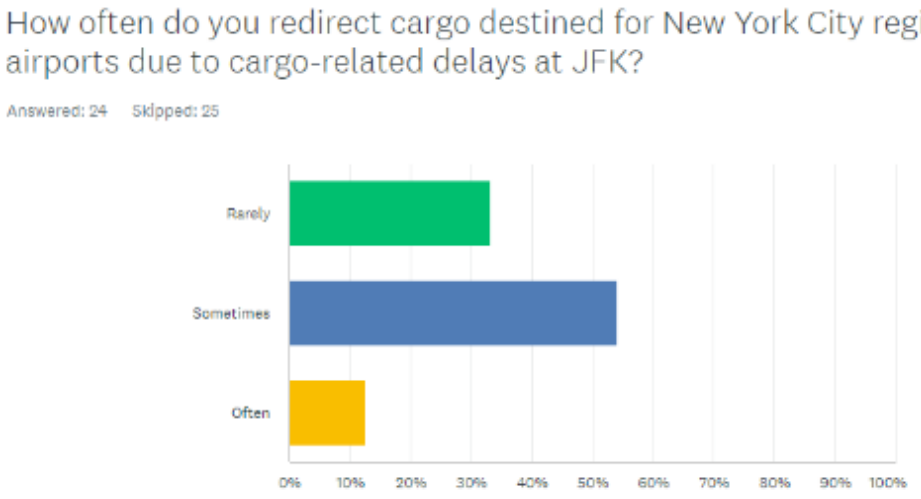
Here are their responses to the Freight Forwarder specific questions.

In a typical week, approximately how many shipments do you make into and out of JFK?

# Shipments	# Responses
100	5
80	2
50	4
30	1
25	3
20	1
6	1
3	1
2	1
1	1

Approximately how many trucking companies do you do business with at JFK?

# Companies	# Responses
20	1
10	3
8	1
6	2
5	6
4	3
3	4
2	2
1	1



From a forwarder/broker perspective, what would you say are some of the biggest challenges doing business at JFK?

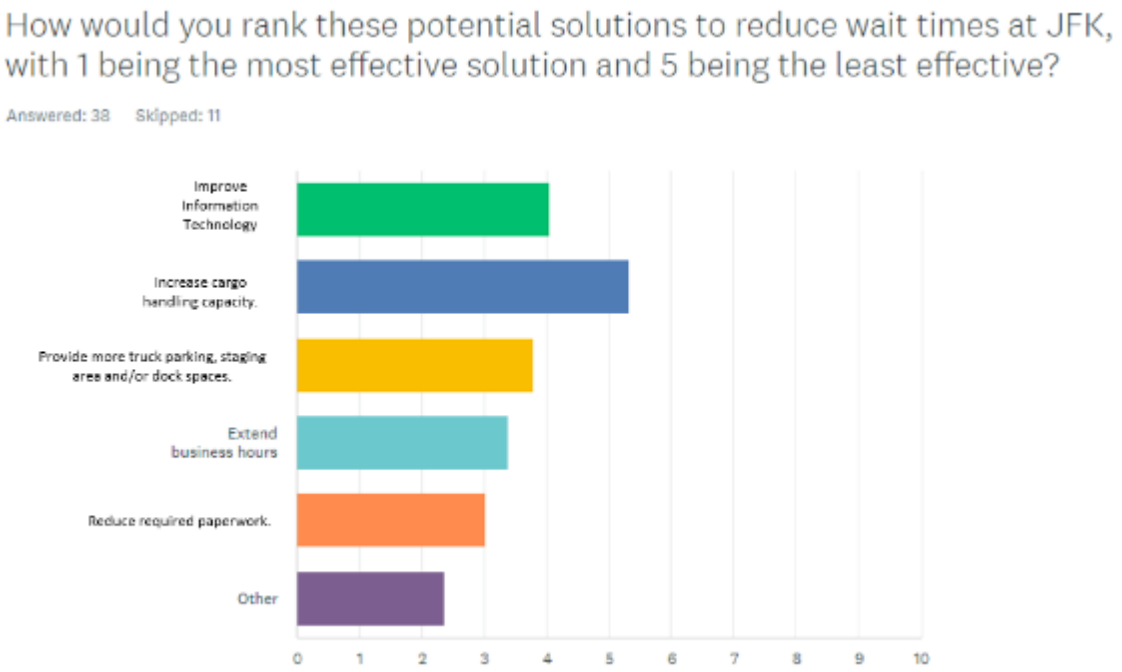
Verbatim responses:

- Arranging Pick up within free time. Especially over the weekend.
- Because of the long waiting time, Trucking companies hesitate to deliver or pick-up freights at JFK, or limit the time waiting at the terminal, charge extra for the long waiting charges.
- Cargo breakdown times and long delays for pick up once freight is available
- Congestion, ground handling facilities.
- Delays, expense, aggravation.
- diminished free-time, onerous storage charges, lack of affordable warehouse and truckyard space in the surrounding areas

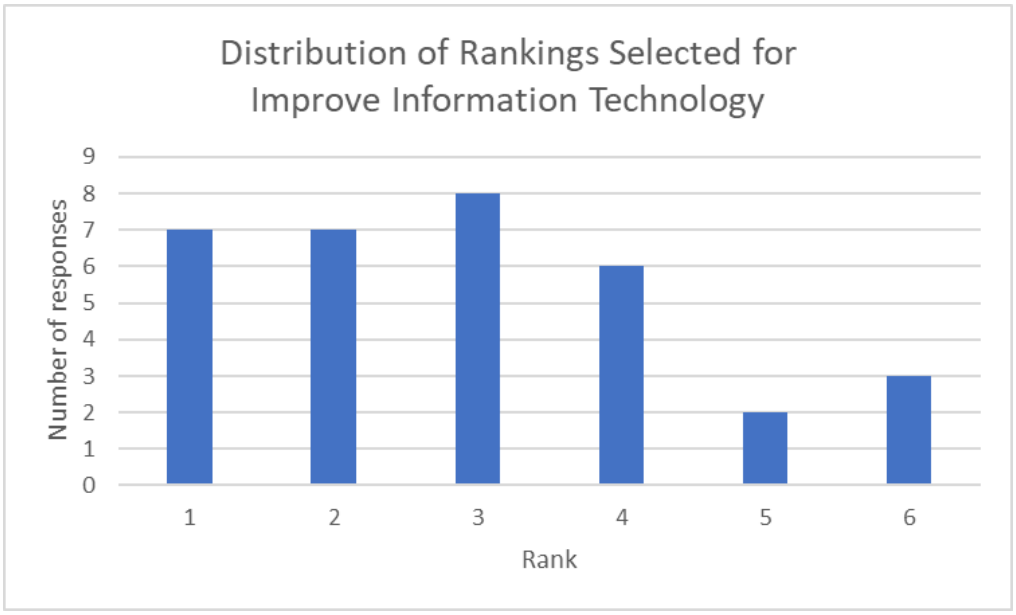
- Efficiency of airport operation
- excessive waiting time for airline pickup, not much trucker would like to pick up directly from JFK
- finding correct handling agent for minor airlines
- Getting freight picked up
- Ground handling agents not being held accountable for their lack of service. Storage fees being charged within 48 hours of arrival, regardless of the arrival date, including weekends and holidays.
- having to pick up freight on the weekend when it arrives on Friday and Sunday is the last free day. Monday storage starts at $1 per kilo per day or like thousands of dollars per day.
- incompetence, not enough employees to handle workload
- lack of communication, lack of staffing, lack of training, lack of knowledge, lack of oversight, lack of caring for the job
- no one answers the phone, and when they do have no training on how to verify AMS (Automated Manifest System), fees, LFD (Last Free Day) ....
- On time Cargo delivery to Airlines by flight's cut off time
- There is no one to talk to in order to correct. Most airlines do not pick up the phone. Airline staff are often unskilled, rude, and not proficient enough to correct problems. Not enough understanding of AMS and AMS codes and too many errors arriving cargo in AMS.
- Third party handlers that have no care for the industry. Inadequate system and warehouse automation. Compare to European and Asian freight hubs, JFK is 30 years behind!!
- Though the challenges are not limited to JFK, but certainly the turnaround time of a shipments arrival to freight availability is the greatest issue.
- Trucking overtime charges
- Unable to contact import customer service
- We as brokers spend more time than needed calling and HOLDING (sometimes 45-75minutes) to have free time extended because cargo was not available. TOTAL WASTE OF OUR STAFFS TIME

Solutions Identified

Survey responders were asked to rank potential solutions to reducing air cargo wait times at JFK and were asked for further suggestions.



While increasing capacity was the highest ranked solution, improving information technology was ranked by 34 of the 38 respondents who answered this question. Here is the distribution of their rankings:



Twenty-eight of the responders provided suggestions in response to the question *"Please specify any other suggestions you have to reduce wait times at JFK."* Here is a ranking of the suggestions. Verbatim responses are listed toward the end of this appendix.

Suggestion	# Responses
Add employees	9
Increase dock capacity	5
More/better training	4
Allow more free time before charging storage fees	3
Prioritize build units, Unit Load Devices (ULDs), Special, small packages	2
Motivated agents	2
Increase pay	2
Dock scheduling	2
Rebuild infrastructure	1
Manage to KPIs	1
More effective management	1
Reduce paperwork	1
Provide incentive pay	1
Fire slowest workers	1
Improve ground handler service quality	1
Have airlines hold ground handlers accountable	1
Use robots[38]	1

Survey Conclusions

Based on the responses and comments from this survey, we conclude that

3. There is a high level of dissatisfaction and frustration with air cargo wait times by all participant groups. Specifically, responders are unhappy with:
    a. The length of the wait times.
    b. Having to make return trips.
    c. Communication challenges:
        i. Inaccurate data
        ii. Manual flow of information
        iii. Long hold times and agents not answering the phone
    d. Paying storage fees when the cycle time is not the customer's fault
    e. Lack of parking and turnaround space on the airport campus.

[38] See Freight Operators Plan to Deploy Thousands of Remote-Operated Forklifts, Wall Street Journal, January 19, 2022

f. Insufficient training of employees
g. Lack of courtesy by agents
h. Insufficient warehouse capacities
i. Traffic congestion when picking up and dropping off cargo

4. Introducing a Truck Flow Management System at JFK would help alleviate some, but not all excessive wait times.
5. The following items are required to increase customer satisfaction and re-grow the air cargo business at JFK Airport:
    a. Larger more modern warehouses with more dock space.
    b. Road redesign to accommodate 53-foot trailers.
    c. More on-airport truck parking.
    d. Information technology updates that provide:
        i. Data integration between all supply chain participants:
            1. Customers
            2. Freight Forwarders and Customs Brokers
            3. Airlines
            4. Ground Handlers
            5. Truckers
        ii. Electronic trucker checking process that eliminates the need for truckers to park, and manually check in with agents and wait in queues at ground handling facilities.
        iii. Scheduling and reserving of docks for drop-offs and pickups.
    e. Recruit, pay and train extensively to ensure there are long-term employees with good customer service skills. This will require sufficient pay and desirable career paths that attract people who can effectively perform the tasks required to move cargo quickly.

Responder List

The companies and job titles of responders are on the following page.

Company	Job Title
Agra-Services Brokerage CO., Inc.	CFO
Airtime Express USA Inc.	General Mgr.
alba wheels up	Import Manager
Albatrans, Inc.	Sr. Vice-President of Operations
Alliance Ground International	General Manager
American Airlines	General Manager Cargo Operations JFK/PHL
American Lamprecht	Import Coordinator
Ameriportcan Lamprecht Transport	Import Entry writer
ASL Airlines Belgium	Station Manager
Atelier4, Inc.	Export -Import manager
B&H Customs Services Inc	Vice President
CN Link Freight Services Inc.	President
Corbett International Inc	President
DB Schenker	Air Import Manager
DBM Aviation Consulting	Principal
Elbti Systems of America	Sr. Trade Compliance Specialist
Emirates SkyCargo	Cargo Operations Manager
ETIHAD AIRWAYS	Cargo Supervisor
Euro Cargo Express	Operations Manager
EVA Airways Corp.	Cargo Manager
General Noli USA Inc	brokerage department manager
grace international customs brokers inc	president
H W ROBINSON & CO INC	President
IBC	STATION MANAGER
Immediate Customs Service, Inc	Customs Broker
International Communication & Transport Inc (ICT)	President
J&G Delivery Service, Inc	President
Janel Group	Account Manager
JJS TRANSPORTATION & DISTRIBUTION CO INC	PRESIDENT
JOSEPH SMITH CUSTOMHOUSE BROKER INC	PRESIDENT
K LINE LOGISTICS	GENERAL MANAGER
K Line Logistics USA Inc	Import manager/custom broker
Korean Air	Terminal manager
Korean Air Cargo	Security Manager
koreanair	Regional Manager
Market Pioneer Int'l Corp	Export Manager
Mobile Air Transport	Outbound coordinator
Mobile Air Transport	Terminal Manager
Overton and Co Air Services Inc	President
Sobel Network	Export Coordinator
SOBEL NETWORK SHIPPING	Import Specialist
Sobel Network Shipping	VP Operations
Sobel Network Shipping Co Inc	Import Supervisor
SOE Lines Inc.	President
T.H. Weiss Inc.	entry clerk
Union Logistics (NY) Inc.	V.P.
UPS	Brokerage Manager
V.T.Mancusi Inc	President

Verbatim Comments

The responses to the question *"Please describe any problems that excessive wait times have caused for you or your business. Be as specific as possible."* were:

- - Increased costs posed by the truckers. - Additional time by staff to monitor shipments. - Delays for air freight shipments are costly!!!
- 1- Cargo missing the flight (export). 2- Complaints from Customers ref time wasted by their subcontracted trucking service during drop-off and/or pick-up, which turns into additional money spent. 3- Detention Fees applied to EUV Services.
- All of our costs have doubled in the JFK Area, we have seen alot of our clients move away from NY area and move their warehouses to other parts of the country
- CONJESTION & CONFUSION AT THE JFK 13 GROUND HANDLING TERMINAL HAS A GREAT BEARING ON JJS' ABILITY TO SERVICE OUR CUSTOMERS - THE LONG (UNKNOWN WAITING TIME IMPACTS THE DAILY AVAILABILITY OF JJS' DISPATCH TO MANUEVER DRIVERS/TRUCKS
- consignee deconsolidating cargo on truck dock, missing cargo, no locate, manpower not equally producing
- Creates uncertainty of facilitating timely delivery to the receiving party. Creates excessive or additional storage fees. Creates disruption of service between the service provider and their client.
- Customer complaints
- Customer complaints and unnecessary email exchanges for explaining the situation.
- Customers are unwilling to pay for wait times and storage and many have moved cargo or warehouses to other airports.
- Delayed deliveries/pickups due to excessive wait times increases issues with customers who in this environment expects to see traffic flowing within air cargo.
- Driver hours of service. Hindrance of our ability to pick up and deliver other cargo. Increased overtime costs with office warehouse staff
- Drivers are limited to the times they are permitted to be active, so the wait times causes switching drivers. The trucking companies are not "not for profit" companies forcing them to charge extra fees for the equipment time and driver time-thus the importer is caring the cost of the inefficiency of the GHA and lack of concerning by the GHA customers which is the airline not the importer.
- Drivers can hardly find their docks for pick-up or delivery because of the congestion and less capacity. There's not enough manpower working in the warehouse. Some drivers may pay under pocket to the forklift driver to complete their jobs asap.
- Drivers wait 8+ hours to pick up
- due to we are not working on the spot. so cannot give out details.
- excessive costs (both storage fees and truck wait charges), unhappy customers, slower throughput per importation
- excessive wait times have caused pay airline storage fee and trucker expenses.
- Excessive waiting time cause delay of the delivery as well as overtime paid to trucker, very often, customer will not understand or willing to pay the additional wait time fee.
- Hard contact handling agents. No one answers the telephone at the airlines. Freight not made available for pickup until the last free day and then you have to pay storage due to the airline being short staffed

- Huge amount of waiting time charged by truckers after 1 hour free time. Dead run or attempt fees because freight can not be located or not available in a timely manner.
- Increases hours for drivers creating overtime charges. Creates congestions at the facility There are no places to queue
- Late delivery of cargo and additional charges from our trucking companies
- Listed Above
- Long times for paperwork processing and no door availability
- Loss of business. Longer hours of operation. Limiting the number of airlines a single driver can pick up. Excessive overtime. Loss of revenue.
- Missed pick ups due to long waits at airlines. Enormous storage charges. Hard time getting through on phone. Tremendous amount of time spent trying to resolve and/or negotiate problems
- Missed pick-ups from the airline which resulted in 1 day delay for overnight domestic shipping.
- Screening inquries ; The third party screening company are having difficulty making decisions causing delays .
- so many to choose from. Cargolux (bldg 151) now seems to take 3-4 days to break down freight. Not enough employees / forklift drivers. This past Saturday I had a driver at 151 for 12 hours trying to get one shipment that landed a few days earlier. Bldg 9 is always a disaster. It can take between 5-8 hours to recovere freight.
- the answer is in the question. "problems that excessive wait times have caused" / computerized calculation of storage fees... starting from the date of arrival, not the date the freight is available.
- the increased cost of operation and inability to complete the job as promised to our clients.
- Too long time for delivery AOG (Aircraft On Ground) to Airlines, and it missed Airlines' cut off time for the flight and caused our AOG shipment delay
- Too many to list, overall labor shortages, poor infrastructure, lack of motivation by low-paid employees and poor management.
- Too much to list.
- Truckers are waiting in line for 8-10 hours to deliver export freight. Trucker finally gets processed the warehouse says it is at capacity to come back the following day. Air Freight transit times have increased by weeks due to capacity issues, flights needing to be rebooked. Shipments not being updated properly accrue storage even though no arrival notice is sent, websites are not updated, or handling agents refusing to give notations about OSD (Over, Short, Damage) freight/no locates. We have paid HUNDREDS of thousands in storage due not having proper notations. Truckers are refusing to work in JFK. Customers are diverting freight or leaving the company all together.
- Truckers do not want to wait 5 hours to pick up a shipment
- truckers refuse to wait to pick up cargo
- Trucks come to pick up cargo before knowing if ready - takes additional management to control truck area, prioritize trucks for cargo that is ready and also get export cargo blocked by trucks trying to pick up import cargo
- unable to speak to an agent for cargo availability
- unnecessary storage charges
- wait times cause delays on our linehaul scheduled departures, this delay then causes the linehaul returns to be delayed getting back to JFK for export cargo.
- We have been waving a lot of storage charges caused by delay

Suggestion Verbatim Comments

The responses to the question *"Please specify any other suggestions you have to reduce wait times at JFK."* were:

- Better training to ground handling personal
- Complete infrastructure overhaul, of course not practical.
- Create Priority Lines for small pieces, special cargo and BUPs (Bulk Utilization Programs).
- Cross train cargo staff to understand how the logistics chain works for air cargo.
- Dock Spaces
- Facility space / dock doors are a bottle neck for all handlers
- Get better handling agents that appreciate the need for quick in/out times and cargo deliveries. Find a handling agent that actually cares about the truckers, forwarders and customers concerns
- Get employees that care and will answer the phone or an email.
- Have staff on hand to off load freight
- Have the staff trained and enough for coverage
- Import - Built units/ULDs be processed through dedicated doors. Express doors for shipments less than a certain pc count/wt. More staffing on the dock Export - Appointment deliveries for flights/set a schedule (Ad hoc can be first come first serve). More staff to unload trucks in a timely manner. Turn over the doors quicker/setting KPIs based on the pieces/weight of the shipments being delivered and monitor wait times in and out of the facility.
- Increase airline cargo handler crews
- Increasing handling manpower in JFK
- Introduce more competitive ground handler and with minimum wage going up to $17/hr. Hoping GHA 2 could hire more qualified employees instead of giving higher pay to management yet maintain minimum pay to frontline workers.
- IT solutions to have visibility for availability and release. This would reduce the need to call airlines and reduce wait times. If cargo is not available, trucks would not wait unnecessarily. Also make a number of appointments available for pick ups for those truckers who want them.
- Maybe you should build a warehouse outside of JFK?
- MORE EFFECTIVE MANAGEMENT
- More staffing to deliver cargo.

- Need more free time. Faster write ups. Need a solution for waiting hours and not getting freight. Not broken down. Once available, need more than 24 hours to collect freight don't count free time when plane hits the runway. Free time should start after freight becomes available. Most times, freight becomes available after free time.
- Paperwork processing prior to finding a door.
- Pay the workers more money, trim all the people that work so slow they look like the sloths that work in the DMV. Give them commissions for moving freight fast, and give us 72 hours free on Friday arrivals.
- Properly trained staff at the pickup location. Less nonsense with about LFD and availability. Free time should start from when the cargo is available for pickup NOT when the flight lands. We should not have to spend hours of time having this "corrected" in the various GHA / Airline computer systems.
- Put more people at work.
- Quality of service by GHA must be improved in order to reduce the waiting time
- The cargo departments of most airlines have little accountability for ground handling. Most outsource to third-party providers who seem mostly interested in charging obscene storage fees yet pay their workers the lowest possible wages, resulting in dismal service. Handling capacity is not adequate for the level of demand. I blame the airlines for defaulting on their responsibility to their cargo clients as much as the service providers they use.
- The ground handling agents need to be better staffed
- We need robots!

Appendix B: Truckers Survey Report

Kazem Oryani, Ph.D.

Center for Advanced Infrastructure and Transportation (CAIT), Rutgers University

kazem.oryani@rutgers.edu

kazem.oryani@farmingdale.edu

and

Kwanita Williams, Student Intern

Summary

55% percent of the drivers we surveyed were employed by local companies near the airport. Their time to get the airport was from 5-30 minutes. 45% percent took between two to ten hours to drive to the airport.

Drivers expressed the view that reaching JFK airport was accompanied with **medium difficulty** (31%) and **severe difficulty** (54%).

Comparing JFK Airport to other airports, 85% percent of truckers expressed difficulty reaching the JFK airport. 88% of trucks were carrying full loads while only 2 had partial loads.

31% of the drivers we surveyed took from 5-15 minutes to get to the respective cargo handling facility. 25% said it took 2-3 hours and 19% said it took 5-6 hours.

Cargo availability and wait time at ground handling facilities are key contributors to truck congestion. Excluding a 22 hour outlier, the wait time range is from 0 to 13 hours with an average of 4.8 hours. A few of reasons for long wait times mentioned by the truckers were:

> "Communication between parties involved is the main issue. Airlines directly inform the customer that their cargo has landed. However, airline notification does not indicate whether the cargo has cleared customs, been broken down from its pallet, or is ready for pickup."
>
> "The customer calls the trucking company to arrange for pick-up. The trucking company sends the truck to JFK to pick up the cargo. The trucking company does not have means

for tracing the cargo. As the client wants their cargo, the truck company sends a truck for pick-up."

"Paperwork time and wait time at the warehouse to get the cargo varies at different warehouse buildings. Two to three hours in Building 151. In the month of April 2021, one pickup wait time was 22 hours."

"Not all the time. Many times, truckers must wait."

"Lack of forklifts and people. Covid has contributed to the problem. Mismanagement."

59% of drivers were employed by a company. 41% were self-employed or owner-operators.

The weighted hourly average pay of resident drivers is estimated at $27.5 per hour from this limited sample. The range is between $15 to $35 per hour. The estimated pay by our sample is remarkably close to a larger sample of ninety-one salaries for the New City Area by Glassdoor.com with an estimated hourly pay of $28.6.

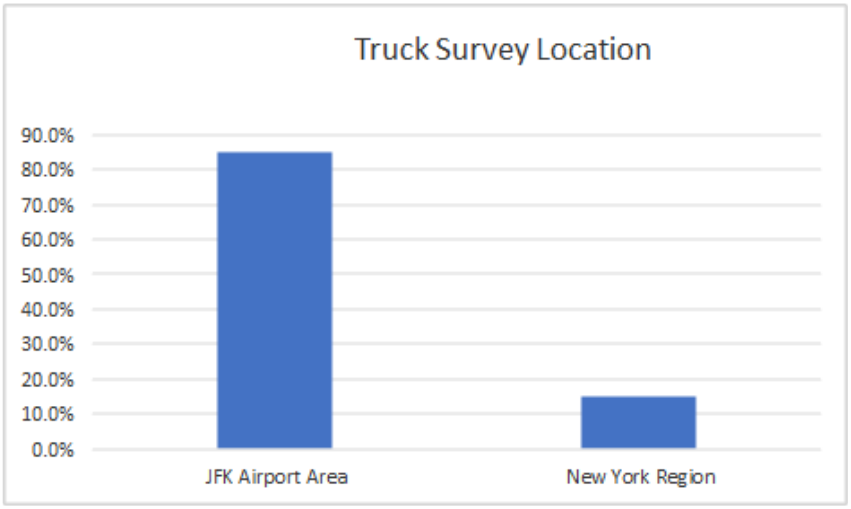
Due to cost of living, difficulty of driving in congested areas, and union efforts; NYC area drivers pay is about 36 percent higher than nationwide. Nationwide, truckers make an annual pay of $43,680 with an average hourly pay of $21.00 (June 1, 2020, survey).

Introduction

Our survey of twenty-seven truckers was conducted to obtain their views on congestion, delays, and work conditions for the JFK Truck Flow Management System (TFMS) Phase I Business Plan Project. Below are summaries of each question's responses.

1- Truck Survey Location

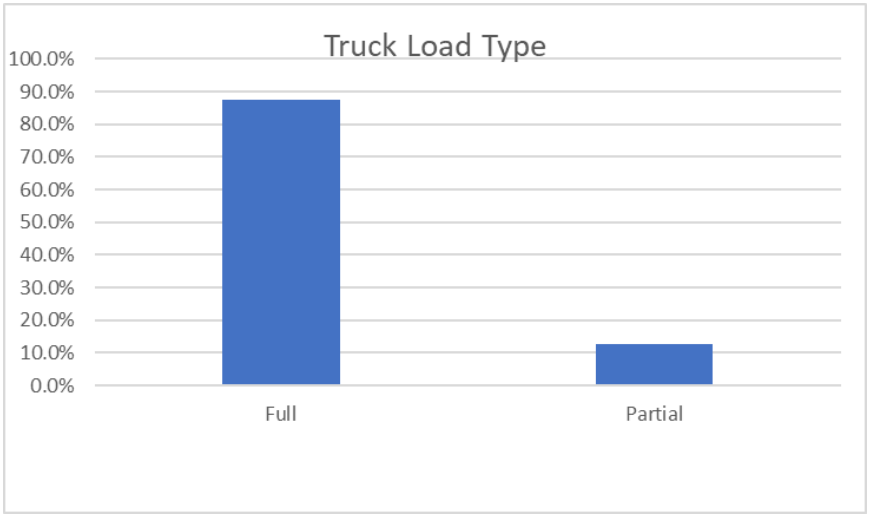
23 of the 27 surveys were conducted at the airport while 4 were performed nearby.



n=27

2- Truck Load Type

88% (14 of 16) trucks were carrying full loads while 2 had partial loads.



n=16

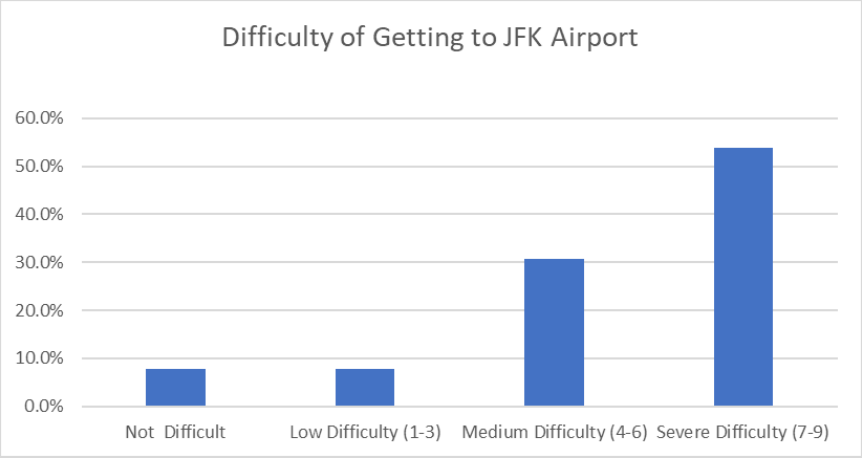
3- How Long (Did It Take) to Get to JFK Airport

55% of the drivers who were possibly employed by local companies near the airport as their time to get the airport was from 5-30 minutes. 45% had travel times between 2-10 hours.

n=11

4- Difficulty of Getting to JFK Airport

Truck drivers expressed the view that reaching JFK airport was accompanied with **medium difficulty** (31%) and **severe difficulty** (54%). Only 15% stated that there was no difficulty or low difficulty to get to JFK airport.



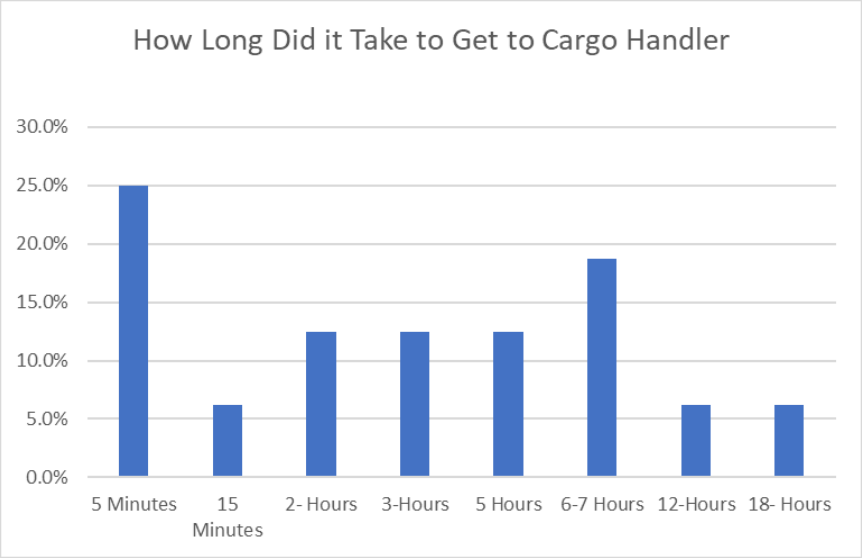
n=9

Driver Comment

When asked "What can I do to help you?", one driver's response was "Do not send me to New York." That trucker travels to JFK airport once per week.

5- How Long Did Take to Get to Cargo Handler

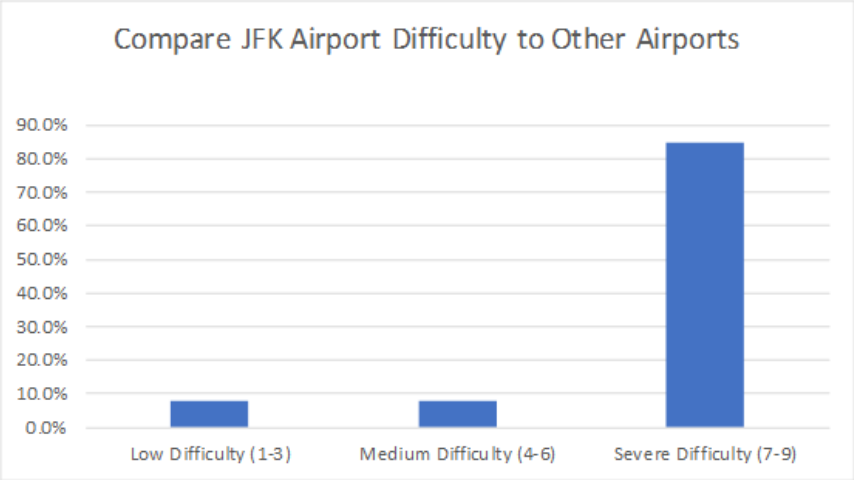
While in the airport, 31% said it took them 5-15 minutes to get to the respective cargo handling facility. 25% said it took 2-3 hours and 12.5% said it took 5 hours and 19% said it took 6-7 hours. Two claimed that it took 12 or more hours to get to the cargo handler. It could be possible that these two drivers were including time of load/unload and wait time in their response.



n=16

6- Comparing JFK Airport to Other Airports

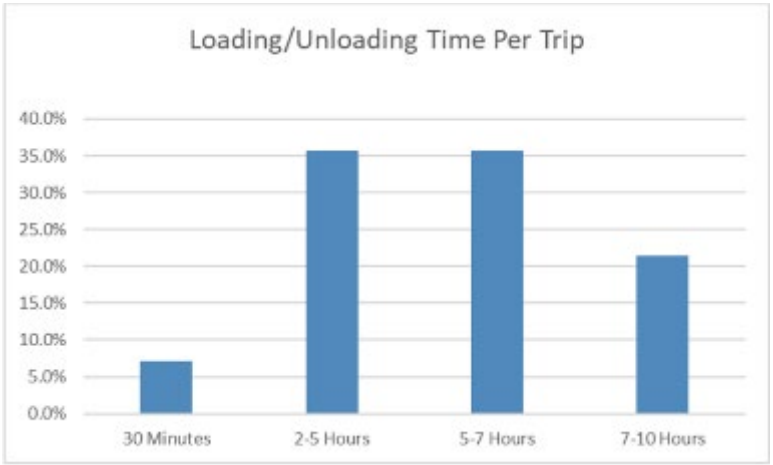
Comparing JFK Airport to other airports, 85% said they had severe difficulty reaching the airport.



n=13

7- Loading/Unloading Time Per Trip

Only one trucker said it takes 30 minutes to load/unload his truck. 36% said it takes 2-5 hours. Another 36% said it takes 5-7 hours. 3 drivers (21%) said it takes 7-10 hours.



n=14

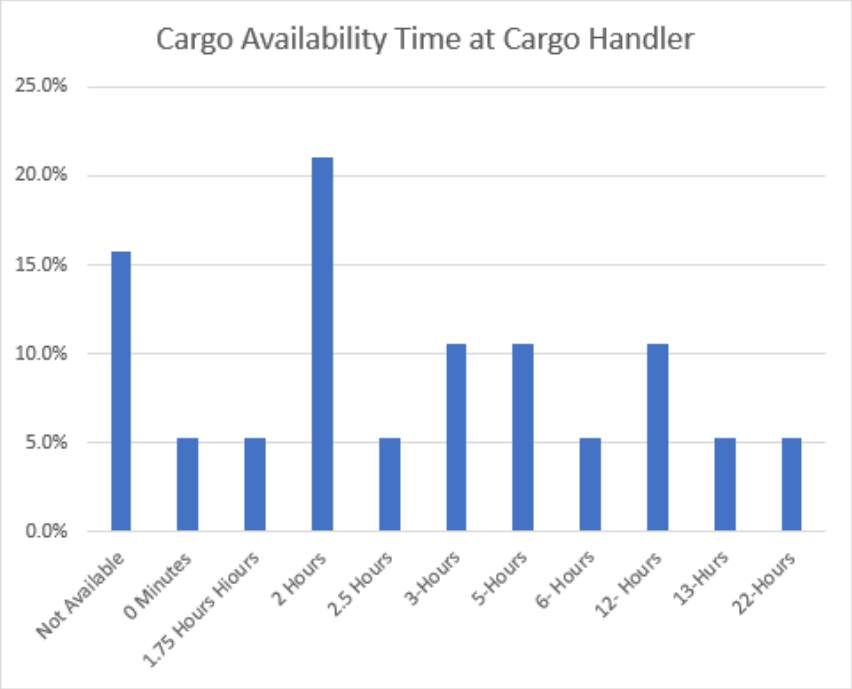
Driver Comment

“Between paperwork and truck load/unload a trip could be from 30 minutes to as much as 8 hours or more.”

8- Cargo Availability Time at Cargo Handler (Wait Time)

Only 1 of 19 truckers (5.3%) said that the cargo was available at the cargo handling facility. 16% said that the cargo is never available. 21% percent expressed a wait time of 2 hours. 26% said it took 3-6 hours.

Out of 27 truckers surveyed, 16 specified wait time hours. The range of wait time is from 0 (cargo available) to 22 hours. This sample provides an average of 5.8 hours. If we exclude the 22-hour outlier from the sample, the range is 0 - 13 hours with an average of 4.8 hours for wait time at the cargo handler.



n-19

Driver Comments

“Communication between parties involved is the main issue. Airlines directly inform the customer that their cargo is landed. It does not indicate whether it has cleared customs, been broken down, or is ready for pickup.” (Truck company A)

“The customer calls the trucking company to pick up. Trucking company sends the truck to JFK to fetch the cargo. Trucking company does not have means for tracing the cargo. Since the client wants the cargo, the truck company must send truck for pickup” (Truck company A.)

“The wait time depends on individual circumstances such as freight breakdown, information available to dispatch freight, and paperwork.”

Building 9 is the worst for drivers [wait time]. There have been cases of 7am to 7pm waiting to pick up cargo (Truck company B)

“Paperwork and wait time at the warehouse to get the cargo takes different times at different buildings. 2-3 hours in Building 151. In April 2021, one pickup wait time was 22 hours.” (Truck company A.)

“Not all the time. Many times, truckers must wait” (Driver No. 4.)

“Lack of forklifts. Covid has contributed to the problem. Mismanagement.” (Truck company B)

“Mismanagement, Lufthansa is worst for cargo pickup. Airlines do not care. Responsibility goes to the cargo handler. Tipping of $5 -$10 helps. Storage fees vary from $100 to $1000.” (Truck company C)

“Warehouse charges by airlines has been $200 to $5000 and sometimes more. Anecdotal charge of $11,000 is rumored.” (Truck company A.)

“No breakdown.” (Driver No. 21.)

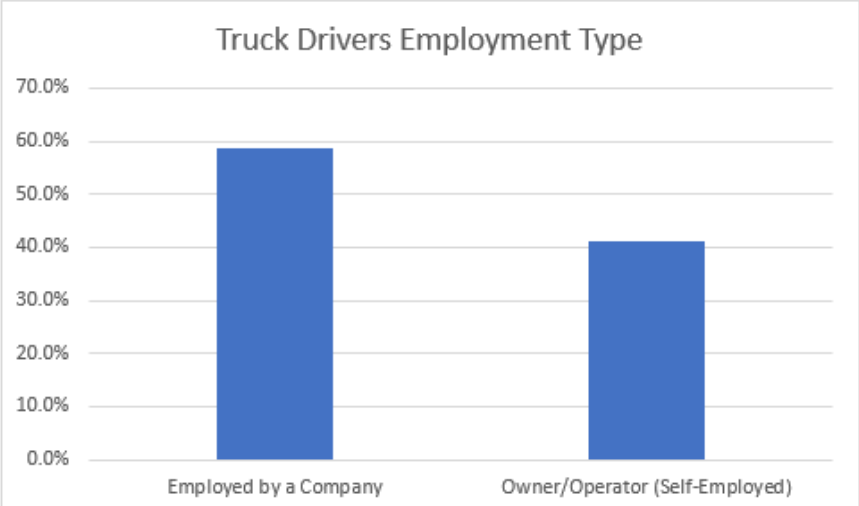
“Not available, waiting.” (Driver No. 24.)

“The congestion hurts the customer for not receiving their cargo on time. There have been more than 12 hour wait times at the Lufthansa warehouse.” (Truck company A.)

“Main congestion points are at warehouses. In Building 9, there were 30 trucks waiting and clogging the roadways to the airport. Then, the Port Authority police came and ordered the trucks to vacate the roadways (with or without cargo). This is because there is not an airport wide information system letting truckers know when to come to airport for cargo pick-up].” (Truck company A.)

9- Truck Drivers Employment Type

About 59% percent of drivers are employed by a company. 41% percent are self-employed or are owner-operators.



n=17

Driver Comments

"Amazon created a separate company for cargo delivery" (Driver No. 3.)

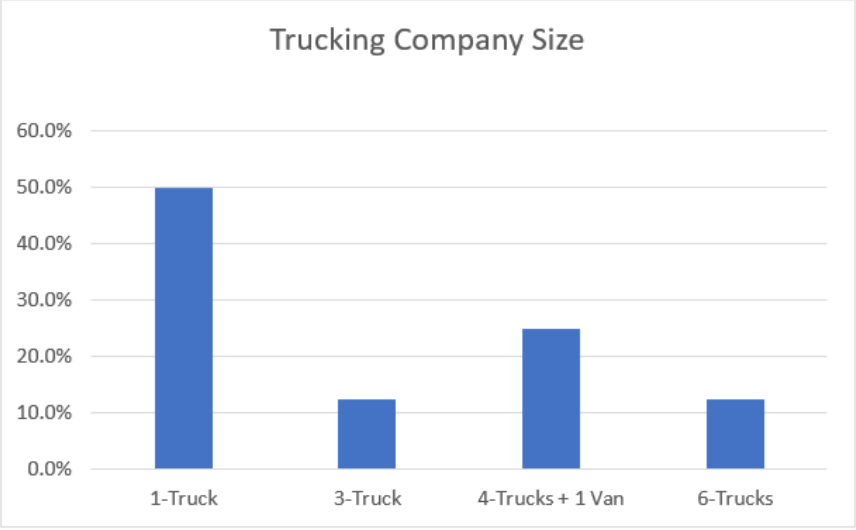
"Because of timed delivery for Amazon, the driver could not provide more information." (Driver No.8.)

"As an independent contractor, if he gets parking ticket, he must pay it himself. The trucker was originally from Guyana." (Driver No. 9.)

"The driver likes to work for a trucking company [instead of being an independent contractor]. He asked me whether I am hiring." (Driver No. 9.)

10- Trucking Company Size

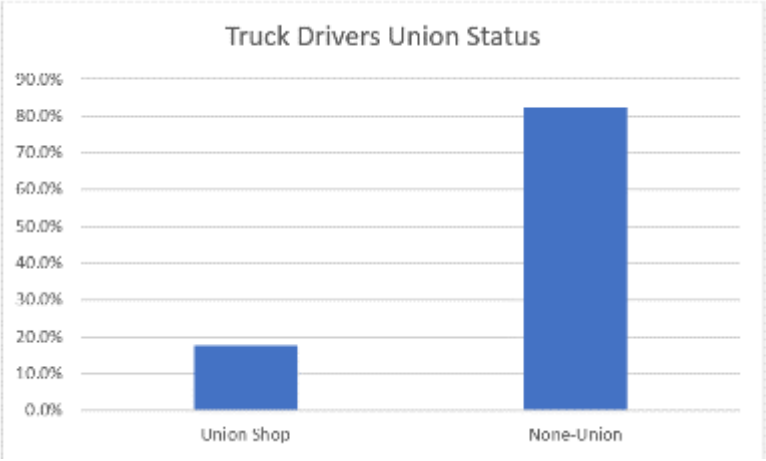
50% of drivers said that their company operates only one truck. These respondents were likely to be independent contractors. 13% percent said that their company has 3 trucks, while 37% said that their company has 4-6 trucks. In a separate interview, another trucking company we will refer to as "Truck Company A" said they have 9 trucks.



n=8

11- Truck Drivers Union Status

18% percent of the drivers were union members while 82% were non-union.



n=17

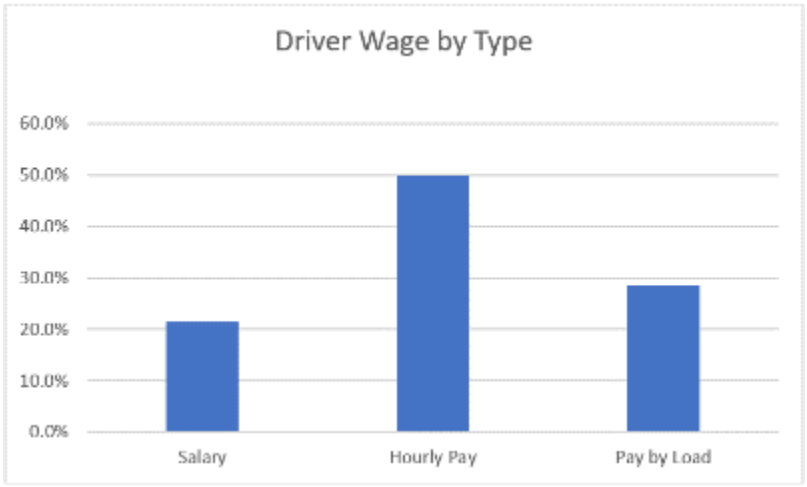
Driver Comments

“Drivers stated that they are “happy with UPS and their union. On the average they work 11.5 hours per day.” “(Drivers Number 2 and 3.)

“Drivers number 2 and 3 were thankful for the interview.”

12- Driver Wage by (Payment) Type

50% of the drivers were paid by hours worked. 29% percent were paid per load regardless of how long it takes to deliver the cargo. 21% percent were salaried.

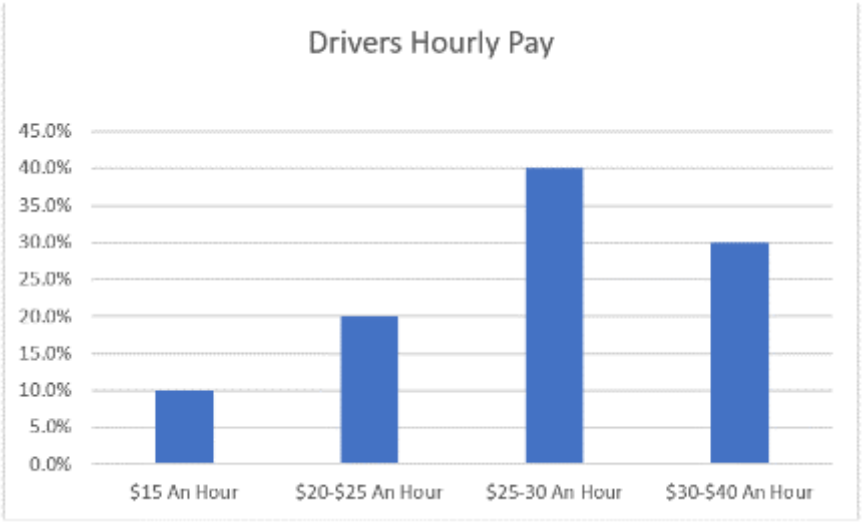


n=11

13- Drivers Hourly Pay

10 drivers provided information about their pay. The hourly average pay was $27.5 per hour from this limited sample. The reported average hourly range was $15 to $35 per hour. This is equivalent to $57,200 per year assuming 2080 hours of 52 weeks, 5 days per week and 8 hours per day.

The reported pay in our sample is remarkably close to a larger sample of 91 salaries for the New City Area by Glassdoor.com that reported average hourly pay of $28.6. Due to its high cost of living, difficulty of driving in congested area, and union efforts, NYC area drivers pay is about 36 percent higher than nationwide. Nationwide truckers make an annual pay of $43,680 with an average hourly pay of $21.00. (June 1, 2020, survey)



n= 10

Driver Comments

“In a hurry to leave. He did not give wage and benefit information. (Driver No. 11.)

“Trucker was in a rush for a timed delivery. Had no time to give information or did not want to share information. He just said that Amazon has a set-up a separate company for delivery.” (Driver No. 4)

“$600 per week” (Driver No. 25).

Summary and Conclusions:

Trucking is a difficult job particularly in and around JFK airport due to congestion levels, the legacy network of tight roadways, and lack of space for truck parking. As a trucking company manger said, “The main congestion points are at warehouses”. In Building 9, there were thirty trucks waiting and clogging the roadways to the airport. Then, the Port authority Police ordered the trucks to vacate the roadways (with or without cargo).

Situations like the congestion mentioned above happen because there is no airport-wide information system available to let the truckers know the status of cargo availability and when to come to airport to pick-up.

The difficulty of hiring workers at the airport for security reasons and regulations has contributed to increased wait times at cargo handling facilities. Lack of sufficient forklifts and insufficient staffing levels due in part to Covid have contributed to the problem of long wait times. Some cargo handlers are economizing with the reduced staffing levels due to Covid, even though cargo volumes are now much higher.

Appendix C: GatewayJFK Airport Network Geometric Deficiency Analysis

Investigator: Michael Shenoda, P.E., Ph.D, LEED AP BD+C, PTOE

Graduate Assistant: Irfan Siddiqui

This aspect of the project involved analyzing the landslide cargo flow network at JFK Airport to consider any geometric design deficiencies, make determinations on potential improvements to the operations of the network, and clarify the applicability of the information derived to the operation of the proposed JFK Cargo View system.

At John F. Kennedy Airport, these days it is very normal to experience extensive delays in freight mobility due to increased number of freight movements that are carrying medical supplies and other products in pandemic. There are sometimes hourlong traffic jams, since the airport has only one primary access road for freight — the Van Wyck Expressway. In the current geometric design of the landslide cargo flow network at JFK Airport, there are a lot of deficiencies that can be overcome to reduce significant delays and help making improvements to the cargo operation. The current investigation considers the possible design deficiencies, make changes in the design to improve the cargo system. We will propose the actions that should be taken in order to improve the traffic in the area.

Steps Involved:

There were four main steps in the process:

1. Use aerial/satellite photos in Google Maps to survey the area, inventory the network, and identify deficient areas.
2. Use the live traffic view in Google Maps during rush hour to locate congested intersections that correlate to the deficient areas considered in step 1.
3. Take the physical survey of the area, including taking pictures and verifying the findings with the visualization and images captured at the area.
4. Correlate with findings reported by Philip Habib & Associates[39], which was done in May 2019.

Survey/Inventory:

The network was observed on Google Maps for the usual traffic, one way / two-way roads, number of lanes and the lanes dedicated for right or left turns. It was observed that almost none of the streets are dedicated for right and left turns that make it difficult for the long length trucks

[39] GatewayJFK Traffic Study Phase 1 Conclusion.pdf, Phillip Habib & Associates memo to Scott Grimm-Lyon, PHA #18-114, 2019

to turn on the streets specially when the streets have only one lane and the cars are already parked on both sides of the streets.

The area is mostly populated with the trucks that move to and from their respective loading/unloading stations. The following is the list of the streets that are in the area that were focused on to consider the areas of traffic congestion.

Street	One-way / 2-way	Lanes	L-turn lane	R-turn lane
182nd Street	2-way	1	0	0
183rd Street	2-way	1	0	0
150th Drive	2-way	1	0	0
Rockaway Blvd.	One-way	4	0	0
150th Road	One-way	1	0	0
Guy R Brewer Blvd.	One-way	2	1	0
150th Ave.	2-way	1	0	0
149th Road	2-way	1	0	0
149th Ave.	2-way	1	0	0
175th Street	One-way	1	0	0
148th Avenue	2-way	1	0	0
Porter Road	2-way	1	0	0
Farmers Boulevard	2-way	2	1	0
Rockaway / Nassau Blvd.	2-way	3	2	1
Nassau Expressway	One-way	3	0	0
159th Street	One-way	1	0	0
146th Ave.	2-way	1	0	0
158th Street	One-way only	1	0	0
157th Street	2-way	1	0	0
156th Street	One-way only	1	0	0
155th Street	One-way only	1	0	0
146th Ave	2-way	1	0	0
Cranston Street	2-way	1	0	0
South Conduit Ave.	One-way	5	1	2
136th Avenue	2-way	1	0	0

135t Avenue	2-way	1	0	0
Street	**One-way / 2-way**	**Lanes**	**L-turn lane**	**R-turn lane**
134th Avenue	2-way	1	0	0
133rd Avenue	2-way	1	0	0
North Conduit Ave.	One-way	4	0	0

Aerial/satellite visualization of the streets with description:

We have captured the streets with satellite view to observe the real cause of problem for the congestion of traffic in the area. It was observed that most of the streets have only one lane with no dedicated left or right turn lane. It was also observed that on most of the streets, vehicles have been parked on both sides of the road making the traffic flow hard.

182nd Street:

182nd Street is a two-way street that has mostly trucks parked usually. The traffic is usually heavy on the road. The reason is this road has all the logistics and transportation facilities on both sides due to which trucks inwards and outward movement continuously occurs. There is only one lane available for the flow of traffic in either way including left or right turns. There is no specific left or right turn lane available that can reduce the congestion on the road and make the traffic flow smooth.

183rd Street:

183rd Street is a two-way single lane street that connects with 150th Street, it is usually not a very busy street due to no thru traffic is allowed on that street. The trailers, trucks and car parking reduce the street space to a half though. Like 182nd Street, there is no specific left or right turn lane available. Also, only one lane is available for the flow of traffic in either direction that sometimes results in the blockage in traffic flow.

150th Drive:

150th drive is a two-way single lane street that connects 183rd Street with 182nd th Street. The trailers, trucks and car parking reduce the street space. There is no specific left or right turn lane available. Also, only one lane is available for the flow of traffic in either direction that results in the blockage in traffic flow.

Rockaway Boulevard:

Rockaway Boulevard is a very busy four lane street in which two lanes turn toward JFK Airport that help reduce the pressure on the traffic flow. The traffic on this road is usually very heavy.

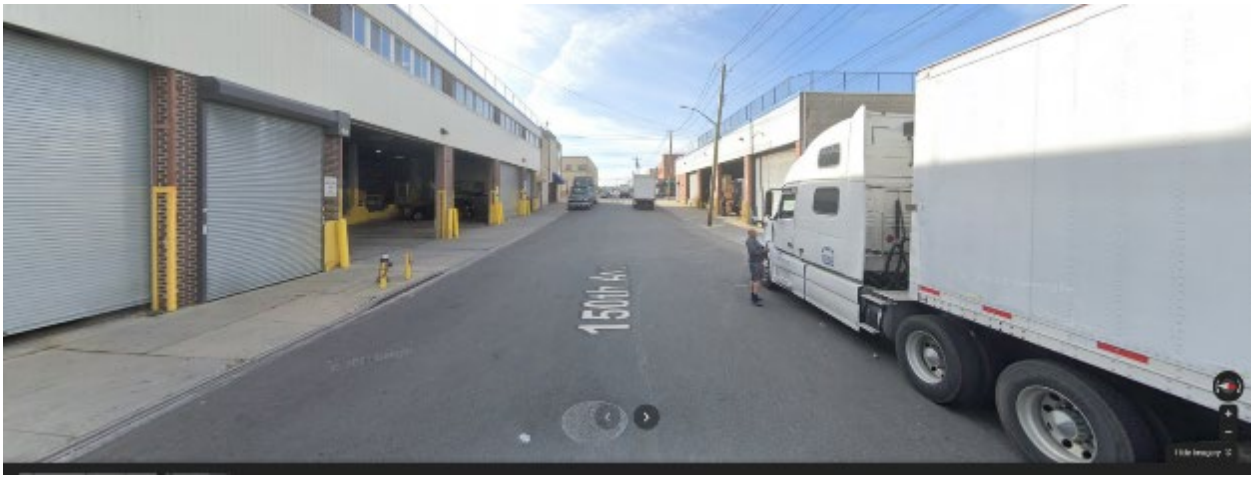
150th Road:

150th Road is a 2-way (single lane each) road where air cargo service trailers are parked, and garbage is seen on the road. The road has the warehouses that have a lot of cars, trailers, and tractors parking inside that come and go from there for loading/unloading and movement of freight.

Guy R Brewer Boulevard:

Guy R Brewer Blvd. is a very busy road that connects to Rockaway boulevard. The road is two-way and is only two-lane road despite heavy traffic. The trucks make the traffic movement difficult. The dedicated left lane helps reduce the congestion on the road for the vehicles that want to go straight. However, due to the heavy traffic and single lane road for the straight traffic, the road is usually very busy with heavy traffic.

150th Ave.:



150th Ave connects 183rd Street to Rockaway Blvd. The road is single lane two-way road with both sides' trucks parking and truck garages. The road is usually not very busy but sometimes when the trucks are entering/exiting to and from the parking garages, the traffic flow slows down.

149th Road:

149th road is a two-way road with a single lane and lot of driveways. The entering and exiting of the heavy vehicles make the traffic flow really slow on this road at times. The road has usually heavy to normal traffic flow.

149th Ave.:

149th Avenue is a two-way single lane road with vehicles parked on both sides. The road does not have a dedicated left or right turn lane. The parking and entry/exit from parking lots allow the congestion of traffic on the road.

South Conduit Avenue:

NY-27 South Conduit Avenue is a road that mostly cargo trucks use as a service road of JFK expressway. The road is a four-lane road that turns left for Rockaway boulevard. Left turn on the road make a traffic to be a little more organized.

147th Ave:

147th Ave is a two-way single lane road that is very busy connecting Springfield Lane to Nassau expressway and usually gets very busy passing Guy R Blvd. where traffic from 176th Street joins the road. There is no dedicated left or right turn lane. There is parking on only one side of the road. The trucks stopping on the road make the traffic congested.

176th Street:

176th Street is a single lane one-way street that usually has very heavy traffic between 148th Avenue and 147th Avenue. The reason is the cars are parked on both sides of the street with only one lane moving. There is movement of trucks on both sides of the road. There is no dedicated left or right turn lane. The single lane with turning trucks make the traffic flow slow.

Porter Road:

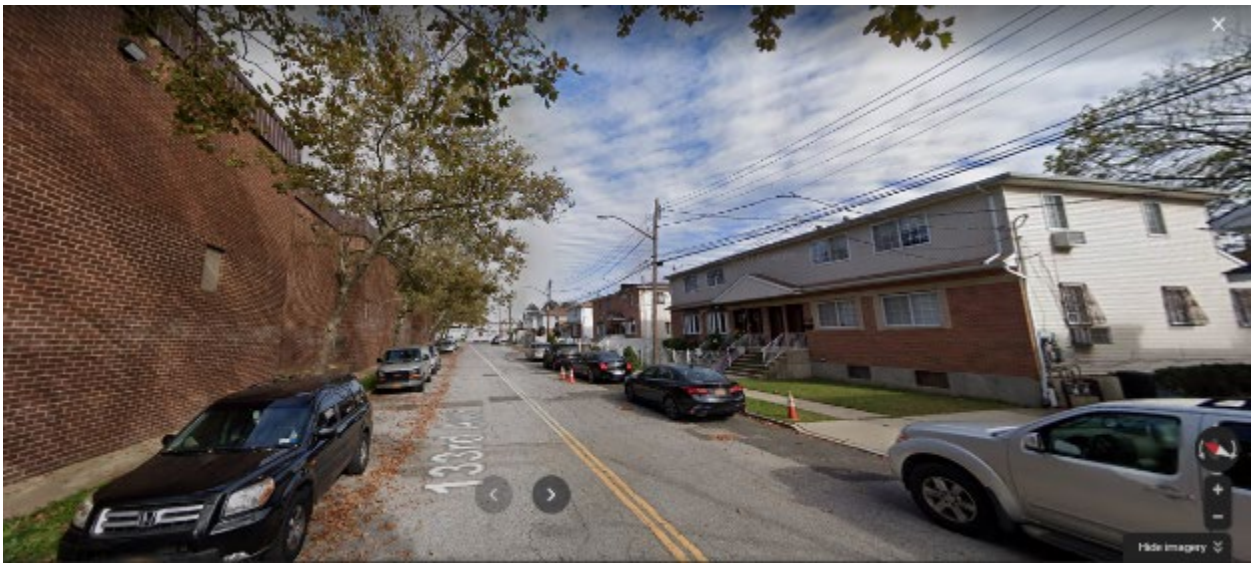
Porter road is a two-way single lane toad that connects 175th Street to Rockaway Blvd. The road has narrow lanes with parking on both sides. The road is usually operated with light traffic. The narrow lanes, sometimes, make the traffic movement difficult.

Cranston Street:

Like most of the roads in the area, Cranston Street is a narrow two-way road with cars parked on both sides. The road connects to Rockaway Blvd. Cranston Street doesn't have a dedicated right

or left turn lane. The road is usually not very busy but due to narrow lanes and both sides parking, traffic gets congested sometimes.

133rd Avenue:



133rd Avenue starts with a dead end with FedEx and UPS facilities. The road is two-way single lane road with cars parked on both sides. Usually there is not too much traffic on the road but sometimes it gets congested because of car parking and no dedicated turn lane.

Live Traffic on the Streets:

We captured real time traffic on each of the streets to get the better idea of how the traffic is on each of the streets in morning rush hours. It was observed that some of the streets has heavy traffic in the morning rush hours that is caused by the factors discussed above. Following is the street overview of the area with real time traffic.

182nd Street:

182nd Street is a two-way street that has mostly trucks parked usually. The traffic is usually at the intersection of 147th Ave. The reason is this road has all the logistics and transportation facilities on both sides due to which trucks inwards and outward movement continuously occurs. There is only one lane available for the flow of traffic in either way including left or right turns. There is no specific left or right turn lane available that can reduce the congestion on the road and make the traffic flow smooth.

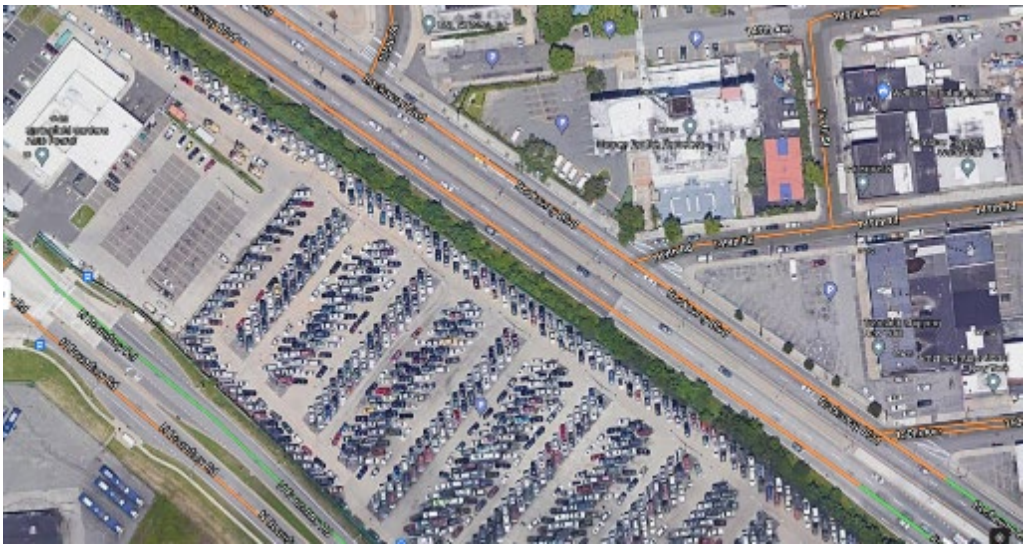
183rd Street:

183rd Street is a two-way single lane street that connects with 150th Street, it is usually not a very busy street due to no thru traffic is allowed on that street. The trailers, trucks and car parking reduce the street space to a half though. Like 182nd Street, there is no specific left or right turn lane available. Also, only one lane is available for the flow of traffic in either direction that sometimes results in the blockage in traffic flow.

150th drive

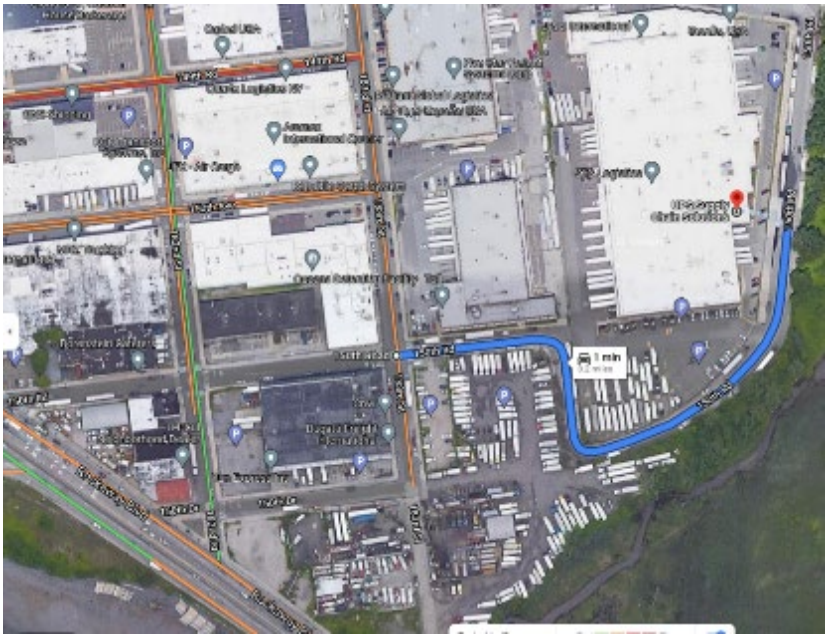
150th drive is a two-way single lane street that connects 183rd Street with 182nd Street. The trailers, trucks and car parking reduce the street space. There is no specific left or right turn lane available. Also, only one lane is available for the flow of traffic in either direction that results in the blockage in traffic flow.

Rockaway Blvd



Rockaway Boulevard is a very busy four lane street in which two lanes turn toward JFK Airport that help reduce the pressure on the traffic flow. The traffic on this road is usually very heavy.

150th road



150th road is a single lane road in each direction where air cargo service trailers are parked, and garbage is seen on the road. The road has the warehouses that have a big lot of car, trailer, and tractor parking inside that come there and go from there for loading/unloading and movement of freight.

Guy R Brewer Blvd

Guy R Brewer Blvd. is a very busy road that connects to Rockaway boulevard. The road is two-way and is only two-lane road despite heavy traffic. The trucks make the traffic movement difficult. The dedicated left lane helps reduce the congestion on the road for the vehicles that want to go straight. However, due to the heavy traffic and single lane road for the straight traffic, the road is usually very busy with heavy traffic.

150th Ave.

150th Ave connects 183rd Street to Rockaway Blvd. The road is single lane two-way road with both sides' trucks parking and truck garages. The road is usually not very busy but sometimes when the trucks are entering/exiting to and from the parking garages, the traffic flow slows down.

149th road

149th road is a two-way road with a single lane and lot of driveways. The entering and exiting of the heavy vehicles make the traffic flow really slow on this road at times. The road has usually heavy to normal traffic flow.

149th Ave.

149th Avenue is a two-way single lane road with vehicles parked on both sides. The road does not have a dedicated left or right turn lane. The parking and entry/exit from parking lots allow the congestion of traffic on the road.

175th Street

148th avenue

Porter Road

Porter road is a two-way single lane toad that connects 175th Street to Rockaway Blvd. The road has narrow lanes with parking on both sides. The road is usually experiences light traffic. The lanes are narrow, which sometimes makes traffic movement difficult.

Farmers Boulevard

Rockaway / Nassau Blvd.

Nassau Expressway

159th Street

146th Ave

157th Street

Cranston Street

Like most of the roads in the area, Cranston Street is a narrow two-way road with cars parked on both sides. The road connects to Rockaway Blvd. Cranston Street doesn't have a dedicated right or left turn lane. The road is usually not very busy but due to narrow lanes and both sides parking, traffic gets congested sometimes.

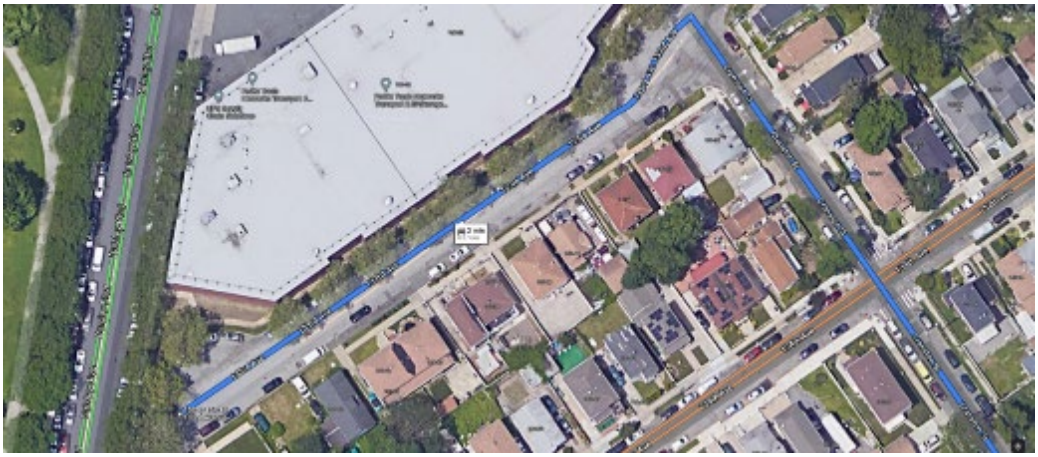
136th Avenue

135th Avenue:

134th Avenue

134th Avenue that connects to the Rockaway Boulevard is usually with heavy traffic on both sides. During normal traffic hours, there are congestions on the road.

133rd Avenue



The traffic on 133rd Avenue usually flows freely since the road is a dead end. The road is two-way single lane road with cars parked on both sides. Usually there is not too much traffic on the

road but sometimes it gets congested because of car parking and no dedicated turn lane. 133rd Avenue has FedEx and UPS facilities.

North Conduit Avenue

Usually, at north conduit Avenue, traffic flows freely. The Avenue runs parallel to the Belt parkway that is usually very busy with the heavy traffic resulting in the easy flow of traffic for north conduit Avenue. Since trucks and trailers are not allowed on parkway, they can only be routed through the Conduit Ave. North Conduit Avenue is a four-lane road with free flow of traffic. One dedicated lane other than these four lanes is for connecting the avenue to the freeway.

Additional Pictures taken at the Site Survey can be found here.

Consideration of Particular Locations:

There were many areas that were found to be congested and could be addressed by considering the geometric deficiencies. We consider five of them below:

1. **146th Avenue:**
   a. Satellite View:

In satellite view, it was observed that there is parking on both sides of the road. That will cause the trucks with trailers difficulty in turning. Trucks can be freely moved if parking restrictions are applied. It was observed that parking on both sides of the road with traffic moving makes it hard for the cars and trucks to move easily and resulted in the congestion in the area.

   b. Pictures taken at the location:

When driving to the area, we confirmed that the movement of trucks is difficult in the area due to the parking on both sides that congestion in the area. The picture is taken at the area that shows the congestion at the Avenue which caused trucks not to turn easily.

c. Google maps traffic view:

The traffic was monitored in the area at rush hour. The roads are congested, and the reason is that the parking on both sides of the road makes the movement of vehicles difficult especially the trucks with trailers.

d. Philip Habib & Associates survey in May 2019:

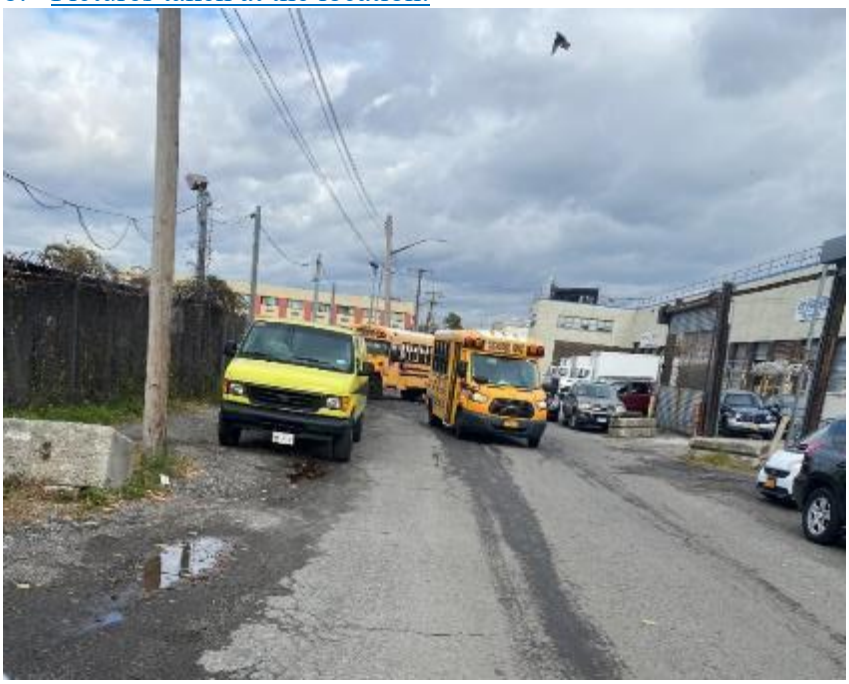
Philip Habib & Associates surveyed the area in May 2019 and have the same opinion about the two sides parking on the street. Their statement is quoted below:

> *"146th Avenue between 155th Street and 159th Street currently allows for parking on both sides of the Street, which makes it difficult for the larger tractor-trailers to maneuver. "No Parking" or day/time-restricted parking regulations could be proposed along the south side of 146th Avenue to give trucks more room for turning and maneuverability*". (Philip Habib & Associates, 2019)

2. **155th Street & 145th Avenue:**
   a. Satellite View:

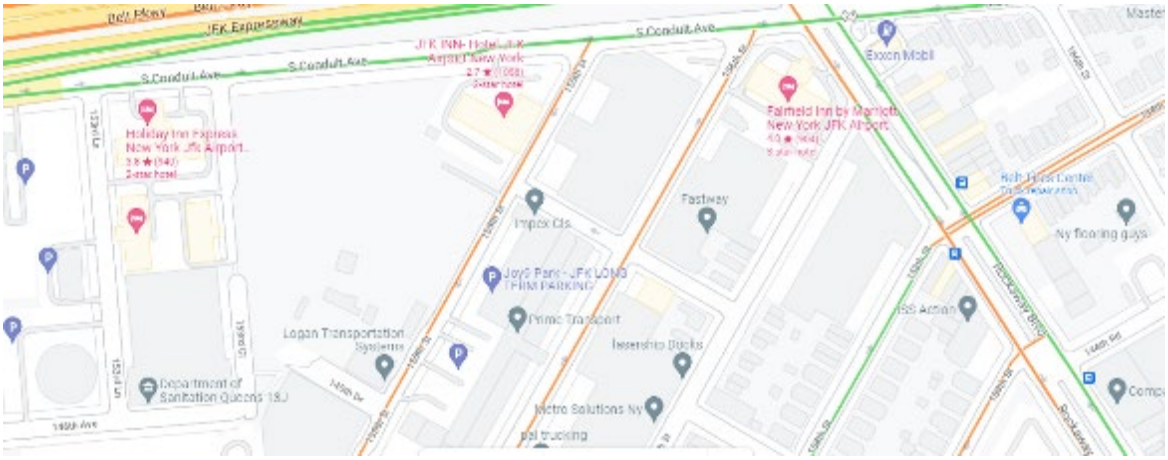
155th Street / 145th Avenue is one more congestion spot where a lot of buses seen parking and queuing that is making the road congested and making the movement of cars and trucks difficult especially with parking on both sides of the road.

   b. Pictures taken at the location:



When we drove to the location, we witnessed a lot of buses that were parked, and some were idling in the area. They were creating a lot of congestion in the area.

c. Google maps traffic view:



It can be seen in the Google maps traffic view that 155th Street has congestions and that is due to the bus idling in the area that were causing the congestion.

d. Philip Habib & Associates survey in May 2019:

Philip Habib & Associates surveyed the area in May 2019 and have the same opinion about the two sides parking on the Street. Their statement is quoted below:

"Heavy bus queuing occurs on 145th Avenue between 155th Street and 157th Street for buses accessing Grandpa's Bus Co. (bounded by S. Conduit Avenue to the north, 155th Street to the south, and 153rd Court to the west). Alternate entrances to the bus yard, such as access via S. Conduit Avenue or 153rd Court, could be analyzed to divert buses from the residential area." (Philip Habib & Associates, 2019)

3. 182nd Street:

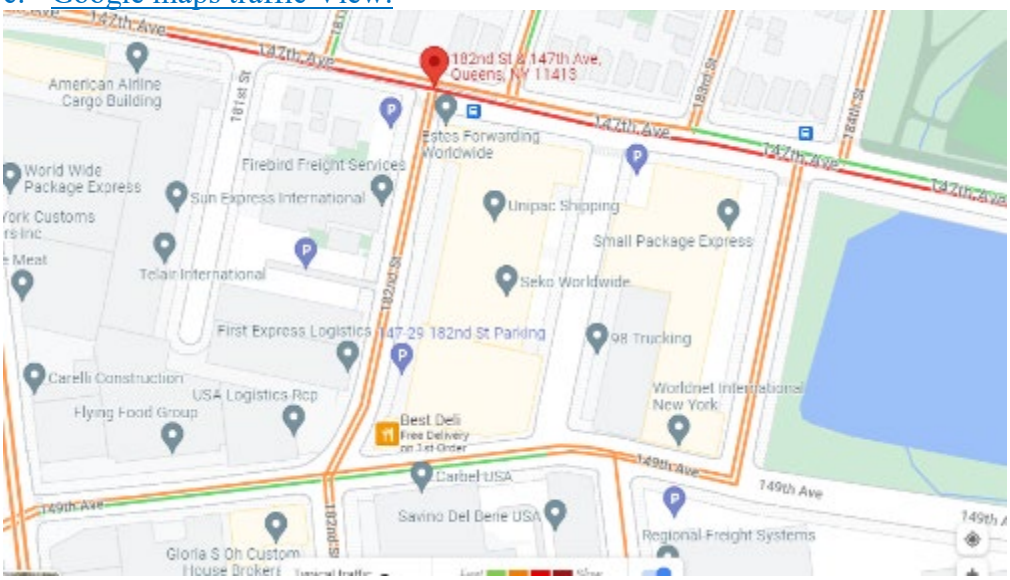
a. Satellite View:

182nd Street is a two-way street that has mostly trucks parked usually. The traffic is usually heavy on the road. The reason is this road has all the logistics and transportation facilities on both sides due to which trucks inwards and outward movement continuously occurs. There is only one lane available for the flow of traffic in either way including left or right turns. There is no specific left or right turn lane available that can reduce the congestion on the road and make the traffic flow smooth.

b. Picture taken at the location:

To verify the satellite view, we drove to the street and it was observed at the area that due to loading/ unloading of trucks, the street is congested.

c. Google maps traffic View:



d. Philip Habib & Associates survey in May 2019:

Philip Habib & Associated also mentioned in their report that 182nd Street and 147th Avenue has traffic congestion.

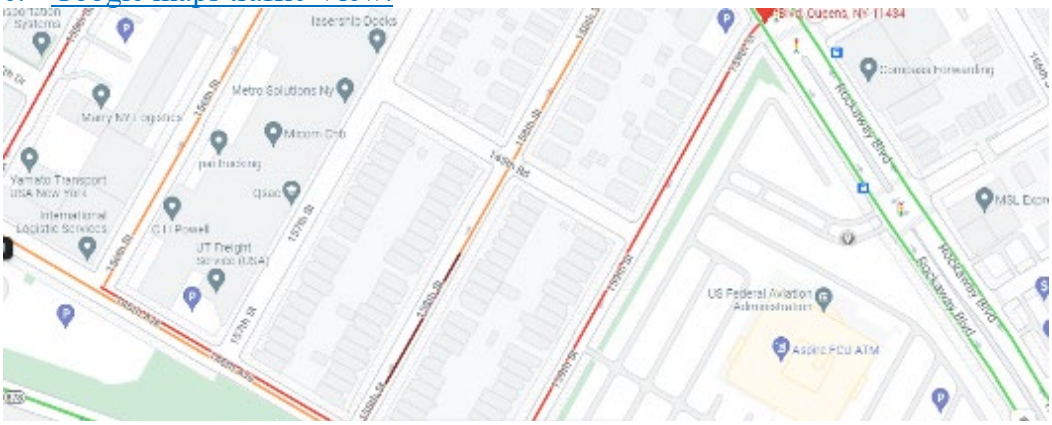
4. **159th Street**
   a. Google Photo:

When trucks enter from Rockaway Boulevard to the truck loading areas, the only way to reach there is 159th Street resulting in heavy truck traffic. Our suggestion is to provide more access areas to trucks so that truck traffic can be distributed more evenly.

   b. Picture taken at the location:

The only way for trucks to enter their businesses is via 159th Street, as illustrated in the above photo.

c. Google maps traffic View:



d. Philip Habib & Associates survey in May 2019:
Philip Habib & Associates observed the following:

> *"Currently, 159th Street is the only access to loading areas and businesses for trucks coming from Rockaway Boulevard. This creates a heavy amount of truck traffic and noise within the Springjam Block Association. Alternate points of access, such as off of S. Conduit Avenue, could be analyzed to divert truck traffic from the residential area."* (Philip Habib & Associates, 2019)

We observed that the bus companies have no parking for their employees. Many drivers park their cars on the streets due to the no parking restriction in the bus yard. This results in congestion and blockage of the roadway.

> *"The lack of parking, specifically for trucks and employees, is a significant District-wide issue. Specifically, as Grandpa's Bus Co. provides very little on-site parking for drivers, its employees must find on-street parking within the residential area. Dedicated parking lots for employees and/or trucks could be identified and analyzed throughout the district."* (Philip Habib & Associates, 2019)

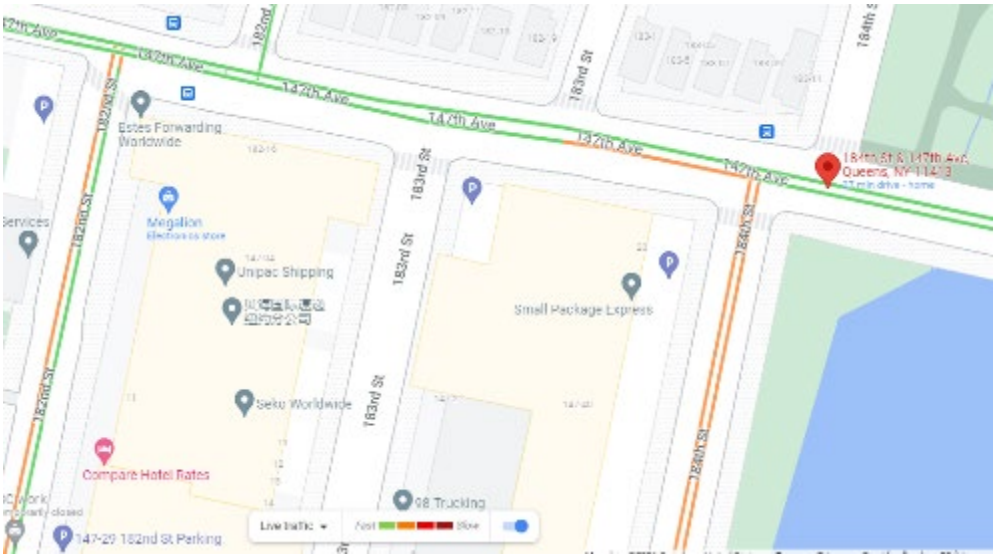
5. **147th Avenue and 184th Street**

a. Satellite View:

Trailers are seen parked throughout the area near the airport, and especially on 147th Avenue. Some of them are detached and cause considerable congestion in the area. Parking detached trailers should not be allowed and measures should be taken against the illegal parked trailers' owners.

b. Picture taken at the location:

c. Google maps traffic View:



Google Maps verifies the street congestion and traffic delays in the area.

d. Philip Habib & Associates survey in May 2019:

Philip Habib also mentions the illegal parking and congestion in the area as a key reason for the congestion.

> *"Illegal trailer parking and detached/abandoned trailers, particularly within the eastern portion of the IBID (GatewayJFK Industrial Business Improvement District), take up parking spots that could be used for employees. As previously mentioned, more dedicated truck parking lots could be identified. Additionally, parking regulations could be proposed and coordinated with NYCDOT" (Philip Habib & Associates, 2019)*

Summary/Conclusion:

We were able to make a preliminary consideration of geometric deficiencies in the Gateway/JFK Airport roadway network using four primary steps: (1) examination of the network using satellite images from Google Maps; (2) review of the real-time traffic conditions during morning rush hour via Google Maps; (3) taking pictures of locations in the network during site visits; and (4) consideration of the Philip Habib and Associates traffic review done in 2019. We were able to find a number of major deficiencies, and made further consideration of those deficiencies by focusing on 5 locations: (a) 146th Street; (b) 155th Street and 145th Avenue; (c) 182nd Street; (d) 159th Street; and (e) 147th Avenue and 184th Street. Through this further consideration, we were able to both find alignment among the four steps in our consideration of the particular deficiencies present at particular locations and make preliminary considerations as to how to address them. Further steps would include computer simulation of the network using measured traffic data, which would allow both confirmation of the negative effect of the deficiencies on truck traffic in the network and study of the effectiveness of potential measures to address them.

Appendix D: JFK Cargo View: A System to Speed Truck Traffic Flow at JFK Airport

Title:
Cargo and Security System Analysis

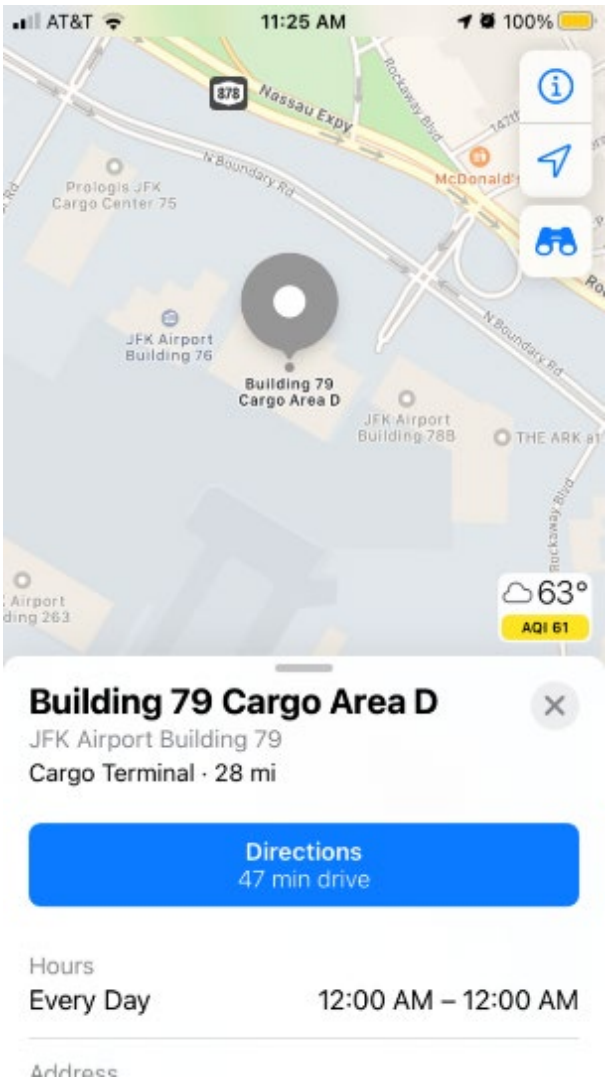
Investigator:
M. Nazrul Islam, Professor, Computer Security

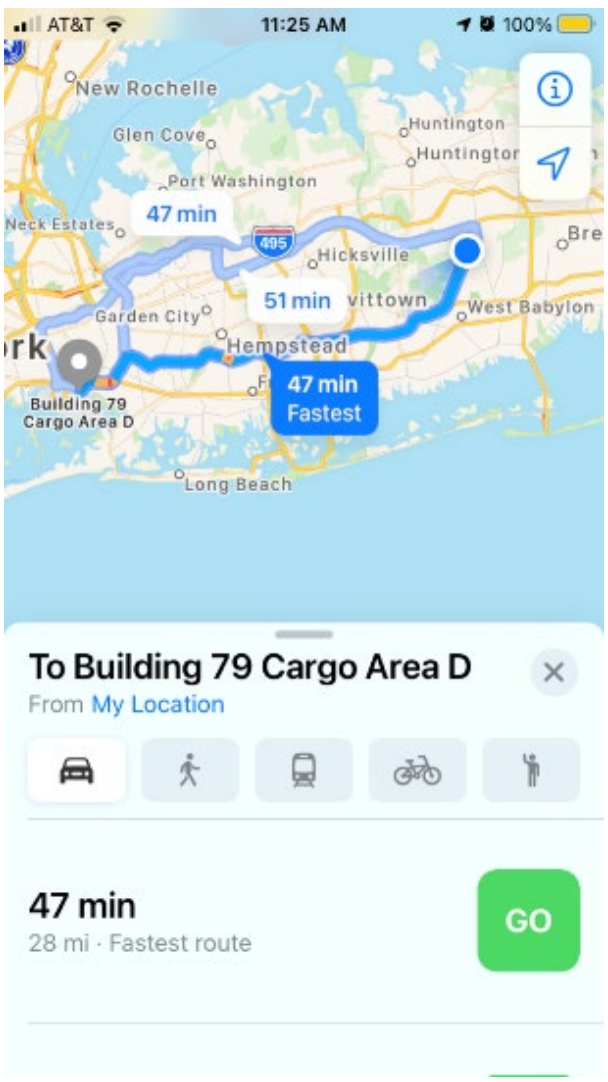
Objectives:
The John F. Kennedy (JFK) airport is one of the busiest facilities in terms of cargo traffic. Presence of numerous cargo infrastructures makes it difficult to manage the traffic efficiently and ensure security. The objective of the project is to evaluate the cargo monitoring and security system at JFK airport. Current cargo management system will be analyzed including identification and location of a cargo.

Cargo Management:
There are several cargo management issues identified by the Team. First, it was reported that the truck drivers complained about low or no GPS signals at the airport. As a result, they find it difficult to navigate to the correct cargo facility and waste time reaching the destination. Second, there seems to be no secure electronic monitoring system to track the cargo movement. Arrival and departure status of a truck are not updated automatically, which are crucial for cargo management and security.

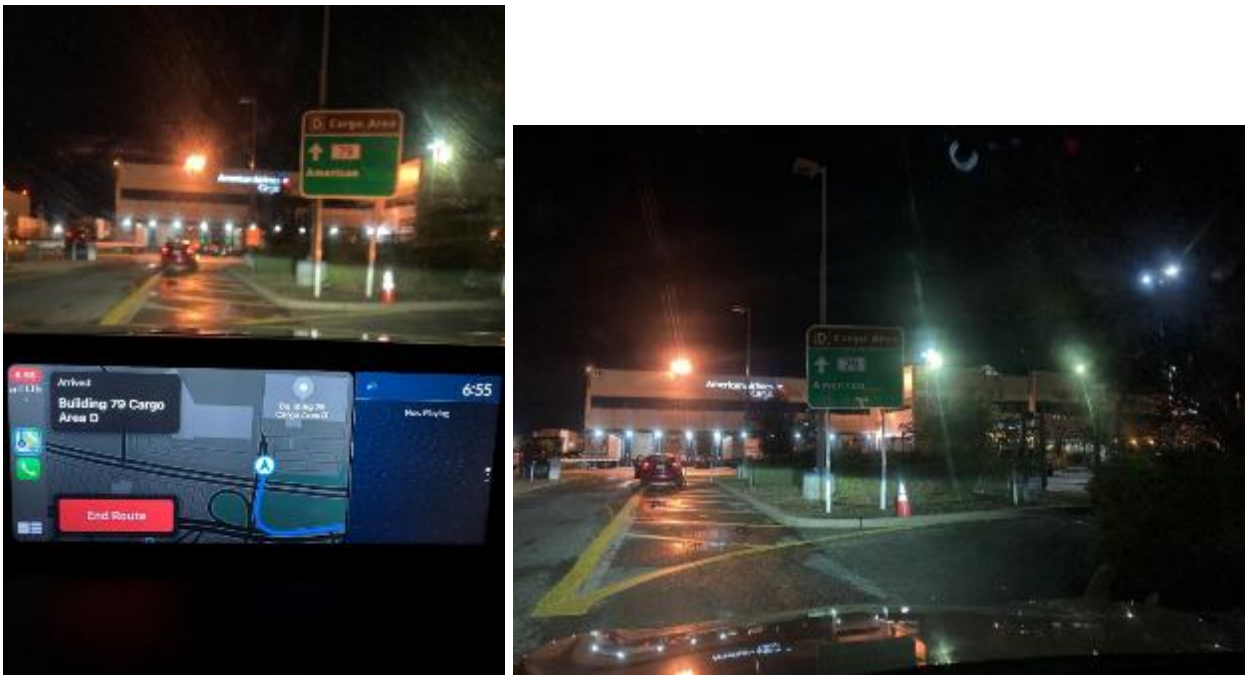
GPS Signal:
An experiment was conducted to evaluate the GPS signal conditions in the cargo area. The investigator used his cell phone network to navigate to Building 79 of JFK cargo area. Instead of putting any location address on the GPS, "Building 79 JFK" was added to the navigation destination as shown in Fig. 1(a). As is obvious from Fig. 1(b) that the navigation system was able to locate the destination and suggest the direction.

Then the investigator drove to the facility following the cellphone navigation. During the travel the network signal strength seemed to be of good strength. It navigated straight to the destination without any issue, like signal loss, missing direction, losing destination. Figures 1(c) and 1(d) depict the arrival of the vehicle at the cargo facility.





(a) Finding the destination building on navigation (b) Getting direction to destination



(c) Being directed by cellphone navigation (d) Reaching the physical destination

Figure 1: Cellphone GPS navigation to cargo Building 79

Proposed System:
Cellular connectivity seemed be to good in the vicinity of JFK cargo facilities. In addition, the satellite signals should be strong enough to guide the truck drivers. However, the network condition may worsen during busy hours. In addition, there are numerous aviation signals around the area which may interfere with the navigation signals. As a result, the truck drivers may experience loss of navigation signals which will further deteriorate the traffic management.

It was also observed that while Google Maps can recognize the location with only building number, other GPS devices may not be able to recognize without street address. A couple of trucker navigation devices were tested but many of them could not recognize the location with only building number. Therefore, it is recommended that the airport authority or the cargo agencies publish the street (or latitude and longitude) addresses and share with the truck drivers.

The second challenge of JFK cargo management is the absence of a secure and automated cargo monitoring system. As a result, it is difficult to track a truck and update the cargo movement status.

The project proposes a secure cargo management system as depicted in Figure 2. It includes a central control system that will communicate with all authorized trucks in and around the airport. A secure communication channel will be established through either a dedicated secret signal frequency or encrypted communication over a public signal frequency. Following are the steps of cargo management.

1. Each truck will be equipped with a special transmitter. When a truck approaches the airport, it will request connection with the control system.

2. The control system will verify the identity of the truck using an authentication protocol.

3. Once authenticated, the control system will connect with the truck and guide it to its destination.

4. The control system will also record the status of each authorized truck, including arrival time, departure time, and station location.

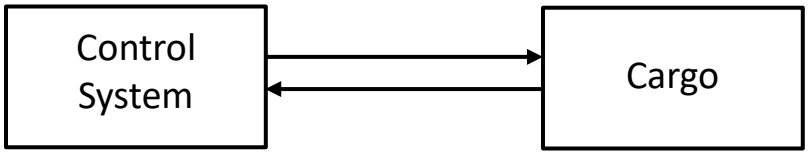


Figure 2: Cargo signal system

Conclusion:
The proposed system could not be tested because it will incur a significant cost and legal permission. However, it should resolve any current cargo management issues and rather make it automatic, secure, and efficient. Any unauthorized vehicle or malicious attempts can be identified, and necessary actions can be taken before an incident. Fully automated cargo traffic system should be cost-effective in overall and provide secure operation of the cargo area.

Appendix E: American Airlines JFK Cargo Handling Observations

Introduction

This appendix provides a high-level overview of the processes observed during two visits to American Airlines' cargo handling facility in Building 79 at JFK airport. Our visits were hosted by Brian Cooley, General Manager for Cargo at both JFK and PHL airports and Brian Ridley, who manages warehouse operations in building 79.

American Airlines (AA) provides cargo transportation on its passenger aircraft throughout the world. It does not fly cargo-specific freighter aircraft. As a result, its cargo-carrying capacity is determined by its passenger flights.

Due to its status as the number one ranked airport in the US for international passenger traffic, much of its cargo volumes throughout JFK are export and import. JFK ranks 13th in the US for total passenger traffic and 1st for US international passenger traffic. [40] For cargo, JFK ranks 9th for total volume and 5th for international cargo volume. [41]

According to Port Authority reports, American was the 3rd-ranked airline for cargo tons at JFK behind Delta and FedEx in the pre-pandemic year 2019[42] and is currently running 10th[43] as of Aug 2021.

During 2020, AA upgraded its cargo handling operations system from their legacy Sabre system to iCargo, a product of IBS software. Details about iCargo can be found at https://www.ibsplc.com/product/air-cargo-solutions/icargo. Brian Ridley has been with AA Cargo for 35 years and iCargo has been the only successful cargo software upgrade he has experienced. (There was one failed attempt with another home-grown application that was not deployed.) Because the Sabre system continues to be used by AA for its passenger flight operations, AA is running iCargo and Sabre in parallel and plans to continue to do so until Sabre is replaced company wide.

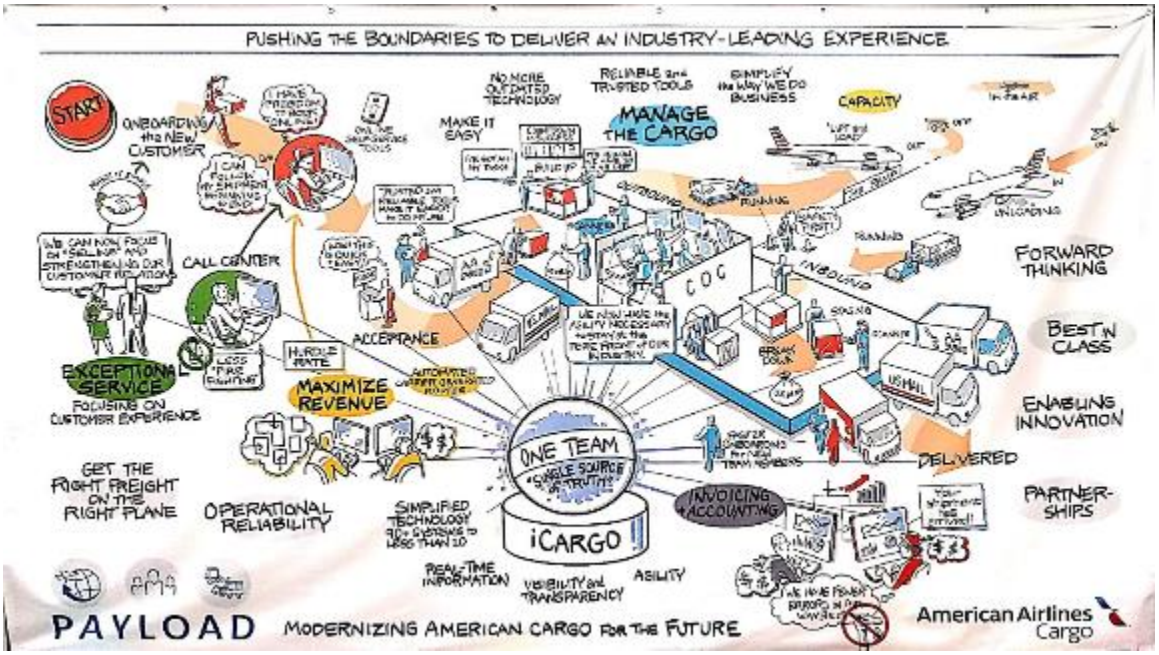
[40] http://www.fi-aeroweb.com/Top-100-US-Airports.html#PAX

[41] www.fi-aeroweb.com/Top-100-US-Airports.html#CARGO

[42] https://www.panynj.gov/content/dam/airports/statistics/statistics-general-info/annual-atr/ATR2019.pdf

[43] https://www.panynj.gov/content/dam/airports/statistics/statistics-general-info/monthly-2021/JFK_AUG_2021.pdf

The deployment of iCargo represented a significant change for AA's cargo handling employees. Significant efforts were put into training and change management starting in 2018, a full 2 years before iCargo was finally deployed. There is a large poster of artwork that describes the benefits of iCargo in the lobby of Building 79:



AA sells cargo transportation directly to customers as well as to Freight Forwarders and Customs Brokers.

Two visits and tours were hosted by Brian Cooley at Building 79: the first one in May for the entire JFK Truck Flow Management System study team, and a subsequent visit in November with Andy Huber and the Rutgers research team. This document contains photos from both visits.

Prior to each tour, the team met with Brian Ridley and Brian Cooley in a conference room. Here Brian Cooley discusses his operation with me as the research team looks on:

Brian Ridley also shared his 35 years of air cargo knowledge where he first worked at Boston's Logan Airport before moving to JFK 13 years ago.

Yi Ge, Yizhou Wang, Kazem Oryani, Andy Huber, Peter Jin, Anjiang Chen, and Di Kang in the lobby of Building 79.

The document describes two process flows:

- Export process: where cargo is dropped off by trucks for departing flights.
- Import process: where cargo is received from arriving flights and loaded to trucks.

Below is a photo of Buildng 79 with approxmate locations of each area noted in blue rectangles:

Export Process

Truckers arrive at the facility to drop off cargo. Most of the arriving trucks are either box trucks or 53' trailers. Some may be full truck loads for American Airlines cargo only and some may be less than truck loads and/or may contain cargo for several airlines.

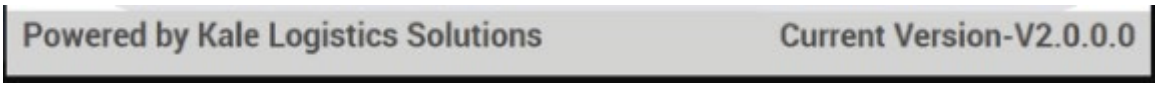
Currently, there are no pre-established dock reservations. Cargo must arrive within a certain time before the departing flight. I believe this is 24 hours. Other than the cutoff time requirement, trucks generally arrive at their convenience. This often leads to more trucks arriving than can be unloaded at once. During our November tour, Brian Ridley commented that assigning truckers arrival times like 3:30 in the afternoon would not be well received by trucking companies.

While there are currently no dock reservations at AA, Brian Cooley did share that IBS software is working on a dock reservation capability for iCargo. Brian also shared that AA provides significant requirements input to IBS and works collaboratively with them so that once released, the software will be a good match for AA's operations.

Worldwide Freight Services (WFS) is the largest air cargo ground handling outsourcing organization at JFK airport in terms of the number of airlines it services but not in the tons of cargo it handles. Lufthansa used to provide ground handling for its own airline and some others, but now outsources ground handling to WFS. WFS is planning to introduce a dock reservation capability from Kale Logistics.

As chairman of the Kennedy Airport Airlines Management Council (KAAMCO) Cargo committee, Brian obtained a poster announcing WFS's upcoming dock reservation system from Rinzing Wangyal, who is Brian's counterpart at WFS:

Note that the image of the WFS smartphone app for truckers contains these words:

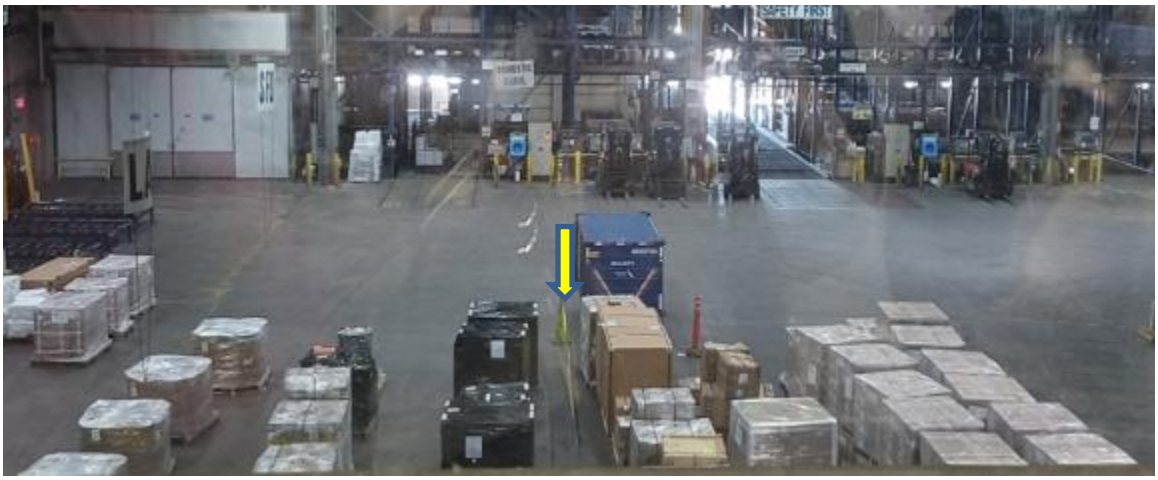


When truck drivers arrive, they must park their truck, enter Building 79 and check in at the registration desk located in a fenced-in area of the warehouse. The fence is because no person may enter the bonded warehouse without obtaining permission in advance from US Customs and Border Protection (CBP).

The fence was installed in 2021 to meet newly issued security regulations. The blue tarps are to protect employees from bird droppings.

After registering, truckers wait until AA tells them they can back their truck to a dock for unloading. There are nine doors where cargo is unloaded.

Recently, the US Transportation and Security Agency (TSA) instituted the requirement to scan 100% of all air cargo. Some cargo arrives pre-scanned and other cargo must be scanned by AA. Cargo that has been scanned is separated from cargo that has yet to be scanned by means of two yellow cones and yellow tape separating the rows:



The TSA does not allow photographing of cargo scanners. The scanner is a large rectangular device with rollers, capable of scanning entire pallets of material. The device appeared to us to be a very large version of the luggage scanners that passengers encounter at airports.

Scanning is not done by AA employees. AA uses a contractor that scans cargo at the AA facility to TSA regulations.

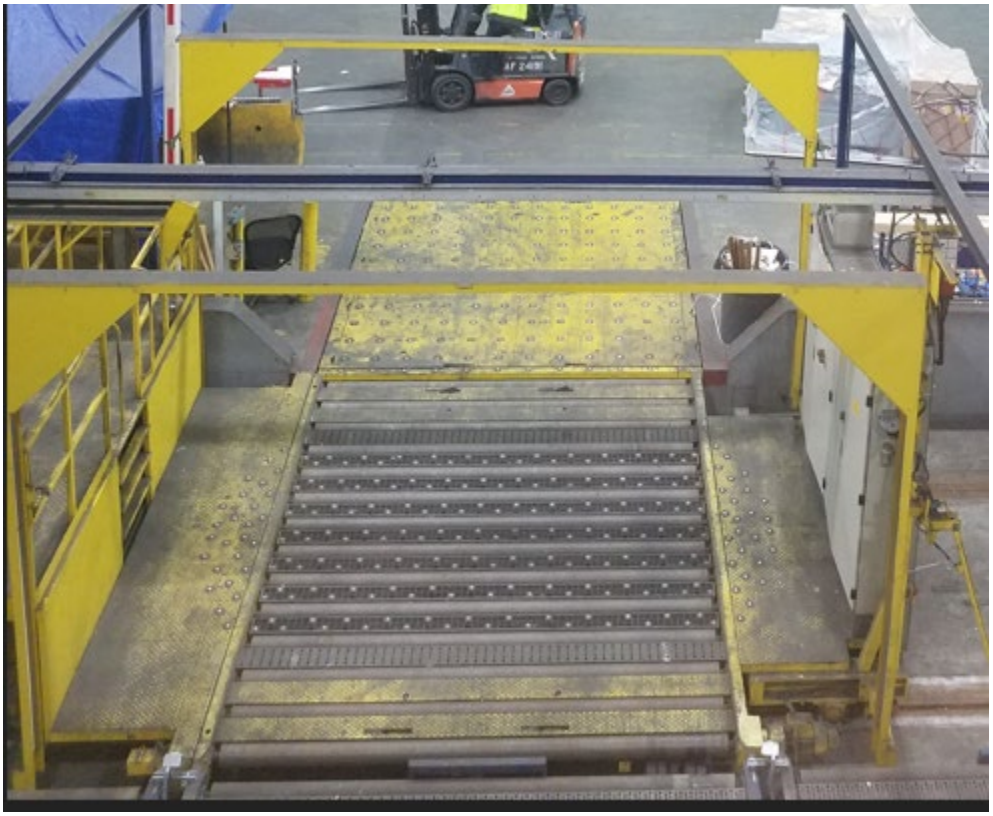
While the cargo is placed loosely in rows, the row and placement location detail are not contained in the iCargo system. AA chose to record the location of incoming cargo in a single location in iCargo labeled as Buildup Area.

There are signs hanging from the warehouse ceiling indicating Domestic, Europe and South America. However, Brian Ridley told us that those signs no longer apply and that AA has not bothered to remove them yet.

Incoming materials are also sorted by special handing requirements. Hazardous materials are placed in one section located directly in front of the cargo scanner:

Pharmaceuticals are segregated into those that require 2-8 degrees centigrade refrigeration and those that require 15-25 degrees centigrade ambient (room) temperature. Pharmaceuticals are kept cool in containers with refrigeration capability. These devices located in front of the hazardous materials are charging stations for refrigerated containers:

While each customer supplies descriptions of the commodity, dimensions and weight of all incoming cargo, AA must verify the accuracy. This large yellow device is a cargo scale:



Air cargo is then “built up” either in a container or on an aluminum sheet. Cargo placed on aluminum sheets are tied down with webbing and locked to the floor of larger jets to prevent shifting in flight. The containers are often referred to as “cans” and the aluminum sheets are referred to as “cookie sheets”.

Before the webbing is secured, cargo is wrapped in plastic so that it can be transported outdoors to departing planes. Here is a photo of Brian Cooley standing in front of a cookie sheet that is either ready to depart or has just arrived:

Cayuga Partners Walt Beadling and Rutgers Professor Jing "Peter" Jin are standing with Brian.

Brian Ridley pointed out that the method of packing is "water resistant" and not guaranteed to be fully waterproof. In the wintertime when it is snowing, cargo cannot be left outdoors and must be transported directly from the warehouse to the aircraft.

The two doors that appear below are where built-up sheets and containers are loaded to dollies for transportation to departing aircraft.

The cans and cookie sheets are placed onto large dollies that are towed in “trains” of up to 4 dollies to departing aircraft. Here are three of those trucks:

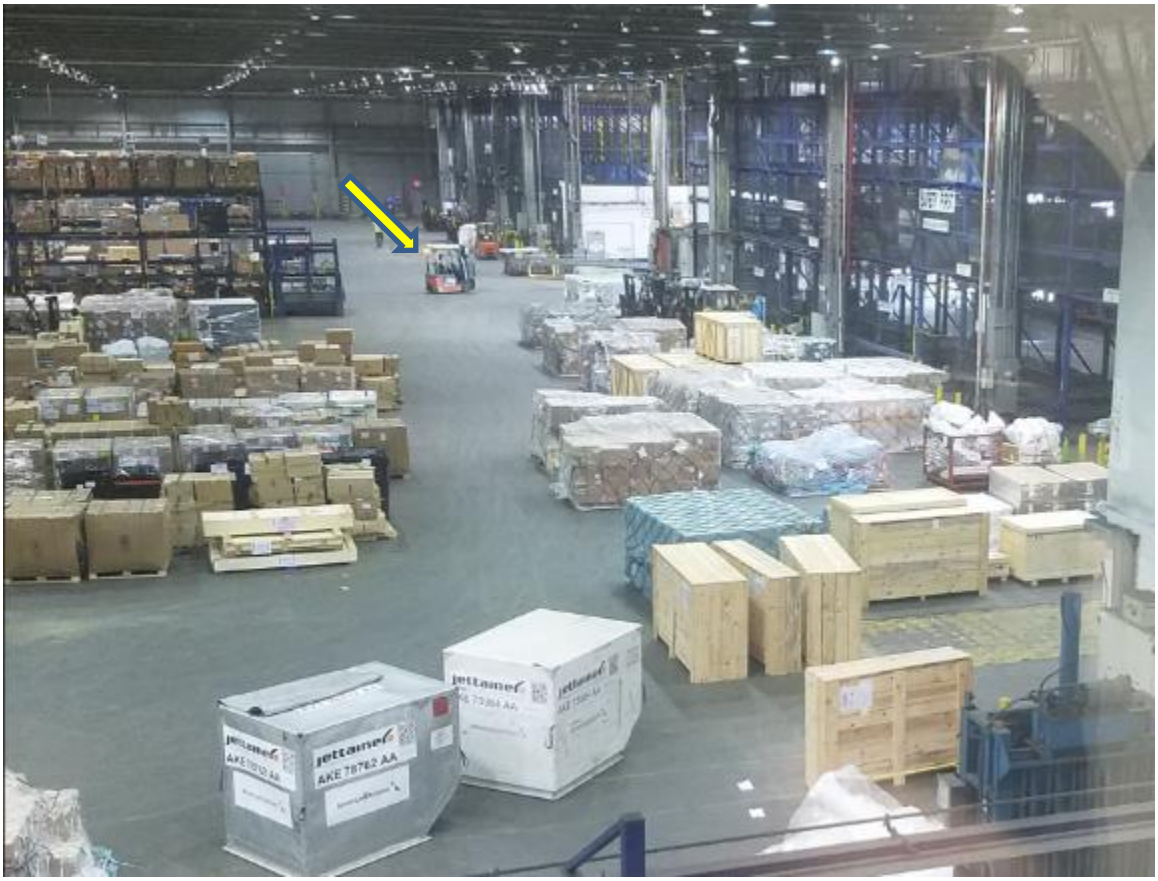
In the photo below are parked dollies some of which contain cans or cookie sheets with cargo:

The order in which cargo is loaded onto each plane is determined by the level of service and price paid by each customer. We suspect that load balancing must be another critical consideration. High priority cargo gets loaded on first and comes off first and low priority cargo goes last, like passenger baggage.

Cookie sheets and cans are locked into place in the floor of wide-bodied aircraft. Brian Ridley said that narrow-bodied aircraft like the Boeing 737 are packed and secured with netting contained within the aircraft.

Import Process

Incoming cargo arrives in cans or on cookie sheets through a large main door and unloaded by forklift. In the photo below, a forklift driver is approaching the door:



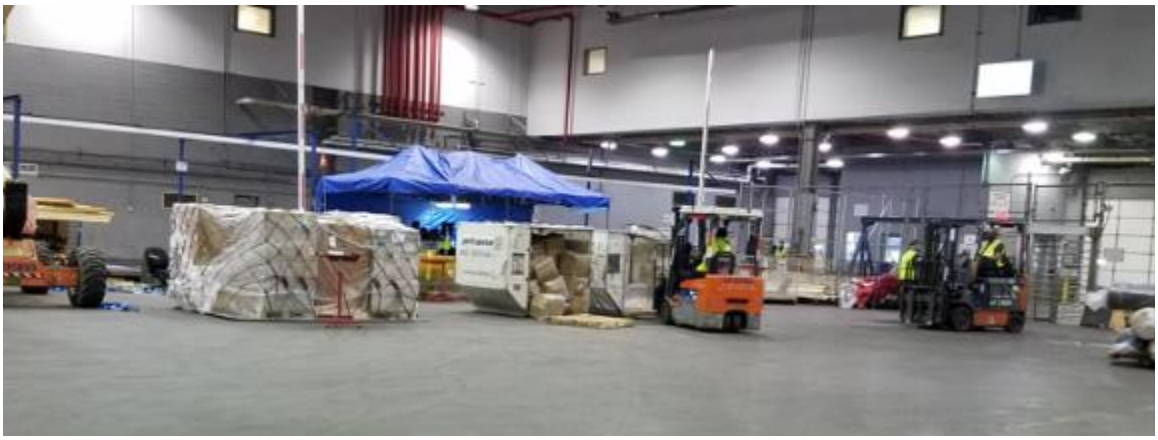
The cargo is then placed on the floor of the warehouse where they are then broken down. In the photo below, cookie sheets of cargo before being broken down are within the yellow circle. Cans with cargo to be unloaded are in the green circle. Small packages are placed in the racks in the red circle and larger pallets of cargo are placed in rows seen in the blue circle.

There are 8 rows of pallets of cargo placed on the floor. Brian Ridley told us that iCargo contains the row number that each piece of cargo has been placed, but not the place within the row. As with the export process, trucks arrive to pick up cargo somewhat randomly. This can result in a forklift operator having to move as much as half a row of cargo to deliver some cargo that is located in the middle of the row. Brian Ridley commented that sometimes cargo is moved to other rows causing extra time to be spent searching for cargo to deliver.

While trucking companies know when cargo has landed at the airport via AA's flight tracking system, they do not know exactly when the cargo has been broken down and is ready to be picked up. The target for breaking down international cargo is 4 hours and for domestic the target is 2 hours. Those targets are not always met for several reasons:

1. It takes up to 1 hour to unload a large aircraft
2. Large wide-bodied aircraft can contain up to 16 dollies of cargo requiring 4 trips from the terminal to the warehouse. Each trip takes 20 minutes!
3. It is not uncommon for several large aircraft to arrive at nearly the same time resulting in only being able to allocate a single truck with a train of 4 dollies to each flight.

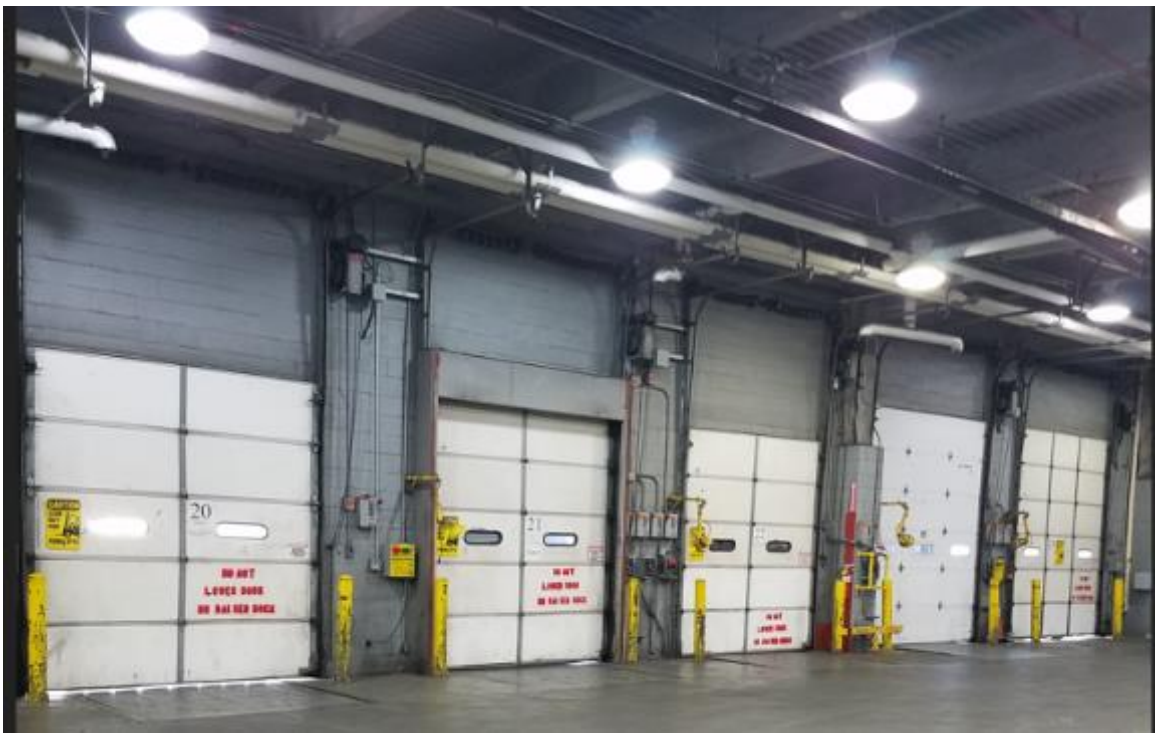
The import process is supervised by a floor manager who sits under another blue tarp and operates a computer to track shipments. Here a can is being broken down in front of the floor manager area:



I asked Brian Ridley how long cargo typically sits in the warehouse before being picked up by a trucker. "Hard goods" such as those seen within the red and blue circles on the previous page typically sit 24-48 hours. Perishables and pharmaceuticals move much quicker.

Capacities

AA employs 120 people in Building 79 during 3 shifts. The night shift has a small skeleton crew. It has 25 fork trucks. There are 14 docks for pickup and 9 for drop off. The maximum number of trucks that can be at the facility are 31: 23 at the docks and 8 in the parking lot. Overflow and overnight parking are available for trucks across the road from the travel plaza at JFK airport.



Loading docks

AA employees will usually assist truckers to load their trucks, however, this truck had storage boxes in the way inside the truck, so the driver had to prepare his truck and load it himself, causing unnecessary delay.

Appendix F: Interview Notes: Joe Clabby, CEO, Corporate Loss Prevention Associates

8/3/2021

During one of our visits to JFK, Walt Beadling and Andy Huber sat down with Founder and CEO Joe Clabby and President Vidya Ramsammy of Corporate Loss Prevention Associates. Joe is also an adjunct instructor at SUNY Farmingdale State College School of Engineering Technology, where he teaches a course on security. From his many years of experience managing and teaching about security in cargo operations at JFK, Joe quickly wrote down a list of improvement ideas for JFK airport. Those thoughts ideas are listed here, sorted by subject category. Joe was able to rapidly explain each thought, making it difficult for us to document each idea.

1. Infrastructure
    a. Buildings very old – infrastructure an issue
    b. No Technology
    c. License Plate Readers – ID customers
    d. Directions before entry & access
    e. Parking areas – Holding lots – plenty of space
    f. GPS – not working / not sufficient
    g. Storage of trucks
    h. Wait times for pickup is out of control, resulting in cargo going to less busy airports
    i. Tremendous amount of Technology & research needed to screen cargo – not room in warehouse – Trucks are waiting 24 hours to off load – TSA problems impact entire airport
    j. Hot line needs to be improved
    k. Convince the Port Authority to spend their $ on these improvements
    l. Many empty buildings to use as stage areas for trucks
    m. CAR WASH [for screening} – would help alleviate Back log / improve security / help develop Technology / used for training of personnel
    n. 5% charge should pay for these programs
2. Process
    a. Create TASK FORCE

b. Multiple pickup orders at one location w / different carriers
c. Set an SOP & follow it
d. Carriers bend their own rules to accommodate their special customers
e. One truck picks up & then they disburse to smaller trucks
f. Runners – dropping paperwork before trucks are at location
g. 100% screening – 7/1
h. Coordination w/ larger trucking firms / freight forwarders
i. Need Port Authority to get involved
j. Clean the cargo area up "Daily" not Yearly
k. Get equipment laying around airport to central area. This delays cargo movement

3. Security
    a. Security can be improved
    b. No enforcement by carriers / security / P.A. Police
    c. Bribery / CASH
    d. Truckers use lots for their "own" activities
    e. "illegal touch" / no licenses / no insurance
    f. Develop a "TWIX" [TWIC] type card – scan at parking area – goes to center – advises movement / AWB / time / access to facility
    g. Port Authority Police need to check drivers, vehicles to prevent "gypsy" and THEFT
    h. Arrests made publish pictures & M.O. to all of airport
    i. Stop watch list needs to be improved
    j. Face Recognition computer system
    k. License (Drivers) Technology
    l. Background checks on truck drivers to get a better driver – get rid of criminal element
4. Training
    a. No training in traffic control
    b. Educate Trucking firms
    c. Counter personnel not trained in procedures
    d. Forklift operators lazy / not trained
    e. Should be a certificate program for forklift operators
    f. Not enough management on jobs – no training
    g. Create a training center for delivery
    h. Turnover rate very high
    i. Create a "Traffic Management" College

Appendix G: Project Site Visits, In-Person Meetings, and Web Interviews

Photographs from many of these meetings with a document describing the people in them can be found here.

1. 5-21-2021 Project Kick-off Meeting

Duration: Half a day meeting

Participants:

1. Frank Liggio, GatewayJFK Chairman, Managing Director, Cushman & Wakefield
2. Scott Grimm-Lyon, AICP, former GatewayJFK Executive Director
3. Andrew J. Montero, Sales Manager, Mobile Air Transport, Inc.
4. Joe Hentze, Cushman & Wakefield
5. Ali Maher, Ph.D., Professor and Director, Center for Advanced Infrastructure and Transportation (CAIT) at the Rutgers University
6. Kazem Oryani, Ph.D., Adjunct Professor and Senior Research Scientist, CAIT at the Rutgers University
7. Peter Jin, Ph.D. Associate Professor, CAIT, at the Rutgers University
8. Walt Beadling, Managing Partner, Cayuga Partners
9. Andy Huber, MBA, Associate and Senior Consultant, Cayuga Partners
10. John Juzbasich, Associate and Senior Consultant, Cayuga Partners
11. Richard Voith, Ph.D. E-Consult Solutions

2. 5-21-2021 Visit to American Airlines Cargo Building ("Air Cargo 101" session)

Duration: Half a day meeting

Participants:

1. Brian Cooley
2. Scott Grimm-Lyon
3. Andrew J. Montero
4. Kazem Oryani
5. Walt Beadling
6. Andy Huber
7. John Juzbasich
8. Peter Jin
9. Richard Voith

3. **6-10-21 Project Site Visit to GatewayJFK and Cargo Areas of JFK Airport.**
Duration: Full one day site visit, observation, and discussion.
Participants
    1. Scott Grimm-Lyon
    2. Kazem Oryani

4. **6-14-2021 Zoom interview with Peter DeBenigno, Mobile Air Transport, Team leader for Cargo at KAAMCO**
Participants:
    1. Peter DeBenigno
    2. Kazem Oryani
    3. Walt Beadling
    4. Andy Huber
    5. John Juzbasich
    6. Peter Jin

5. **6-24-2021, Zoom Interview,** Team Interview with Tom Marzano, Air Cargo Forwarders Association
Participants:
    1. Tom Marzano
    2. Walt Beadling
    3. Andy Huber
    4. Kazem Oryani

6. **7-10-2021, Zoom Meeting, Freight Group of New York City Department of Transportation for truck movement data**
Participants:
    1. Tiffany Taylor
    2. Denice Mendes
    3. Scott Grimm-Lyon
    4. Kazem Oryani

7. **7-22-2021 In-person Project Meeting, JFK Airport Crown Plaza Hotel**
Duration: Full one day site visit, observation, and discussion.
Participants:
    1. Scott Grimm-Lyon
    2. Kazem Oryani
    3. Walt Beadling
    4. Andy Huber
    5. John Juzbasich
    6. Peter Jin
    7. Yi Ge
    8. Yizhou Wang

9. Steve Caulo, General Manager, AGI
10. Dave Dickson, AGI
11. Joaquin (Jack) Fiol, Director of Business development, Cargo SprinPass

8. 7-23-2021, Zoom Interview, Tom Green, Seattle-Tacoma Air Cargo

Participants:

1. Kazem Oryani
2. Walt Beadling
3. Andy Huber

9. 7-23-2021 Zoom Interview with J Dr. Oliver Gao

Participants:

1. Kazem Oryani
2. Walt Beadling
3. Andy Huber
4. John Juzbasich
5. Peter Jin

10. 8/3/2021 Zoom Interview with Joe Clabby

Participants:

1. Kazem Oryani
2. Walt Beadling
3. Andy Huber

11. 8-13-2021. Korean Airlines Telephone Interview

Participants:

1. Mr. Kim
2. Kazem Oryani
3. Walt Beadling

12. 8-26-2021 Full Day In-person Project Site Visit, Observation and Interviews

Participants:

1. Kazem Oryani
2. Truckers
3. Residents
4. Employees

13. 8-26-2021 in-person, Uniglobe Worldwide

Participants:

1. Scott Grimm-Lyon
2. Kazem Oryani
3. Weiwel Lou
4. Stanley
5. Colt

14. **8-26-2021 in-person, K&N Trucking and Courier Service**
Participants:
    1. Scott Grimm-Lyon
    2. Kazem Oryani
    3. Nadia Deodat, Manager, K&N Trucking and Courier Service
    4. Truck driver, K&N Trucking and Courier Service

15. **8-27-2021 Full Dy, in-person, Alliance Ground International (AGI) Site Visit and Data Gathering**
Participants:
    1. Steve Caulo, General Manager, AGI
    2. Isaac Donkor, Operation Manger, AGI-JFK
    3. Kazem Oryani
    4. Peter Jin
    5. Yi GE
    6. Yizhou Wang
    7. Di Kang
    8. Kwanita Williams

16. **9-22-2021 Full Day, In-person, Mobile Air Trucking Site Visit, Data Gathering and Trucker Interviews**
Participants:
    1. John DeStefano, Manager, Mobile Air Transport
    2. Diana
    3. Kazem Oryani
    4. Peter Jin
    5. Yi Ge
    6. Yizhou Wang
    7. Di Kang
    8. Kwanita Williams

17. **9/29/2021, Zoom Interview,** Introduction to Kale Logistics, an Indian software company with an Airport Cargo Community software system
Participants:
    1. Andy Huber
    2. John Juzbasich
    3. Anjiang Chen
    4. Nazrul Islam
    5. Kazem Oryani
    6. Donna Mullins, Vice President, Kale Logistics
    7. Amar More, CEO, Kale Logistics
    8. Sheereedah Copening, Account Manager, Kale Logistics
    9. Sahil Deshpande, Kale Logistics
    10. Mandar Uteka, Kale Logistics
    11. Mayur Nikam, Kale Logistics

18. **10-2-2021, Microsoft Teams Meeting,** Introduction to Nallian, a Belgian software company with an air cargo truck slot management software called BRUCloud
Participants:
    1. Walt Beadling
    2. Andy Huber
    3. Steven Polmans, Nallian

19. **10-06-2021 Full Day In-person, American Airlines Cargo Site Visit and Data Gathering** (second visit)
Participants:
    1. Brian Cooley
    2. Kazem Oryani
    3. Andy Huber
    4. Peter Jin
    5. Yi Ge
    6. Yizhou Wang
    7. Di Kang

20. **10-13-2021, Zoom Interview,** Product demonstration of Kale Logistics Airport Cargo Community software system
Participants:
    12. John. A. Muckstadt, PhD, Founding Partner and Professor Emeritus, Cornell University
    13. Andy Huber
    14. John Juzbasich
    15. Kazem Oryani
    16. Donna Mullins, Vice President, Kale Logistics
    17. Amar More, CEO, Kale Logistics

21. **10-15-2021, Microsoft Teams Demo,** Team Interview with Nallian, a Belgian software company with an air cargo truck slot management software called BRUCloud
Participants:
    4. John Muckstadt
    5. Andy Huber
    6. John Juzbasich
    7. Kazem Oryani
    8. Steven Polmans, Nallian
    9. Sara Van Gelder, Nallian

22. **10-20-2021, Zoom Interview,** Team Interview with FreightWaves regarding data
Participants:
    1. Peter Jin
    2. Kazem Oryani
    3. Andy Huber
    4. John Paul Hampstead, FreightWaves
    5. Henry Byers, FreightWaves

23. **11-15-2021, Zoom Interview,** Team discussion with Daniel Muscatello, Principle, DBM Aviation Consulting
Participants:
    1. John Muckstadt
    2. Andy Huber
    3. John Juzbasich
    4. Kazem Oryani
    5. Frank Liggio
    6. Scott Grimm-Lyon
    7. Joe Hentze

24. **11-19-2021 In-person Cargo Site Visit and Data Gathering for GPS Working Conditions**
Participant
    1. M. Nazrul Islam

25. **11-19-2021 in-person Cargo Site Visit for Network Geometric Deficiency Analysis and Data Gathering**
Participants:
    1. Michael Shenoda
    2. Irfan Sidiqui, Graduate Student

26. **11-20-2021, Microsoft Teams Meeting Kale Logistics Product Training to WFS Stakeholders**
Participants:
    1. Donna Mullins, Kale Logistics
    2. Evan Catarelli, WFS
    3. Andy Huber
    4. Jeff Yapalater, Airport News
    5. Various trucking and freight forwarder participants

27. **11-23-2021, Zoom Presentation to GatewayJFK Board**
Participants:
    1. Frank Liggio
    2. Scott Grimm-Lyon

3. Ali Maher
4. John Muckstadt
5. Andy Huber
6. Kazem Oryani

28. 11-24-2021, Microsoft Teams Demo, Team Interview with INFORM Software, a German software company with a truck slot management product called Syncrosupply.

Participants:

1. John Muckstadt
2. Andy Huber
3. John Juzbasich
4. Kazem Oryani
5. Oliver Graf, INFORM
6. Mattias Wurst, INFORM

29. 11-29-2021, Telephone Discussion with Bob Caton, Regional Vice President, Business Development, Aeroterm

Participants:

1. Bob Caton
2. Kazem Oryani

30. Weekly Zoom Team Project Meetings, April 2021 - December 2021

(39 Meetings, Duration 0.75-1.5 Hours each)

Participants:

1. Client Representatives
2. Project team members

This section authored by:
Kazem Oryani
Center for Advanced Infrastructure and Transportation (CAIT), Rutgers University

Andrew J. Huber
Cayuga Partners