Air Cargo Assessment

Minneapolis – St. Paul International Airport

FINAL – September 2021

PREPARED FOR

Metropolitan Airports Commission (MAC)

PRESENTED BY
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Executive Summary

This study analyzed air cargo service conditions at MSP, estimated future demand, assessed facility capacity and needs and made recommendations for preparing for that future demand. Air cargo activities at MSP are mainly all-cargo freighter operations with most cargo handled by FedEx and UPS. Amazon air cargo is just starting to develop at MSP and is expected to become a larger contributor in the next few years, helped by the addition of Sun Country cargo operations which Amazon launched in 2020. Belly air cargo is the smaller segment at MSP and is heavily dominated by Delta Air Lines.

In 2020, MSP was ranked as the 29th largest cargo airport in the United States according to ACI. That ranking was down three spots from 2019 and five spots from 2010. Air cargo tonnage dropped to 203,697 metric tonnes in 2020 during the COVID-19 pandemic from just over 229,000 in 2019, mostly from a significant drop in belly cargo. The 2020 tonnage level was nearly the same as MSP last reported back in 2016. MSP fared better in the region, ranking eighth among the Midwest airports. MSP ranked second in passengers for all Delta hubs, but fifth in cargo tonnage.

MSP's cargo traffic was made up of 13% international and 87% domestic flights in 2019. As the pandemic took hold in 2020, those numbers changed to 8% international and 92% domestic. Belly cargo took a bigger hit going from 24% of the cargo in 2019 to just 12% in 2020. At the same time FedEx and UPS's combined share of cargo tonnage went from 67% in 2019 to 79% in 2020 while Delta's share went from 19.0% to only 9% for the same timeframe.

International freighters are the one category of cargo business that is currently missing from MSP. MSP has direct service to Europe and Asia utilizing passenger aircraft which has a limited amount of belly space available for air cargo. That belly space also has a height limit of only 64 inches compared to widebody freighters that can accept pallets up to 120 inches. Airports like Chicago's O'Hare has the mix of both wide body passenger aircraft and dedicated wide body freighters that makes it a desired option for freight forwarders and trucking companies.

Looking at international air exports and imports, we notice that Canada is MSP's largest export trading partner and Germany is the largest import trading partner. Netherlands and Great Britain are second and third in both exports and imports. Germany ranks fourth for exports. Germany is also the largest trading partner with no year-round direct service to or from MSP.

A unique part of this study involved the intensive outreach to stakeholders. The consultants gave an online workshop early in the process and followed it up with more than 25 interviews and more than 50 individuals participating. This unprecedented level of cooperation significantly improved the quality of both the forecasting and the conclusions that came from the assessment.

Over the last eleven years, MSP's cargo tonnage has been relatively stagnant. Tonnage has ranged from a low of just under 200,000 tonnes in 2013, to a high of about 240,000 tonnes in 2018. Prior to the global slowdown in cargo traffic in 2019, MSP had shown increased tonnage for four straight years. An anticipated bounce back in 2020 was quickly stalled with the pandemic.

The forecast prepared for MSP, projects cargo levels to recover quickly in the next year and to increase to 415,000 metric tonnes by 2040 with 80% of all cargo transported on dedicated freighter aircraft and 90% of all cargo being domestic. Freighter operations are projected to increase from just over 15,000 in 2020 to 22,400 operations in 2040. Overall, cargo activity at MSP is estimated to grow at an average annual rate of 3.6% for tonnage and 2.0% for freighter operations.

The existing airport cargo facilities are generally concentrated in four main areas 1) FedEx and UPS facilities to the north of Terminal 1, 2) WFS facility (Amazon/DHL) on the west side of the Airport, 3) Air Cargo Center in the southwest corner of the Airport, and 4) Main Delta Cargo facility to the south of Terminal 1. Collectively these facilities provide about 522,700 square feet of building space for cargo handling, storage and office space and nearly 1 million square feet of apron area capable of parking a total of 16 large freighters (widebody aircraft) and 20 small freighters (feeder aircraft). The estimated capacity of the existing facilities totals about 606,000 metric tonnes, so the forecast of 415,000 metric tonnes by 2040 could be managed with the existing facilities if a common use approach and shared facility capacity was applied.

Much of the anticipated growth in air cargo tonnage at MSP is linked to development and growth of Amazon cargo activity which would be more appropriately handled in a dedicated facility for Amazon operations. The UPS and FedEx facilities were assessed to have excess capacity through most of the forecast as does the WFS facility which is mainly DHL operations. The primary recommendation and planning scenario analyses performed for MSP were focused on assessing and providing for the future needs of Amazon at the Airport. A few alternatives were prepared to provide for Amazon cargo operations to be housed in a dedicated facility on an available parcel of airport property on the west side of the Airport just north of their existing shared operation at the WFS facility with space for phased expansions during the forecast. The facility development concept should be sufficient to accommodate the forecasted Amazon cargo tonnage potential for the first 10 years, with reasonable expansion options to accommodate the 20-year forecast.

1 Introduction

The Metropolitan Airports Commission (MAC) contracted Landrum & Brown (L&B) to complete this Air Cargo Assessment (the Study) for the Minneapolis-St. Paul International Airport (MSP or Airport). The purpose of this Study is to analyze air cargo service conditions at MSP and make recommendations to maintain and expand service levels based on existing opportunities and to review the forecast of air cargo demand and consideration of the impact of business and carrier strategic initiatives.

Air cargo service conditions at MSP are a function of the adequacy of its physical facilities and supporting services (including handlers and regulators, as well as off-airport allied services such as freight forwarders and trucking companies), as well as the network connectivity provided by its airlines – both belly cargo-carrying passenger airlines and all-cargo carriers.

Additionally, this Study will have a secondary focus on the freight forwarding and trucking networks. These businesses are consolidating air cargo for transport to airports other than MSP. We will identify the causes and see if there is a way to stop or reduce it.

Only after completing this Study would MSP and the consultants be adequately informed to pursue prospective cargo operators for expansion or introduction of service to the Airport.

Initiating the analysis requires definitions of some basic terminology. Cargo comprises freight and mail. Throughout this study, freight will include express shipments (parcels and small packages). Some regulators and airport operators require express tonnage to be reported separately but this requirement has not been standardized adequately for comprehensive utilization in benchmark comparisons.

Unless otherwise noted, the principal measure throughout the Study will be metric tonnes (one MT = 1,000 kilos or 2,204.62 pounds) which is exclusively used by Airports Council International (ACI), the International Air Transport Association (IATA) and much of the commercial air cargo industry. Sourced data that has been converted from U.S. tons or pounds will be specified in the source notes.

2 Understanding the Air Cargo Industry: Air Cargo Business Models

A major challenge in developing regional air cargo strategies is a general lack of understanding about the industry by people and organizations not involved with goods movement, but who are potentially essential partners. Before delving into specific trends that affect MSP, it is important to provide context as to cargo operations, major business partners, and critical success factors.

The Federal Aviation Administration (FAA) defines air cargo as freight, express and mail - typically categorized as either international or domestic. It can move in the bellies of passenger aircraft or in freighters.

Built upon tradeoffs between time and cost, the air cargo industry offers constituents incredible flexibility but at a premium. Air cargo shipments begin with the shipper, which can range from an individual to a major manufacturer. Shippers have the option of taking a product directly to a carrier or alternatively using a third-party logistics provider (usually a freight forwarder) to find optimal shipping options and to ensure that all document and other arrangements are satisfied. The graphic below illustrates four shipping channels: an integrated express carrier like FedEx or UPS, an integrated forwarder like DHL, a non-integrated forwarder like Expeditors or Panalpina, or a non-integrated carrier. The various air cargo business models follow.

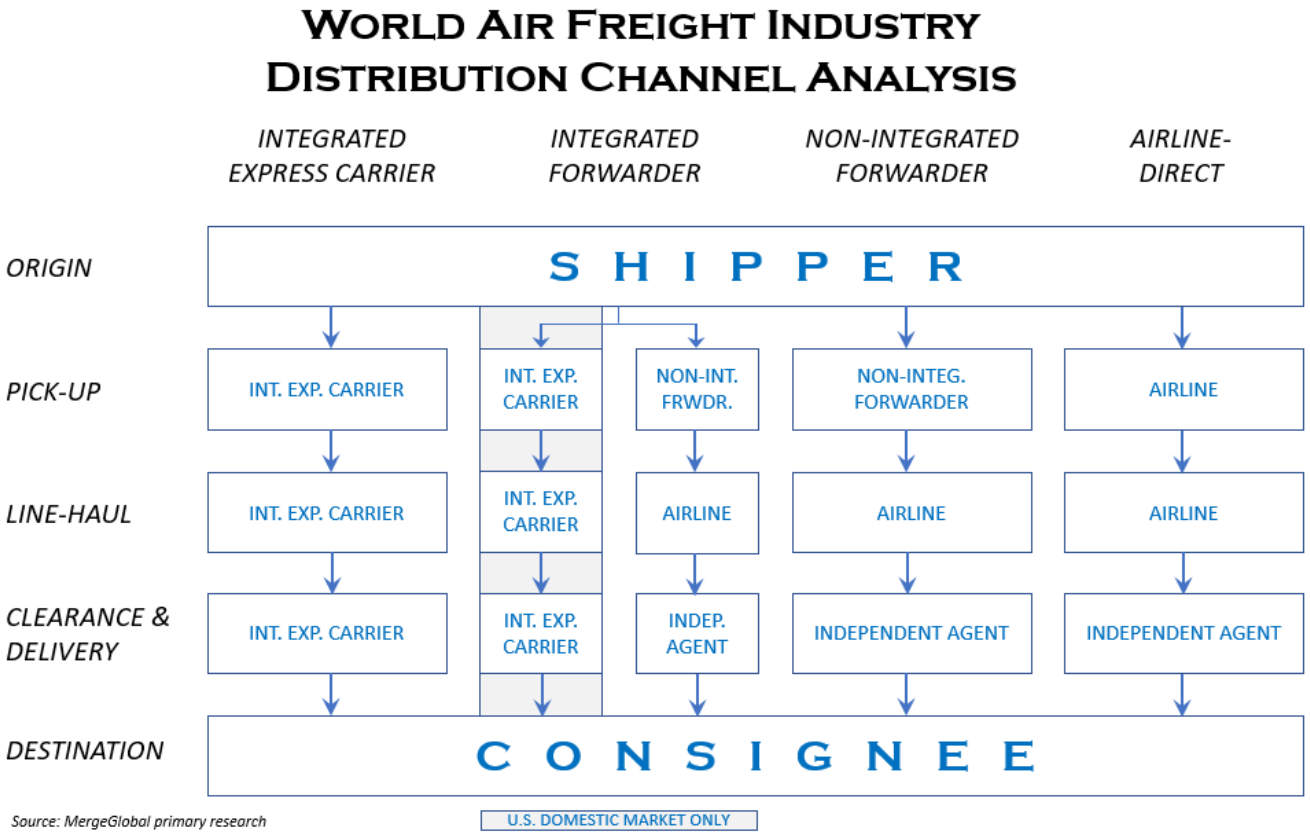
A successful air cargo operating environment is predicated upon the efficient interaction of businesses with different operating requirements and facility needs. These firms have different levels of involvement based on the nature of the cargo and the markets through which it moves.

Ideally, these operations would be co-located on the airport, creating an efficient, integrated, air cargo community where operating costs are lower, economies of scale are achievable, and international goods can be cleared more efficiently. The realities of limited on-airport space and higher leasing costs have caused businesses to locate operations that do not require ramp access off airport, leaving on-airport cargo facilities mostly to carriers and cargo handlers.

The air cargo industry comprises at least four basic types of carriers. The dominant carriers of U.S. domestic cargo are **integrated carriers** (integrators) like FedEx and UPS. The two largest cargo carriers at MSP in 2020 in terms of air cargo tonnage were all-cargo carriers FedEx and UPS, which operate scheduled air service and proprietary trucking that both substitutes and complements its air operation. With this roadway capacity, integrators offer door-to-door service for businesses and consumers. The integrators also operate as freight forwarders, buying capacity from other air carriers. Previously both DHL and its acquisition, the former Airborne Express, operated as integrators in the U.S. domestic market but until recently, DHL had limited its U.S. activities to international shipments, as well as being a service partner for Amazon, which is now beginning its own operations along with a long list of contracted carriers. Amazon is not technically an integrator but is discussing (as of March 2021) offering third party services in addition to just handling their own e-commerce packages and supply chain products.

Depending on their level of activity at an airport, integrators tend to require substantial aircraft parking but may not require a large amount of on-airport warehouse. They also frequently require large amounts of truck parking, and because they are labor intensive, employee parking. In some markets, integrators may also provide customs brokerage and forwarding functions – either in the same or in a separate facility.

FIGURE 2-1 WORLD AIR FREIGHT INDUSTRY DISTRIBUTION CHANNELS



Other **all-cargo airlines**, such as international carriers Cargolux and Nippon Cargo Airlines (NCA), provide only airport-to-airport transport, while off-airport surface transportation is likely to be provided by common commercial trucking companies. While the referenced carriers operate their own scheduled service, ACMI (aircraft, crew, maintenance, and insurance) carriers such as Atlas Air, Kalitta Air, and Southern Air operate chartered and scheduled freighter aircraft on a leased basis on behalf of carriers that may not require scheduled service year-round but only on a seasonal basis. The DHL and Amazon networks in the U.S. are entirely operated by ACMI carriers. DHL and Amazon may own large stakes in the carriers they have contracts with and may own some aircraft, but they do not have their own pilot crews to operate the aircraft that are more commonly flying their livery.

Part 135 carriers (named for their FAA operating certificate) operate substantial small feeder networks on behalf of the integrated carriers, typically with aircraft smaller than the integrators' standard fleets.

Combination carriers operate both passenger and all-cargo flights on which cargo is carried. In some cases, combination carriers retain common branding for both operations, while others may create separate subsidiaries and even separate brands for new or acquired all-cargo operations. Combination carriers offer shippers network advantages by pairing the dedicated capacity of freighters plus additional destinations and frequencies justified only by passenger demand. Combination carriers gain efficiencies from having both passenger and all-cargo flights leverage the same facilities and labor but will operate only one service or the other. MSP currently hosts no operations that fit this description, although Lufthansa operates such combination service at a few other U.S. gateways.

Pure **belly cargo carriers** only provide cargo capacity on passenger flights, accounted for roughly 12 percent of total air cargo in 2020 at MSP. At least partly due to their modest cargo totals, these carriers tend to outsource most (if not all) of their cargo functions. The sales function is basically outsourced to freight forwarders and general sales agents (GSA's) while the warehouse operations are typically outsourced to third party cargo handling companies and to other airlines. While belly carriers have lost considerable domestic market share to integrators and trucking companies, they are still the main carriers of mail and provide essential capacity on transcontinental routes, especially to destinations lacking adequate demand to justify freighters. MSP's Delta Air Lines domestic hub and international gateway is a critical competitive advantage against many regional rivals.

Cargo handling companies, such as Air General, Matheson Flight Extenders, Inc., Menzies and Worldwide Flight Services (WFS) allow many carriers to maintain a cargo presence that otherwise might be unprofitable if the carrier had to maintain its own equipment, warehouse and labor. Depending on the terms of its contracts with individual carrier customers, handling companies may provide fueling, loading and unloading of aircraft, tug transport to/from the ramp, warehouse functions such as the breakdown and buildup of pallets and containers, as well as the handling of documents on international shipments. By leveraging its warehouse space, labor and ground service equipment, third party cargo handlers maximize utilization of cargo facilities well beyond what was possible when each carrier had its own cargo operation. Historically, airports leased facilities to airlines which would possibly sub-lease to handlers but increasingly airports lease directly to the handling companies.

Freight forwarders account for the routing of more than half (50%) of international but only 10% of domestic shipments (excluding domestic segments of international shipments). Depending on the needs of their shipper customers, forwarders may provide a variety of services but most commonly they profit from the spread between the rate they pay carriers for capacity based on volume purchasing discounts and what they charge shippers for that same capacity. Forwarders support international gateways but can also be the agents of diversions to other gateways. To serve the critical needs of shippers, forwarders must depend upon the frequencies, destinations and capacity types (belly and freighter) provided by air carriers, which typically are more diverse and plentiful at the largest gateways. Forwarders prefer the control afforded by local gateways where interaction with regulators and airline managers can be beneficial but will still mostly truck to/from larger gateways. Like any business that does not (typically) operate aircraft, forwarders usually prefer cheaper warehouse space near but not necessarily on airport.

Customs Brokers facilitate the clearance of inbound international cargo through local federal customs. Like forwarders, they usually maintain a small amount of office space but typically have little need for warehouse - preferring to form alliances with trucking companies that handle large storage requirements. They do not need to be on airport and can handle most of their business with the federal clearance agencies electronically. Like their forwarder counterparts, customs brokers typically locate off airport. Many brokers also serve as forwarders, which may impact facility needs by requiring additional dedicated warehousing space.

Consolidators work with forwarders to provide assembly points for cargo prior to delivery to a carrier on the airport. Consolidation creates shipping economies of scale and reduces the shipping cost per pound to specific destinations. The ability to consolidate shipments and the frequency of flights to such a broad range of destinations are important to an airport's continued success. Consolidators do not have to be on-airport but as with forwarders and brokers, efficient access is critical to allow for delivery to the carriers.

Federal agencies are essential to the functioning of an international gateway. U.S. Customs and Border Protection (CBP) is critical at all international cargo gateways, while specific commodities escalate the roles of the Department of Agriculture and the U.S. Fish & Wildlife Service. Ideally, these regulators are in a centralized facility with easy access to one another and to dependent commercial operators but in some cases, agencies may be located at or nearer the major seaports. CBP has dual responsibility for interdiction and facilitation. Customs inspects a targeted

(based on risk assessment) portion of imported cargo for contraband. They also ensure that the inspection process does not arbitrarily delay the flow of goods.

The TSA's major role is to ensure that cargo moving in bellies of passenger aircraft is safe and not exposed to contact outside a secure shipping chain. Currently, they inspect outbound cargo on a risk assessment basis. On the inbound side, they are concerned with belly cargo targeted for transfer. They also oversee off-airport elements of the inspection process that delegates inspection to Certified Shippers that could be either the manufacturers or freight forwarders acting as their agents.

Trucking Companies make up the ground component of air cargo operations. While these companies rarely lease space on an airport, it is critical that air cargo facilities be designed to accommodate trucking, including frontage, access, and roadway geometry. Trucking operations from an airport like MSP can be a major operating element. Proprietary trucking is also essential to the integrated carriers' business model but is ultimately no less critical for the non-integrated operators. Virtually all air cargo shipments begin or end their journey on a truck, making the ground distribution system equally critical.

3 Understanding the Air Cargo Industry: Air Cargo Success Factors

As the industry undergoes major changes, the basic ingredients of a successful air cargo environment have remained essentially intact, playing major roles in the success of MSP to date. However, regional growth and goods movement dynamics could negatively impact MSP's development, unless future air cargo industry needs are addressed. Evidence of challenges to MSP's growth already exist, even while the region's market indicators are encouraging. This section summarizes basic air cargo success factors and market indicators, ahead of the demand forecasts and capacity analysis that will follow in later sections.

Substantial Passenger Market – Origin & Destination and Transfers. While the focus of this study is air cargo, MSP's principal functions are as a domestic passenger hub and partially as an international passenger gateway. Rather than passenger and cargo development being competing priorities, belly cargo often provides the margin of profit on both transcontinental and international passenger flights, especially during softer seasons.

Large Regional Consuming and Producing Marketplace. The consumer and industrial demand of the region, along with the specific growth of food products and medical devices, generate substantial inbound and outbound freight. The challenge for MSP is to create an operating environment that attracts product from a surrounding region that overlaps with multiple other international gateways and regional integrator hubs. Air cargo business reacts to economies of scale: large volumes enable all parties to reduce costs and potentially pass on savings to customers. MSP's leadership must not be passive to regional competitors that can capture tonnage that otherwise would support growth at MSP.

Lift to a Number of International Markets. A substantial number of operations to global markets and sufficient volumes of cargo to each destination enables shippers to consolidate shipments, thus reducing overall shipping rates. MSP has a strong core with Delta providing access to both its domestic and international networks, supplemented by transatlantic capacity from Aer Lingus, Air France, Condor, Icelandair, and KLM. However, forwarders are attracted to airports with the most extensive network connectivity – the most direct international destinations, as well as frequencies to provide options when the targeted flight is cancelled or delayed. A mix of freighter and belly capacity is ideal.

Supporting Business Infrastructure of Freight Forwarders, Customs Brokers, and Trucking. While integrated carriers control nearly 90% of domestic cargo shipments, freight forwarders and customs brokers control more than 50% of the international market but the integrators are pursuing a larger share of the international business, as well. While freight forwarders favor different modes for specific purposes, the ability to access all modes (even ocean, principally via rail but also truck) is inherently attractive to the forwarder industry.

Physical Capacity to Accommodate Growth. The most obvious criterion for future air cargo development is physical capacity to accommodate the airside and landside requirements of tenants and their users. This includes aeronautical infrastructure, physical facilities, landside parking and queuing, and roadway geometry. Feedback from the stakeholder conference call indicated that some constraints already face MSP's cargo tenants due to outdated (or inefficient) cargo buildings. MSP may have adequate land for its near to intermediate cargo needs, some additions to existing facilities will likely be necessary to accommodate longer term cargo growth.

4 US Air Cargo Industry

Table 4-1, *Top 30 Air Cargo Airports in the U.S. – Ranked by Annual MTs* presents the top thirty cargo airports in the U.S. ranked by both 2010 and 2020 annual tonnage. MSP ranked 24th in the U.S. for total air cargo tonnage handled in 2010. In 2020, MSP's rank dropped to 30th among top U.S. cargo airports due to the COVID-19 pandemic and its impact on the industry.

Table 4-1 Top 30 Air Cargo Airports in the U.S. – Ranked by Annual MTs

CY 2010			CY 2020		
ACI #	Airport	Tonnage	ACI #	Airport	Tonnage
1	Memphis (MEM)	3,916,811	1	Memphis (MEM)	4,613,380
2	Anchorage (ANC)	2,646,695	2	Anchorage (ANC)	3,157,684
3	Louisville (SDF)	2,166,656	3	Louisville (SDF)	2,917,243
4	Miami (MIA)	1,835,797	4	Los Angeles (LAX)	2,234,532
5	Los Angeles (LAX)	1,747,629	5	Miami (MIA)	2,137,699
6	Chicago (ORD)	1,376,552	6	Chicago (ORD)	2,003,342
7	New York (JFK)	1,344,126	7	Cincinnati (CVG)	1,300,758
8	Indianapolis (IND)	1,012,589	8	Indianapolis (IND)	1,101,478
9	Newark (EWR)	855,594	9	New York (JFK)	1,088,230
10	Atlanta (ATL)	659,129	10	Ontario (ONT)	843,832
11	Dallas/Ft. Worth (DFW)	645,426	11	Dallas/Ft. Worth (DFW)	790,229
12	Oakland (OAK)	510,947	12	Newark (EWR)	667,230
13	Honolulu (HNL)	440,733	13	Atlanta (ATL)	599,184
14	San Francisco (SFO)	426,725	14	Oakland (OAK)	578,866
15	Houston (IAH)	423,483	15	Philadelphia (PHL)	565,915
16	Philadelphia (PHL)	419,702	16	Honolulu (HNL)	550,366
17	Cincinnati (CVG)	371,297	17	Seattle (SEA)	455,214
18	Ontario (ONT)	355,932	18	Houston (IAH)	446,271
19	Washington DC (IAD)	332,275	19	San Francisco (SFO)	438,788
20	Seattle (SEA)	283,425	20	Phoenix (PHX)	380,729
21	Boston (BOS)	259,539	21	Rockford (RFD)	377,745
22	Denver (DEN)	251,777	22	Portland (PDX)	304,315
23	Phoenix (PHX)	250,704	23	Denver (DEN)	299,817

CY 2010			CY 2020		
ACI #	Airport	Tonnage	ACI #	Airport	Tonnage
24	Minneapolis (MSP)	211,691	24	Boston (BOS)	271,115
25	Detroit (DTW)	193,344	25	Baltimore (BWI)	269,784
26	Portland (PDX)	190,117	26	Fort Worth (AFW)	253,256
27	Salt Lake City (SLC)	145,412	27	Tampa (TPA)	230,757
28	Rockford (RFD)	143,612	28	Salt Lake City (SLC)	214,928
29	Orlando (MCO)	135,895	29	Minneapolis (MSP)	203,697
30	Fort Worth (AFW)	126,577	30	Orlando (MCO)	202,416
			34	Detroit (DTW)	171,114

Source: Airports Council International World Annual Traffic Reports with analysis by L&B

The significance of these airport cargo rankings is for comparison purposes to show potentially underperforming markets in considering future development. As a benchmark, the largest market by total air cargo tonnage higher than MSP in the rankings and not a major international passenger airport or international cargo gateway airport or cargo hub for FedEx, UPS, DHL or Amazon is PHX with 380,729 metric tonnes in 2020.

Beyond the FedEx and UPS global hubs of Memphis and Louisville, the U.S. top 30 cargo airports include three regional hubs for FedEx (Indianapolis, Newark, Oakland), four regional hubs for UPS (Dallas/Ft. Worth, Ontario, Philadelphia, and Rockford), as well as DHL's North American hub at Cincinnati/Northern Kentucky (CVG) and Amazon hubs in CVG and Fort Worth (AFW). In addition to refueling stops for numerous carriers, Anchorage also serves as a transpacific sortation center for FedEx, UPS, DHL, and Amazon (reflected in tonnage reported by Atlas, Polar, Southern and others.

Of the top 30, there are only four airports that have lower reported tonnages than they did in 2010. Those airports include JFK, EWR, ATL, DTW and MSP. The reasons for these airport tonnage decreases are numerous and largely as applicable to MSP as to others:

- Diversion of domestic shipments from air transport to trucks by integrated carriers (FedEx and UPS) that had provided much of the air cargo growth in the 1980's and 90's.
- Diversion of the domestic segment of international shipments by belly cargo carriers – partially motivated by elevated TSA screening requirements and partially by the demise of the U.S. domestic wide body aircraft fleet.
- Erosion of U.S. Postal Service first class mail, as bills and checks (among many communications) were replaced by electronic transactions.
- Movement of former domestic manufacturing abroad, as well as increased miniaturization and loss of value in electronics.
- Regionalization of U.S. distribution centers, cutting average shipping distances and consequently the need for air transport.

5 MSP and the Midwest Regional Market

As shown in **Table 5-1**, ***Top 20 Mid-West Cargo Airports – Ranked by 2020 Annual MTs,*** MSP ranks eighth in the Mid-West region by 2020 tonnage. All the Mid-West region airports ranked higher than MSP, are national hubs or regional hubs for FedEx, UPS, DHL or Amazon with the exception of Chicago O'Hare (ORD), which is a major international gateway airport and hub to both United and American Airlines. Interestingly, MSP is the biggest (tonnage) in this list with no direct widebody international freighters. Certain airports in this list will also be referenced in comparisons of the benchmark airports and competitive airports.

Table 5-1 Top 20 Mid-West Cargo Airports – Ranked by 2020 Annual MTs

RANK	CITY	STATE	CODE	METRIC TONNES
1	Memphis	Tennessee	MEM	4,613,380
2	Louisville	Kentucky	SDF	2,917,243
3	Chicago	Illinois	ORD	2,003,342
4	Cincinnati	Ohio	CVG	1,300,758
5	Indianapolis	Indiana	IND	1,101,478
6	Philadelphia	Pennsylvania	PHL	565,915
7	Rockford	Illinois	RFD	377,745
8	**Minneapolis-St. Paul**	**Minnesota**	**MSP**	**203,697**
9	Detroit	Michigan	DTW	171,171
10	Columbus	Ohio	LCK	119,985
11	Allentown	Pennsylvania	ABE	95,363
12	Kansas City	Missouri	MCI	89,930
13	Pittsburgh	Pennsylvania	PIT	87,329
14	St. Louis	Missouri	STL	82,857
15	Cleveland	Ohio	CLE	82,646
16	Milwaukee	Wisconsin	MKE	77,284
17	Harrisburg	Pennsylvania	MDT	50,261
18	Des Moines	Iowa	DSM	52,585
19	Nashville	Tennessee	BNA	43,538
20	Grand Rapids	Michigan	GRR	41,497

Source: Airports Council International World Annual Traffic Reports with analysis by Landrum & Brown

Table 5-2, *Top 10 Delta Airports – Ranked by 2020 Annual Passengers and Cargo,* provides a reference of how MSP ranks among other Delta hub and focus airports in the U.S based on total air cargo among the Top 10 Delta passenger airport markets.

Table 5-2 Top 10 Delta Airports – Ranked by 2020 Annual Passengers and Cargo

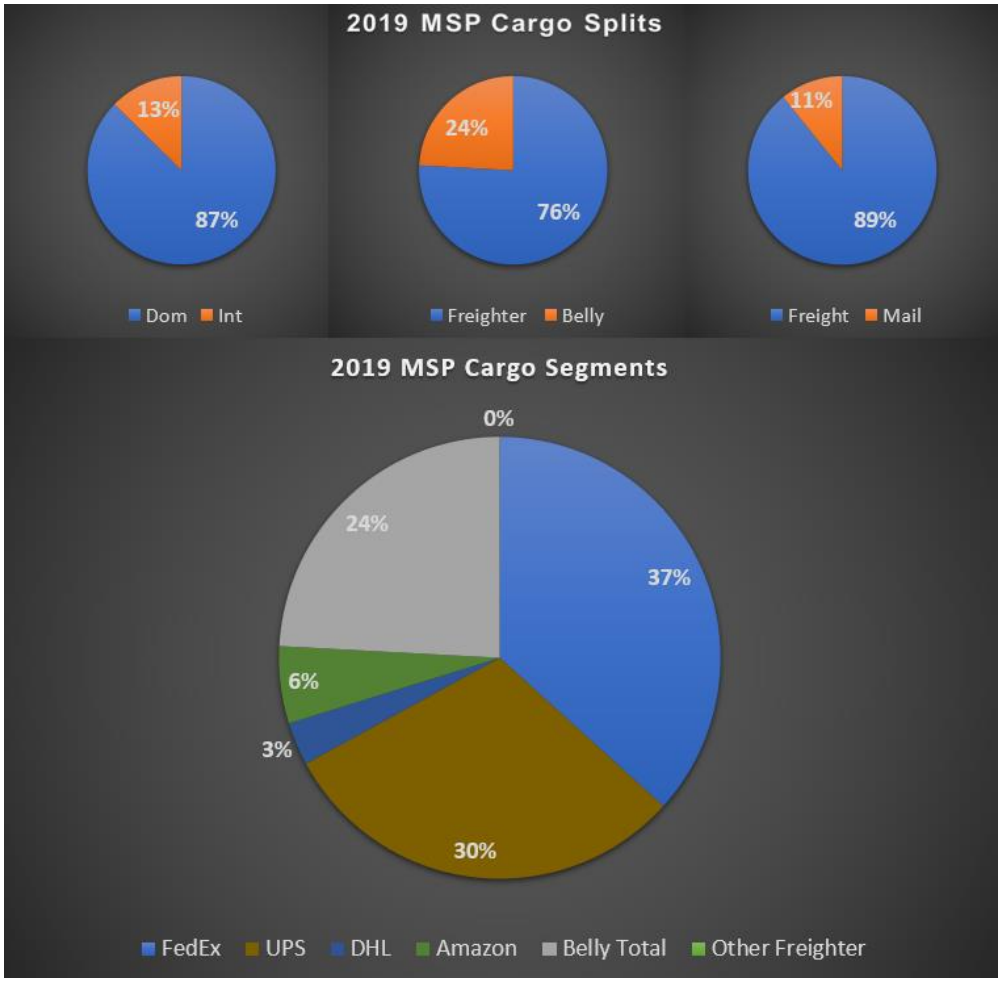
PASSENGER RANK	DELTA CARGO RANK	CITY	CODE	DELTA METRIC TONNES	TOTAL METRIC TONNES
1	1	Atlanta	ATL	173,718	599,184
2	**5**	**Minneapolis-St. Paul**	**MSP**	**49,163**	**203,697**
3	4	Detroit	DTW	75,112	171,171
4	8	Salt Lake City	SLC	20,244	214,928
5	2	New York	JFK	113,802	1,088,230
6	3	Los Angeles	LAX	80,490	2,234,532
7	15	New York	LGA	3,268	9,515
8	6	Seattle	SEA	30,790	455,214
9	7	Boston	BOS	20,616	271,115
10	10	Orlando	MCO	6,180	202,416

Source: U.S. DOT Schedule T100 data with analysis by Landrum & Brown

6 Composition of MSP Air Cargo Market

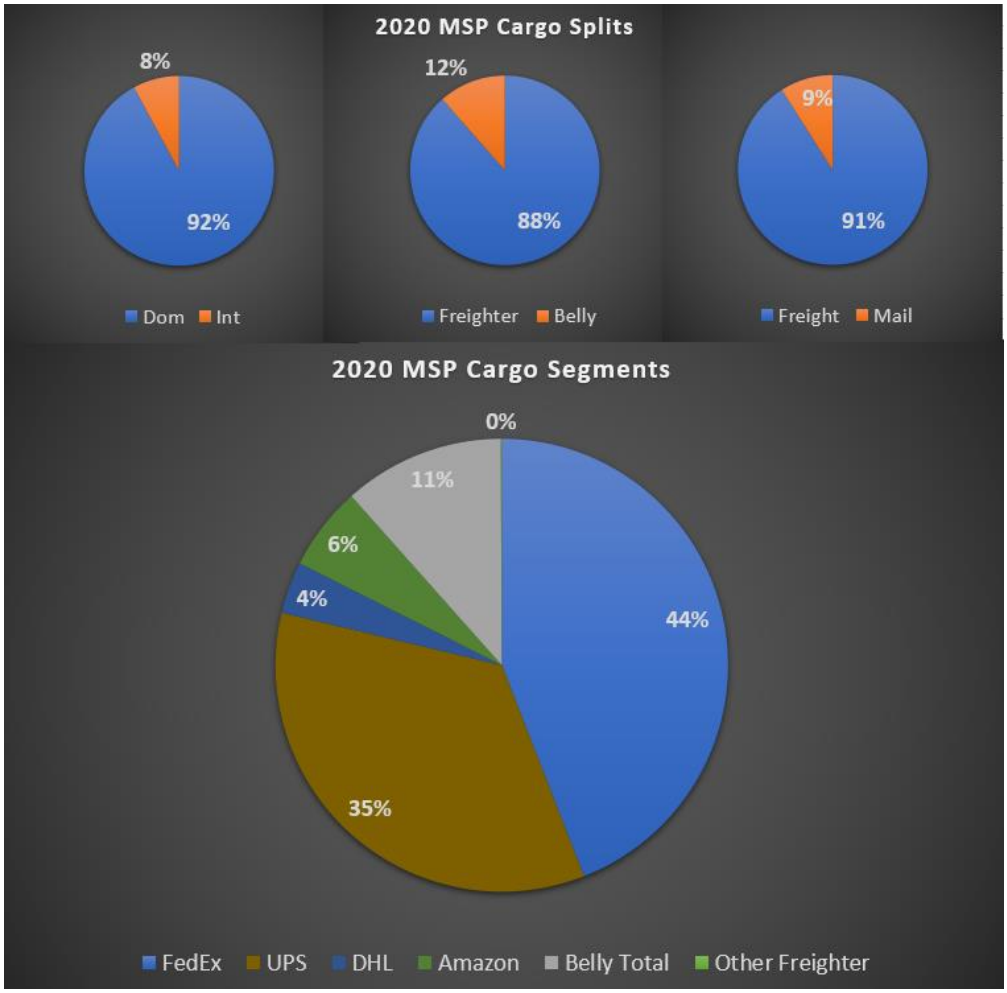
Figure 6-1, ***MSP Air Cargo Segments 2019,*** and **Figure 6-2,** ***MSP Air Cargo Segments 2020,*** provide cargo segment shares at MSP for both 2019 and 2020, respectively.

Figure 6-1 MSP Air Cargo Segments 2019



Sources: MSP airport data; U.S. DOT Schedule T100 data; Landrum & Brown

Figure 6-2 MSP Air Cargo Segments 2020

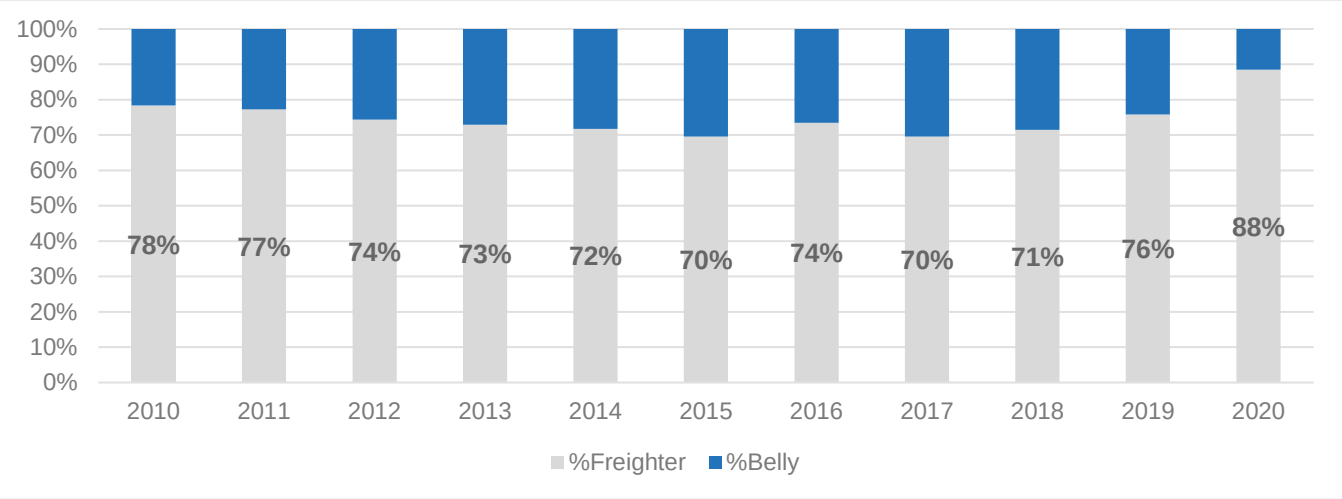


Source: MSP airport data; U.S. DOT Schedule T100 data; Landrum & Brown

6.1 Air Cargo Carrier Service Profiles

The share of freighter cargo at MSP has generally remained between 70% and 80% before reaching 88% in 2020, due to reduced belly cargo offerings during the COVID-19 pandemic, as evidenced in **Figure 6-3, *Share of Total Cargo Transported by Freighter (All-Cargo) Aircraft at MSP***. The cargo capacity offered in freighters and in the belly of passenger aircraft complement one another to maximize the network connectivity of a gateway. Scheduled freighter flights are considered more reliable in that shipments are not susceptible to being displaced by excess baggage and more flexible in allowing cargo types that may be impermissible in the bellies of passenger flights. However, at most airports – including MSP – many more routes and frequencies can be justified for passenger demand than would be sustainable for scheduled freighters. Gateway airports – such as Chicago – O'Hare (ORD), Los Angeles International (LAX) or Miami International (MIA) which host hubs for both passenger and all-cargo operators, can leverage transit tonnage to justify more service than local market demand could sustain alone. MSP does not fit into the same category and as such handles more origin and destination cargo (O&D) than transfer cargo. As MSP is a passenger hub airport for Delta, the belly cargo segment can serve as a transfer cargo opportunity market with significant market offerings and flexibility for both O&D and transfer cargo demand.

Figure 6-3 Share of Total Cargo Transported by Freighter (All-Cargo) Aircraft at MSP



Sources: MSP airport data; U.S. DOT Schedule T100 data; Landrum & Brown

6.1.1 MSP Cargo Market Share by Carrier

MSP's two largest cargo carriers by tonnage shares in 2019 and 2020 were FedEx and UPS, followed by Delta and Amazon. Combined, FedEx and UPS comprised 67% and 79% of total air cargo in 2019 and 2020, respectively. Belly cargo tonnage experienced a drop from 24.1% to roughly 12% of total air cargo from 2019 to 2020, with Delta remaining the largest belly cargo carrier at 9.0% of total cargo and 78.3% of the belly cargo segments. Amazon cargo tonnage is beginning to show signs of a surge in mid-2021 after three years at MSP. Amazon's 2021 cargo tonnage is up nearly 78% over 2020 (through July). DHL cargo has been flat to declining since 2017. **Table 6-1, *Shares of Total Cargo by Carrier for CY2019*** and **Table 6-2, *Shares of Total Cargo by Carrier for CY2020,*** presents the carrier cargo tonnage shares at MSP for 2019 and 2020 respectively. The biggest change from 2019 to 2020 is the shift of belly cargo shares to FedEx and UPS with the COVID-19 pandemic induced reduction in commercial passenger flights and thus, reduced belly cargo capacity.

Table 6-1 Shares of Total Cargo by Carrier for CY2019

ALL-CARGO CARRIERS	SHARE	BELLY CARGO CARRIERS	SHARE
FEDEX (Mountain, IFL)	36.7%	Delta	19.0%
UPS (Bemidji, Suburban)	30.3%	Sun Country	1.9%
Amazon (Atlas/Sun Country)	5.6%	KLM	1.3%
DHL (Atlas/Kalitta/Southern/Swift/Encore)	3.1%	Southwest	0.8%
Other Freighters	0.1%	United	0.3%
		American	0.3%
		Others	0.5%
Total All-Cargo	**75.9%**	**Total Belly Cargo**	**24.1%**

Source: MSP Airport data; Landrum & Brown analysis

Table 6-2 Shares of Total Cargo by Carrier for CY2020

ALL-CARGO CARRIERS	SHARE	BELLY CARGO CARRIERS	SHARE
FEDEX (Mountain, IFL)	44.1%	Delta	9.0%
UPS (Bemidji, Suburban)	34.6%	Sun Country	0.9%
Amazon (Atlas/Sun Country)	6.0%	Southwest	0.7%
DHL (Atlas/Kalitta/Southern/Swift/Encore)	3.7%	KLM	0.2%
Other Freighters	0.1%	American	0.5%
		United	0.2%
		Others	0.1%
Total All-Cargo	**88.5%**	**Total Belly Cargo**	**11.5%**

Source: MSP Airport data; Landrum & Brown analysis

6.1.2 All-Cargo Carriers: Aircraft & Routes

FedEx and UPS, for the most part, use their own large freighter aircraft for scheduled operations with additional daily feeder aircraft providing network connectivity to smaller markets within the region. The all-cargo industry relies heavily on ACMI airline leases for a significant amount of scheduled and unscheduled service. Consequently, piecing together the network operations of these carriers can be far more challenging than for scheduled passenger airlines. **Table 6-3, *MSP All-Cargo (Jet) Flights by Carrier, Aircraft and Schedule (Feb/Mar 2021)*** depicts numbers of flights, by aircraft type and day of week for the main cargo carriers. The larger quantities of flights by Bemidji Aviation is due to the smaller size of the aircraft in use reaching many smaller regional markets.

Table 6-3 MSP All-Cargo (Jet) Flights by Carrier, Aircraft and Schedule (Feb/Mar 2021)

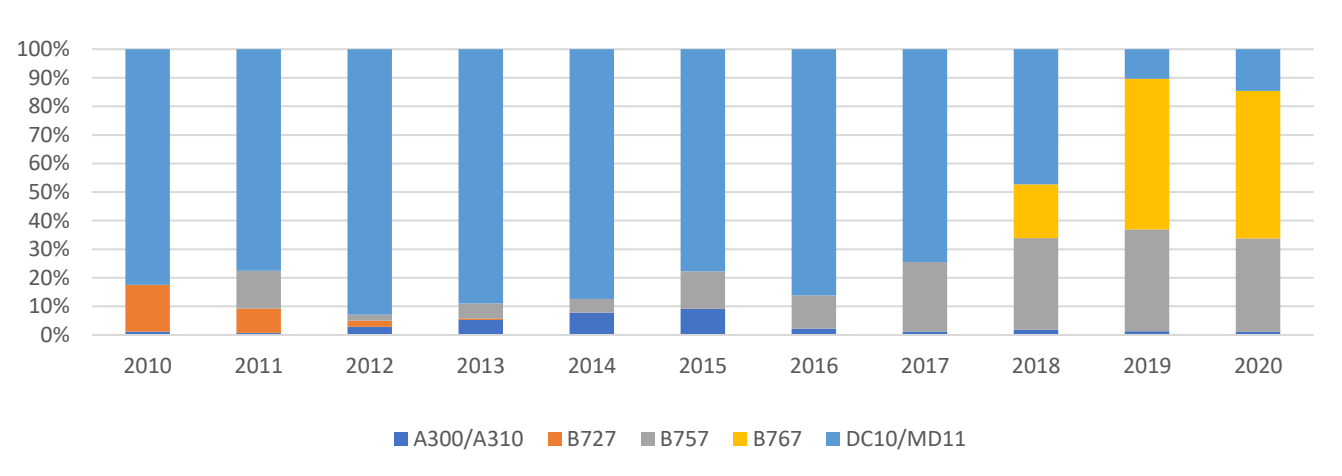
AIRLINE	AIRCRAFT	MON	TUE	WEDS	THUR	FRI	SAT	SUN
UPS	B752/A306/B744/B763	5	9	8	8	5	1	1
Bemidji (UPS)	BE65, BE99	7	10	11	9	9	9	0
FedEx	B752/B763	6	7	7	6	6	3	2
Mountain Air (FedEx)	AT43	1	1	1	1	1	1	0
IFL (FedEx)	CRJ2	1	0	0	1	1	0	0
Amazon (ATI/Atlas/Sun Country)	B763/B738	3	3	3	3	3	2	3
DHL (Encore)	SW4	2	2	2	2	2	0	0

Sources: FlightAware.com review of reported activity, February and March 2021

6.1.2.1 *United Parcel Service (UPS)*

UPS operates an extensive network system throughout the U.S. as an integrated carrier with many gateways, several larger regional hubs and their largest operation, Worldport, in Louisville, Kentucky (SDF). UPS connects many smaller operations or gateways with daily operations levels from roughly one to eight aircraft in use. UPS commonly uses their extensive fleet of Airbus 300-600 freighters, Boeing 757-200 freighters, Boeing 767-300 freighters and McDonald Douglass MD-11 freighters within the United States. Larger long-haul aircraft such as the Boeing 747-400 freighters and Boeing 747-8F freighters are commonly deployed on transcontinental flights and international routes. UPS contracts with smaller feeder aircraft carriers (Bemidji and Suburban Air) to consolidate freight into markets like MSP before transferring to a larger regional hub or to SDF. **Figure 6-4, *UPS Fleet Development*** displays UPS's fleet changes since 2010.

Figure 6-4 UPS Fleet Development

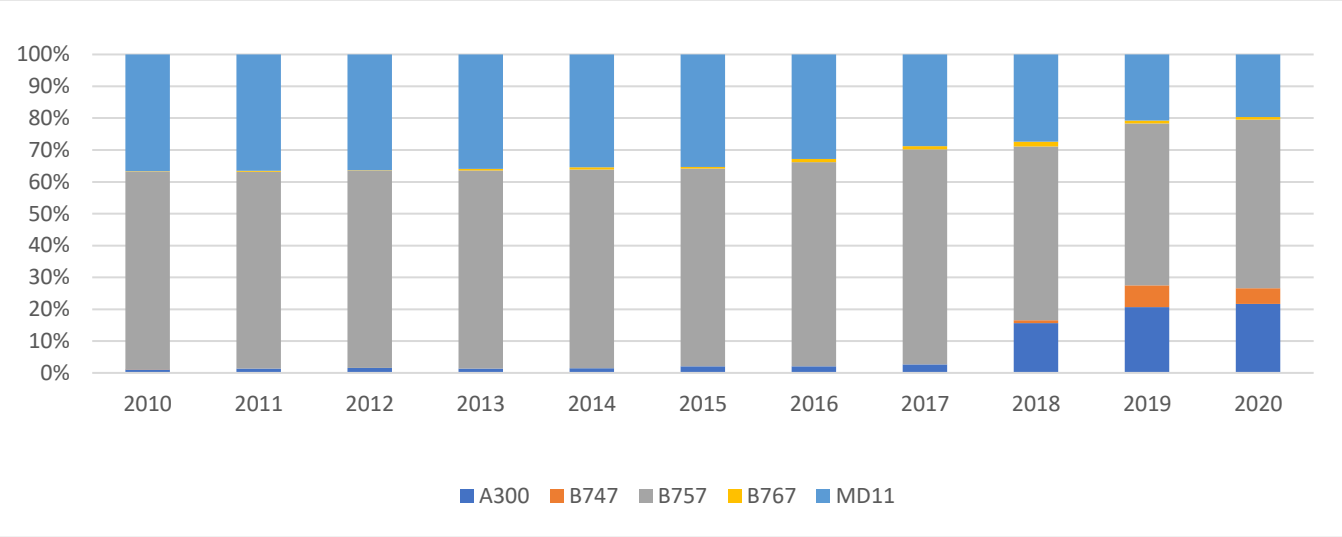


Source: U.S. DOT Schedule T-100 data; Landrum & Brown analysis

6.1.2.2 *Federal Express (FedEx)*

Like UPS, FedEx also has an extensive network system throughout the U.S. As an integrated carrier with several larger regional hubs and the world hub airport located in Memphis, Tennessee (MEM). FedEx air cargo also maintains many smaller hubs or focus airport markets with daily operations levels with at least two aircraft in use. The FedEx fleet is similar to UPS and also commonly uses a fleet of Airbus 300-600 freighters, Boeing 757-200 freighters, Boeing 767-300 freighters within the United States. Larger long-haul aircraft such as the Boeing 777-300 freighters are commonly deployed on longer international routes. FedEx also utilizes the services of smaller feeder aircraft carriers (Mountain Air Cargo and IFL) to consolidate freight into MSP before transferring to or from aircraft connected to a larger regional hub or to the mega hub in MEM. **Figure 6-5, *FedEx Fleet Development*** shows FedEx's fleet changes since 2010.

Figure 6-5 FedEx Fleet Development



Source: U.S. DOT Schedule T-100 data; Landrum & Brown analysis

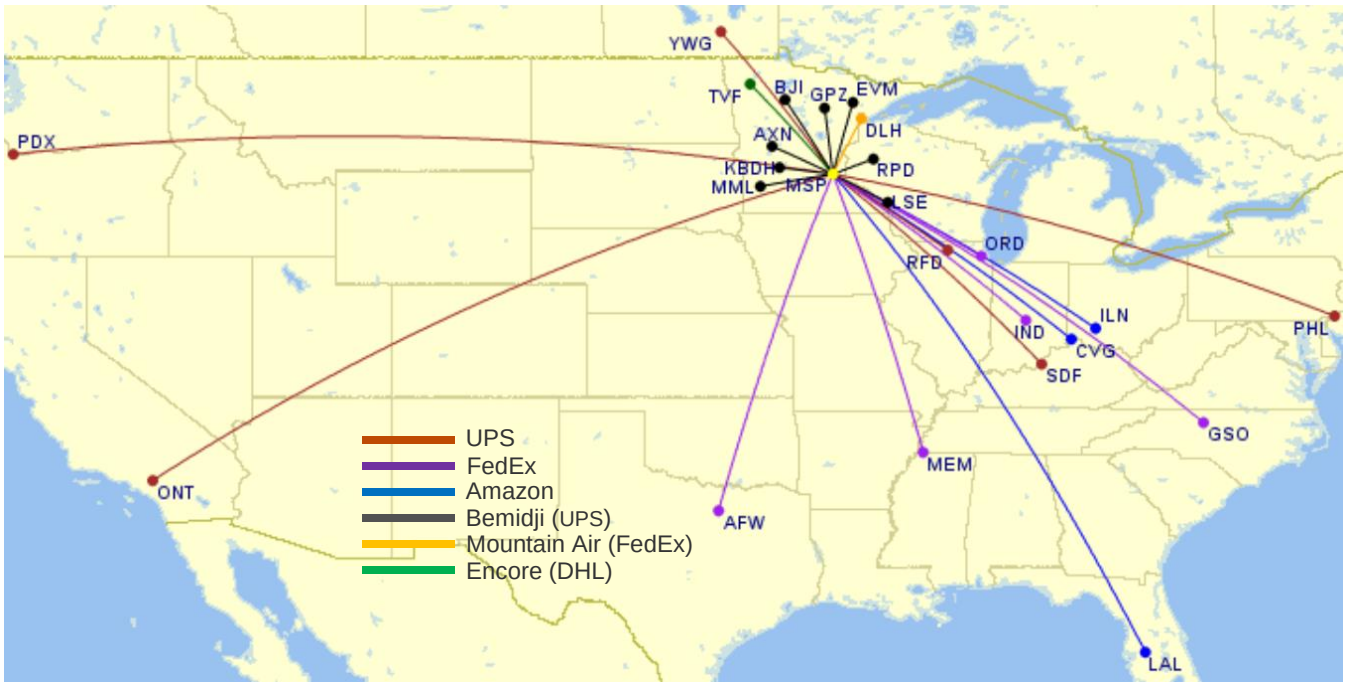
6.1.2.3 DHL

The DHL network is very different from either UPS or FedEx. DHL has a single major hub in the United States in Hebron, KY (CVG). It serves the same purpose as UPS's SDF and FedEx's MEM, which is as an all points hub. They have no regional hubs and only operate out of major airports. DHL has contracts with more than a dozen cargo airlines to help them move their cargo to and from CVG. Aircraft sizes in the US include the Boeing 737-400 and Boeing 737-800, the Boeing 757-200, the Boeing 767-300, the Boeing 777F, the Boeing 747-400 and the Boeing 747-8F. In Europe, the carrier also adds Airbus aircraft to their fleet. Most of the cargo at MSP is handled by Encore Air Cargo which serves as a feeder aircraft carrier using Metroliner converted freighters (SW4).

6.1.2.4 Amazon

The new and developing Amazon air network has a similar structure to UPS and FedEx with a focus on express freight delivery services to a vast domestic and growing international market network. The ACMI lease contracts with Atlas Air, Air Transport International, Southern Air and most recently Sun Country airlines provides a fleet of Boeing 767-300 freighters and Boeing 737-800 freighters consolidating and transporting product replenishments to warehouses and fulfillment centers and e-commerce deliveries on a priority basis to markets mainly across the United States.

Figure 6-6 CARGO CARRIERS GENERAL ROUTE MAP AND MARKETS



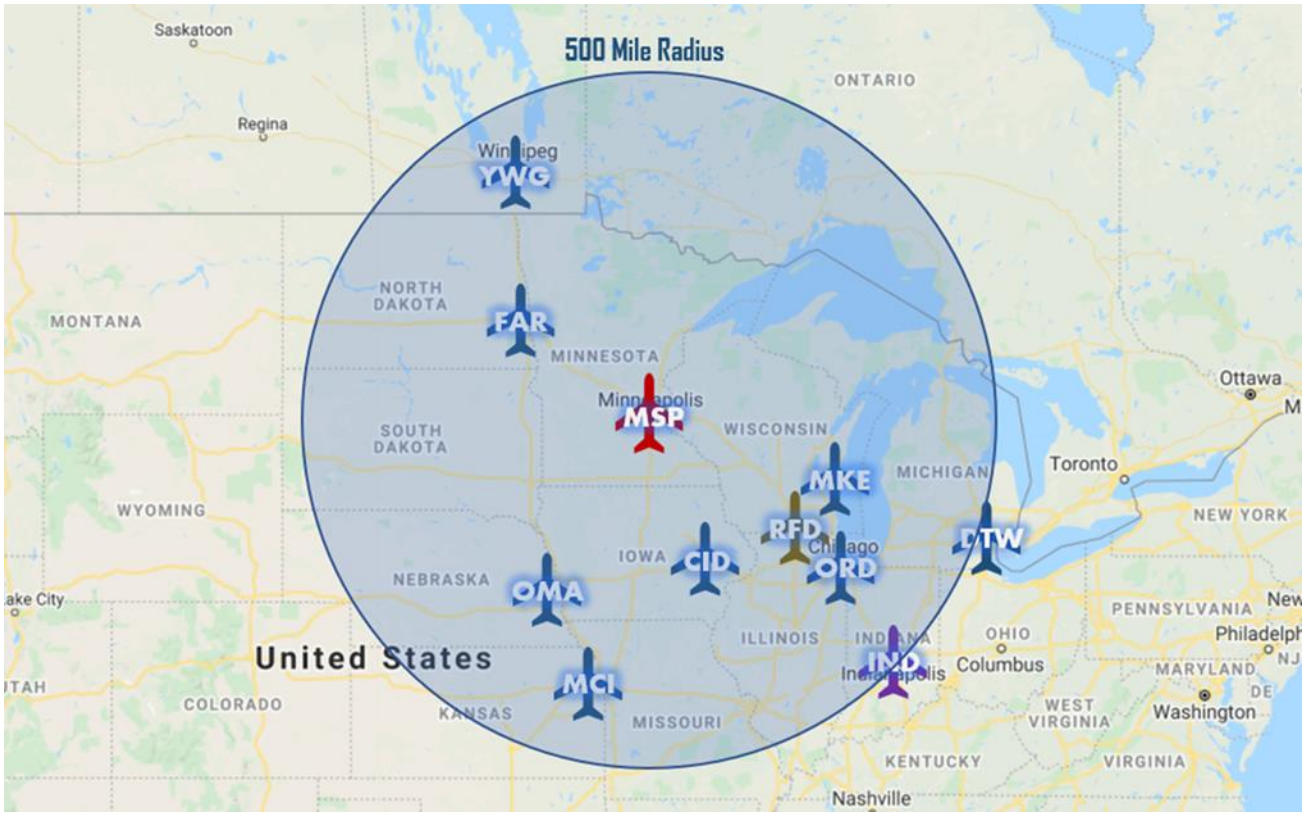
UPS	FedEx	Amazon	Bemidji	Encore
DFW	AFW	AFW	AXN	TVF
ONT	GSO	CVG	BDH	
PDX	IND	ILN	BJI	
PHL	MEM	LAL	BRD	**Mountain Air**
RFD	ORD		DLH	DLH
SDF			EVM	
YWG			GPZ	
			INL	
			LSE	
			MML	
			RPD	

Sources: FlightAware.com research; U.S. DOT Schedule T100 data; Landrum & Brown

7 International Competition & Regional Catchment Area

In multiple respects, the air cargo industry is more flexible than the passenger side of the industry, which creates a variety of challenges for analysis. While the catchment area for the domestic overnight express segment tends toward origin & destination markets, the domestic deferred-delivery (2nd day and beyond) and international segments may entail trucking segments of 500 miles (equivalent to a one-day trucking trip) and beyond. **Figure 7-1**, ***500-Mile Catchment Area for Minneapolis,*** depicts the area encompassed by the 500-mile radius from MSP. MSP's theoretical catchment area heavily overlaps with other regional airports, including substantially larger international gateway ORD. St. Louis, MO (STL), Kansas City, MO (MCI) Milwaukee, WI (MKE), UPS Regional Hub Rockford, IL (RFD) and FedEx Regional Hub, Indianapolis, IN (IND) are also all within the catchment area. International cargo gateways compete based on network connectivity – defined broadly as the combination of direct international destinations, frequencies and ideally, mixes of belly and freighter capacity. For competitive purposes, forwarders prefer multiple carriers competing on the same segments. That is what makes ORD such a draw for forwarders in the MSP area.

Figure 7-1 500-Mile Catchment Area for Minneapolis – Saint Paul



Sources: Google Earth; Landrum & Brown analysis

MSP's most extensive long-range international network coverage is in Europe, with four destinations served year-round (AMS, CDG, LHR, KEF). The routes are operated with aircraft offering limited capacity and are typically routes also served with freighters from other gateways, including by integrated carriers from their hubs. Due to the erosion of transatlantic trade as both Europe and North America transferred more trade to Asia, freighters have become scarce over the Atlantic – dramatically increasing the importance of belly capacity.

When analyzing why origin volume from Minnesota, and more particularly, MSP, is trucked to other airports, common themes were heard in interviews with the area's largest freight forwarders. MSP does not have the needed freighter capacity to be able to move pallets with large cargo. Belly cargo positions are available to Europe and Asia, but without the capability to be able to have pallets taller than 64 inches, manufacturers, freight forwarders and trucking companies are forced to look elsewhere. A relatively short, inexpensive drive to ORD is the answer for most. ORD has large, wide-body, freighters (able to carry pallets up to 120 inches tall) to virtually every corner of the globe, making the decision to truck there a simple one. Another reason for the MSP areas largest freight forwarder (CH Robinson), to truck loads out of town is that they have a Midwest regional hub in Chicago. They consolidate loads from a catchment area that is up to 650 miles around ORD. Having the capability to bring cargo to one location allows them to negotiate the best rates for shipping larger numbers of positions on these international freighters.

It is important to mention the Global Wellness Consortium (GWC). This is a group championed by current and former business and political leaders in the Minneapolis region to promote the thriving agricultural and medical businesses that exist therein. They are joined in their efforts by likeminded businesses in the Wallonia District of Belgium and members of the airport staff at Liege. Liege is one of the fastest growing cargo airports in the world and the GWC is working with them to understand how to bring that type of growth to the MSP airport. Ongoing meetings and workshops occur periodically to share ideas on how to move forward in their endeavors.

The advantage Liege has over MSP is its location in the middle of the logistics "golden triangle". The "golden triangle" encompasses an area between Amsterdam, Frankfurt and Paris. Nearly 70% of all European transport runs through this area. MSP simply doesn't have the traffic moving through it that Liege does and therefore the ability to grow using ground cargo movements is limited. As the plans for the Hyperloop between MSP and Rochester, MN continue to mature, and construction actually begins, the potential for growth in MSP cargo tonnage will almost certainly occur.

Regarding bypass traffic, detailed information is available from the Census Bureau, among other sources, that allows analysts to consider the foreign trading partners and commodities at the Minneapolis-St. Paul Customs Port. For both exports and imports, the leading markets and commodities are presented in terms of dollar values and kilos in this report's appendices.

As evident in the excerpt shown in **Table 7-1**, ***Top Five (by kilo weight) Air Export Markets from Minneapolis-St. Paul Customs Port,*** the MSP Customs Port's export markets favored Canadian markets. The next three out of four trading partners have nonstop service from MSP. The biggest partner without year-round nonstop service is Germany, followed by South Korea, however, past service to ICN is expected to return by the end of 2021.This is easily explained by the fact that exports and imports to/from markets not served by MSP will most often be trucked to international gateways (in this case, ORD) that have superior network access. Even for air trade with international markets that have direct flights from MSP, shipments requiring freighters will most often be trucked to another gateway or require chartered flights at MSP. **Table 7-2**, ***Top Five (by kilo weight) Air Import Markets from Minneapolis-St. Paul Customs Port,*** further shows a similar situation with air import markets where three of the top four markets have nonstop service from MSP, but Germany does not.

TABLE 7-1 Top Five (by kilo weight) Air Export Markets from Minneapolis-St. Paul Customs Port

Export Market by Country	Air Total Exports Value ($US)	Air Total Exports SWT (kg)
Canada	$163,999,693	1,730,462
Netherlands	$52,721,888	579,924
United Kingdom	$47,293,816	471,971
Germany	$40,908,624	347,951
South Korea	$28,314,197	331,389

Source: Census Bureau with analysis by Landrum & Brown, Inc.

TABLE 7-2 Top Five (by kilo weight) Air Import Markets from Minneapolis-St. Paul Customs Port

Export Market by Country	Air Total Exports Value ($US)	Air Total Exports SWT (kg)
Germany	$72,069,053	1,043,147
Netherlands	$10,770,509	453,971
United Kingdom	$32,887,100	382,319
South Korea	$10,556,826	330,005
Denmark	$9,749,011	304,168

Source: Census Bureau with analysis by Landrum & Brown, Inc.

8 Cargo Industry Outreach

An air cargo presentation on the state of the industry and more specifically, MSP, was completed in April 2021. Following that, several weeks of individual Microsoft Teams conference calls occurred with the assistance of Brian Peters. His efforts specifically helped attract a significant number of respondents to the interviews. All the airport's cargo-related tenants were invited and most participated, including Delta Air Lines, Sun Country Airlines, UPS, DHL, Amazon, Bemidji Aviation, WFS, and Air General. In addition, supporting industries, such as freight forwarders and trucking companies based on airport and off-airport took part. State and local community groups and organizations such as GREATER MSP, several members of the Regional Air Service Partnership (RASP) (Cargill, CH Robinson, General Mills, Medtronic, Polaris, Thomson Reuters) the Minnesota Chamber, Medical Alley, University of Minnesota, Global Wellness Consortium, Metropolitan Council and representatives of Minnesota's Department of Transportation also participated. The interviews lasted from 10 minutes to 1 hour.

Participants were assured that their feedback would be synthesized into composite form, rather than directly attributed to them in public documents. Any carrier or handler-specific data presented in this report can be found in publicly or commercially available databases. Direct contact with the carriers and handlers was mostly for the purpose of confirming the consultants' interpretations of that data and other inputs, as well as to inform cargo and operations forecasts and the consequent effect on airport capacity.

The interviewing process brought out numerous ideas, opinions and facts. Where possible, those were included in the chapters of this Study. However, many of them don't fit perfectly into one of the main chapters in this report but are important and should be mentioned. The following list is an abridged version of those comments:

- GREATER MSP and supporting organizations are working on closing 35 active deals over the next 12-18 months for new businesses. Good potential for new cargo. Many of them are in the Health Tech/Medical Device space
- An oil and gas sensor manufacturer, with German roots is located in Bloomington
- Traffic flow off I-494 to airport is not good
- One of the small aircraft operators would possibly use a facility for maintenance
- Lots of requests for better public air cargo data
- Mention of another German company, Turck in the area
- Calls for more international flights to open opportunities to provide handling services. International flights much more lucrative. Need more warehouse if this comes to fruition
- Hard to hire people with the competition from Amazon paying higher wages
- Lots of local product moving into Canada via truck
- Contract carriers that are TSA approved is a big plus
- The World Health Organization (WHO) has multiple headquarters around the world, but not in the US. A push to have them move to the MSP area could be gaining momentum and another possible source of air cargo
- State grant in process for MnPass express lanes. It will help with better access to the airport from the west side of town
- Like to see bonded facilities for international shipments
- Mention of another German company, Truvia
- Another airline needs space if they can handle more airlines. Could use more space for retail too

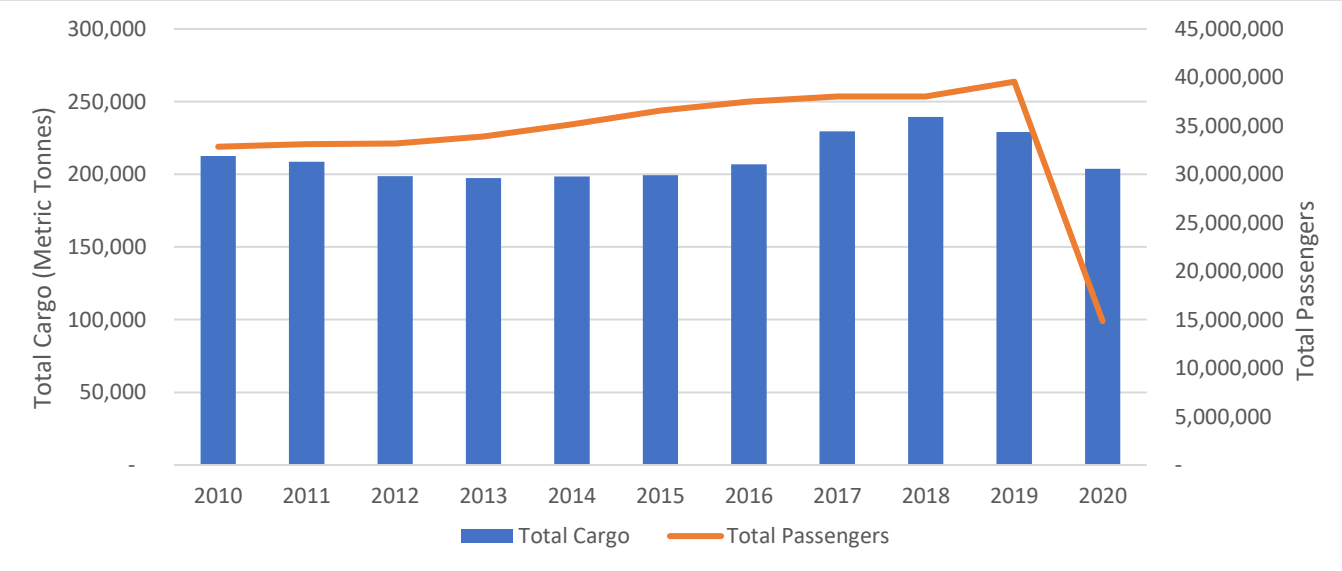
- FDA hours are a problem. Cargo arrives on Friday night and put in hold. No weekend hours for FDA puts perishables in danger
- Large manufacturer ships product all over southeast Asia. Uses many freight forwarders
- Chamber working on several long-range projects. Grow MN program and MN 2030. Opportunity for airport to get the word out on cargo
- Freight forwarders all asking for heavy lift to and from MSP
- Recommendation to focus on Europe to bring 1 freighter flight a week in to start
- ORD currently has a 5-7 day delay for processing cargo
- Offer incentives to get new service

9 MSP Air Cargo History

Demand for Air Cargo around the world and in the U.S. has faced some challenges since the 2008 Financial Crisis and many of the top U.S. cargo airports have still not fully recovered to their former peak year tonnages from around 2000. The impact of the 'Great Recession' in 2007/2008 and the increased cost of fuel led to relatively weak performance of air cargo in the U.S. and at MSP in recent years. From 2016 to 2018 air cargo at MSP was starting to show increased demand until the industry in 2019 slowed down and then the impact of the COVID-19 pandemic in 2020 caused a shift in the industry. Some markets saw an increase in demand, but MSP experienced a small decline due mainly to reduced capacity and demand for belly cargo. Cargo traffic at MSP in 2004 was nearly 300,000 metric tonnes. By 2009, it had dropped to 190,683 metric tonnes before recovering to 239,544 metric tonnes in 2018 and then decreasing to 203,697 metric tonnes in 2020.

Figure 9-1, *Total Cargo and Total Passengers for MSP for Period 2010 – 2020,* shows the improvement in cargo tonnage demand at MSP from 2016 to 2018, and the impact of the COVID-19 pandemic on air cargo at MSP in 2020, even after a small decline in 2019. In general, major freight all-cargo carriers started to fair better in 2020, but belly cargo suffered a major hit as commercial passenger traffic was down significantly in the U.S. and worldwide due to pandemic concerns, travel restrictions and uncertainty through the end of 2020. Also noticeable in **Figure 9-1** is the consistent passenger growth period at MSP after 2012.

Figure 9-1 Total Cargo and Total Passengers for MSP for Period 2010 - 2020

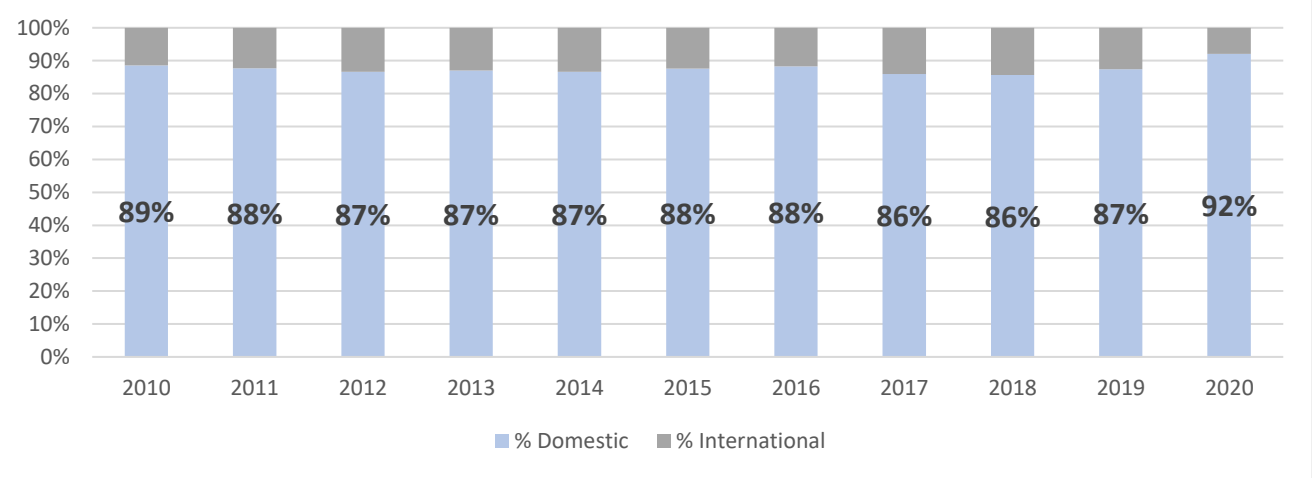


Sources: MSP Airport data and ACI World Annual Traffic Reports; Compilation by L&B

During the historical years of 2010 to 2019 at MSP the air cargo segments of domestic vs. international and belly vs. freighter showed minimal change with an average domestic cargo share of 87 percent and an average freighter cargo share of 76 percent. Domestic cargo increased to 92 percent in 2020 and freighter cargo increased to 88 percent as commercial passenger traffic declined due to the pandemic.

Figure 9-2, ***MSP Air Cargo Tonnage Shares by Domestic/International,*** graphically shows the historical trend in domestic and international cargo at MSP through 2020, while the historical trend in the belly and freighter cargo split was presented in Figure 6-3 previously.

Figure 9-2 MSP Air Cargo Tonnage Shares by Domestic/International

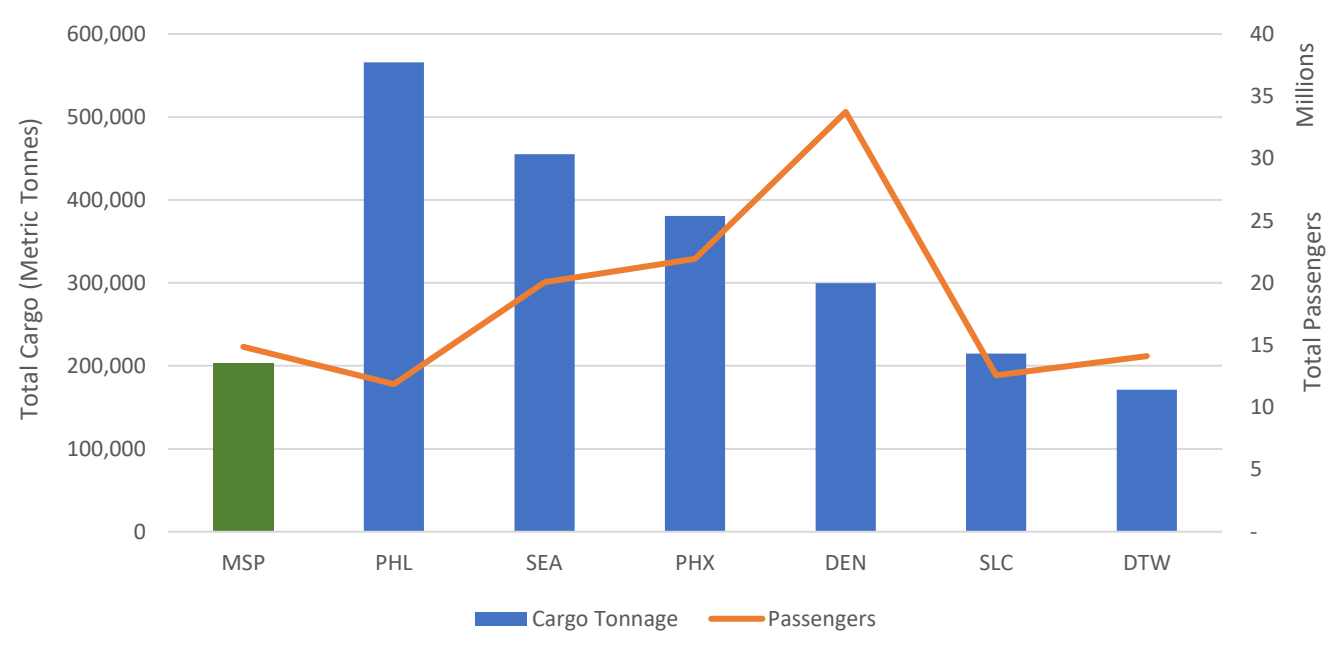


Sources: U.S. DOT Schedule T100 data; Compilation by L&B

10 Benchmark and Competing Airports

When considering which airports should be included as a benchmark or competitor to MSP, airports were reviewed from among those in the Midwest region of the U.S., those with similar profiles as hub airports for a major airline, those with moderate scheduled international service and not a major gateway, and those with similar cargo tonnage levels in total and with comparable FedEx and UPS services. Competing airports were selected due to proximity to MSP and reasonable selection as an alternative to MSP based on distance and alternatives more so than similarities. **Figure 10-1, *CY 2020 Total Passengers & Cargo at Benchmark Airports***, illustrates the range in passenger traffic and cargo tonnage at the benchmark airports selected. Seattle-Tacoma International (SEA), Philadelphia International (PHL), Phoenix International (PHX), Detroit-Wayne International (DTW), Denver International (DEN) and Salt Lake City International (SLC) were considered benchmark airports for MSP in this assessment. The benchmark airports have a range of about 200,000 to 550,000 annual metric tonnes of processed air cargo, and a total passenger range of 12 to 35 million annual passengers in 2020 (down from the 33 to 69 million annual passengers in 2019 before the onset of COVID-19).

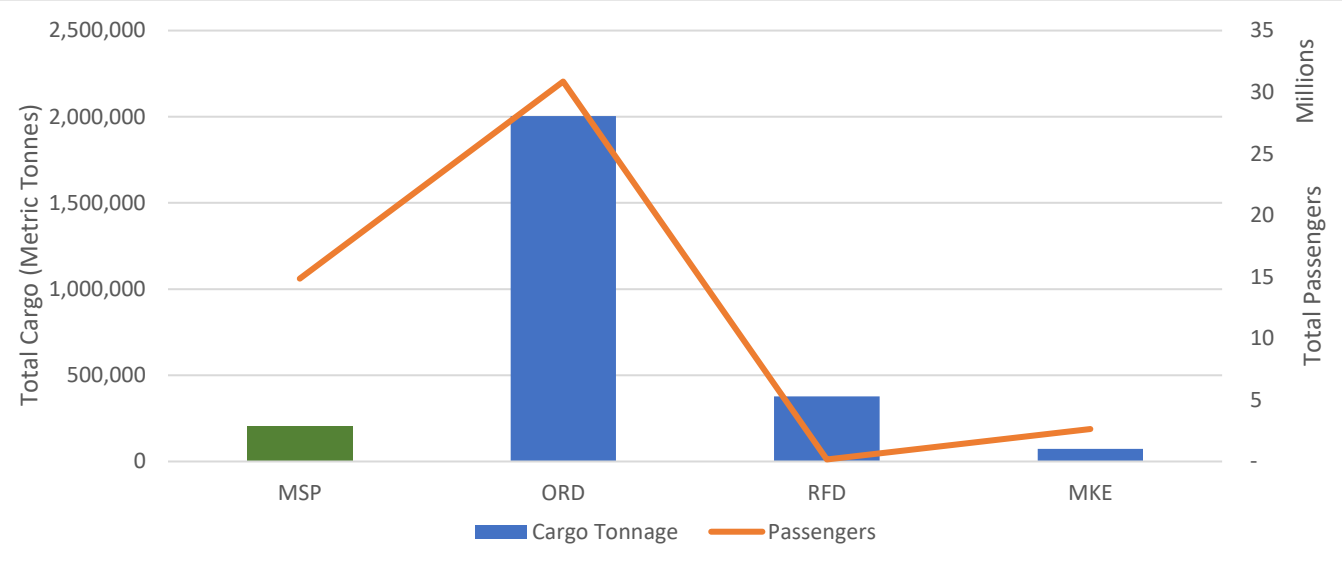
Figure 10-1 CY 2020 Total Passengers & Cargo at Benchmark Airports



Data Source: Airports Council International with Analysis by L&B

Figure 10-2, *CY 2020 Total Passengers & Cargo at Competing Airports* depicts the competing airports in the region chosen to be Chicago-Rockford International (RFD), Milwaukee International (MKE) and Chicago-O'Hare International (ORD) airports.

Figure 10-2 CY 2020 Total Passengers & Cargo at Competing Airports



Data Source: Airports Council International with Analysis by L&B

The competing airports were mainly selected for cargo service offerings and total tonnage levels as true competitors within a reasonable distance (by air and by road) from MSP. ORD is the largest competitor with just over 2.0 million metric tonnes processed in 2020, followed by RFD at 377,745 metric tonnes and MKE with 77,284 metric tonnes.

Table 10-1, *Benchmark Airport Metrics Comparison – Table 1,* displays several statistical categories for the airports determined to be benchmarks. The first comparison is made by the determination of the dominant carrier at the airport and what percent of the passenger traffic they have. Interestingly, the three airports with Delta as the top carrier also garners more than 70% of the traffic. Next is the percent of international passenger traffic. MSP falls in the middle of these seven airports and note that international traffic is somewhat less than typical in 2020 due to the pandemic. MSP falls in the middle of the next category too, percent of traffic being cargo freighters. For the percent share that FedEx and UPS have at each of these airports, MSP is again in the middle of all of them.

Table 10-1 Benchmark Airport Metrics Comparison – Table 1

AIRPORT	DOMINANT AIRLINE	% SHARE OF PAX	% INT PAX	% FREIGHTER	FEDEX % SHARE	UPS % SHARE
DEN	United	41%	3%	82%	31%	34%
DTW	Delta	71%	6%	73%	44%	20%
MSP	**Delta**	**69%**	**6%**	**88%**	**44%**	**35%**
PHL	American	66%	6%	93%	17%	69%
PHX	American	44%	4%	91%	32%	30%
SEA	Alaska	57%	7%	82%	28%	0%
SLC	Delta	72%	3%	90%	45%	40%

Sources: MSP Airport data; U.S. DOT Schedule T-100, 2020 data analysis
Note: * UPS utilizes Boeing Field (BFI) for Seattle volume

Table 10-2, *Benchmark Airport Metrics Comparison – Table 2,* displays additional statistical categories for the airports determined to be benchmarks. As was the case with Table 1, MSP falls in the middle of this group of airports in all categories except UPS Operations. The main reason for this is the extensive small feeder aircraft network operations that UPS utilizes out of DEN.

Table 10-2 Benchmark Airport Metrics Comparison – Table 2

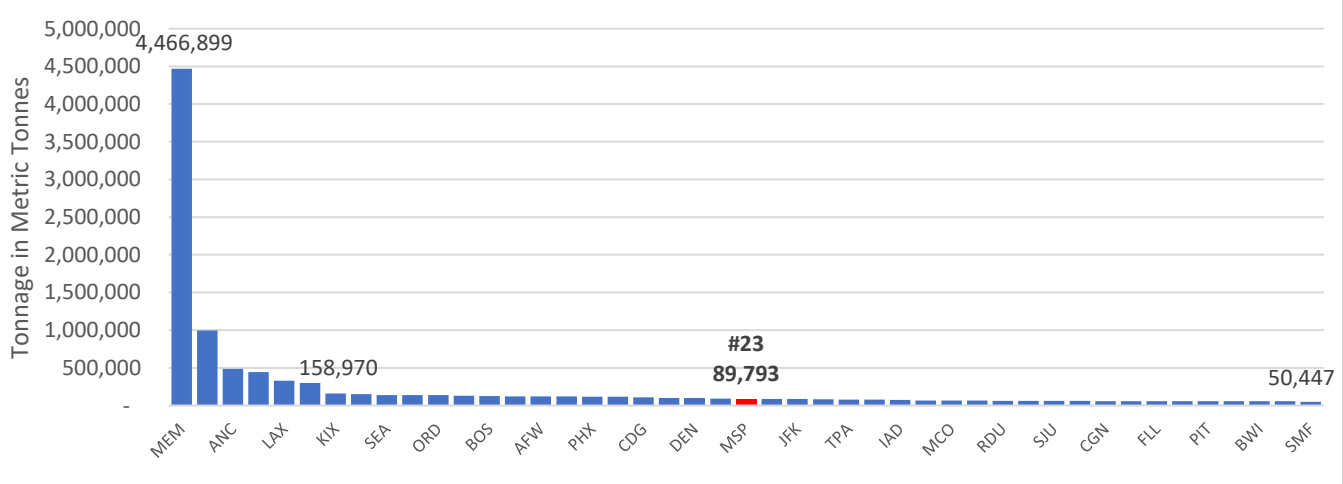
AIRPORT	2020 ACI Passengers	Market Population (Mil)	Economy (GRP Mil USD)	2020 FedEx Operations	2020 UPS Operations
DEN	33,741,129	3.61	249,073	3,408	5,178
DTW	14,103,015	5.35	299,134	2,808	1,519
MSP	**14,851,185**	**4.03**	**270,026**	3,704	3,393
PHL	11,864,151	7.23	472,800	3,326	16,581
PHX	21,932,127	4.98	246,252	4,959	5,354
SEA*	20,061,507	4.90	413,946	5,528	4,038*
SLC	12,559,026	2.64	148,175	6,751	4,053

Sources: U.S. DOT Schedule T-100, 2020 data analysis
Note: * UPS utilizes Boeing Field (BFI) for Seattle volume

10.1 FedEx Airport Comparison

Among the airports where FedEx reports the most tonnage loaded and unloaded each year, MSP ranked 23rd in 2020 with 89,793 metric tonnes according to MSP airport data and U.S. DOT Scheduled T-100 data, see **Figure 10-3, *2020 FedEx Air Cargo by Airport (T-100).*** The benchmark airports specific to FedEx operations were observed from airports in the range of approximately 50,000 to 160,000 metric tonnes.

Figure 10-3 2020 FedEx Air Cargo by Airport (T-100)

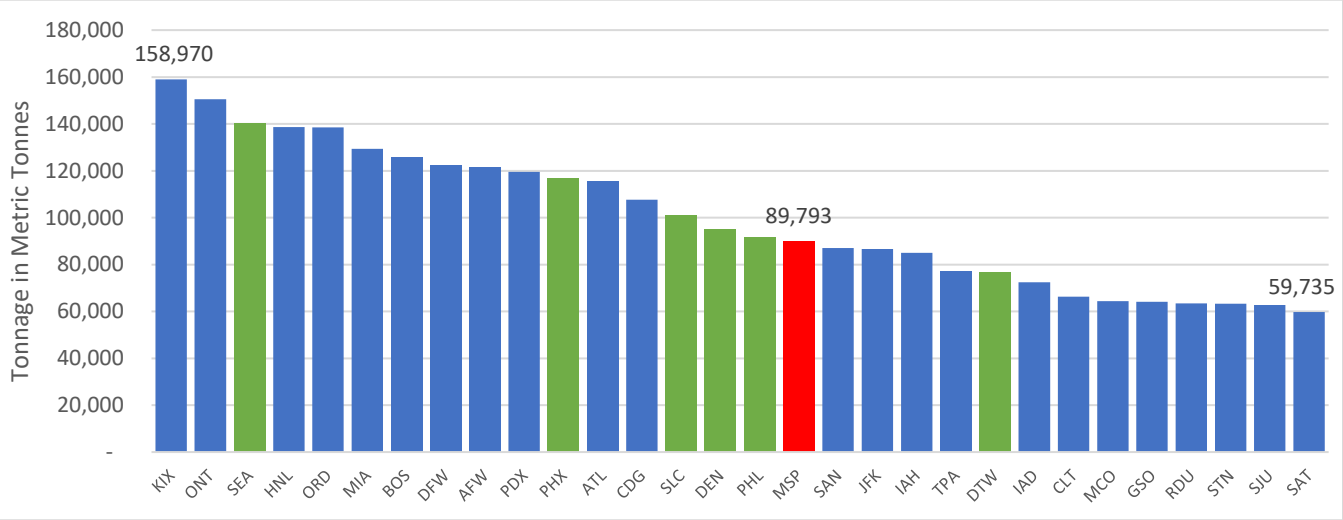


Sources: U.S. DOT Schedule T-100, 2020 data analysis; Landrum & Brown

Of the general benchmark airports previously mentioned, PHX, SLC, DEN and PHL are represented in **Figure 10-**

4, ***2020 FedEx Air Cargo by Benchmark Airport (T-100)*** and were observed as future traffic levels that may be reasonably attainable at MSP within the FedEx network strategy. The 2020 range of traffic from DEN up to SEA is approximately 95,000 to 140,000 metric tonnes annually, which can serve as guidance in the FedEx forecasting scenario.

Figure 10-4 2020 FedEx Air Cargo by Benchmark Airport (T-100)

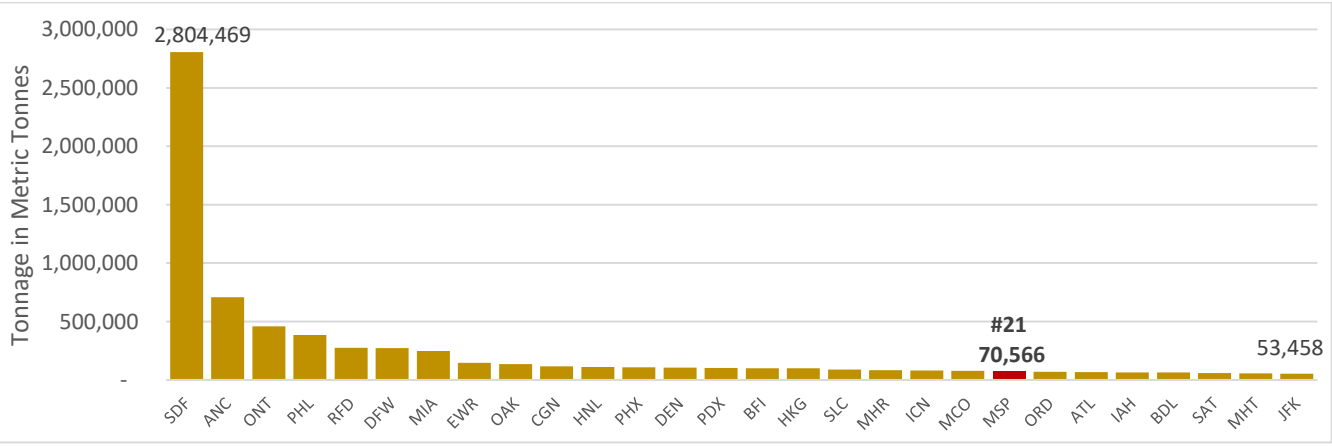


Sources: U.S. DOT Schedule T-100, 2020 data analysis; Landrum & Brown

10.2 UPS Airport Comparison

Among the airports where UPS reports the most tonnage loaded and unloaded each year, MSP also ranked 21st in 2020 with 69,813 metric tonnes according to U.S. DOT Scheduled T-100 data, see **Figure 10-5*, 2020 UPS Air Cargo by Airport (T-100)***. The benchmark airports specific to UPS operations were observed from airports in the same comparable range of approximately 60,000 to 140,000 metric tonnes.

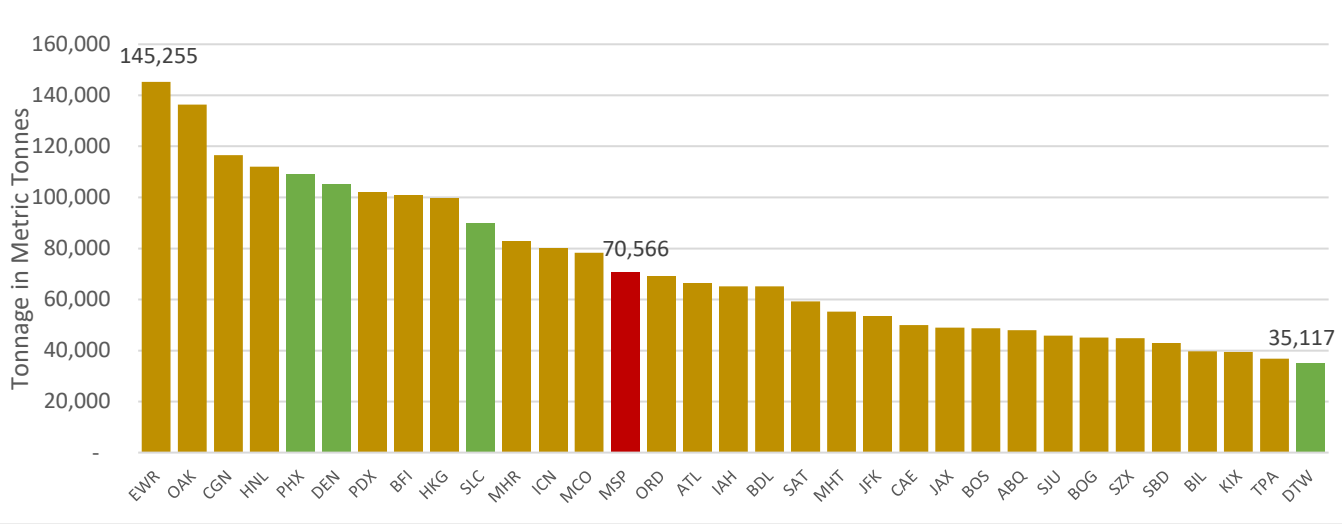
Figure 10-5 2020 UPS Air Cargo by Airport (T-100)



Sources: U.S. DOT Schedule T-100, 2020 data analysis; Landrum & Brown

Of the general benchmark airports previously mentioned, PHX, DEN and SLC are represented in **Figure 10-6, *2020 UPS Air Cargo by Benchmark Airport (T-100)*** and were observed as future traffic levels that may be reasonably attainable at MSP within the UPS network strategy. The 2020 range of traffic from SLC up to PHX is roughly 90,000 to 110,000 metric tonnes annually, which can serve as guidance in the UPS forecasting scenario. DTW UPS cargo was just 35,117 metric tonnes in 2020 representing a smaller market in comparison to MSP and other UPS markets, and not as closely comparable as in the FedEx benchmark.

Figure 10-6 2020 UPS Air Cargo by Benchmark Airport (T-100)

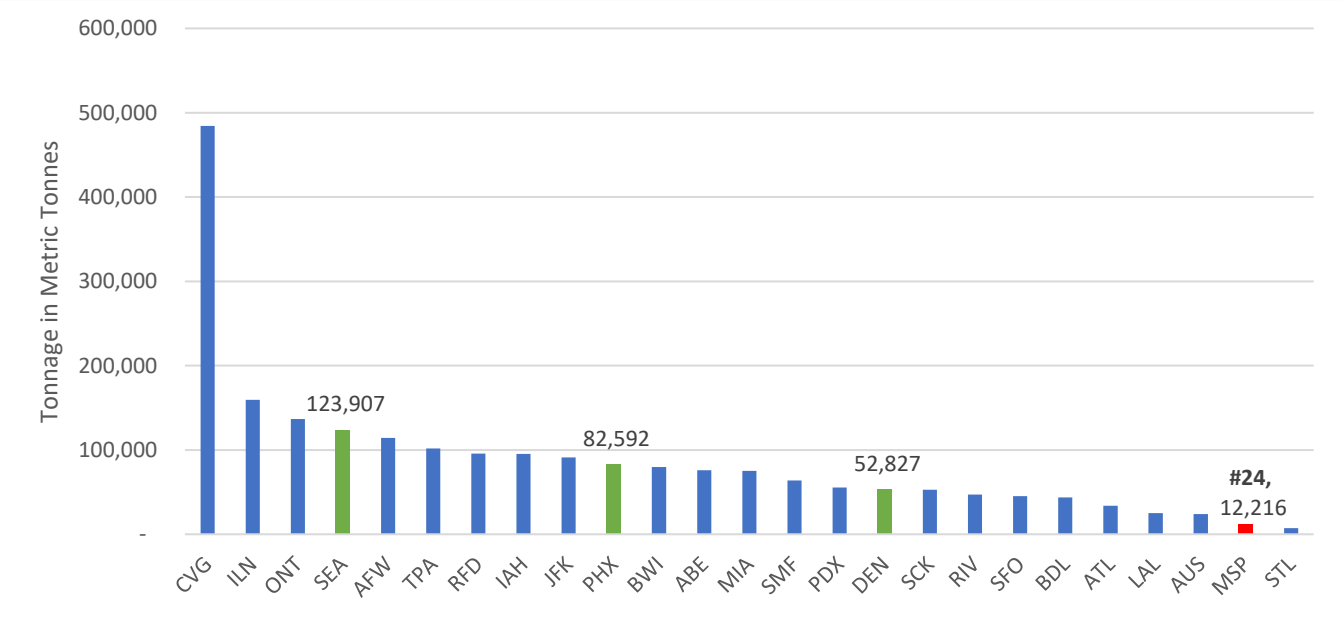


Sources: U.S. DOT Schedule T-100, 2020 data analysis; Landrum & Brown

10.3 Amazon Airport Comparison

The Amazon network system is still taking shape unlike the more established networks of FedEx and UPS. In reviewing the latest data from 2020 of the airports where Amazon air freighters have observed cargo tonnages from the main ACMI carriers contracted to handle Amazon cargo, MSP ranked 24th in 2020 with 12,216 metric tonnes. See **Figure 10-7, *2020 Amazon Air Cargo by Airport (T-100).*** The benchmark airports specific to Amazon operations were observed from airports in a growing range from 10,000 up to 125,000 metric tonnes. Of the general benchmark airports, DEN, PHX and SEA handled between 53,000 and 123,000 metric tonnes for Amazon in 2020. Amazon does not currently operate out of DTW. Future potential growth for MSP as a new gateway for Amazon would suggest MSP could be utilized in the Amazon network system as much or more than DEN and PHX during the forecast period. More details on the growth and network of Amazon air cargo is presented in Section 11.

Figure 10-7 2020 Amazon Air Cargo by Airport (T-100)



Sources: U.S. DOT Schedule T-100, 2020 data analysis; Landrum & Brown

11 Air Cargo Forecast

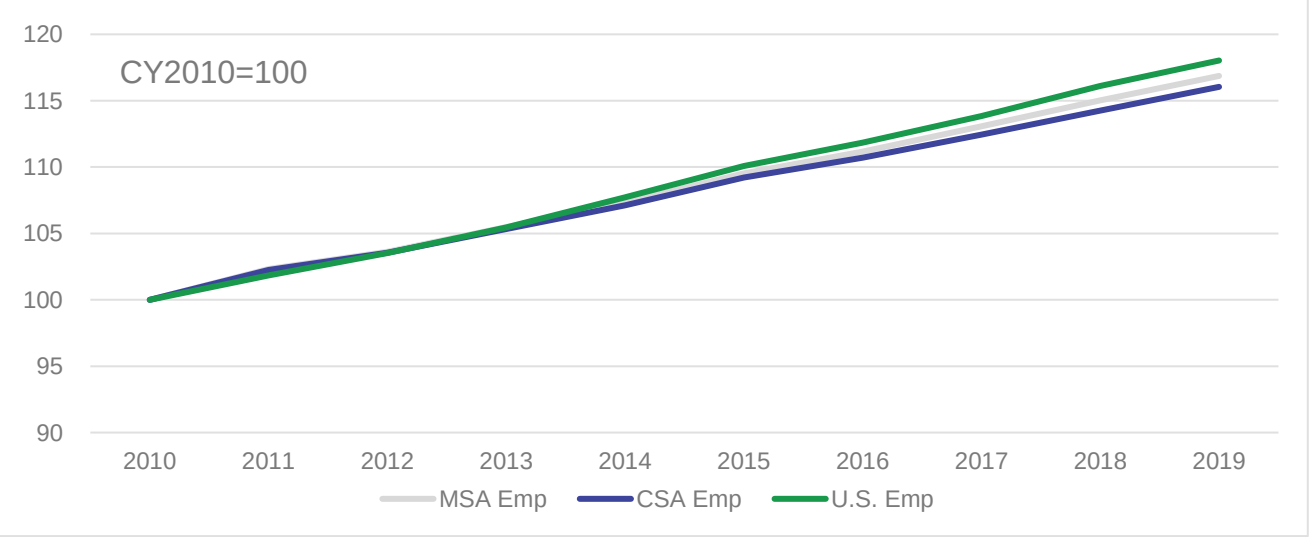
The approach to the development of the air cargo forecast for MSP incorporates the traditional historical traffic assessment and establishment of trends in local and industry cargo segments. Observable trends were used to guide the econometric modeling efforts and essentially the selection of a forecast trend or economic forecast model with a blend of stimulation efforts and potential strategic initiatives from key stakeholders such as FedEx, UPS, Amazon, Delta and business/community development programs. Where possible, a socioeconomic regression analysis correlating the dependent metric (air cargo tonnage) to independent socioeconomic or demographic variables defined as demand drivers is used to predict future growth in air cargo based on expected growth in other related independent variables. Typically, historical relationships are good indicators of future relationships and trends, but they are not exact and forecast predictions should be understood as reasonable and defensible, but not guaranteed. The best data and understanding of current and likely near-term future conditions related to the air cargo industry always contain levels of uncertainty and dependence upon external factors such as strategic decisions by network carriers and regulations that can impact demand and/or capacity.

11.1 Socioeconomic History

A review of key trends in employment levels and economic output levels represented as Gross Domestic Product (GDP) or Gross Regional Product (GRP) for local and national economies illustrated a general consistency or similarity in the growth trends among the Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area (MSA), Minneapolis-St. Paul, MN-WI Compound Statistical Area (CSA) and the whole United States (U.S.) with a slightly slower growth in employment locally, and a slightly higher growth in GRP/GDP near Minneapolis compared to the U.S. These consistent trends are shown in the following index charts.

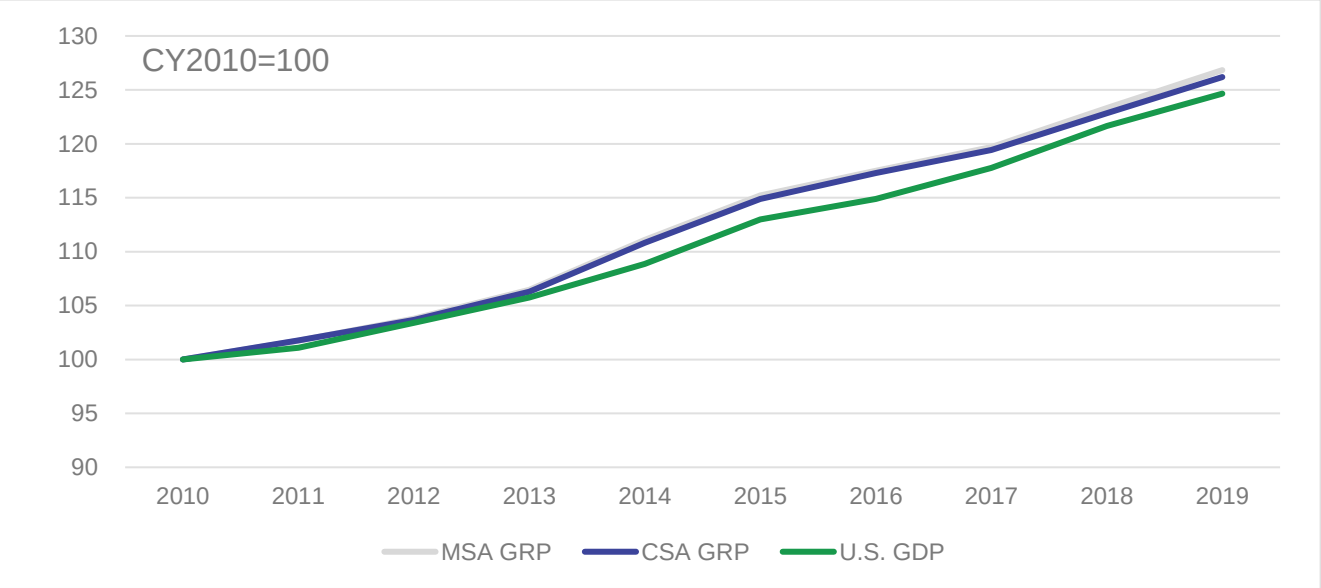
Figure 11-1, *Employment Growth Index Comparison,* and **Figure 11-2, *GRP/GDP Economic Output Growth Index*,** present the historical growth indexes for employment levels and GRP/GDP output levels as indicators of freight demand as both also directly impact personal and household income which are dependent variables.

Figure 11-1 Employment Growth Index Comparison



Sources: Woods and Poole Economics Database 2020; Landrum and Brown analysis

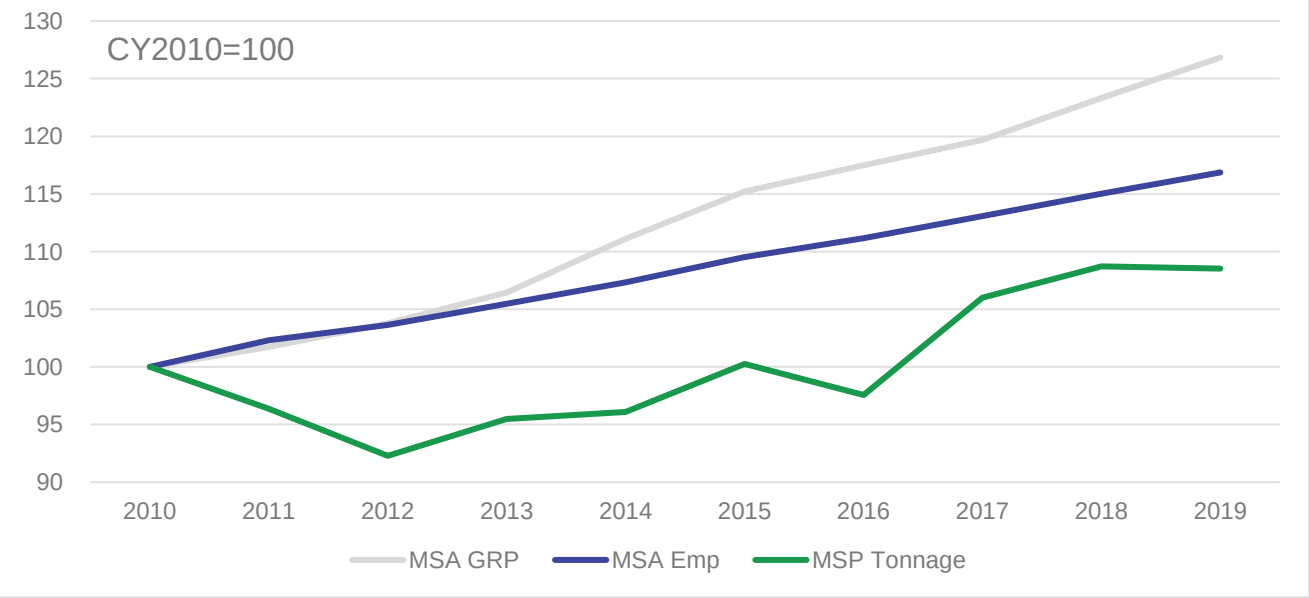
Figure 11-2 GRP/GDP Economic Output Growth Index



Sources: Woods and Poole Economics Database 2020; Landrum and Brown analysis

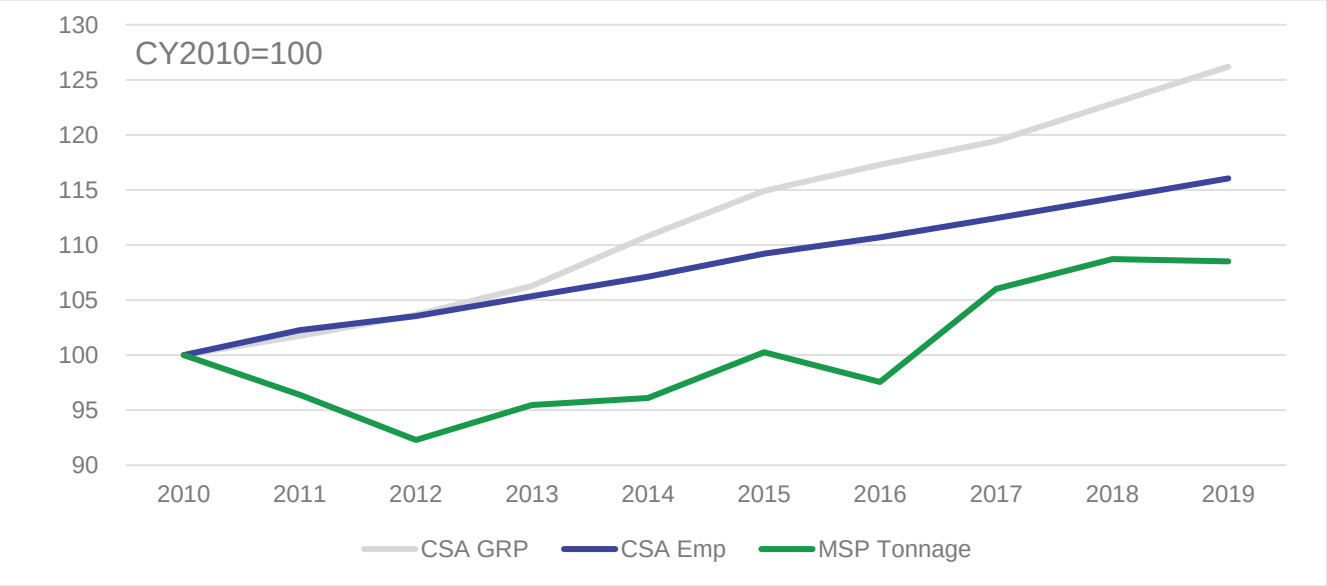
Figure 11-3*, MSA Economic and Traffic Index Comparison,* **Figure 11-4, *CSA Economic and Traffic Index Comparison,*** and **Exhibit 11-5, *U.S. Economic and Traffic Index Comparison*** show the similarities in trends at the MSA, CSA and U.S. levels and further show the disconnect between air cargo growth at MSP and in total for the U.S., following the Great Recession and World Financial Crisis with a return to comparable growth trends in air cargo since 2016.

Figure 11-3 MSA Economic and Traffic Index Comparison



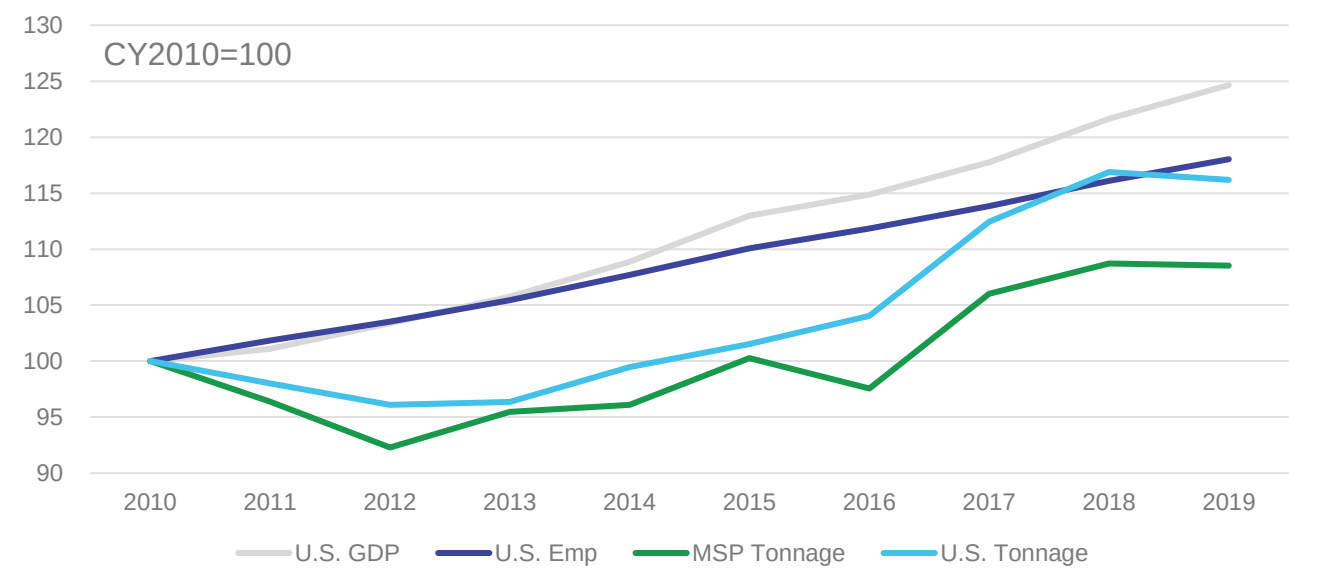
Sources: Woods and Poole Economics Database 2020; MSP airport traffic data; Landrum and Brown analysis

Figure 11-4 CSA Economic and Traffic Index Comparison



Sources: Woods and Poole Economics Database 2020; MSP airport traffic data; Landrum and Brown analysis

Figure 11-5 U.S. Economic and Traffic Index Comparison



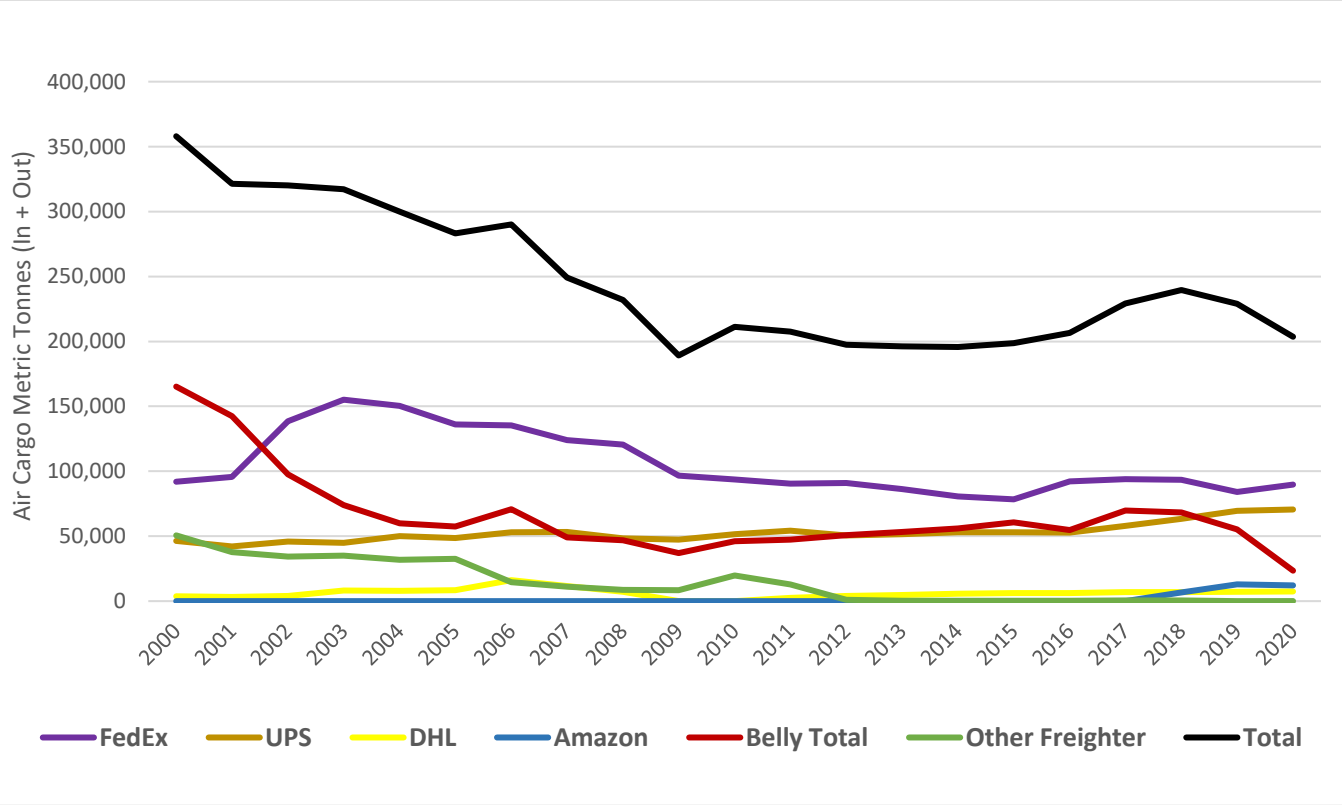
Sources: Woods and Poole Economics Database 2020; MSP airport traffic data; Landrum and Brown analysis

11.2 Air Cargo Tonnage History

Changes in air cargo tonnage by main carrier group and segment from MSP from 2000 to 2020 show the major shifts in the cargo segments and provide some background for the time period of historical traffic segments to use in the forecast and of which segments can be analyzed individually and in combined groups. The review of and analysis of historical socioeconomic variables as demand drivers with historical cargo traffic segments was performed to assess the likely correlations between the dependent (cargo) and independent data variables (socioeconomic drivers).

Figure 11-6, *MSP Air Cargo Segments – Historical Traffic* presents a chart of historical activity of the major all-cargo carriers, belly cargo and other freighter traffic trends at MSP. With total air cargo showing a general historical decline it proves to be a difficult task to project a forecast of growth with only the assistance of historical cargo and economic data to support higher future cargo activity. Overall, the drop in air cargo from 2000 through 2009 came from decreased belly cargo from Northwest Airlines and Delta Air Lines following the 9/11 terrorist attacks, a drop in chartered air freight and then after 2003 a decrease in utilization of MSP by FedEx.

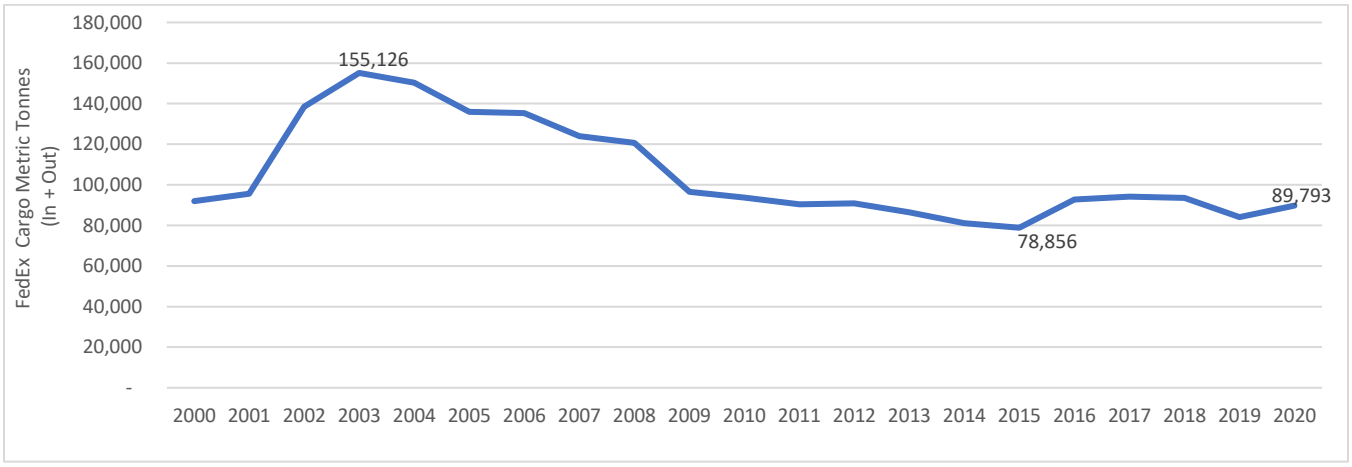
Figure 11-6 MSP Air Cargo Segments – Historical Traffic



Sources: MSP Airport traffic data; Landrum & Brown analysis

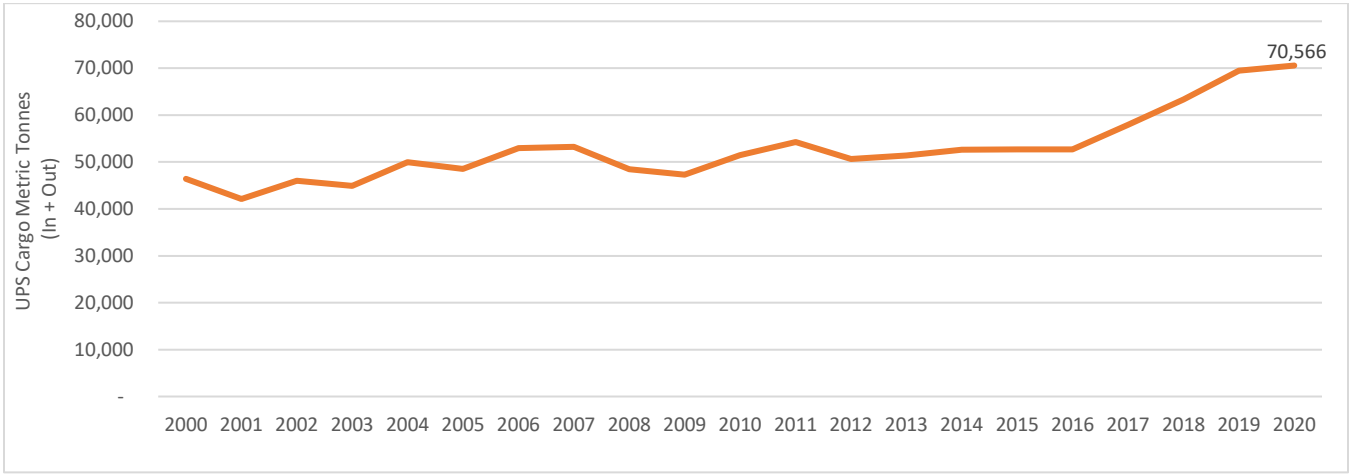
Figures 11-7 through **11-12** present charts of each main cargo segment's historical activity at MSP. FedEx traffic peaked at MSP in 2003 before strategic relocating of flights took nearly half of the FedEx transfer volume away from MSP. Since 2015, the FedEx volume has continued to grow more naturally. UPS has shown a long period of natural growth through 2017 with a recent addition of service to DFW beginning in 2018. DHL has held a small share of cargo at MSP (mainly international) and suffered loss of demand after oil prices began rising in 2004. DHL demand hit a low in 2009 during the Financial Crisis but has shown consistent yet modest growth since. Amazon only began services through MSP in 2018 with service mainly to hubs at CVG, AFW and ONT. Delta belly freight has varied historically, but has mainly been similar at MSP and dependent upon the commercial passenger segment strategy of the hub carrier. The 2020 drop is directly linked to the lack of commercial passenger traffic demand due to the pandemic. Other cargo and mail has decreased significantly over time as Emery and Airborne Express activity decreased and stopped all together at MSP between 2003 and 2013 (Emery was acquired by UPS and Airborne was acquired by DHL and activities were relocated).

Figure 11-7 MSP Air Cargo – FedEx Historical Traffic



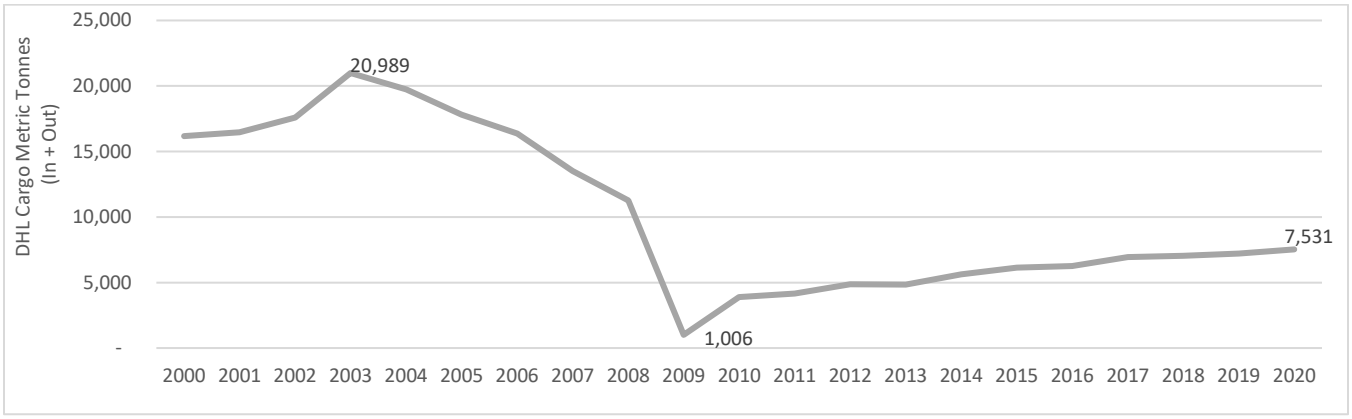
Sources: MSP Airport traffic data; Landrum & Brown analysis

Figure 11-8 MSP Air Cargo – UPS Historical Traffic



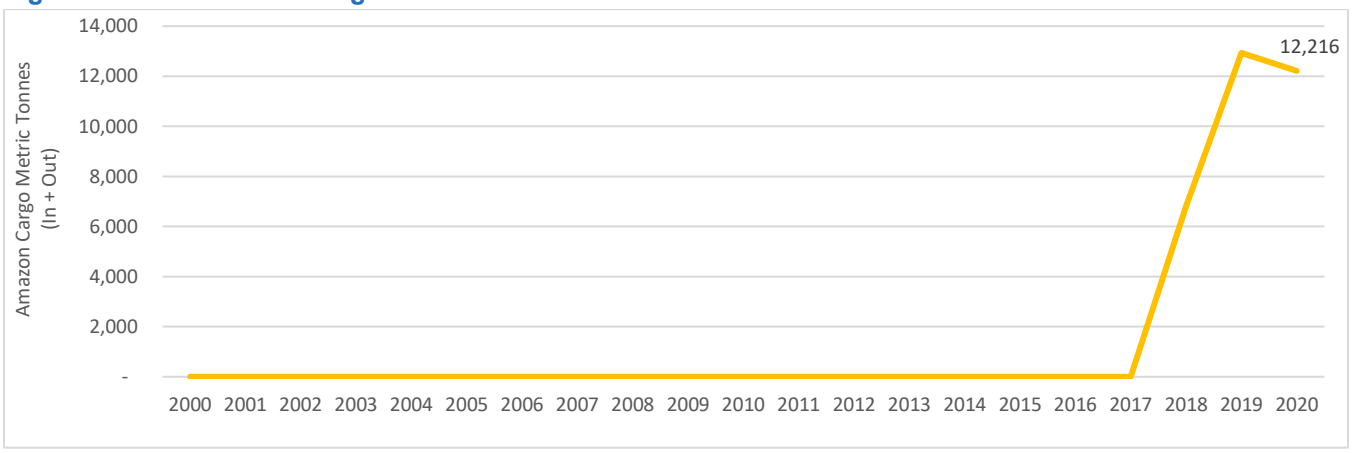
Sources: MSP Airport traffic data; Landrum & Brown analysis

Figure 11-9 MSP Air Cargo – DHL Historical Traffic



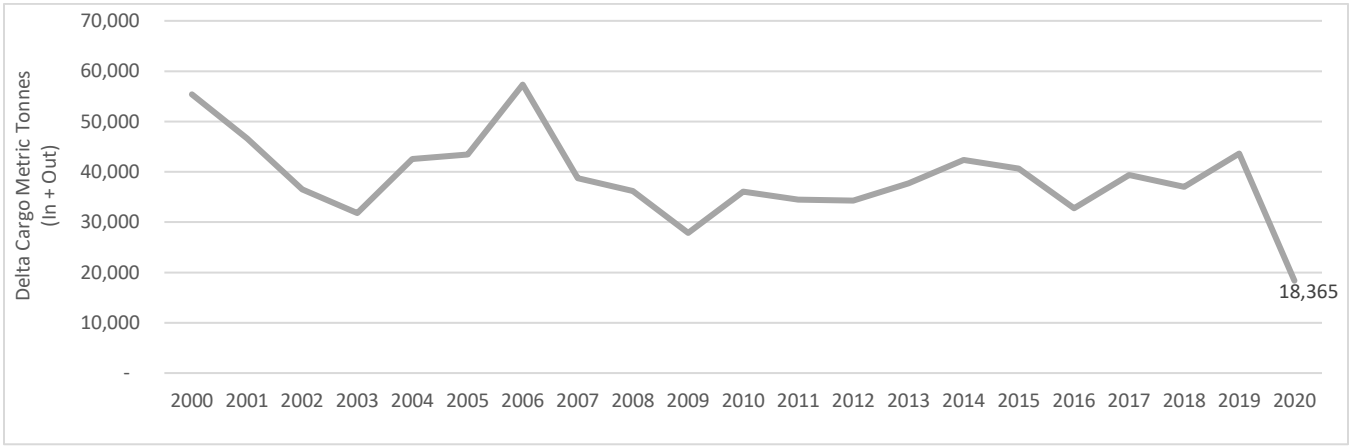
Sources: MSP Airport traffic data; Landrum & Brown analysis

Figure 11-10 MSP Air Cargo – Amazon Historical Traffic



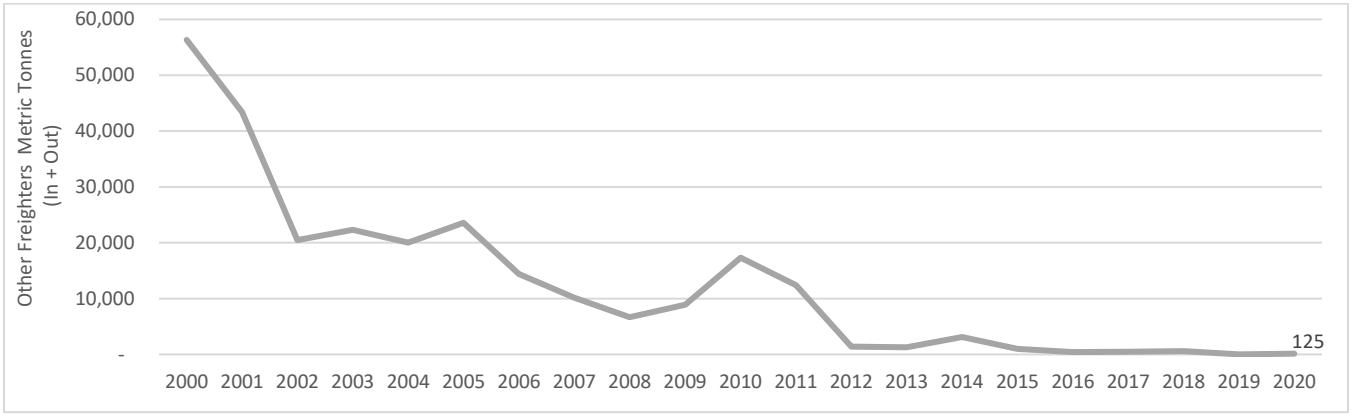
Sources: MSP Airport traffic data; Landrum & Brown analysis

Figure 11-11 MSP Air Cargo – Delta Historical Traffic



Sources: MSP Airport traffic data; Landrum & Brown analysis

Figure 11-12 MSP Air Cargo –Other Freighters Historical Traffic



Sources: MSP Airport traffic data; Landrum & Brown analysis

After the Great Recession, the related impact on air cargo at MSP exhibited a static non-growth period from 2012 through 2016 until two years of increased demand are reported for 2017 and 2018, before another small decline in 2019 and 2020. Key to estimating any future growth at MSP under these less than optimistic historical circumstances is understanding the causes and industry issues with each drop or increase in demand and assessing the underlying demand for the region and any strategic initiatives or opportunities in the industry for additional demand at MSP. The 2019 drop in air cargo was moderately small at about 10,000 metric tonnes or 4.4% compared to the 11.2% drop in 2020. The impact of the COVID-19 pandemic in 2020 is mostly exhibited in the drop in belly cargo due to reduced schedules and capacity in commercial passenger aircraft operations at MSP. Freighter cargo was higher in 2020 by nearly 7,000 metric tonnes offsetting some of the belly cargo loss. Unexpectedly, the reported level of Amazon air cargo was not higher in 2020, contrary to what was expected to occur with increased demand for e-commerce goods across the U.S. and the world. According to Amazon, the Amazon Air segment experienced some growing pains during the second half of 2020 and modified their aircraft network which temporarily reduced activity at MSP. During that time, other air service (i.e. UPS) and more ground movements occurred to bring volume into the area.

Table 11-1*, MSP Total (In + Out) Air Cargo Trends 2016 - 2020 by Carrier (in metric tonnes)* shows the recent changes in cargo tonnage by carrier at MSP and the relative stability in cargo traffic from 2016 to 2020. In 2020, FedEx was still the largest carrier at MSP by tonnage, handling 44.1% of total air cargo. Overall total air cargo has decreased slightly from 2016, with a compound annual growth rate (CAGR) of -0.4%.

Table 11-1 MSP Total (In + Out) Air Cargo Trends 2016 - 2020 by Carrier (in metric tonnes)

Year	FedEx	UPS	Amazon	DHL	Belly	Others	Total
2016	92,761	52,673	0	6,260	54,822	419	206,935
2017	94,177	57,933	0	6,941	69,874	494	229,419
2018	93,524	63,326	6,805	7,037	68,280	571	239,544
2019	84,066	69,502	12,932	7,213	55,298	15	229,026
2020	89,793	70,566	12,216	7,531	23,466	125	203,697
CAGR	**-0.8%**	**7.6%**	**n.c.**	**4.7%**	**-19.1%**	**-26.1%**	**-0.4%**

Sources: MSP Airport traffic data; Landrum & Brown analysis

In addition to the changes occurring in the individual cargo segments, information from stakeholder interviews and questionnaires about opportunities and future strategies in the local community provided some insight into potential new areas of demand for air cargo at MSP. The possible development of a World Health Organization (WHO) headquarters and the growing ‘health corridor’ in the Minneapolis area is considered as a potential stimulation for cargo demand.

The development of a larger Amazon Air presence at MSP was reviewed and considered as a reasonable assumption after multiple interviews. Amazon is looking for a facility on airport to alleviate their eleven-mile drive to their closest existing building. The partnership with Sun Country is also seen as a major benefit and potential driver for a larger operation.

In 2021, Airport data shows a surge for Amazon Air cargo with a strong 59% increase year over year through June 2021. Although not officially identified as a gateway market or future growth market for Amazon, the increased activity in 2021 and the launch of Sun Country at MSP as a new carrier and freighter base with Boeing 737-800F aircraft - the potential for growth and development at MSP is promising.

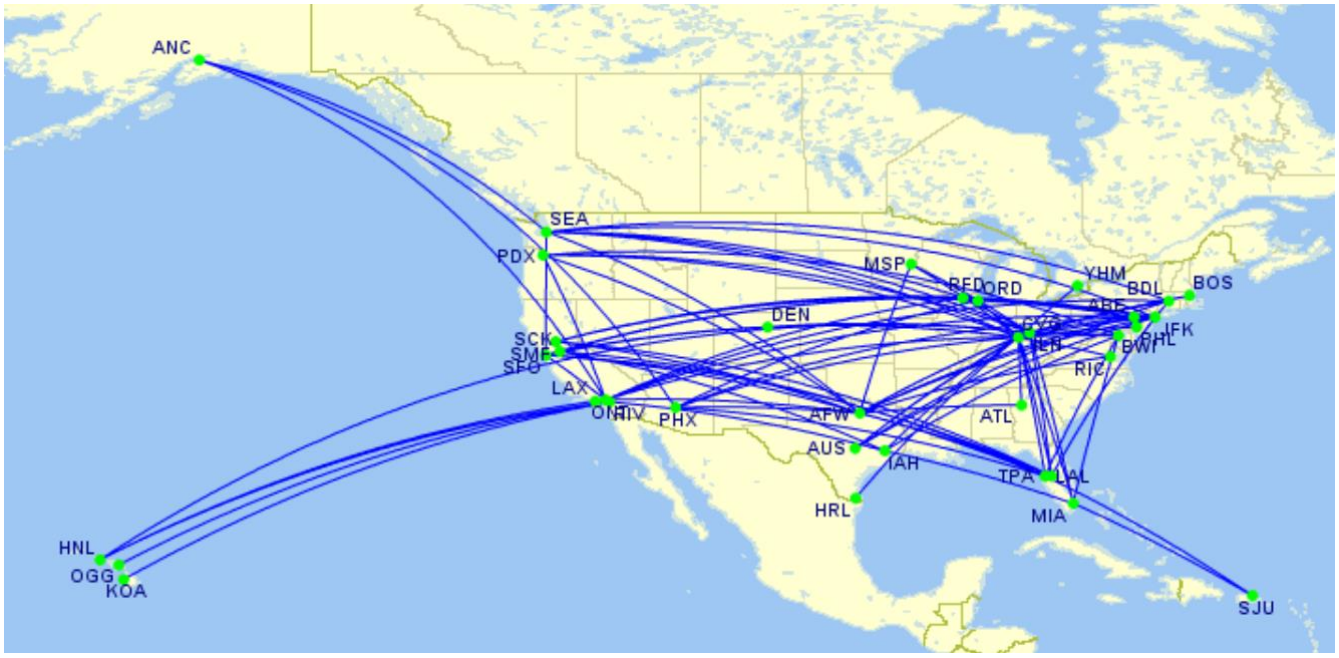
Amazon Gateway Potential

The current Amazon Air fleet was assumed to be 69 aircraft (Boeing 737-800F and B767-300F) in March 2021 with another 11 B767-300F aircraft conversions for Amazon in process. Up to 200 aircraft could make up the Amazon Air fleet by 2028, a summary of the current fleet mix for Amazon is shown below:

Amazon Air Fleet			
Aircraft	**In Service**	**Orders**	**Operator**
Boeing 737-800 F	8		Southern Air
	13		Sun Country Airlines
	2		ASL Airlines Ireland (Europe network)
Boeing 767-300 F	24	11	Air Transport International 11 purchased by Amazon from Delta and
	22		Atlas Air WestJet (to be assigned)
Totals	**69**	**11**	*assumed, as of March 2021*

The fleet of Amazon continues to grow as does its domestic air network and ground distribution network in the United States. In **Figure 11-13, *Amazon Route Network Summary – April 2021 Air Cargo Segments,*** below, the domestic Amazon air cargo network flight activity as of April 2021 is displayed. In total, 38 airports were identified as potential Amazon Air locations. The April data shows that some airports have as few as one daily Amazon aircraft flight while CVG had an average of 40 daily aircraft. Benchmark airports for comparison to MSP potential demand markets like DEN and PHX average five and eight daily aircraft, respectively.

Figure 11-13 Amazon Route Network Summary – April 2021 Air Cargo Segments



Sources: U.S. DOT Schedule T-100 data for April 2021; Landrum and Brown analysis

In 2020, most of the Amazon regional air hubs show significant growth as part of the quickly expanding Amazon fleet and network. MSP ranked 24th among Amazon air markets in 2020 with 12,216 metric tonnes reported to MAC.

Table 11-2, *Amazon Air Growth 2019-2020,* provides a tonnage summary of the 27 largest Amazon markets for 2020 (and the newly announced San Bernardino market) from data analyzed in the benchmarking study.

Table 11-2 Amazon Regional Air Hub Growth 2019-2020

Top Amazon Markets	2019 Metric Tonnes	2020 Metric Tonnes	2020 Growth
NATIONAL HUBS			
CVG - Cincinnati	410,177	398,227	-3%
ILN - Wilmington	32,908	160,691	388%
REGIONAL HUBS			
ONT - Ontario	102,394	148,055	45%
SBD-San Bernardino			**New 2021**
AFW - Dallas/Fort Worth	11,952	124,751	944%
RFD - Rockford-Chicago	70,166	59,248	-16%
LAL - Lakeland	-	28,733	**New 2020**
BWI - Baltimore	73,801	72,838	-1%
GATEWAYS			
SEA - Seattle	75,037	123,907	65%
TPA - Tampa	75,353	89,278	18%
PHX - Phoenix	76,815	76,596	0%
ABE - Allentown	65,228	76,093	17%
IAH- Houston	49,157	75,932	54%
MIA - Miami	46,506	68,354	47%
JFK - New York	-	65,784	**New 2020**
SMF - Sacramento	35,214	63,939	82%
DEN - Denver	23,834	50,256	111%
SCK - Stockton	56,842	49,878	-12%
PDX - Portland	34,006	47,676	40%
RIV - Riverside	44,992	47,133	5%
BDL - Hartford	30,879	46,778	51%
SFO - San Francisco	-	45,258	**New 2020**
ATL - Atlanta	17,586	30,430	73%
AUS - Austin	-	28,409	**New 2020**
MSP - Minneapolis-St. Paul	**12,932**	**12,216**	-5.5%
RIC - Richmond	302	6,707	2121%
STL - St. Louis	1,936	2,662	38%

Sources: MAC data for MSP, U.S. DOT Schedule T-100 data, with international tonnage complete up to Aug 2020; Landrum and Brown analysis

Note: Amazon fleet identified as Atlas and ATI B767F aircraft and Southern Air and Sun Country B737-800F aircraft.

11.3 Cargo Tonnage Forecast Summary

Review and initial analysis of the historical cargo data from the airport and historical socioeconomic data from the 2020 Woods and Poole dataset provided understanding of observed trends and relationships that resulted in a forecast approach that utilized multiple forecasting methodologies for different segments of cargo traffic at MSP.

The following forecast scenario considers a combination of various forecast methods for six primary cargo segments at MSP. Considerations were made for recent trends based on analysis of post Great Recession/World Financial Crisis cargo activity at MSP since 2012, a shift in FedEx/Amazon demand with the end of FedEx's contract with Amazon and reduced belly cargo in 2020 due to the COVID-19 pandemic.

Economic regression models were not statistically reasonable in most segments due to the lack of correlation in the dependent cargo variable with independent socioeconomic variables that continued to exhibit growth during many years of no growth or decline in cargo tonnage. A market share analysis considering MSP contributions to total air cargo demand in the U.S. was also considered but also did not have support with the overall industry trend.

An economic regression analysis forecast for tonnage was prepared for the DHL cargo segment with a reasonable correlation found with Minneapolis-St. Paul, MN-WI CSA (CSA GRP). A summary of the forecast methods applied for each segment is shown below.

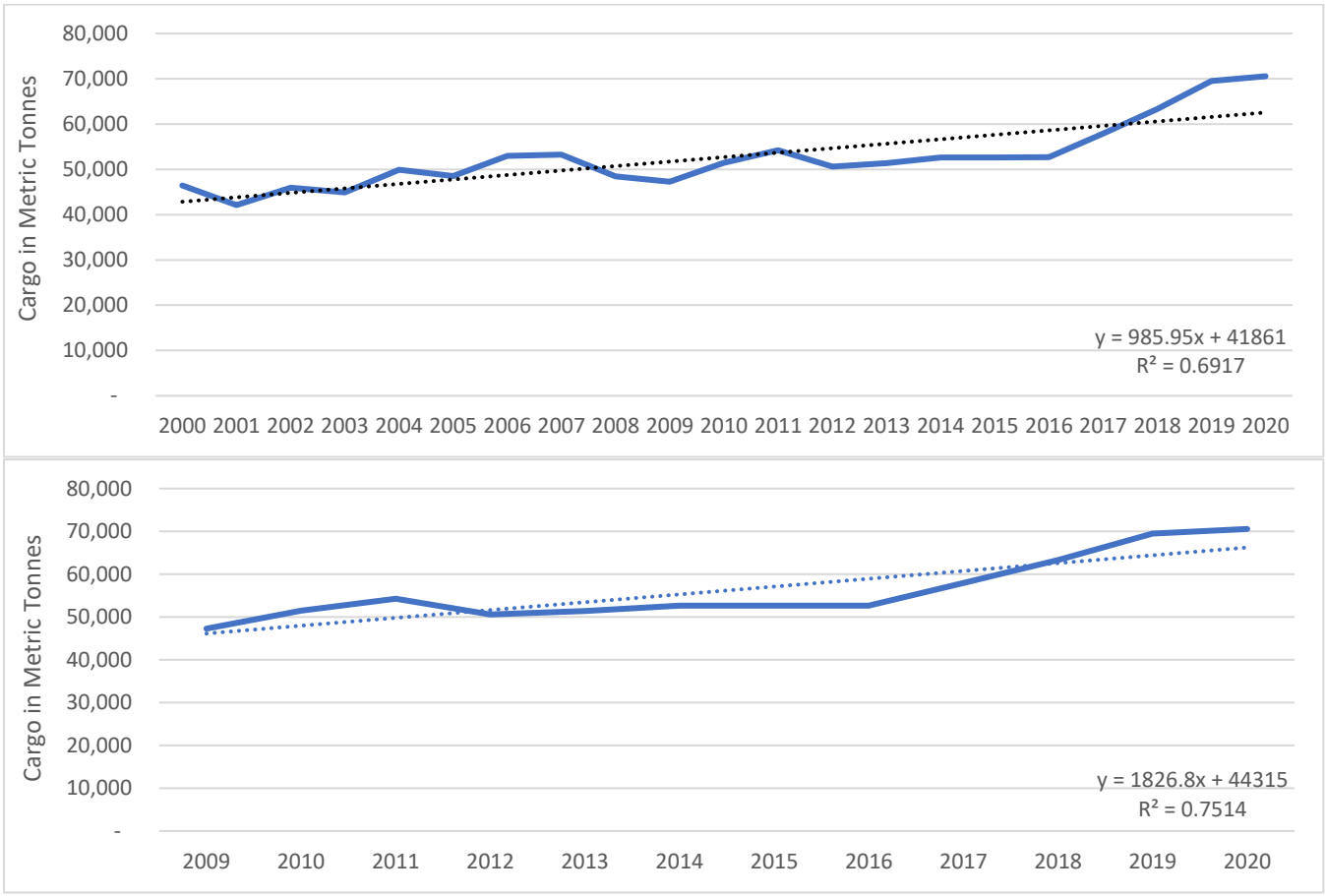
The total air cargo tonnage forecast was developed from the combined forecasts and trends of the six main cargo segments reviewed:

UPS cargo	- Linear Trend Analysis (2009-2020)
FedEx cargo	- Comparative Growth Trend (MSA Employment Forecast)
Amazon cargo	- Regional Air Hub Build Up, long-term average trend
DHL cargo	- Regression analysis (Tonnage & CSA GRP)
Belly cargo	- Comparative Growth Trend (Passenger Forecast)
Other Freighter/Mail cargo	- Average Industry Growth Rate

The **UPS cargo** segment showed no reasonable correlations with individual or combinations of independent variables but maintained a general positive growth trend through 2020, with higher than average growth during the 2016 to 2019 years at MSP. UPS input suggested that the recent growth was unsustainable. A linear trend from 2009 to 2020 was used to more modestly project future growth at MSP with an average CAGR of 2.3%. Average growth from 2000-2016 was just 0.6%, but growth since 2009 has been more in line with expectations based on UPS network growth, so the more recent trend was analyzed. **Figure 11-14, *MSP UPS Regression Model Results Comparison,*** graphically depicts the results of the regression correlation and how well the model predicts the cargo tonnage compared to the actual reported cargo tonnage from MSP.

	Intercept	Coefficient	R^2 Value
UPS Trend	44,315	1826.8	0.7514

Figure 11-14 MSP UPS Linear Trend Model Results Comparison



Sources: MSP Airport; Landrum & Brown

The **FedEx cargo** segment was previously almost double the cargo volume of 2020, back in 2003. Tonnage has fluctuated up and down since the Great Recession (2008/2009) and has shown no true trend which could be used to predict future growth. It was assumed that FedEx was responding to more true Origin and Destination (O&D) demand with somewhat less reliance on the FedEx system demand so it was decided to allow a small recovery and for modest growth going forward based on growth in MSA Employment.

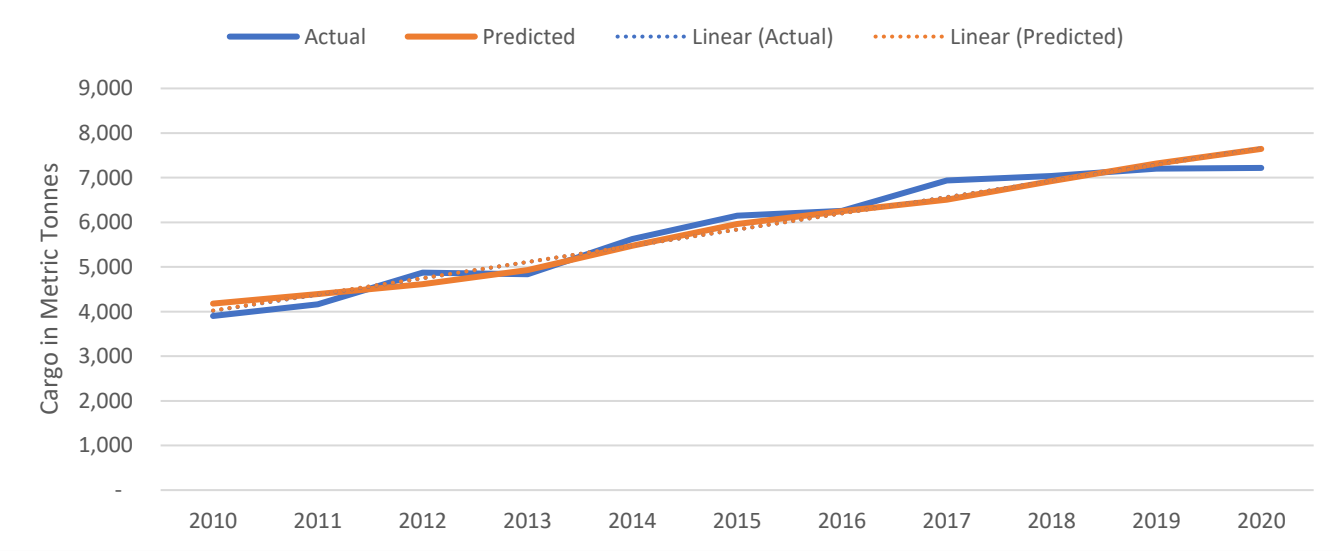
Amazon cargo is expected to increase somewhat dramatically (compared to the current small base demand) as MSP builds up to a regional air hub market comparable to many other current regional air hubs/focus cities in the Amazon network. From the benchmark analysis of the Amazon regional air hub potential discussed earlier, it was assumed that as more emphasis was placed on the MSP market and more daily flights were added to the currently three daily aircraft at MSP that the cargo tonnage level would increase in steps towards a benchmark level of processed cargo.

Year-over-year Amazon growth reported at MSP through July 2021 was nearly 78%. This forecast for Amazon cargo assumes a doubling of cargo tonnage for 2021 and then general stepwise increase to 40,000 metric tonnes in 2022 and 60,000 metric tonnes for 2023. Facilitating additional cargo facilities for Amazon would be necessary to achieve the assumed near-term growth. Thereafter, once established a general long-term growth rate of 3.0% CAGR was assumed and applied to the forecast for years 2024-2040. By 2040, Amazon daily aircraft is assumed to reach 6-8 daily aircraft or 12-16 daily operations (in+out) at MSP on Amazon Air aircraft.

The **DHL cargo** segment was analyzed for correlations to independent variables through socioeconomic regression analyses. It was observed that DHL tonnage from 2010 to 2019 was found to regress well against with the CSA GRP data and yielded statistically significant results. The selected regression scenario yielded the following statistical results. **Figure 11-15, *MSP DHL Regression Model Results Comparison,*** graphically depicts the results of the regression correlation and how well the model predicts the cargo tonnage compared to the actual reported cargo tonnage from MSP.

	Coefficient	t Stat	P-value	Adjusted R^2
Intercept	-7,817.72	-8.08866	2.03E-05	0.952
CSA GRP	0.056063	14.17808	4.17E-05	

Figure 11-15 MSP DHL Regression Model Results Comparison



Sources: MSP Airport; Landrum & Brown

The **Belly cargo** segment experienced a general reduction in demand from 2000 to 2009 and has since recovered partially and has fluctuated with gains and losses through 2020. Most of the commercial passenger service and thus also the majority of belly cargo, has been contributed by Delta. As MSP is a major Delta hub it was decided to assume that applying the growth rate of the FAA Terminal Area Forecast (TAF) of enplaned passengers for MSP to belly cargo tonnage would be a reasonable estimate of future growth. The Delta fleet at MSP will upgauge some with the use of larger aircraft in the future, thus allowing for more belly cargo capacity and the ability to meet greater demand for cargo transport. The average passenger growth from the FAA TAF was applied to the MSP belly cargo segment estimated a CAGR of 1.7% during the forecast through 2040. The overall belly cargo growth from a low base year in 2020 is projected at 6.4% CAGR (incorporating the COVID-19 pandemic and recovery).

The **Other Freighters** cargo segment combined the remaining cargo freighter activities at the Airport. This segment of cargo traffic was very small in 2020 with just 125 metric tonnes reported. Other freighters traffic has also shown a general reduction in demand from 2000 through 2015. Since 2015, demand has shown no growth and has

remained very small . Since this segment of non-primary freight still represents charter opportunities at MSP and has been impacted by the pandemic, it was decided to assume a small recover to pre-pandemic levels and then apply an industry average expected growth for domestic air cargo to this segment. Due to the lack of historical growth, an economic regression analysis was not used. The latest 20-year industry forecasts available for domestic cargo traffic suggest the following:

Boeing North America Domestic Cargo Forecast (2020-2039)[1]	**2.6% CAGR**
FAA Aerospace Forecast Domestic All-Cargo Forecast (2020-2040)[2]	**1.9% CAGR**

A general CAGR of 2.0% was selected as a reasonable long-term average growth rate for Other Freighters cargo tonnage with most of the demand being anticipated by the main integrator carriers and focus on e-commerce transport. The 2.0% CAGR was applied evenly to each year of the 20-year forecast period for this segment.

11.4 Air Cargo Forecast Projections

Cargo tonnage and freighter operations at MSP have not shown any consistent growth in recent years. Average annual tonnage since 2008 has been roughly 211,000 metric tonnes with a high of 239,544 metric tonnes in 2018 and a low of 197,385 metric tonnes in 2013. The 203,697 metric tonnes in 2020 was a decrease of 11.1% from 2019 which can be mostly attributed to the significant loss of belly cargo due to the COVID-19 pandemic. The expected recovery in both passengers and belly cargo with the expected growth in Amazon cargo is shown in the results of the forecast projections for MSP through 2040. The cargo tonnage forecast for MSP as described in Section 11.4 was developed for independent cargo segments and summarized for a total air cargo forecast.

Table 11-3, *MSP Air Cargo Forecast 2020 – 2040 (metric tonnes),* provides the summary forecast projected for MSP through 2040 by general cargo segments. Total air cargo tonnage is projected to increase at 3.6% CAGR during the forecast period to 2040, reaching approximately 415,000 metric tonnes (in + out) based on the available data and assumptions in the forecast methodology. The forecast predicts total tonnage to nearly double during the 20-year period of the forecast and return to levels previously seen back in 2000. This growth is a little higher than what may be anticipated at a typical domestic airport in the United States, but due to the growing demand for e-commerce and the strategic growth anticipated for Amazon Air in the MSP market, the forecast is considered reasonable.

Table 11-3 MSP Air Cargo Forecast 2020 – 2040 (metric tonnes)

Year	Belly	Freighter	Total	Domestic	International	Total
2020	23,466	180,231	203,697	190,994	12,703	203,697
2025	58,400	249,800	308,200	278,200	29,500	308,200
2030	64,500	277,000	341,500	308,900	32,600	341,500
2035	71,500	305,700	377,200	341,200	36,000	377,200
2040	79,200	335,800	415,000	375,200	39,800	415,000
CAGR	**6.3%**	**3.2%**	**3.6%**	**3.4%**	**5.9%**	**3.6%**

Sources: 2020 MSP Airport actual data; 2025-2040 Landrum & Brown

[1] Boeing Cargo
[2] FAA Aerospace Forecast 2020, Table 19

Table 11-4, *MSP Air Cargo Freighter Tonnage per Operation Estimates (metric tonnes),* provides a summary of the projected freighter operations based on freighter tonnage and average throughput growth from 12 up to 15 metric tonnes/operations by 2040, estimating 22,400 freighter operations for 335,800 metric tonnes of total cargo (in + out).

Table 11-4 MSP Air Cargo Freighter Tonnage per Operation Estimates (metric tonnes)

Year	% Freighter Tonnage	Metric Tonnes/Op	Freighter Operations
2020	88.5%	12.0	15,022
2025	81.1%	14.0	17,800
2030	81.1%	14.25	19,400
2035	81.0%	14.5	21,100
2040	80.9%	15.0	22,400
CAGR		**1.1%**	**2.3%**

Sources: 2020 MSP Airport actual data; U.S. DOT Schedule T-100 operations data

UPS has been operating mainly three aircraft types at MSP: Airbus 300-600 Freighter, Boeing 757-200 Freighter and the McDonald Douglas MD-11 Freighter with tonnage capacities of an estimated 55, 35 and 90 metric tonnes respectively. UPS also periodically uses their largest freighter at MSP, the Boeing 747-8F with a maximum tonnage capacity of roughly 132 metric tonnes. UPS flights through MSP are mainly used to connect MSP to Worldport in SDF or other UPS regional hubs such as RFD. They can also be part of multi-stop routes between other gateway airports where average loads onto and off the aircraft are generally only a portion of the actual capacity. Future aircraft operations at MSP during the 20-year forecast are expected to remain focused on the medium sized mainline freighters such as the A300 and B757 freighters currently used, with potential to up gauge to the B767 freighter as needed. UPS also uses feeder carriers such as Bemidji to ship some cargo through MSP by way of smaller aircraft with tonnage capacities of roughly 1.5 to 2.0 metric tonnes each.

FedEx has been operating Boeing 767-300 Freighter and Boeing 757-200 Freighter aircraft at MSP with tonnage capacity estimates of 55 and 35 metric tonnes respectively. FedEx could use their Airbus A300-600 Freighters as alternatives or add the Boeing 777-300 Freighters as needed for larger capacity, but the B777 is mainly an international freighter choice for FedEx where MSP is mainly part of a domestic market segment. A continuing mix of the B767 and B757 are expected to be the primary aircraft throughout the forecast period. FedEx also uses feeder carriers in Mountain Air Cargo and IFL to ship some cargo through MSP by way of smaller aircraft with tonnage capacities of roughly 1.5 to 2.0 metric tonnes each.

DHL contracts ATI, Atlas, Kalitta, Swift and others to infrequently ship larger volumes of freight on freighters such as the Boeing 757-200 and Boeing 767-300 freighter aircraft. DHL uses a feeder carrier in and Encore Air Cargo twice daily five days a week to ship most of its cargo to MSP by way of a small turbo prop Fairchild Swearingen SW4 aircraft with a payload capacity of nearly two metric tonnes.

Amazon just began operations at MSP in 2018 and is now operating two aircraft types; Boeing 767-300 freighters operated by Atlas or GTI, and Boeing 737-800 freighters operated by Sun Country Airlines, both as ACMI leases.

UPS/FedEx/DHL Feeder aircraft for small charter and contract carriers (Bemidji, Encore, Mountain Air Cargo, IFL, CSA etc.) have been and are expected to continue to operate small piston and turboprop aircraft such as the Fairchild Swearingen SW4, Cessna 208 Grand Caravan, ATR-43, Dornier J328 and converted small regional jet aircraft like the CRJ200 Freighter.

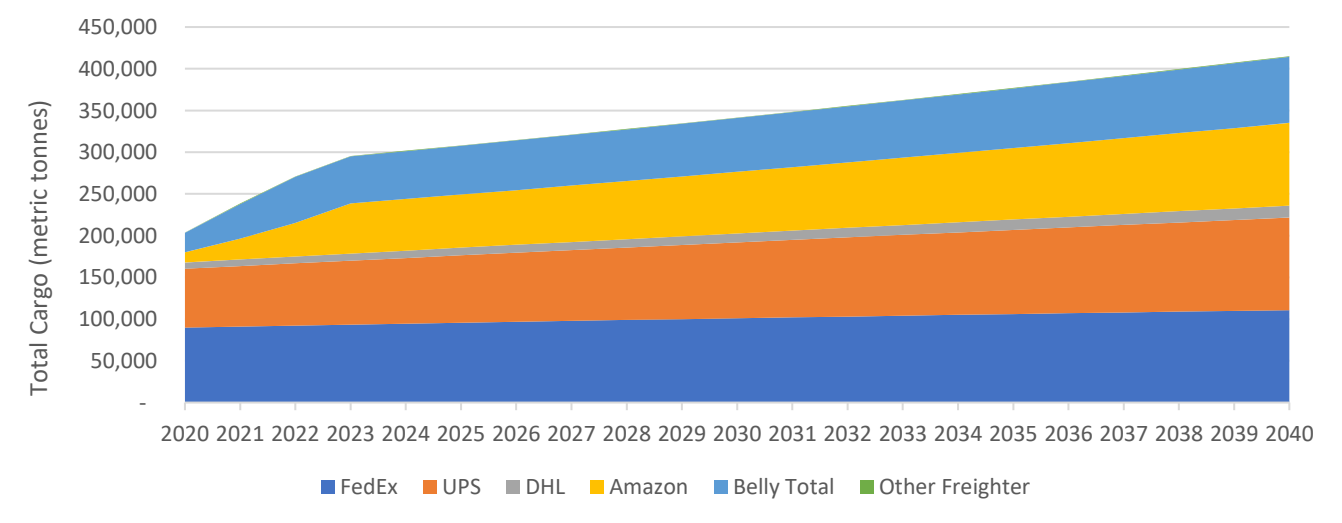
Table 11-5, *MSP Air Cargo Forecast Table by Carrier 2020 – 2040 (metric tonnes),* provides a summary of the total cargo tonnage forecast at MSP with a graphical depiction provided in **Figure 11-16, *MSP Air Cargo Forecast Chart by Carrier 2020 – 2040 (metric tonnes)***. The MSP air cargo tonnage forecast by carrier shows the four major cargo segments are expected to be more comparable with FedEx by 2040. FedEx and UPS are forecast to remain the largest carriers with shares at nearly 27%, followed by Amazon at 23.9% and belly cargo at 19.1%. The two smallest segments in 2020 are projected to remain the smallest in 2040 with DHL at 3.4% and the Other freighters segment at 0.2%. Amazon is positioned to have the largest potential for growth but just as with the integrator carriers, corporate strategies to a large degree determine how much or how little growth there may truly be in transfer cargo (not origin and destination or base demand for a market) at an airport market that is part of a larger systemwide network strategy.

Table 11-5 MSP Air Cargo Forecast Table by Carrier 2020 – 2040 (metric tonnes)

Year	FedEx	UPS	Amazon	DHL	Belly	Others	Total
2020	89,793	70,566	12,216	7,531	23,466	125	203,697
2025	95,700	80,700	9,200	63,700	58,400	500	308,200
2030	101,000	90,800	10,800	73,800	64,500	600	341,500
2035	106,000	100,900	12,500	85,500	71,500	700	377,200
2040	110,700	111,000	14,200	99,200	79,200	700	415,000
CAGR	**1.1%**	**2.3%**	**11.0%**	**3.2%**	**6.3%**	**9.0%**	**3.6%**

Sources: 2020 MSP Airport actual data; 2025-2040 Landrum & Brown analysis

Figure 11-16 MSP Air Cargo Forecast Chart by Carrier 2020 – 2040 (metric tonnes)



Sources: 2020 MSP Airport actual data; 2021-2040 Landrum & Brown analysis

12 Facilities and Infrastructure

12.1 Cargo Facilities Planning Background

Key elements in this analysis include:

- Compatibility of the Airport's physical resources with the cargo industry's evolving needs;
- Modifications required to meet the business goals of airport management; and
- Capacity of the existing facilities and infrastructure to accommodate long-term requirements suggested by the air cargo forecast.

For airports (like MSP) with multiple facilities, as well as a diverse tenant and user base, one must examine the facilities individually and the cargo complex holistically. This section utilizes input received from property inventories, input from airport staff and feedback received directly from cargo tenants. Then, that information is reconciled with the preceding cargo forecasts to develop a demand and capacity analysis. A wide variety of constraints – financial, geographic and competitive - can impose limitations upon physical planning without invalidating industry planning guidelines.

New cargo facilities must be designed to respond to increased demand for freighter aircraft parking on the airside, as well as expanded trucking on the landside and roadways. Accordingly, at least three aspects of an air cargo leasehold are relevant:

- The airside, including taxiways and ramps, as well as setbacks;
- The building, as pertains to the dimensions, configuration, and operating characteristics of the internal space allocated to warehouse, office and other related purposes, as well as the concentration of truck and airside doors;
- The landside, including building frontage, setbacks, truck queuing capacity, parking for customers and employees, as well as roadway access.

Aeronautical Component. The aeronautical operating area (AOA) includes aircraft parking apron and/or ground service equipment (GSE) operating space, as well as the taxiways and taxi lanes that provide access, in addition to any restricted service roads (RSR) or non-licensed vehicle roads (NLVR) that enable cargo tugs to move on non-public roads to and from the passenger terminals. Contiguous aircraft parking apron is not necessary for every cargo tenant, as pure belly carriers and handling companies exclusively handling belly cargo only need access to the AOA via a restricted service road. However, most carriers flying freighters, or handling companies serving freighters strongly prefer ramp directly adjacent to their cargo building.

Building Component. The dimensions of a building directly impact the number of access points on both the airside and landside, and the resultant complexity of access control. Buildings must be designed with throughput, operating efficiencies, and leasing costs in mind. In leasing cargo facilities, rental rates are based on the leasehold square footage and the footprint of the building. Operating efficiencies may be substantially affected by facility height. The design and installation of security systems may also impact throughput and costs.

Other critical elements in building design are the number, dimensions, and spacing of cargo doors on the aeronautical and landsides, the use of floor versus mezzanine for office, and storage for equipment. Requirements for screening can require significant space to allow cargo to be off loaded from a truck, broken down for screening,

screened, and then rebuilt in shipping containers or pallets. Particularly for smaller operations with limited space, this can impose financial and operational costs.

Landside Component. The landside element of an air cargo facility must have sufficient space for truck turning and queuing, acceptable proximate roadway geometry, and acceptable overall access to the leasehold. In many airports, older cargo facilities were not designed to accommodate the larger trucks (70-foot tractor-trailer combinations) typically used for contemporary long-haul trucking. This is true of areas surrounding the cargo buildings, as well as access roads to the cargo areas. Ensuing problems usually result in diminished traffic flows, random off-site truck parking, and a negative impact on air quality.

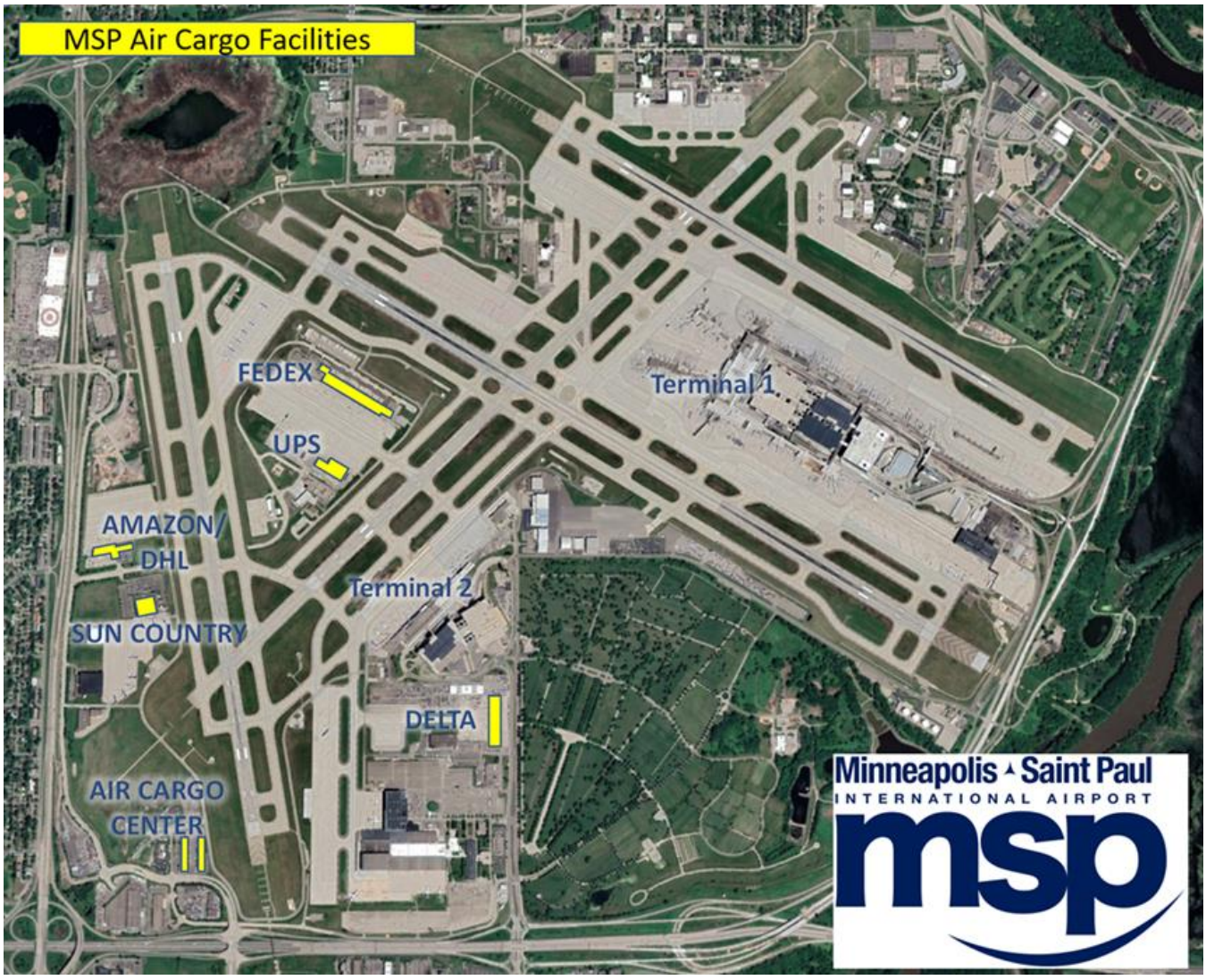
Another critical element of landside planning is automobile parking. Typically, a freight operation does not require extensive parking but on an airport, the need varies. An ideal cargo facility layout segregates automobiles and trucks in access and egress to the complex, as well as in parking. The separation should be physical with employee and visitor lots positioned away from the building and secured with a manned pedestrian access gate. Employee vehicle parking should be separated from the building. Parking for key management staff or for persons with disabilities should be provided as needed but located away from cargo bay doors. Where automobile parking is limited, employee parking may be shifted to a remote area and shuttles established, recognizing that operating costs may increase.

In an ideal environment, cargo trucking activity should be separated from passenger traffic at entry onto the airport grounds. A system of readers and transponders in a large cargo complex will allow a central control to track the vehicle from the airport entry as it moves to a central screening area, and eventually, to the cargo facility. Roadways should be wide enough and have geometry appropriate to allow unrestricted movement and avoid blockage.

13 Inventory of Facilities

Air cargo facilities at MSP are located on the west and south sides of the Airport with on-airport cargo handling and processing generally occurring in four primary locations: 1) FedEx and UPS facilities, 2) the DHL facility (Amazon/DHL) and Sun Country facility, 3) Air Cargo Center, and 4) Main Delta Cargo facility. **Figure 13-1, *MSP Air Cargo Facilities Map*** shows a map of the Airport and location of the cargo facilities.

Figure 13-1 MSP Air Cargo Facilities Map



Sources: Google Earth aerial image; Landrum and Brown

The existing cargo facilities at MSP shown in **Table 13-1, *Existing Air Cargo Facilities at MSP,*** represent nearly 522,678 square feet (SF) of total cargo building area designated for air cargo activities. All the space leased to FedEx and UPS is dedicated to air cargo whereas Delta facilities, the DHL facility housing Amazon and DHL, and

the Air Cargo Center also have other aeronautical or non-cargo related activities which are not accounted for in the summary table below. Freighter cargo (primarily FedEx and UPS) represented about 88% of total air cargo in 2020 but has historically only represented about 74% of total air cargo, the remainder being transported in the belly hold of commercial passenger aircraft. The recent shifts in air cargo segments is mainly due to the impact of the COVID-19 pandemic and the reduction in scheduled passenger services at MSP.

Table 13-1 Existing Air Cargo Facilities at MSP

Building	CARRIER	Building SF	Apron SF	Landside/Other SF	2020 Metric Tonnes
FedEx	FedEx	203,000	341,000	522,540	89,793
UPS	UPS	67,000	406,128	558,374	70,566
Delta	Main Delta Cargo	104,036	0	585,698	18,365
	Delta Dash	2,064	0	33,000	
DHL	Amazon (Atlas/Sun Country)	3,009	240,000	54,828	12,216
	DHL	33,284			7,531
	WFS	10,134			Handler only
Sun Country HQ	Sun Country (Belly/Amazon)	6,165		Shared	1,837
Air Cargo Center	Other/WFS	23,953	0	Shared	3,389
	Southwest	7,458	0	Shared	
	Air General	7,575	0	Shared	
	Vacant (old DHL)	55,000	0	Shared	0
	Total Estimate	**522,678**	**987,128**		**203,697**

Source: Cargo Facts, April 2019 from data provided by carriers

Due to the pandemic, the Delta Dash facility has been closed. All volume is being processed through their main cargo facility. As passenger flights return and more belly space becomes available, the Dash facility will reopen.

13.1.1 Gap Analysis

The consultants interviewed representatives of the all-cargo and belly cargo carriers and principal cargo handlers. The consultants also interviewed regional and state transportation planners. Communications were also exchanged with local and national representatives of freight forwarders serving MSP. All of these interviews had the purpose of leveraging primary sources for anecdotal and technical feedback to complement the more algorithmic analysis used in conventional capacity planning.

The primary questions were: 1) have MSP cargo facilities limited the airport's cargo development to date; and 2) have access to cargo services and equipment limited the airport's cargo development to date. While types of opportunities and challenges can be stratified, the basic gap analysis revolves around whether deficiencies have artificially constricted growth (is there a surplus of demand over capacity) either historically or in the present. The forecasts can project when additional capacity will be required.

13.1.1.1 Overview: Adequacy of Facilities

The major cargo facilities at MSP can generally be segmented into four major components: 1) belly cargo which is predominantly Delta Air Lines, 2) Integrated air cargo from FedEx, UPS and DHL, 3) emerging e-commerce from Amazon and 4) other all-cargo. The facilities assessment and the details of the preceding sections will illustrate that the separate operations at MSP operate independently of each other in separate facilities and mostly separate areas at the Airport. Other than the most recent expansion of the facilities at the DHL cargo building in the west campus in 2018, the other major facilities at MSP have remained very similar and unchanged since the FedEx and UPS facilities were constructed in 2004. Overall, the adequacy of the cargo facilities at MSP is observed to show excess capacity for the existing buildings and carriers other than for growth in e-commerce and Amazon air cargo. Actual utilization of existing facilities may not be as suitable as desired for existing carriers based on changes in operations and types of cargo demand, but the size of the main buildings appears to be more than adequate for existing demand. Future renovations and subsequent developments can better make use of the available space in terms of future needs and changes in operations or utilization requirements. At many airports, certain buildings previously used for air cargo are no longer suitable for modern air cargo tenants – and have been repurposed for other uses. At MSP, the cargo buildings under review are mostly viewed as reasonable for use as cargo facilities with some likely tenant desired upgrades and improvements for future demands.

Most of the cargo activities at MSP are located on the west half of the Airport. The main integrator cargo carriers of FedEx and UPS each have independently operated stand-alone cargo warehouse facilities on the north end of the west side of the Airport between the intersections of three runways. These facilities do share a large apron area with designated and leased ramp for parking their own freighters adjacent to each site.

Belly cargo activities are mainly handled in the Delta Air Lines cargo facility located south of Terminal 1 and at the Air Cargo Center located in the southwest corner of the Airport. Some belly cargo processing occurs at the terminals and on the apron with tail-to-tail transfer cargo, but the Delta Dash cargo services have been suspended due to the impact of COVID-19 (but are expected to resume as overall activity recovers).

The major concern at MSP appears to be addressing the potential future needs of Amazon. The current level of cargo demand is expected to increase very quickly and resemble the demand being observed at other Amazon markets that are being noted as regional hubs. This will undoubtedly require a new facility at MSP large enough to handle a significantly larger demand than what is currently being met in sharing the DHL cargo building. FedEx and UPS facilities appear to have excess capacity at this time and have handled greater demand levels in the past, which has been verified through discussion with both carriers about adequacy of building capacity. The Delta belly cargo facility is not truly a major concern in terms of raw capacity to handle the current demand, yet Delta may prefer to have greater flexibility in space utilization or a more desirable location closer to Terminal 1 for future growth in passenger operations.

13.1.1.2 Overview: Adequacy of Cargo Services & Equipment

One of the principal drivers of gains in air cargo operating efficiencies has been the advent of third-party handling, which has often resulted in higher utilization rates for space, labor and equipment. At MSP, these services are most obviously provided by Air General (cargo handling for American, Alaska, United, Condor (seasonal), and Icelandair, WFS for DHL/FedEx, and Delta Ground Services (DGS) for Delta.

While MSP's cargo facilities seem not to have limited growth by the Airport's major cargo carriers, handlers suggested capacity constraints had inhibited their own growth. Such limitations may have stunted cargo growth, to some extent. Both Air General and Delta have stated that the lack of cooler space has been a major drawback. Both companies are at capacity in their limited facilities and would both desire larger capacity. Delta believes that an increase from 700 sf to 2,000 sf is ideal. Perhaps more demonstrable, the lack of flexible warehouse capacity

for the handling of wide body charters may have caused MSP to lose unscheduled operations to other airports. Especially for handlers lacking warehouse capacity such additional capacity could have been beneficial.

13.1.2 Demand and Capacity

Two primary elements are explored in this section related to accessing adequate capacity for future demand. First is a critical consideration of the long-term ability of the Airport to accommodate forecast growth in its air cargo facilities. While the overall sizes of the facilities are important, how efficiently they are utilized is a primary consideration. This is measured in throughput – the number of tonnes that can be processed in a facility over the course of a year. The overall efficiency of the cargo operation must also consider landside and airside infrastructure to include configuration and size.

13.1.2.1 Space Utilization

Historically, industry planning axioms indicated a norm of processing one ton of cargo per square foot of warehouse per year. This generic guideline for physical planning was eventually modified to reflect individual carrier practices that can affect spatial requirements substantially. Throughput may vary based on many factors:

- Age and configuration of a building may mitigate or enhance mechanization/automation. Modern buildings with higher ceilings and greater clear spans tend to be more efficient and deeper buildings accommodate more efficient belt sortation operations;
- Domestic throughput is generally faster than international;
- Containerized freight (being towed by tug) typically moves through a facility faster than palletized freight (below loader on right side of picture) and both containerized and palletized cargo are handled more efficiently than loose (breakbulk) cargo;
- 
- Life sciences (pharma) and other perishables ideally should have a very high throughput;
- Certain countries of origin require more intrusive inspection, slowing throughput (e.g., Colombia vs. Canada);
- Time of arrival for international goods may delay processing due to federal agency staffing; and relatedly, authorized and filled staffing levels of federal agencies affect the processing of international cargo;
- Delivery of cargo to consignees may include built in delays based on retailing and/or wholesaling operations;
- Security procedures may prolong processing (dwell) time, while screening requirements require dedicated space.

Cost issues are as important to leasing cargo space as factors listed. Since cargo operates on small profit margins, a carrier or handling company will typically lease the minimum (and not necessarily modern) space necessary to

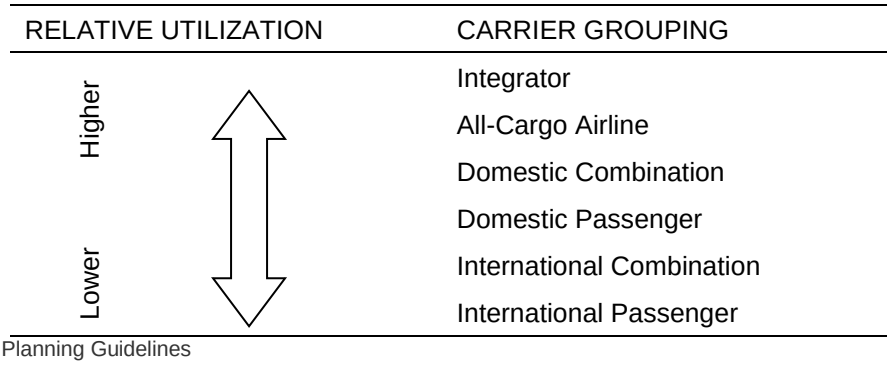
sustain its operations. As a result, these businesses tend to operate in environments that are congested, particularly in the fourth quarter when volumes peak.

In a typical cargo facility, the bulk of space is considered warehouse but is more correctly described as processing space for freight and mail. An additional 10% of the warehouse space can be allocated to office and counter use and another 5-10% may accommodate security, GSE, supply storage, and miscellaneous. The result is less useable space for cargo handling and a usage ratio that strains the one ton per square foot per year guideline. Newer more modern facilities typically will locate most office space on a second floor (mezzanine level) or in a separate office tower to keep as much contiguous warehouse space available for storage and processing of air cargo.

Independent tonnage forecasts are a required input and when combined with recommended utilization rates, can present a realistic demand and capacity analysis. These rates are predicated upon specification of carrier categories and definition of utilization ranges appropriate for each carrier category.

The carrier categories reflect the impact of the factors described at the beginning of this section on potential utilization rates. Thus, international passenger carriers, as a group, tend to experience the conditions leading to slower cargo processing, and thus, the lowest utilization rates. Domestic passenger carriers would achieve higher utilization rates. Combination carriers would be expected to move cargo more efficiently than passenger carriers. Integrators, whose business models are built around expedited processing, represent the most efficient cargo processors and will achieve the highest utilization rates. Non-integrated all-cargo carriers achieve somewhat lower utilization rates than integrators, but higher rates than passenger or combination carriers. The relative positions of these groups of carriers in terms of space utilization are presented in **Figure 13-2**, ***Carrier Groupings & Relative Utilization.***

Figure 13-2 Carrier Groupings & Relative Utilization



Source: IATA Planning Guidelines

To establish the utilization ranges for each category, L&B (through its historical planning efforts) compared cargo facilities at dozens of airports with cargo tonnages (throughput) reported for those facilities' tenants. The resultant data provide generally representative levels of the tonnage processed through the warehouse space or controlled by a tenant. Actual tonnage processed within individual premises can vary dramatically from the reported figure based on whether the tenant:

- Handles cargo for other carriers;
- Is handled by a third party that also handles other cargo in that space;
- Shares space on an informal basis with adjacent tenants;
- Has entered into a subleasing agreement;

- Has a portion of its cargo handled at another facility; or
- Has a substantial trucking component.

The facilities at MSP present some operating challenges to tenants and users based on age and configuration of the buildings but are generally not constraining most current operations. Landside operations can often be a constraint at airports with older buildings and limited road access, but MSP is not as limited as some airports.

13.1.2.2 Forecast Implications

The ratios in **Table 13-2, *Throughput Ratios – Modern Facilities*,** form a framework for what would be anticipated at MSP utilizing modern facilities anticipated from new development and current utilization at updated facilities. Since the vast majority of cargo activity is integrator/e-commerce-based, the anticipated throughput (productivity) is expected to be relatively high, increasing the productive lifespan of the facility, relative to overall capacity.

Table 13-2 Throughput Ratios – Modern Facilities

Type of Facility	Cargo Throughput Range (MT/SF/annum)
International Passenger	.75 – 1.5
International Combination	.75 – 1.5
Domestic Passenger	.75 – 1.5
Freighter	1.5 – 2.0
Integrator	2.5 and higher

Source: IATA Planning Guidelines, L&B Review and Analysis

Table 13-3, *Throughput Ratios – Legacy Facilities*, indicates the lower throughput reasonably anticipated from some existing facilities. Productivity losses are attributable to sub-optimal configuration, dimensions, landside limitations, and lack of mechanization in the buildings. Keeping productivity from going even lower is the industry's experience in responding to such limitations.

Table 13-3 Throughput Ratios – Legacy Facilities

Type of Facility	Cargo Throughput Range (MT/SF/annum)
International Passenger	.75 – 1.0
International Combination	.75 – 1.2
Domestic Passenger	.75 – 1.2
Freighter	1.0 – 1.5
Integrator	1.5 and higher

Source: IATA Planning Guidelines, L&B Review and Analysis

13.1.2.3 Existing Capacity

Assessing capacity of current cargo facilities at MSP was limited to the primary cargo handling carriers and was not expanded to support entities, freight forwarders or other tertiary cargo functions that can and are normally located

off-airport. For capacity purposes, warehouse space is the primary focus of the throughput model, with office and other elements of cargo capacity considered for the total facility requirement.

As evident in **Table 13-4, *Theoretical Capacity – MSP Legacy Facilities*,** MSP has a theoretical warehouse capacity of at least 606,115 annual metric tonnes of cargo from its existing cargo building inventory. This theoretical capacity assumes the validity of the building areas as observed from existing airport leases and the minimum efficient throughput levels from historical industry averages and previous analysis. With the same building areas since 2018, previous cargo tonnage levels as high as 376,000 metric tonnes in 2000, before a more recent high of 239,546 metric tonnes in 2018, the current processing capacity shows opportunity and adequate capacity overall with some notable surplus assumed for the FedEx and Air Cargo Center buildings. The estimates of building capacity are theoretical in nature and do not precisely represent the actual utilization and capacity of each building independently or collectively, but this estimation should be a reasonable assessment for MSP that there is not a specific and immediate need for more facilities other than to accommodate speculative growth for Amazon.

Table 13-4 Theoretical Capacity – MSP Legacy Facilities

Building	Main Tenants	Building SF	Estimated MT/SF/Year	Estimated Throughput (MTs)
FedEx	FedEx	203,000	1.5	304,500
UPS	UPS	67,000	1.5	100,500
Delta (Main & Dash)	Delta	106,100	0.75	79,575
DHL	Amazon/DHL	46,427	1.0	46,427
Air Cargo Center	Air General/WFS/Southwest	93,986*	0.75	70,489
Sun Country HQ	Sun Country (belly)	6,165	0.75	4,624
	Total Estimate	**522,678**		**606,115**

Source: IATA Planning Guidelines, L&B Review and Analysis *includes 55,000 sf of empty space in building

13.1.2.4 Future Demand

The variances in throughput ratios have a demonstrable impact on projected space requirements for cargo development and, as such, are necessary in planning for future cargo growth. In doing so, it is important to allow - to the extent possible - for unanticipated growth and/or anomalous activity. At MSP, several unknown factors must be considered in planning new facilities and infrastructure for Amazon. Amazon anticipates growth at MSP. Initial discussions have addressed elements of that expansion, but many questions remain pursuant to future volumes with implications for facilities and infrastructure development. There is 55,000 sf of available space in the Air Cargo Center. Because of its age and location, it does not present an ideal option for a new entrant into the MSP market. The space lacks an adjacent ramp and the distance to the terminal is also a drawback.

For physical planning purposes the MSP air cargo forecast of 394,100 metric tonnes does not suggest the need for additional buildings purely based on the existing total processing capacity estimate of nearly 606,000 metric tonnes. This space has been observed in the development of the cargo forecast and expected growth of Amazon cargo demand, the existing shared facility with DHL is not adequate nor preferential to the projected growth of Amazon demand. The 20-year forecast of cargo demand for MSP suggests the other existing facilities are adequate for demand during the forecast but a new facility for Amazon would be necessary and prudent to maintain opportunity for even greater growth in Amazon and e-commerce demand looking into the future. Since the numbers reflect a

20-year forecast with modest increased planning activity levels for other integrator and belly cargo segments, the Airport will have ample options from a timing and financial perspective to phase actual development appropriate with actual market demand.

13.1.2.5 Air Cargo Facility Requirements

Assessing the facility requirements entails the following:

- Calculate gross building requirements for warehouse, office, and GSE, based on tailored throughput ratios.
- Identify and accommodate any specialized facility needs to include perishables, high-risk material, animals, security inspection and clearance, etc.
- Plan the facilities to accommodate estimated peak traffic requirements. Attention is given to options that impact cost and to any unique challenges represented by access and egress points.
- Consider the distances and travel time for cargo to and from the terminal, potential off-airport partners, and the regional highway system.
- Estimate the building footprint based on the operations of the tenants. Typically, in larger facilities, mezzanine office space is recommended to reduce the footprint. For express carriers, office space is typically on the ground floor for both operating and security reasons.

For physical planning purposes, there are two targeted years in the forecast. The first is 2030 to define near-term requirements that would be impacted by terminal and infrastructure enhancements. The second is 2040 to project long-term requirements for cargo operations. These dates form the main area of discussion and analysis. The primary concern is to define nearer-term requirements that enable MSP to effectively phase development that adequately and efficiently meet the needs of Amazon.

The demand requirements have been segmented to reflect the operations of Amazon, FedEx, UPS, DHL, Delta/Other belly, and Other all-cargo. Each of the six main segments will be shown with a requirements range assuming a conservative throughput rate and a more efficient optimal throughput rate which could be achieved to modest renovations to existing facilities within the same building footprint of 2020 (i.e. better use of existing space without adding more building space).

Amazon Cargo Forecast & Building Requirements

Projected traffic for Amazon is indicated in **Table 13-5, *Estimate of Amazon Basic Facility Requirements***. Amazon is expected to operate more like an integrator with sortation facilities on site for cross-transfer of packages and thus the primary cargo requirement for Amazon is warehousing - square footage of which is a function of estimated tonnage throughput. For the Amazon operation, a throughput of 1.0 metric tonnes per square foot is appropriate for the existing facility, and 1.5 metric tonnes per square foot for a new facility with more automation specifically designed for Amazon cargo activities. Amazon is currently utilizing available space left over at the DHL building due to the renovations and new space built for DHL. The current cargo facility (utilizing 3,009 sf) is not ideal for Amazon but with the current small level of demand it is functional. A new facility designed for Amazon and either built by a third-party developer or the Airport is necessary for the higher demand levels expected for Amazon at MSP.

To reflect comprehensively the total space requirements of a cargo operation, it is essential to include an allocation for office and other operating requirements. Office space is allocated at 10% of warehouse space – totaling 7,400 SF in 2030 and 9,900 SF in 2040 for the existing facilities. An additional 5% should be allowed for security, special facilities, and storage for equipment and supplies. Mezzanine-level office is recommended to reduce the footprint of the facility, although that judgment must consider additional costs associated with constructing a second floor.

The total facility requirement for Amazon ranges from 114,100 SF by 2040 for assumed metrics of the existing facility down to 76,000 SF for a new modern facility developed specifically for Amazon operations.

Table 13-5 Estimate of Amazon Basic Facility Requirements

	2030 Metric Tonnes or SF	2040 Metric Tonnes or SF
Forecast of Amazon Cargo Tonnage		
Total Tonnage	73,800	99,200
Amazon Existing Facilities – Scenario One: Throughput = 1.0 Metric Tonnes/SF		
Warehouse	73,800	99,200
Office	7,400	9,900
Other	3,700	5,000
Total Square Feet	**84,900**	**114,100**
Amazon Modern Facilities - Scenario Two: Throughput = 1.5 Metric Tonnes/SF		
Warehouse	49,200	66,100
Office	4,900	6,600
Other	2,500	3,300
Total Square Feet	**56,600**	**76,600**
Current facility provides 3,009 SF of building space.		

Source: Landrum & Brown

Integrator/Express Cargo Facility & Building Requirements

While Amazon was analyzed separately from the integrators and belly cargo (Delta Air Lines mainly), scheduled all-cargo (specifically integrated) carriers account for a decisive majority (82.4%) of the MSP cargo market in 2020. Amazon does have a distinctive business model as an e-commerce company rather than cargo airline. Their operations do resemble those of integrated carriers from an airport planning perspective. Forecasts for the three true integrator carriers (FedEx, UPS and DHL) are included in **Table 13-6*, Forecast of Integrated Carriers (Express) Tonnage (in Metric Tonnes)***. While FedEx is projected to remain MSP's largest all-cargo carrier by tonnage volume, both FedEx and UPS are likely to maintain relatively modest organic growth rates. Amazon's growth is expected to experience a surge in traffic as the MSP regional hub is established and then the near-term growth is expected to normalize over the longer term, the e-commerce carrier is expected to overtake the level of UPS and draw close to the FedEx tonnage level by 2040.

Table 13-6 Forecast of Integrated Carriers (Express) Tonnage (in Metric Tonnes)

	2030 Tonnage	2040 Tonnage
FedEx	101,000	110,700
UPS	90,800	111,000
DHL	10,800	14,200
Total Integrator Tonnage	**202,600**	**235,900**

Source: Landrum & Brown

While composites of demand are necessary for land use planning, demand for facilities by the market share leaders must be examined and projected on an individual level. Surplus capacity at one carrier's cargo facilities does nothing to alleviate a capacity deficit at its competitor's facilities.

Since integrator operations focus so heavily on speed, their facilities typically achieve substantially higher throughput rates than those of non-integrated carriers. For MSP, a conservative throughput rate of 1.5 tonnes per square foot (at the lower end of industry norms) was applied for Scenario One (existing facilities) and 2.0 tonnes per square foot for Scenario Two (new facilities). Individual demand by UPS, FedEx and DHL is presented for the planning horizons of 2030 and 2040 in **Tables 13-6 through 13-8**.

While the same throughput assumptions will be applied to each carrier, contexts are to be considered individually. Of the three integrators, UPS is the one whose current facilities are most likely to be perceived to have some potential growth constraint based on a higher current throughput. This can be attributed to UPS incorporating more off-airport and ground sorting operations into their normal operations. During the interviewing and stakeholder evaluation process, FedEx and UPS express adequacy with their existing facilities and no real projections of needing additional space during the forecast period.

FedEx Integrator Cargo Forecast & Building Requirements

Currently the largest share of cargo at MSP is handled by FedEx at 44.1% of total cargo tonnage. FedEx has experienced greater demand at MSP in the past and is forecast to show modest growth linked to originating and destination cargo from the Minneapolis region. As was shown previously, the existing capacity of the FedEx facility shows a surplus not expected to be exceeded during the 20-year forecast period. **Table 13-7, *Estimate of FedEx Basic Facility Requirements*,** projects the square footage of total building required for forecast periods 2030 and 2040 under the assumed throughput rates of the existing building and potential improved throughput with better utilization or enhanced modern facilities.

Office and other functional area requirements were projected at an additional 10% of the base warehouse requirement for office and five percent for other needs (security/storage/GSE). The total facility requirement for FedEx ranges from 84,900 SF by 2040 for assumed metrics of the existing facility down to 63,700 SF for a new modern facility developed specifically for FedEx operations.

Table 13-7 Estimate of FedEx Basic Facility Requirements

	2030 Metric Tonnes or SF	2040 Metric Tonnes or SF
Forecast of FedEx Cargo Tonnage		
Total Tonnage	101,000	110,700
Existing Facilities – Scenario One: Throughput = 1.5 Metric Tonnes/SF		
Warehouse	67,300	73,800
Office	6,700	7,400
Other	3,400	3,700
Total Square Feet	**77,400**	**84,900**
Modern Facilities – Scenario Two: Throughput = 2.0 Metric Tonnes/SF		
Warehouse	50,500	55,400
Office	5,000	5,500
Other	2,500	2,800
Total Square Feet	**58,000**	**63,700**
Current facility provides 203,000 SF of building space.		

Source: Landrum & Brown

UPS Integrator Cargo Forecast & Building Requirements

Currently, UPS maintains the second largest share of cargo at MSP with 34.6% of total cargo tonnage. UPS tonnage demand has shown moderate yet consistent growth at MSP becoming more competitive with FedEx in recent years. UPS future growth is like that of FedEx with an additional element of strategic network growth assumed for MSP operations. The existing capacity of the UPS facility also shows a surplus not expected to be exceeded during the 20-year forecast period under the 'modern facilities' scenario, but under existing operating practices a small deficit in facility space could result between 2030 and 2040 during the forecast period. **Table 13-8, *Estimate of UPS Basic Facility Requirements*,** projects the square footage of total building required for forecast periods 2030 and 2040 under the assumed throughput rates of the existing building and potential improved throughput with better utilization or enhanced modern facilities.

Again, office and other functional area requirements were projected at an additional 10% of the base warehouse requirement for office and five percent for other needs (security/storage/GSE). The total facility requirement for UPS ranges from 85,100 SF by 2040 for assumed metrics of the existing facility down to 63,800 SF for a new modern facility developed specifically for UPS operations.

Table 13-8 Estimate of UPS Basic Facility Requirements

	2030 Metric Tonnes or SF	2040 Metric Tonnes or SF
Forecast of UPS Cargo Tonnage		
Total Tonnage	90,800	111,000
Existing Facilities – Scenario One: Throughput = 1.5 Metric Tonnes/SF		
Warehouse	60,500	74,000
Office	6,100	7,400
Other	3,000	3,700
Total Square Feet	**69,600**	**85,100**
Modern Facilities – Scenario Two: Throughput = 2.0 Metric Tonnes/SF		
Warehouse	45,400	55,500
Office	4,500	5,600
Other	2,300	2,700
Total Square Feet	**52,200**	**63,800**
Current facility provides 67,000 SF of building space.		

Source: Landrum & Brown

DHL Integrator Cargo Forecast & Building Requirements

DHL has a relatively small presence at MSP with just 3.7% of total cargo tonnage reported in 2020. DHL operations at MSP were improved in 2018 with the renovation/expansion of the DHL building in the west cargo area. With such a recent expansion occurring on site and modest growth forecast it would be presumed that DHL would not require any new facilities in the near-term or during the 20-year forecast period. **Table 13-9, *Estimate of DHL Basic Facility Requirements,*** presents the same scenarios and computations for DHL at MSP that was assumed for Amazon with an assumed 1.0 metric tonnes/SF throughput rate for the existing modern facility and up to 1.5 metric tonnes/SF with even more efficient potential future facility conditions.

As with the other integrator assumptions, office and other functional area requirements were projected at an additional 10% of the base warehouse requirement for office and five percent for other needs (security/storage/GSE). The total facility requirement for DHL ranges from 16,30 SF by 2040 for assumed metrics of the existing facility down to 11,000 SF for a new modern facility developed specifically for DHL operations.

Table 13-9 Estimate of DHL Basic Facility Requirements

	2030 Metric Tonnes or SF	2040 Metric Tonnes or SF
Forecast of DHL Cargo Tonnage		
Freighter Tonnage	10,800	14,200
Existing Facilities – Scenario One: Throughput = 1.0 Metric Tonnes/SF		
Warehouse	10,800	14,200
Office	1,100	1,400
Other	600	700
Total Square Feet	**12,500**	**16,300**
Modern Facilities – Scenario Two: Throughput = 1.5 Metric Tonnes/SF		
Warehouse	7,200	9,500
Office	700	1,000
Other	400	500
Total Square Feet	**8,300**	**11,000**
Current facility provides 43,418 SF of building space (includes WFS).		

Source: Landrum & Brown

Belly and Other All-Cargo Charter Requirements

Belly Cargo at MSP has been dominated by Delta for some years as MSP is their second largest hub after Atlanta (ATL). Belly cargo operations are not expected to change notably from current conditions even during the period of growth expected at MSP during the 20-year forecast. Belly Cargo was the second largest cargo component at MSP back in 2017 with 30.4% of total tonnage. In 2020, the belly share dropped to 11.5% due to the impact of COVID-19. The remaining segment analyzed at MSP is the Other All-Cargo segment which accounts for other scheduled or charter freighters operating at MSP. This segment has represented the smallest segment at MSP with just 0.1% of total tonnage in 2020. Both the Belly Cargo and Other All-Cargo segments are observed to be stable cargo segments with mature operational practices. These two segments are projected to maintain a conservative throughput rate of 0.75 metric tonnes/SF during the forecast and are not expected to see increased efficiencies similar to the integrator carriers' operations. **Tables 13-10, *Estimate of Delta Air Lines Belly Cargo Basic Facility Requirements*** and **Table 13-11, *Estimate of Other Belly Cargo Basic Facility Requirements*** present the forecast tonnage and requirements using the indicated throughput assumptions.

Table 13-10 Estimate of Delta Air Lines Belly Cargo Basic Facility Requirements

	2030 Annual Tonnes or SF	2040 Annual Tonnes or SF
Forecast of Belly Cargo Tonnage		
Belly Tonnage	51,600	63,400
Existing Facilities – Standard Conditions: Throughput = 0.75 Metric Tonnes/SF		
Warehouse	68,800	84,500
Office	6,900	8,500
Other	3,400	4,200
Total Square Feet	**79,100**	**97,100**
Current facility provides 106,100 SF of building space.		

Source: Landrum & Brown
Note: Assumed dedicated belly cargo facilities for Delta (main facility and Delta Dash facility)

Table 13-11 Estimate of Other Belly Cargo Basic Facility Requirements

	2030 Annual Tonnes or SF	2040 Annual Tonnes or SF
Forecast of Belly Cargo Tonnage		
Belly Tonnage	12,900	15,800
Existing Facilities – Standard Conditions: Throughput = 0.75 Metric Tonnes/SF		
Warehouse	17,200	21,100
Office	1,700	2,100
Other	900	1,000
Total Square Feet	**19,800**	**24,300**
Current facility provides 13,623 SF of building space.		

Source: Landrum & Brown

Most of the non-Delta belly cargo is processed at the terminal buildings and on the apron moving cargo directly between aircraft (tail to tail operations) or directly to the freight company or courier service. There is additional space available not currently being used at the Air Cargo Center that could also be used for expanding the other belly cargo facility needs.

Table 13-12, *Estimate of Other All-Cargo Charter Basic Facility Requirements* presents the forecast tonnage and requirements using the indicated throughput assumptions.

Table 13-12 Estimate of Other All-Cargo Charter Basic Facility Requirements

	2020 Metric Tonnes or SF	2040 Metric Tonnes or SF
Forecast of Other All-Cargo Tonnage		
Freighter Tonnage	600	600
Existing Facilities – Standard Conditions: Throughput = 0.75 Metric Tonnes/SF		
Warehouse	1,000	1,000
Office	100	100
Other	100	100
Total Square Feet	**1,200**	**1,200**
Current facility provides 62,575* SF of building space.		

Source: Landrum & Brown
Note: * 62,575 SF includes 55,000 SF of currently Vacant space at adjacent Air Cargo Center and Air General Air Cargo space.

13.1.2.6 Aeronautical Infrastructure Requirements

The aeronautical (airside) infrastructure requirements have three priorities:

- To minimize taxi-time and distance for freighter aircraft.
- To ensure sufficient aircraft ramp to accommodate peak demand for cargo terminal access and parking, specifically respecting average occupancy time for aircraft stands.
- To ensure that the aircraft apron has sufficient access and egress for operating peaks.

In addition, a minimum of 50 feet is required between the rear of the cargo buildings and the nose of the aircraft for staging and equipment maneuvering. An additional 30 feet is required for B747-8F with nose loading capabilities.

MSP Airside Operations

A review of MSP's operations data suggest that scheduled cargo operations are occurring five to six days a week by the major cargo carriers for a metric of 300 cargo days/year (based on an average of cargo industry working days/week). This metric can be generally applied to air cargo apron planning. Changes to express delivery services over the past decade have increased operations on Saturdays and even Sundays, such that this number may need revision in future cargo models. Still, for planning purposes, the emphasis is on the peak day and time, more than the number of operating days.

Typical planning includes a reasonable assumption that at least two daily turns per freighter parking position should be achievable but operating schedules should be checked for validation. Non-scheduled charter operations vary, possibly resulting in unanticipated aircraft parking on the apron for an extended time but are not expected to occur at MSP at any significant level.

There are two dedicated air cargo ramp areas at MSP between the shared ramp for FedEx and UPS north of the terminals, and the shared ramp area to the west for Amazon, DHL and others. The Delta belly cargo facility and general use Air Cargo Center do not provide aeronautical access and have no parking positions. Typically, aircraft parking positions are leased to the building tenants for their specific loading, unloading and staging needs with some common use or other remote parking positions available for unscheduled, unexpected or non-signatory airlines usage. Given their schedules, many ramp operations will occur simultaneously. A ramp management plan is necessary to continue ensuring adequate positions to accommodate these aircraft near their cargo facilities.

Amazon, FedEx, UPS, and DHL are the primary operators of freighter aircraft at MSP. The primary aeronautical concerns for these cargo carriers are dependent upon their daily operations and scheduled profile as well as the way they operate. Collectively their requirements are in the number of parking positions required to accommodate peak demand during a design day and total apron area to provide the parking positions with buffers for building and roadway safety offsets and staging of cargo and equipment around the parked aircraft.

The forecast of annual freighter operations at MSP for the main cargo airlines is summarized in **Table 13-13**, ***Forecasted Annual Freighter Operations***. Total annual freighter operations are projected to increase from an estimated 15,022 in 2020 to 19,400 in 2030 and up to 22,400 by 2040. Most of the increased freighter activity is expected to come from a near-term jump in Amazon activity at MSP.

Table 13-13 Forecasted Annual Freighter Operations

Freighter Operators	2030	2040
FedEx	4,370	4,730
UPS	9,780	11,290
Amazon	3,060	4,080
DHL	1,750	2,020
Other All-cargo	10	10
Total	**19,400**	**22,400**

Source: Landrum & Brown

An operation is defined as a takeoff *or* a landing. In calculating aircraft parking positions, the number of operations is divided by operating days and then halved to determine the number of freighter aircraft. The estimated number of daily freighters at MSP are shown in **Table 13-14, *Peak Number of Daily Freighters by All-Cargo Carriers.***

Table 13-14 Peak Number of Daily Freighters By All-Cargo Carriers

Freighters	2030	2040
FedEx	7	8
UPS	16	19
Amazon	6	7
DHL	3	3
Other All-Cargo	1	1
Total Daily Average	**33**	**38**

Source: Landrum & Brown

Apron Requirements

Current utilization patterns and stakeholder input were used to estimate aircraft parking requirements. Typically, two turns/apron position/day would be the guideline for planning. However, given the operating patterns of the primary freighter operators and the existing contiguous apron, 1.5 turns per day was used. The resultant requirement for freighter aircraft parking positions is shown in **Table 13-15, *Required Freighter Simultaneous (Peak) Parking Positions***. A total of 23 freighter positions are needed for 2030 and up to 25 freighter parking positions for 2040. UPS has a larger number of small feeder aircraft that make up roughly 60% of their operations, as such the same ratio can be applied to the parking position requirements for UPS. Overall the total freighter parking capacity at MSP is observed to be 36 parking positions with 16 positions for large aircraft (mainly widebody) and 20 positions for small feeder aircraft. During the forecast period to 2040, each main cargo group should have enough apron space and sufficient parking positions to meet future demand except for Amazon which would require two additional spaces in its current location or at least 4 dedicated positions for Boeing 737-800F or Boeing 767F aircraft at a new facility at MSP.

Table 13-15 Required Freighter Simultaneous (Peak) Parking Positions

Apron Positions	Existing	2030	2040
FedEx	6	5	6
UPS	21 *(5 Large/16 Small)*	11 *(4 Large/7 Small)*	12 *(5 Large/ 7 Small)*
Amazon	2	4	4
DHL/Other All-Cargo *(1 shared position)*	7 *(3 Large/4 Small)*	3	3
Total	**36**	**23**	**25**

Source: Landrum & Brown

13.1.2.7 Landside Infrastructure Requirements

All air cargo will eventually arrive and depart an airport by truck at some point. Therefore, landside planning must consider trucking operations, as well as automobile parking at cargo buildings. Landside planning requirements include truck parking and queuing, roadway geometry, employee parking, customer parking, and potential alternative access for employees. These inputs were combined with industry planning guidelines to size requirements for the facilities and to understand potential traffic on roadways serving the cargo complex.

Trucking

For MSP, two types of trucking operations must be considered: express (including Amazon) and belly cargo, which have distinctive truck fleet mixes and daily peak impacts.

The most commonly utilized vehicle types are 53-foot trucks, 40-foot trucks, and vans for the integrators. The largest of these – the 53-foot tractor-trailers - determines the sizing of truck aprons, roadway geometry, and truck queuing. Truck courts at least 150' deep are necessary to enable trucks of this size to back into bays without impacting movement of other vehicles on access roads during peak hours. A minimum separation of 12 feet from centerline of truck to centerline of truck is also necessary. Anticipated usage by smaller trucks, as well, requires that the numbers of truck bay doors be maximized at each cargo building.

Four basic assumptions are utilized in estimating truck traffic: 1) the trucks operate with less than a full payload; 2) trucks operate 300 days a year; 3) van utilization will increase; and 4) inbound and outbound traffic will be equal. These considerations raise the estimate of anticipated daily trucking activity above simple capacity calculations. Based on projected tonnages and fleet mix, annual levels of trucking activity were calculated and distilled to an estimated daily activity level, then converted into peak hour levels.

The anticipated size of the facilities and associated numbers of bay doors should accommodate the requirements without difficulty. Compared with the common-carrier trucking companies serving the forwarders and belly cargo carriers, express operators mostly use their own proprietary truck fleets, but also heavily utilize vans that can rotate through the truck dock areas quickly.

Truck queuing should provide capacity equal to approximately 10 percent of the number of dock doors. The ideal truck apron depth should be 120 to 150 feet from the building to the road (exclusive of the queuing area). Land permitting, the overall size of the trucking apron should roughly equal the size of the building.

Automobile Parking

A number of operating assumptions factor into the review of automobile parking requirements. In total MSP has a requirement of 643 automobile parking spaces for 2030 and 708 parking spaces for 2040. Observations of existing parking at each major cargo facility suggest adequate parking capacity is provided through 2040. An estimated 1,037 automobile parking spaces were observed for the major cargo areas evaluated and shown below in **Table 13-16, *Auto Parking Positions***. These estimates represent counts of automobile parking areas associated with the main cargo areas. Of note is that the Air Cargo Center has non-cargo tenants also operating in that facility and the Delta Belly Cargo building is located in a larger Delta complex with other function occurring, so only the parking spaces directly surrounding the facility were counted. FedEx and UPS parking totals remain unchanged because their existing facilities exceed the projected space needs based on the forecasted tonnages out to 2040.

- The automobiles belong to one of three groups: employees working in the cargo facilities; visitors/customers of the carriers; and government employees and individuals working on regulatory issues.

- Typical employee auto parking for an air cargo operation ranges from three to eight spaces per 10,000 SF of warehouse. A utilization of eight per 10,000 SF, due to absence of extensive public transport or shuttles.
- Employee auto parking is two-three spaces per 1,000 SF of air cargo office. Based on typical utilization levels and the absence of public transport, a utilization of three spaces per 1,000 SF.
- Integrator operations are labor intensive and may require twice the ratio of parking positions.
- Two customer parking positions per 10,000 SF of warehouse (integrators, one per 25,000).
- Typical employee auto parking for Customs Office Space is typically one to four spaces per 1,000 square feet. A utilization level of two spaces per 1,000 SF was assumed for MSP
- Typical planning allows for 300 SF per parking space or about 150 spaces per acre.

Utilizing these assumptions and applying the base or Scenario One building requirements, auto parking requirements at MSP would be as shown in the summary table below.

Table 13-16 Auto Parking Positions

Parking Space	Estimated Existing	2030	2040
FedEx	345 spaces	243 spaces	243 spaces
UPS	248	168	168
Amazon*	58	96	129
DHL/Other All-Cargo*	94	24	30
Delta/Belly cargo**	292	112	138
Total Positions	**1,037**	**643**	**708**
FedEx	~103,500	72,900	72,900
UPS	~74,400	50.400	50.400
Amazon	~17,400	28,800	38,700
DHL/Other All-Cargo	~28,200	7,200	9,000
Delta/Belly cargo	~87,600	33,600	41,400
Total Parking Area (SF)* **	**~311,100**	**193,608**	**213,108**

Source: Landrum & Brown
Notes: * Estimated separation between Amazon side and DHL side of the facility
** Other Belly Cargo with Delta (104+ spaces) includes the Air Cargo Center (188 spaces)
*** Existing Parking area estimated at 300 SF per parking space

13.1.2.8 Specialized Facilities

CBP and Other Regulatory Operations

CBP and the TSA are key regulators and facilitators of goods movement. Their primary focus is on O&D traffic arriving by air. In the event that international charter activity expands, CBP may require space dedicated to their cargo operations. This would facilitate clearance and resolution of other transport issues for carriers, shippers, freight forwarders, and customs brokers, as well as the added benefit of reducing vehicular movements. Automated goods clearance facilitates pre-clearance of goods when wheels lift off at the point of origin. As the system matures, as much as 90% of inbound goods will be cleared electronically, greatly reducing dwell-time for imports in the cargo buildings.

Perishable Cargo (Temperature Sensitive Goods)

A substantial portion of recent air cargo growth has derived from life sciences (including pharmaceuticals), requiring temperature-controlled climates. Globally, perishables are estimated at about 15% of total international cargo, historically comprising flowers, fruits, vegetables, meats, and fish. For the near-term planning horizon, Delta and Air General have both indicated an immediate need to expand existing cooler capacity. Air General's cargo is being accommodated in temporary (portable) coolers and trailers in or near their existing facilities.

13.1.3 Demand Summary

Facilities demand was calculated independent of the capacity of existing facilities. The inputs in **Table 13-17, *Air Cargo Study Forecast Tonnages*,** form the basis of these requirements. The square footages reflect reasonable planning requirements to enable the Airport and its cargo community to sustain and grow their operations. These planning requirements should apply generally to an airport wide general requirement.

Table 13-17 Air Cargo Study Forecast Tonnages

Carrier	2030	2040
FedEx	101,000	110,700
UPS	90,800	111,000
Amazon	73,800	99,200
Delta/Other Belly	64,500	79,200
DHL	10,800	14,200
Other-All Cargo	600	700
TOTALS (in metric tonnes)	**341,500**	**415,000**

Source: Landrum & Brown

Using the forecasted throughput assumptions, facility sizes are estimated for each main carrier, as shown in **Table 13-18, *Air Cargo Study Individual Carrier Requirements (in Square Feet)***. Estimated building footprints represent the sum of the warehousing and office space requirements with an assumed mezzanine (second floor above the office) for storage and other secondary functions.

Table 13-18 Air Cargo Study Individual Carrier Requirements (in Square Feet)

Main Carriers	Existing Estimated Area (SF)	2030	2040
Amazon			
Warehousing		73,800	99,200
Office		7,400	9,900
Other		3,700	5,000
Footprint	3,009	77,500	109,100
Aircraft Ramp	83,148	184,800	184,800
Auto Parking	17,400	28,800	38,700
Truck Apron	4,899	65,600	90,000
FedEx			
Warehousing		67,300	73,800
Office		6,700	7,400
Other		3,400	3,700
Footprint	203,000	70,700	80,600
Aircraft Ramp	376,937	231,000	277,200
Auto Parking	103,500	72,900	72,900
Truck Apron	75,053	60,000	65,600
UPS			
Warehousing		60,500	56,700
Office		6,100	5,700
Other		3,000	2,800
7Footprint	67,000	63,500	62,400
Aircraft Ramp	451,950	237,300	283,500
Auto Parking	74,400	50,400	50,400
Truck Apron	61,917	52,500	65,600
DHL			
Warehousing		10,800	14,200
Office		1,100	1,400
Other		600	700
Footprint	43,418	11,400	14,900
Aircraft Ramp	124,722	138,600	138,600
Auto Parking	28,200	4,200	5,400
Truck Apron	7,735	5,600	9,400

Main Carriers	Existing Estimated Area (SF)	2030	2040
Delta/Other Belly			
Warehousing		86,000	105,600
Office		8,600	10,600
Other		4,300	5,200
Footprint	106,100	90,300	110,800
Aircraft Ramp	NA	0	0
Auto Parking	87,600	33,600	41,400
Truck Apron	71,094 + 14,792 (Bldg. H) = 85,886	76,900	95,600
Other All-Cargo			
Warehousing		1,000	1,000
Office		100	100
Other		100	100
Footprint	43,036	1,200*	1,200*
Aircraft Ramp *(shared with DHL)*	NA	*46,200*	*46,200*
Auto Parking	36,933 (Bldg. H) + 19,081 (Bldg. I) = 56,014	3,000	3,600
Truck Apron	14,792 (Bldg. I)	3,800*	3,800*

Source: Landrum & Brown
Note: * Other All-Cargo has a minimum requirement, therefore the footprint does not assume a mezzanine office area, and a minimum of two truck bays were included in the assessment.

13.1.4 Facilities Conclusions

Based on the preceding estimates, the operating preferences of the carriers, stakeholder input, and the goal of the Airport to optimize the available land envelope in which the existing cargo facilities are located and potential new ones could be built, several conclusions appear reasonable.

- There is 522,678 sf of cargo building capacity available which can handle a theoretical 606,115 tonnes of cargo at the modest throughput levels currently estimated.
- The existing building capacity, truck parking, and automobile parking based on reasonable forecasting, should suffice through 2040 for most carriers.
- Cooler space is in high demand. Current temporary facilities are less than desirable. Both Air General and Delta want more cooler space today.
- There are approximately 19.1 acres of available land on the western side of the airport, just north of the Amazon/DHL ramp and building.

- Landside infrastructure will only grow in importance. This includes the access and egress, levels of service with trucking activity increasing and landside connectivity between facilities, airport roads, and the regional highway system.

For the past two decades, new construction of traditional air cargo facilities has conformed (where practical) to planning specifications developed by the Air Transport Association (ATA). **Table 13-19, *ATA Promulgated Cargo Facility Specifications,*** outlines them. Physical constraints, operating requirements, and airport planning guidelines may warrant adaptations to the base, but these parameters have largely proven relevant.

Other considerations include:

- Planning should be based on modern throughput numbers and land allocations to meet long-term needs.
- Modern facilities with higher throughput will substantially reduce the required land footprint.
- Planning should allow for phasing of new development to be linked to market demand.
- New facilities and infrastructure should provide state-of-the-art service levels for tenants and users.
- New development should minimize adverse financial impact on tenants and users.
- New development should capitalize on existing infrastructure.

Table 13-19 ATA Promulgated Cargo Facility Specifications

Trucking	Frontage	Measuring Approximately 120’ – 150’ from building to road
	Separation	12’6” from centerline of truck to centerline of truck
Parking	Autos	300 SF per auto, 150 spaces per acre
	Ratios	3-8 auto spaces per 10,000 SF of warehouse (based on operation). 2-3 spaces per 1,000 SF of office. At least double the totals for integrators
Buildings	Depth	150’
	Spacing	50’ between columns
	Height	24’
	Office	10% of the total square footage
Doors	Trucking	10’ x 10’
	Container	12’ x 12’
	Airside	18’ x 12’ high. At least 2 per leasehold
Ramp	Setback	Aircraft 50’ from the building, 80’ for 747-8F nose loading
Ratios	Freighters	1.50 – 1.75 SF of ramp per SF of warehouse
	Integrator Spoke	1.75 – 2.50 SF of ramp per SF of warehouse
	Integrator Hub	2.50 + SF of ramp per SF of warehouse

Source: Facility Planning Guidelines, Air Cargo Facilities, McClier Aviation Group

As has been detailed in the preceding pages, MSP's West Cargo area has its virtues in combining most of the cargo operations in an area that is geographically separated from the passenger terminals and its vehicular traffic.

MSP's principal belly cargo carrier, Delta, currently operates in their own building. According to local management, the building has inadequate cooling capabilities. While this is problematic, it has not limited the airline's expansion to date. However, belly cargo is a critical contributor to the profitability of transcontinental passenger routes, so Airport management must be attentive to the reality that even if international passenger service is their top priority, taking care of the cargo needs of these carriers is essential.

The scheduled integrated carriers – FedEx, UPS and DHL – account for the vast majority of MSP's air cargo tonnage. Predictably, they also account for the greatest demand for cargo facilities and services. E-commerce giant, Amazon has enormous potential at MSP. This may require an expansion to Amazon's existing leased space, a new building or a combination of the two.

13.2 Facility Alternatives

As mentioned earlier, a 19.1-acre parcel of undeveloped land on the west side of the airport is available for future cargo opportunities. L&B was tasked with looking at possible cargo layout alternatives for the site. **Figure 13-3, *MSP Air Cargo Project Area***, depicts the available area. The goal of this task was to maximize land use on the site while providing sufficient cargo capacity to accommodate projected growth of existing and future cargo tenants at MSP. Each of the alternatives has the capability of accommodating a phased approach to development.

Figure 13-3 MSP Air Cargo Project Area

Source: L&B analysis, 2021

The 19.1-acre site in question is currently vacant, so new development would have no adverse financial impact on current tenants and users. Three alternatives were developed which utilize the existing project area for cargo facilities, truck apron, aircraft apron, GSE storage, and employee parking. Each alternative provides a facility with 150-foot depth, a truck apron with 150-foot depth, employee parking, GSE storage, and space to park a range of aircraft types. The aircraft used in these alternatives include: B737-800F, B757-200F, B767-300F, and B747-800F.

The biggest constraint on the 19.1-acre site is airspace restrictions, primarily the 7:1, Part 77 Transitional Surface extending outward from Runway 17-35. The shape of the site envelope was also a constraint to the alternatives, since the northern portion of the 19-acre site does not have enough depth to accommodate a facility, truck apron, or aircraft. This northern area was reserved for landside parking or GSE storage in each alternative, due to site limitations and restrictions on the airspace.

For each alternative, the existing Amazon/DHL apron was utilized for aircraft parking. The Boeing 747-800F was the largest aircraft used in these alternatives. The only viable location for this aircraft, to achieve tail-height clearance of the transitional surface is two parking positions on the west side of the existing Amazon/DHL apron. The B747-800F aircraft shows up as a secondary parking option in every alternative, in the same positions.

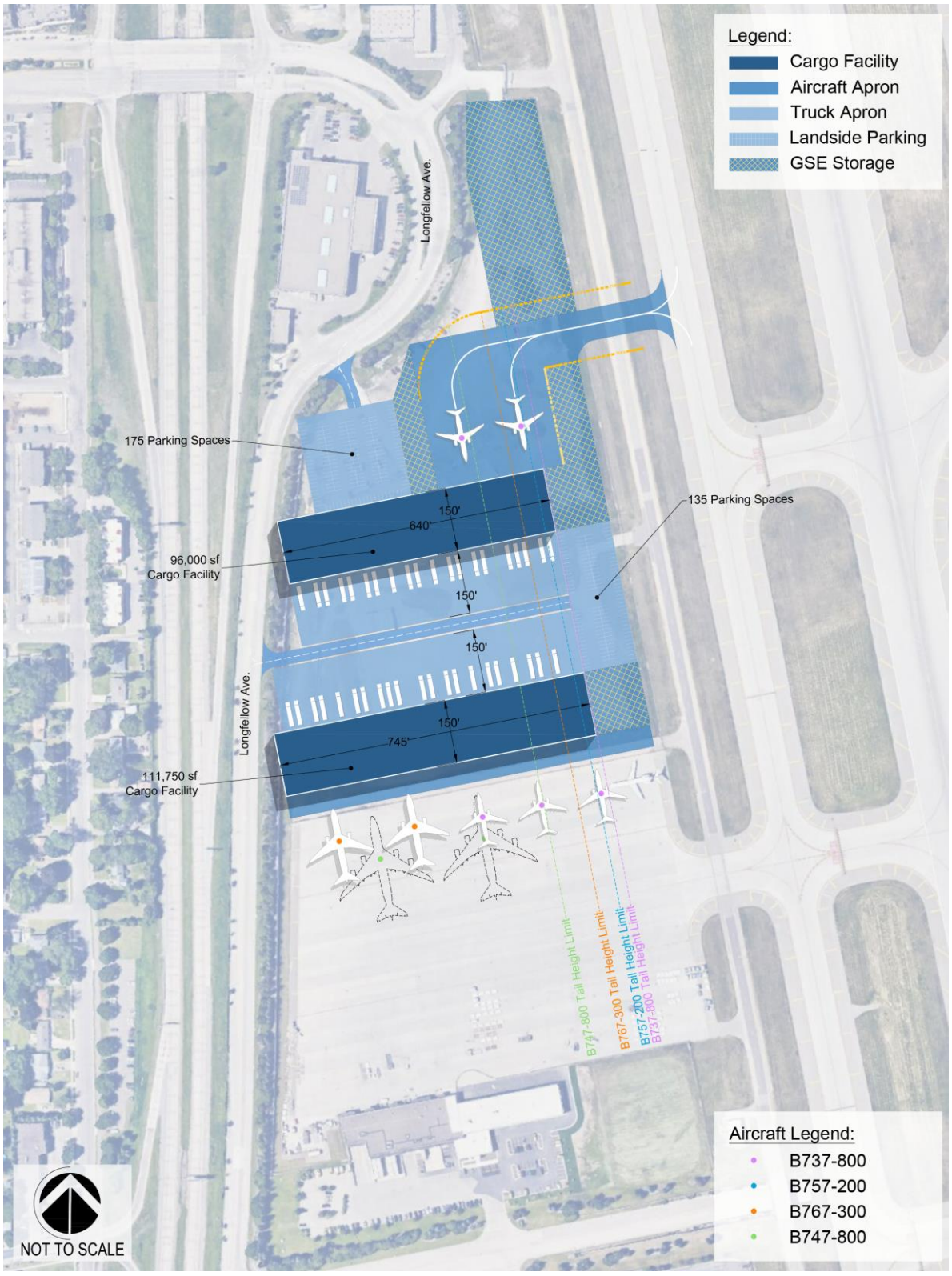
Alternative 1, shown in **Figure 13-4, *MSP Cargo Alternative 1***, consists of two cargo facilities with a east-west orientation, perpendicular to the Runway 17-35 taxiway system, totaling 207,750 square feet. The two facilities share access to the truck apron, connecting from Longfellow Ave. There are two landside parking lots, totaling 310 parking spaces. Access to one landside parking lot is the same access road for the truck apron. The other parking lot has an independent access point on the curve of Longfellow Ave. Alternative 1 is capable of accommodating seven total aircraft, five on the existing Amazon/DHL apron, and two on a future apron connecting to the northern cargo facility from T/W L. This alternative provides approximately 175,000 square feet of GSE storage.

Alternative 2, shown in **Figure 13-5, *MSP Cargo Alternative 2***, consists of one L-shaped cargo facility with the long end of the facility positioned parallel to the Runway 17-35 taxiway system, totaling 165,000 square feet. The truck apron for both sides of the facility connect from the curved portion of Longfellow Ave. There are three landside parking lots, totaling 660 parking spaces. Access to two of the landside parking lots is the same access point for the truck aprons. The third parking lot has an access point north of the site along a small portion of Longfellow Ave departing from the main roadway. This area can also be utilized for GSE storage. Alternative 2 can accommodate nine total aircraft, five on the existing Amazon/DHL apron, and four on a future apron positioned east of the future cargo facility, with access to T/W L. This alternative provides approximately 35,500 square feet of GSE storage.

Alternative 3, shown in **Figure 13-6, *MSP Cargo Alternative 3***, consists of one obtuse cargo facility running parallel with Longfellow Ave, to maximize land use potential, totaling 167,500 square feet. The truck apron for the cargo facility has two access points along Longfellow Ave. There is one landside parking lot, totaling 370 parking spaces, with an access point north of the site along a small portion of Longfellow Ave departing from the main roadway. Alternative 3 can accommodate ten total aircraft, five on the existing Amazon/DHL apron, and five on a future apron positioned along the future cargo facility, with access to T/W L. This alternative provides approximately 110,000 square feet of GSE storage.

In comparison, Alternative 1 provides the most cargo facility area, at 207,750 square feet, compared to the other two alternatives which accommodate approximately 165,000 square feet. Alternative 3 provides the maximum aircraft parking capability with ten positions, followed by Alternative 2 with nine positions, and Alternative 1 with seven positions. While Alternative 1 provides the least amount of employee parking, it utilizes potential parking areas for GSE storage instead. Alternative 2 utilizes this area for parking spaces, which is why it can accommodate the most vehicle parking of the three alternatives.

Figure 13-4 MSP Cargo Alternative 1



Source: L&B analysis, 2021

Figure 13-5 MSP Cargo Alternative 2

Source: L&B analysis, 2021

Figure 13-6 MSP Cargo Alternative 3

Source: L&B analysis, 2021

14 Conclusions, Strategic Direction & Next Steps

This Air Cargo Assessment Study was undertaken on behalf of the MAC with the basic objective of exploring opportunities (domestic and international) for pro-active cargo development at MSP. Inherent in that effort was that the consultants should identify any barriers to that development – most obviously the resources that the Airport can control but also the one they can't, the off-airport freight forwarding community.

This study contains all elements listed in the original scope of work, specifically: 1) An inventory of existing cargo facilities and other services to establish a baseline capacity; 2) Profile of existing conditions at MSP and in the regional market; 3) Identification of trends and future demand (basically, forecasts); 4) Benchmarking; 5) Workshop to set the stage for the Assessment and begin the interviewing process; 6) Gap Analysis to determine if forecasted needs can be met; 6)Summary report with conclusions and recommendations (this section). Predictably, the implementation of the scope of work caused some areas to rise and fall as priorities (according to discovered relevance), so the form of the report does not neatly follow the order suggested in the preceding numbered tasks but all tasks (and more) are addressed herein.

The conclusions are not only the product of analytical exercises and facilities modeling but direct input from the industry workshop hosted by L&B and MAC, as well as numerous interviews with a diverse array of carriers, cargo handlers, freight forwarders, Minnesota and local transportation planners, academia, community organizations and local businesses. Throughout, the consultants were aided by consistently cooperative and thorough input from personnel within the MAC.

14.1 Conclusions

At their broadest, air cargo opportunities can be generalized as domestic and international. Not just in the MSP market but the U.S. in general, the domestic air cargo market has been dominated by FedEx and UPS but more recently Amazon has accounted for as much cargo activity as the integrated carriers in markets of e-commerce emphasis. Generally, the international cargo market is more expansive in terms of the market shares of air carriers and layers of allied operators – with freight forwarders, independent handlers and trucking companies operating in conjunction with both passenger (belly cargo) and all-cargo airlines. At MSP, passenger hub carrier Delta is obviously a major carrier of both domestic and international cargo, while certain seasonal carriers, Condor and Icelandair solely participates in the international sector.

The dominant domestic all-cargo carriers – FedEx, UPS, Amazon, and to some extent, DHL – have extensive networks in which MSP is only one of many nodes. The integration of modes and services – which gives the sector its name – facilitates a more door-to-door service in which FedEx and UPS attempt to control as many operations as possible, typically providing their own handling, operating their own trucks and solely occupying dedicated facilities. Amazon is quickly making giant strides to engage in this part of the cargo delivery business, rather than relying on UPS and the USPS to deliver their products. Consequently, MSP (and any other spoke airport in these networks) has very limited ability to influence growth, apart from ensuring that the carriers have adequate facilities (building, ramp and supporting infrastructure) and services to accommodate the largely organic growth produced by local and regional demand within a service/catchment area. The biggest impacts on domestic cargo growth at a spoke (non-hub) airport derive from consumers and industry located off-airport beyond the direct influence of the Airport.

At MSP, the Amazon network has not fully matured yet. The existing operation, of roughly three flights a day, does no sortation or consolidation of loads or cargo. The existing, shared facility is simply used as a pass-through to a

building located approximately 12 miles away from the airport. As mentioned above, direct influence on carriers is usually very limited apart from ensuring adequate facilities are available to the carriers. In Amazon's case, the existing facility is woefully lacking.

As previously indicated, international air cargo development is more complex due to the greater diversity of operators. International gateways compete on the basis of network connectivity, defined as the diversity of carriers (ideally a mix of belly cargo and freighter operators), direct international destinations and flight frequencies that provide 'recovery' options for time-sensitive shipments to meet schedules even when flight delays and cancellations occur. All of MSP's scheduled international capacity is provided in the bellies of passenger flights operated by Delta and partner carriers. The hub provides MSP with superior capabilities over airports lacking a major passenger hub with international flights but at a disadvantage to gateways – such as ORD – that have extensive international freighter service.

Almost immediately, MSP's existing integrator cargo facilities were indicated to be satisfactory for the near- and long-term forecasts. The carriers suggest that no extensive modifications will be necessary to their existing facilities.

A couple of carriers have expressed concern on the lack of refrigerated space for their operations. Delta has 700 square feet of cooler space in their facility today but believes they need closer to 2,000 square feet to be efficient and meet the demand. Very recent communication with them indicates that they are at cooler capacity daily and "busting at the seams". Air General, located in the Air Cargo Center is currently using a 53' trailer to accommodate their perishable requirements. This is not a preferred alternative and they would like to see a new facility that could possibly be used by multiple entities.

Documented in the report, MSP has third party handlers, such as Air General, WFS, and DGS. Third-party handlers are integral to belly cargo operators and other clients, as well as the accommodation of unscheduled (charter) freighter operations. Air General, WFS, and an existing carrier, cited their need for additional cargo warehouse as a requirement to take advantage of any new international flights that MSP may attract.

Rather than international air cargo growth having been constrained by a lack of air service, the MSP market often has surplus belly capacity on its international routes. When forwarders require freighter capacity, international cargo is trucked to/from larger international gateways and integrator hubs, such as ORD, RFD and IND. Neither the anecdotal feedback from freight forwarders, nor international trade data suggest that sufficient unmet demand exists to justify an aggressive pursuit of scheduled international freighters. That doesn't preclude the MAC from pursuing those interests, but other endeavors (new Amazon facility) may prove more fruitful.

While trade data - excerpted earlier in this report and in more detail in the appendices – and interviews indicates that significant amounts of international cargo bypasses MSP, this is far from an assurance that an ironclad opportunity exists. MSP's main export and import markets are those, which have direct air service. This is not a matter of air service necessarily "making the market" but rather of shippers following the belly cargo opportunity created by the existence of passenger flights. The one notable exception is Germany. Germany is the 4th largest trading export partner, by weight, and the largest import trading partner. The annual weights for German exports and imports, however, would translate into approximately one cargo positions every other day for exports and about one and a half positions per day for imports (assumes each position is approximately 5,000 pounds).

The more intriguing opportunity may be accommodating international charter flights. However, this possibility faces a variety of challenges, specifically the availability of common use facilities. The most obvious candidates (Air General and WFS) to handle such operations have stated that they would both need additional building space to take on those opportunities in addition to lacking dedicated (and bonded for international flights) space for cargo processing. However, while occasional exemptions are available, sustained international freighter charters will

require dedicated, bonded space that the handlers prefer to have be common use – available on a per use charge. When surplus capacity exists, this would be less of a concern but opportunity costs (rental revenue) exist should the MAC reserve such space en lieu of tenants.

The chartered freighter opportunity presents a “test case” for MSP’s collective cargo resources, as well as the MAC’s appetite for a speculative investment. Future revenues depend on newly generated demand (reasonable in a relatively thriving regional economy) and operations captured from other regional rivals. A possible derived benefit from the charter business is that such operations can transition into scheduled service.

14.2 Strategic Direction & Next Steps

Amazon appears to be headed toward a decision to expand their operation at MSP. MAC should be pushing that option forward sooner rather than later. The available land can easily support the anticipated facility requirements with room to expand in the future.

The cargo market over the last year has been growing very quickly. The effects of the pandemic have changed many consumer habits and those habits have translated into even faster e-commerce growth than had been planned, even as soon as two years ago. MAC has an opportunity to make a strategic decision on whether to build a facility to accommodate that potential growth. Current cargo facilities are potentially limiting the possibilities of larger freighters coming to the airport. MSP is fortunate to have enough land to accommodate a growing Amazon and a potential new cargo entity. It appears that the only option for slowing the freight forwarders movement of goods to ORD is to attract all-cargo freighters to MSP.

Facility limitations notwithstanding, MAC should consider an incentive program for new international cargo flights. A waiving of the landing and parking fees for a year may help to attract that needed flight.

15 Appendix

Table A-1 2020 MSP Customs Port Air Exports by Country

Port	Air Total Exports SWT (kg)	Air Total Exports Value (US$)
World Total	**5,367,715**	**615,601,041**
Canada	1,730,462	163,999,693
Netherlands	579,924	52,721,888
United Kingdom	471,971	47,293,816
Germany	347,951	40,908,624
Korea, South	331,389	28,314,197
Hong Kong	297,187	4,091,107
Japan	231,648	50,856,852
China	206,965	13,621,604
France	189,631	26,937,122
Belgium	188,351	15,517,901
Philippines	133,369	23,619,076
Costa Rica	77,384	16,632,646
Singapore	58,412	25,876,436
Italy	58,343	18,995,404
Ireland	57,578	16,089,254
Switzerland	56,063	6,905,358
India	36,708	2,680,138
Taiwan	33,052	11,920,001
Malaysia	29,628	14,233,940
Poland	23,498	1,473,804
Czech Republic	22,020	710,357
Thailand	21,216	5,451,862
Australia	18,531	3,017,137
Sweden	16,606	2,573,706
Finland	14,753	1,172,581
Hungary	13,411	749,028

Source: U.S. Bureau of Census with analysis by L&B.

Table A-2 2020 MSP Customs Port Air Imports by Country

Port	Air Total Imports SWT (kg)	Air Total imports Value (US$)
World Total	**4,968,371**	**317,688,011**
Germany	1,043,147	72,069,053
Netherlands	453,971	10,770,509
United Kingdom	382,319	32,887,100
Korea, South	330,005	10,556,826
Denmark	304,168	9,749,011
Japan	285,217	25,486,885
Taiwan	268,357	28,035,539
China	253,872	18,602,370
Italy	229,300	18,644,642
France	147,791	14,764,057
Belgium	147,050	6,418,167
Finland	141,352	4,198,687
India	122,102	2,335,796
Canada	121,335	13,417,124
Norway	116,185	2,191,590
Poland	90,139	5,048,239
Austria	71,489	3,554,810
Czech Republic	43,692	2,074,420
Switzerland	41,648	6,082,933
Sweden	35,200	3,430,396
Thailand	31,893	1,934,906
Australia	26,409	1,557,856
Ireland	26,100	4,294,880
Spain	23,130	810,811
Hungary	22,987	1,394,048
Vietnam	22,718	1,159,438
Malaysia	17,992	2,095,586
Philippines	11,843	1,113,523
Slovakia	10,284	1,027,611

Source: U.S. Bureau of Census with analysis by L&B.

TABLE A-3 2020 MSP CUSTOMS PORT AIR EXPORTS BY COMMODITY

Commodity	Asia	Europe	Asia	Europe
	kg	kg	$	$
Total All Commodities	1,409,372	2,108,332	185,130,446	240,458,363
84 Nuclear Reactors, Boilers, Machinery Etc.; Parts	544,415	499,339	25,901,989	26,846,383
90 Optic, Photo Etc, Medic Or Surgical Instrments Etc	218,747	349,642	98,209,967	112,614,421
39 Plastics And Articles Thereof	189,124	291,703	5,644,918	10,564,183
85 Electric Machinery Etc; Sound Equip; Tv Equip; Pts	144,310	243,519	34,889,670	28,030,938
29 Organic Chemicals	63,701	7,402	2,413,106	4,735,778
48 Paper & Paperboard & Articles (inc Papr Pulp Artl)	37,356	48,671	151,546	613,289
73 Articles Of Iron Or Steel	23,719	28,321	600,534	630,779
33 Essential Oils Etc; Perfumery, Cosmetic Etc Preps	22,194	43,025	821,316	590,185
38 Miscellaneous Chemical Products	20,369	72,441	838,140	14,253,365
30 Pharmaceutical Products	17,571	52,863	4,135,569	25,735,324
87 Vehicles, Except Railway Or Tramway, And Parts Etc	15,058	81,640	664,103	2,200,923
76 Aluminum And Articles Thereof	13,943	14,367	2,087,591	609,979
96 Miscellaneous Manufactured Articles	12,340	3,012	109,789	108,106
40 Rubber And Articles Thereof	10,886	26,171	607,163	539,948
83 Miscellaneous Articles Of Base Metal	7,257	24,661	963,279	623,628
34 Soap Etc; Waxes, Polish Etc; Candles; Dental Preps	4,914	3,629	37,852	31,571
32 Tanning & Dye Ext Etc; Dye, Paint, Putty Etc; Inks	4,708	6,760	199,683	336,851
21 Miscellaneous Edible Preparations	4,608	48,889	121,769	417,688
82 Tools, Cutlery Etc. Of Base Metal & Parts Thereof	3,751	7,941	612,321	1,064,957
61 Apparel Articles And Accessories, Knit Or Crochet	2,250	2,711	89,616	50,543
35 Albuminoidal Subst; Modified Starch; Glue; Enzymes	2,173	84,314	153,290	912,977
59 Impregnated Etc Text Fabrics; Tex Art For Industry	1,940	18,736	33,537	919,106
49 Printed Books, Newspapers Etc; Manuscripts Etc	913	16,361	134,778	414,168
56 Wadding, Felt Etc; Sp Yarn; Twine, Ropes Etc.	806	8,396	12,630	229,578
74 Copper And Articles Thereof	725	4,238	65,278	100,436
94 Furniture; Bedding Etc; Lamps Nesoi Etc; Prefab Bd	645	20,397	55,706	608,702
95 Toys, Games & Sport Equipment; Parts & Accessories	614	13,171	46,300	381,719
17 Sugars And Sugar Confectionary	339	21,657	5,764	41,614
44 Wood And Articles Of Wood; Wood Charcoal	324	1,941	5,277	28,446
69 Ceramic Products	160	11,783	39,687	131,124
88 Aircraft, Spacecraft, And Parts Thereof	123	12,527	249,898	4,639,513
15 Animal Or Vegetable Fats, Oils Etc. & Waxes		14,750		23,411

Source: U.S. Bureau of Census with analysis by L&B.