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Overnight Air Express: Spatial Pattern, Competition and the Future in Small  
Package Delivery Services

請閱讀上述附件個案後，回答下列幾個問題

- (1)(10分)說明何謂包裹快遞產業?又此運輸產業所具有的特性為何?
- (2)(20分)請替此論文書寫一段摘要。
- (3)(20分)說明何謂軸輻式網路(Hub-and-spoke network)?此類網路的功能為何?說明包裹快遞營運方式?說明中繼站(hub)設置的重要性與原則?
- (4)(25分)說明包裹快遞的市場結構?說明FedEx的競爭策略是什麼?您是否贊成這些競爭策略?您是否認為價格是一項好的競爭策略?請替FedEx提出您認為適宜的競爭策略，使公司能繼續維持顧客的忠誠度與高獲利能力?
- (5)(25分)您認為FedEx最成功的因素為何?有那些競爭策略或管理理念是值得國籍快遞業者所值得學習的?又如何推動，請舉實際案例說明?

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# Overnight Air Express: Spatial Pattern, Competition and the Future in Small Package Delivery Services

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THE history of transportation is full of revolutionary technological innovations that forever change the world of commerce and profoundly affect the patterns of regional and world development. Sometimes, though, the transportation world is swept by a new method of using existing technology—a new system formed by reorganizing commercial activity into more efficient and productive patterns. Such was the case in the 1950's and 1960's when containerization made available a new, more efficient system of intermodal transportation over land and sea for all kinds of general cargoes. Similarly, the inception of overnight air express delivery systems in the 1970's revolutionized small package shipping in the United States.

This "new concept" in air transportation, generally attributed to the genius of Frederick Smith, the founder of Federal Express, has today made it possible for any individual, business, or governmental unit to ship a small parcel overnight, door-to-door, between any two points served by a delivery service's transportation network. In the course of 10 years, these service networks have expanded from serving just a handful of metropolitan areas to, in the case of Federal Express, 305 of the United States' 323 SMSA's (Standard Metropolitan Statistical Areas) and serving areas inhabited by 82 percent of the U.S. population.<sup>1</sup> United Parcel Service, one of the newest entrants into the overnight air express market, announced in October 1983 that its Next Day Air service would reach areas containing 88 percent of the

1. 1983 *Federal Express Corporation Annual Report* (Memphis, TN, 1983), p. 3.

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U.S. population, thus becoming the most extensive overnight delivery system in the nation to date.<sup>2</sup>

Virtually the entire nation has become interconnected by a one-day delivery system for the transport of priority documents, business goods, and small packages. The highly interdependent and integrated economy of the U.S. has provided the necessary demand to drive this service industry from an infant to a giant at a phenomenal growth rate. The demand for time-sensitive delivery of letters, documents, parts, computer equipment, and other parcels created the need for this specialized service, which is most efficiently accomplished through the use of elaborate networks specifically designed for such service.

The \$3 billion a year small package service industry is one of the fastest growing in the American economy.<sup>3</sup> It is also the battlefield of some of the most intense business competition, with a variety of companies vying for a share of this lucrative, previously untapped market. Competition has come from companies formally involved in other transportation services, such as parcel delivery, freight forwarding, or courier services, as well as from the U.S. Postal Service. This article examines the nature and structure of this competitive new service, and focuses on the spatial patterns of the domestic air transport systems employed by carriers involved in overnight air express delivery.

## AIR EXPRESS DELIVERY OPERATIONS

The concept of overnight, door-to-door express delivery over a large, dispersed geographic region like the U.S. depends on using a single central sorting facility where all parcels from any location and destined to any other location pass each night. In general, companies providing this service operate similar systems with their own aircraft organized into complex networks converging on sorting facilities at centrally located airports.

*An Example in Action*

Each day parcels are gathered by ground vehicles (vans, trucks, etc.) in all of a company's local service areas (generally before 5PM), collected at airport terminals, and then loaded into planes for trans-

2. "United Parcel Service," *Defense Transportation Journal* (December 1983), p. 79

3. Eugene Kozicharow, "Small Package Competition Intensifies," *Aviation Week and Space Technology* (April 25, 1983): 42.

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port to the central facility. Flights from all around the country are carefully scheduled to arrive at the sorting facility within a span of a few hours in the middle of the night. Here the cargo is rapidly unloaded and sorted by destination and then reloaded onto waiting planes for passage to the local service areas, all in a matter of a few hours. Once at the local airport terminals, the parcels are loaded back onto ground delivery vehicles and rushed to their final destinations by 10:30AM, noon, or 5PM, depending on the customer's location, the carrier's agreed service, and/or the type of service purchased. In some instances, especially those involving delivery to remote destinations, delivery may even take place on the second day rather than overnight.

This type of system (commonly referred to as "hub and spoke" because of the radial pattern established by the network) is structured around the concept of flying several planes from various points of origin to one central location.

*The Hub and Spoke System*

The use of a hub and spoke system in transportation is certainly not unique to the overnight air express business. Domestic passenger airlines use the hub and spoke concept when they route several flights into a central airport to allow passengers to make connections with flights to a variety of destinations. Although this type of "complexing" activity has become quite common among U.S. domestic passenger carriers, it is not a new development. American Airlines employed a complexing system in their route network as early as 1961.<sup>4</sup>

The hub and spoke system has emerged in transportation as a means of interconnecting a large number of points while efficiently utilizing transportation equipment, fuel, and labor. It allows air express companies to quickly and efficiently connect more city-pairs with service than could be accomplished by flying direct between each city-pair combination in the system.

A comparison of Figures 1 and 2 emphasizes the difference between direct routing and hub and spoke networks. Suppose nine branch offices of a corporation located in nine dispersed locations around the U.S. need to send various parts, documents, and plans to each other on a daily basis. Each office sends out one parcel to each of the other offices every day. If all of these were to be connected directly

4. Howard John Thiersch, *Network and Schedules: A Look at Airline Strategies* (Master of Arts Thesis, University of Washington, Seattle, 1980), p. 62.

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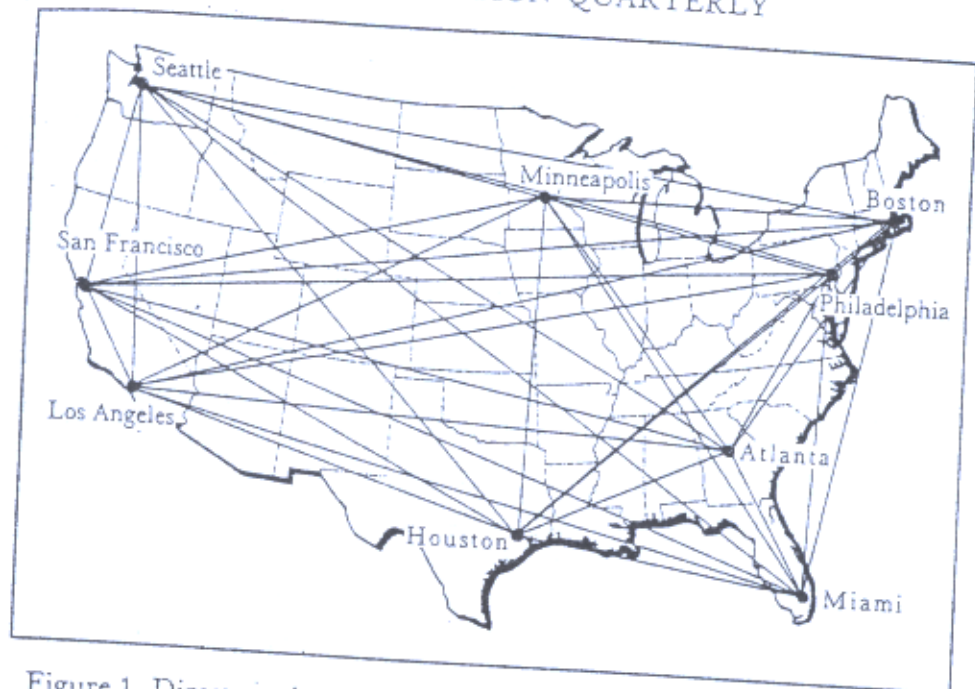


Figure 1. Direct routings connecting nine locations (36 two-way routes)

with each other, a total of 72 one-way direct flights would be required each night (see Figure 1).

Now, assume a facility is established at an airport somewhere in the center of the country where one flight from each of the nine branch office cities would converge nightly. There, the 72 packages would be gathered, sorted, and reloaded on planes for delivery to the destined offices. Such a system would require only 18 one-way flights or nine two-way links to connect all the offices (see Figure 2). Not only are fewer planes and pilots needed, but also tremendously fewer air-miles are flown.

Just as passenger airlines employ complexing networks in order to increase possible sources of passenger flows on their routes, an air express company increases the potential sources for packages through centralized complexing of its routes. However, while passenger airlines have generally found that the traffic generating ability of the hub location itself is an important component in their operations' success, air express delivery operations are really not dependent on business generated by the hub's local area.

Additionally, air express operations can easily alter route networks and reallocate flight equipment in order to compensate for changing volume flows to and from various destinations. Since they do not need to publish and distribute their schedules or book reservations

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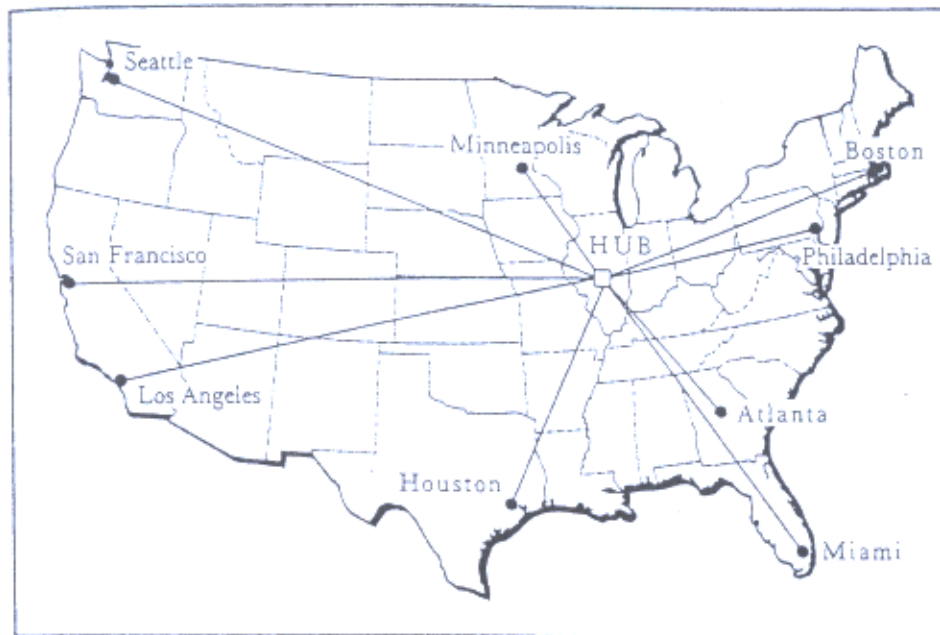


Figure 2. Complexing through a hypothetical Midwest hub (9 two-way routes)

in advance like passenger carriers, small package delivery services are much more flexible. As long as an air express carrier delivers the packages to the proper destinations on time, they can perform the task in the method most convenient for them—even if it requires circuitous routing and many stops. An air passenger probably would not appreciate or tolerate flying from Portland to San Antonio by way of Seattle, Minneapolis, Memphis, Dallas, and Houston; but the sender of a 20-page document in a sealed envelope probably wouldn't object to such a roundabout journey as long as it reached its destination safely and on time.

#### COMPETITION IN AIR EXPRESS SERVICES

Primarily because of the intense competition, the business of overnight air express shipping has become one of the most visible and most dynamic transportation systems in the last few years. The boldly painted delivery vans of various carriers have become common sights in urban areas throughout the U.S. Overnight air express companies have invested heavily in aircraft, sorting facilities, and delivery vehicles in order to expand their geographic coverage and their market shares. They have also spent large sums of money to promote their services; air freight carriers were expected to spend \$160 million on

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television advertising in 1983 to publicize and push their overnight services.<sup>5</sup>

*Federal Express: Industry Leader*

Enjoying a "head start" on its competitors, Federal Express has continued as the industry's leader. By February, 1984 Federal Express handled an average of over 290,000 total packages per day, while its closest competitor in volume, Airborne Freight Corporation, handled about 50,000 packages per day.<sup>6</sup>

Currently, Federal Express operates 76 aircraft, with delivery of 15 Boeing 727-200's expected in the next few years. Their fleet consists of 6 DC-10's (their largest aircraft with a 105,000-pound cargo-carrying capacity); 38 727-100's (each carrying 40,000 pounds), and 32 Dassault Falcons (converted executive jets that carry 6,000 pounds each).

The Dassault Falcon was the first jet operated by Federal Express. Smith had selected the Falcon in order to avoid Civil Aeronautics Board regulations controlling rates, routes, and services of all aircraft carrying over 7,500 pounds of freight. By 1976, however, this same regulatory loophole, which had made Federal Express possible in the first place, was limiting its growth and inflating its costs.

Unable to use large aircraft, the company was sending as many as six fully loaded Falcons nightly to a single city—wasting \$25,000 a night as well as thousands of gallons of fuel.<sup>7</sup> Realizing that federal regulations were deterring expansion attempts, Federal Express proceeded to take their case to Congress. They lobbied heavily for a bill that would permit them to buy and operate bigger jets. But, what they were part of winning in November 1977 was a much bigger victory—total deregulation of the air freight industry. This opened the door for the rapid expansion of Federal's services as well as those of its competitors.

*Growing Competitors*

While Emery Air Freight and Airborne Freight were both involved in domestic and international freight forwarding before

5. Robert Raisman, "Airborne Delivers Challenge," *Advertising Age* (August 29, 1983): 1.

6. *Federal Express Corporation Financial and Statistical Report—Third Quarter Supplement Fiscal 1984* (Memphis, TN, 1984), p. 8. Personal Interview with Graham Dorland, Chairman, Airborne Express (Seattle, WA, May 2, 1984).

7. "Emery Returns Federal Express's Fire," *Fortune* (May 17, 1982): 120.

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entering the air express delivery market, neither had owned or operated aircraft before. As of 1983 Emery owned or chartered 64 aircraft. Airborne, who officially entered the air express business in 1980 after purchasing Midwest Charter Express Airlines, now operates 26 aircraft (13 DC-9's and 13 YS-11's) and charts an additional 30 for short range feeder routes.<sup>8</sup> Emery has built a sorting facility at the municipal airport in Dayton, Ohio, while Airborne's is located in Wilmington, Ohio.

Emery and Airborne have been leading competitors in the express package market in recent years. Airborne widely publicized the fact that it had passed Emery in package volume in the third quarter of 1982. Airborne envisions itself as *the* alternative to Federal Express, a position they intend to maintain.

*'Most people use more than one air express carrier. They don't want to put all their eggs in one basket,' said Louise McNamee, Exec. VP-Director of Marketing at Della Femina [Airborne's advertising agency]. 'One of the things we have attempted to do in this new [market] positioning is to ensure that Airborne is that alternative. . . .'*<sup>9</sup>

Purolator Courier is also a market competitor. They operate a sorting hub in Indianapolis, Indiana. United Parcel Service (UPS), which has been delivering parcels since 1930, started an overnight package service in September 1982.<sup>10</sup> Their Next Day Air Service operates out of a recently expanded Louisville, Kentucky sorting facility near Standiford Field. In October 1983, UPS expanded their service to areas containing 88 percent of the U.S. population and increased their air fleet from 33 to 72 planes.<sup>11</sup> UPS, though, is in a rather different position than other overnight delivery services.

*United Parcel Service, the "brown giant," dwarfs other truck fleets, and most of its vehicles are much larger than those used by its competitors. . . . However, UPS vans are not equipped with radios, so dispatchers can't coordinate their drivers well enough to guarantee that a package will be picked up the day you call. To get an overnight*

8. Robert P. Hanson, Editor-in-Chief, *Moody's Transportation Manual 1983* (New York, Moody's Investor's Service, 1983), p. 2116; *1983 Airborne Freight Corporation Annual Report* (Seattle, WA, 1984), p. 16.

9. Raisman, *Advertising Age*, p. 1.

10. Hanson, *Moody's Transportation Manual 1983*, p. 2146.

11. *Defense Transportation Journal*, p. 79.



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*delivery, you have to take the package to the UPS office by whatever time is the local deadline.*<sup>12</sup>

Nonetheless, due to its sheer size, UPS could prove to be a more prominent competitor in overnight delivery in the future.

*The Competitive Arena*

Air express companies have differentiated their services in a process of asserting what each feels to be their comparative advantage. This market differentiation has been described as a process of each company trying to find its "niche" in the marketplace.<sup>13</sup> For example, Emery has tended to concentrate more on the overnight handling of heavy freight, while UPS has marketed a less expensive Second Day Service to destinations throughout the U.S. Companies offer different-sized packs and envelopes with various weight limitations and rates. Catchy product names accompany these colorful packs supplied by the carriers (Purolator's "PuroPak" and "PuroLetter," Airborne's "Express Pack" and "Letter Express," Federal's "Courier Pak" and "Overnight Letter," and Emery's "Urgent Letter").

While companies generally offer flat-rate charges for packages within certain size and weight limitations destined for any location (most have one charge for letter packs under five ounces and one charge for packages of two pounds or less), their prices and policies for additional charges for remote location delivery, weekend delivery, and discounts vary. Most carriers also offer discounts to high volume users, especially since large national corporations have "shopped around" for the best deals they could get for their frequent use of overnight delivery services. Airborne in particular has been noted as a frequent rate-cutter; they often handle large national customers on an "exception" basis, offering lower rates in return for high volumes of package movement via the company.<sup>14</sup> Such arrangements are handled on an individual basis by Airborne sales representatives.<sup>15</sup>

Further efforts to attract and appease customers, as well as to differentiate service from that of other competitors, were made by Federal and Airborne in 1983. Both opted to move from their previous before-noon delivery goal to delivery by 10:30AM in most of their

12. Gus Hedberg, "The Great Package Delivery Race," *Money* (March 1984): 162.  
13. Dorland, Personal Interview.  
14. Raisman, *Advertising Age*, p. 1.  
15. Dorland, Personal Interview.

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major markets. This feature put even more pressure on the companies to operate swiftly and proficiently. Reliability is another feature these companies work to attain and also promote—some services announce rates of 99 percent on-time delivery.

Overnight delivery companies depend on very complex and efficient operations at their central sorting hubs in order to meet promised delivery times around the country. These facilities are generally very automated, but also quite labor intensive. At Federal's "Superhub" in Memphis, over 2,000 workers sort the night's packages within a "two-hour window"—the time between the last jet's arrival and the first jet's departure. The employees are aided by over 20 miles of conveyor belts and computer controlled diverter arms that send packages down various ramps and chutes. The entire process is video-monitored. Federal's Superhub has a nightly handling capacity of 330,000 packages, and is currently being expanded to handle up to 435,000 packages in time for Christmas 1984.<sup>16</sup>

## HUB LOCATION

The central sorting facilities operated by air express companies are quite obviously the heart of their entire operations—the vital organ that makes the whole system work. Apparently the location of these system hubs can have substantial impacts on the companies' operations. The hub's situation relative to all other points in the air network system can affect not only the time required to traverse the distance between these points, but also the types and sizes of aircraft equipment that can be operated to cover distance within time limitations.

The hubs operated by Airborne, Emery, and UPS are all located in the Ohio River Valley within a 100 mile radius of Cincinnati. Federal's Memphis base is roughly 400 miles southwest of the others.

*Hub Location Selection: Logic or Chance?*

One might expect air express companies to extensively analyze potential hub locations and base their locational decisions on some least-cost or shortest-distance calculations with regard to the air transport network. While some theoretical optimal location might be

16. Telephone Interview with Stuart McGehee, Investor Relations, Federal Express (Memphis, TN, May 4, 1984).

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identified through such a study, in actuality hub location is often determined by other factors.

Federal chose Memphis as their sort facility location when they started the first air express operation. The selection of Memphis as the hub site was influenced by three major factors. The first was that weather characteristics in Memphis are highly favorable for airline operations. Memphis has practically no adverse weather problems year-round and is not very susceptible to fog problems which many airports must contend with. Additionally, the Memphis International Airport was somewhat underutilized. Room was available for future expansion and the local port authority was very cooperative in facilitating development plans. Finally (some speculate most importantly!), Memphis is the hometown of Chairman Fred Smith. Federal had considered other locations before selecting Memphis; most serious consideration was given to Kansas City International Airport and Adams Field in Little Rock, Arkansas.<sup>17</sup>

Airborne is the only carrier to actually own and operate its own airport, Airborne Air Park in Wilmington, Ohio. The location, however, resulted more by chance and circumstance than by any pre-planned locational analysis. Airborne acquired ownership of the airfield—an old strategic air command base—when they acquired Midwest Charter Express Airlines through merger agreement in 1980. At one time Airborne had looked into the possibility of a hub located in St. Louis.<sup>18</sup>

*Implications of Hub Location*

A hub location, however selected, inherently has certain advantages and drawbacks. Federal has certainly benefitted from the fine weather conditions in Memphis that rarely impede flights. However, because Memphis is considerably more distant from the high concentration of cargo generating areas in the Northeast and Midwest, they have had to pay with inefficiency. Federal has been forced to fly larger jets (their 727's) in order to cover the greater distance to many cities in the Northeast-Midwest corridor. Consequently, they have often achieved an inefficient 60 percent load factor on many of these flights. Their competitors in the Ohio Valley can fly smaller planes and achieve higher load factors for flights to the same destinations. In fact,

17. McGehee, Telephone Interview.

18. Dorland, Personal Interview.

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it is Airborne's policy to achieve at least a 70 percent load factor on every flight or use other equipment on that route.<sup>19</sup> Of course, if Federal's future package volume continues to increase, this will be less of a problem.

Federal has experienced other advantages by being in Memphis. Since it is 400 miles nearer to the West Coast cities of San Francisco, Los Angeles, and San Diego, Federal has a longer time span each day to operate at each end of the system, gathering, sorting, and delivering packages, while still maintaining service deadline commitments.

Equipment types flown to and from these hubs can also have cost implications. For example, even though Federal's hub is closer to Los Angeles, Federal spends close to \$1 million more than Airborne each year on flight service to Los Angeles because they fly the 727 while Airborne operates the DC-9.<sup>20</sup> Airborne's savings come in the form of greater fuel-efficiency and greater labor efficiency, since only two pilots are required in the DC-9 cockpit while the 727 requires three.

Federal has indeed recognized that their Ohio Valley competitors have the advantage of proximity to major markets. Federal has plans for building a second hub in that region sometime in the future; a backup hub might be advantageous in the event of some kind of natural disaster at their other hub. Rather than bringing their entire operation to a standstill in such an event, Federal would be able to reroute shipments through the other hub.<sup>21</sup>

## AIR EXPRESS AND THE FUTURE

The overnight air express business continues to grow at a phenomenal pace, with more services offered and more customers using them. Such growth is expected to continue for years to come. As business volume grows, service providers will invest in more aircraft and more ground vehicles, and they will continue to expand sort facility capacities and network extensions. Federal Express will likely continue to be a trendsetter and role model in the industry. A look at their current developments and their plans for handling future cargo volumes may provide a preview of what is to come for the entire industry.

19. Dorland, Personal Interview.

20. Dorland, Personal Interview.

21. McGehee, Telephone Interview.

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*New Operations at Federal*

Federal has initiated two new operational tactics to help alleviate traffic at the Memphis hub. The first was started in late 1983 and is referred to as a "bleed-off operation." It involves the use of a facility in Newark, New Jersey known as the "Metroplex." The Metroplex is essentially a mini-sorting facility. Each night packages are trucked to this facility from nearby metropolitan areas including New York, Philadelphia, Washington, D.C., and Baltimore. Packages destined for other cities in this same region are separated out and sorted in Newark; the rest of the cargo is flown on to Memphis. The 5 to 8 percent of volume handled through this bleed-off operation helps ease some of the congestion at the busy Memphis hub, and there appears to be enough cargo volume in these markets to make the bleed-off operation efficient. Federal may eventually begin bleed-off operations in Chicago, Dallas, and Los Angeles.<sup>22</sup>

The "bypass operation" is Federal's other strategic innovation. This involves the presorting of packages by destination in the field. For instance, the Federal facility in Chicago may have a high volume of cargo destined for one specific area such as New York. Since Federal's cargo is transported in mini containers that are wheeled aboard the aircraft and around sorting facilities, workers at the Chicago station could fill up an entire container (or more) with packages solely for the New York station. When the container is flown to Memphis along with all the other cargo, the entire New York-bound container can be transported outside of the sort facility and taken directly to the cargo door of the jet destined for New York, thereby "bypassing" the sort center entirely. This type of operation can be performed between any city-pair generating a large volume of traffic in either direction.

The ultimate example of such a bypass operation would occur if cargo volumes between a particular city-pair reached the level where an entire plane could be loaded with packages destined for only one city and flown directly without any need for sorting at the central hub. This has not been done yet.

*The Use of Trucks*

Trucks may be used more in the near future to haul express cargoes over relatively shorter routes because some links in service

22. McGehee, Telephone Interview.

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networks may be more efficiently handled by ground transport, with its lower operating costs, than by air transport. For example, several companies have already used trucks to provide feeder links from locations within a few hundred miles of various air hubs.

## CONCLUSION

This article has not addressed the relatively recent activities in international air express service, despite its important role in the operations of many of these companies. This research also has not explored current efforts in electronic mail and other electronic transmission services that deliver same-day documents around the country. The impact of electronic mail on the overnight air express business will be interesting to observe.

The overnight air express industry is still very young and rapidly changing. Some analysts have speculated that the market may not be able to support so many competitors in such a capital intensive "high stakes" business.<sup>23</sup> Only the future will tell how companies respond to their business environment and whether increased cargo volumes will necessitate more development of regional sorting facilities and other innovations. Nevertheless the fast-paced overnight air express industry will certainly continue to provide an intriguing subject for study.

23. Kozicharow, *Aviation Week and Space Technology*, p. 42.