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Up, Up, and Away: The Dynamics of Innovation in the US Air Cargo Transportation Industry

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Up, Up, and Away:

The Dynamics of Innovation in the US Air Cargo Transportation Industry

Abstract:

In 1978 the United States (US) Congress passed the Airline Deregulation Act, allowing all-cargo airlines to compete in an industry that was heretofore highly regulated and stagnant. As companies came and went, successful carriers realized that innovation was necessary to survive. This study analyzes the dynamics of innovation over the industry's life cycle using intellectual property (IP) data. Results indicate that despite having the characteristics of a commodity, the industry follows a reverse life cycle. Furthermore, FedEx and United Parcel Service (UPS) hold the highest levels of innovation while dominating the market, signifying that innovation should be integrated into the competitive strategy of carriers searching for sustained competitive advantage.

Keywords: cargo, airlines, process innovation, product innovation, marketing innovation, United States, industry life cycle, intellectual property, Federal Express, United Parcel Service

1 Introduction

“and they shall yet transport merchandise upon great flying vessels.”
Marquis d’Argenson (1694-1757)

Thirty years ago, the United States (US) Congress passed the landmark Airline Deregulation Act, subsequently removing significant government control of airlines with hopes of increasing competition and allowing carriers to “operate as a business.” Following passage, passenger airline start-ups quickly moved into the turbulent industry, however transport of airline cargo remained largely a by-product of passenger travel service (Anonymous, 1998). Nonetheless, the Airline Deregulation Act also opened doors for cargo airlines to subsequently form and, in time, prosper in the new air transport environment. The implications for successful companies were and continue to be exceptional as market growth skyrockets resulting from the emergence of e-commerce and the escalation in economic globalization (Trilling, 2008). Just prior to deregulation, US transportation activity in air freight for 1975 was 3470 millions of ton-miles. By 1990, it was 9064 millions of ton-miles, and by year 2025 it is expected to grow to 33,925 millions of ton-miles (Trilling, 2008).

Similar to passenger airline service, the air transport of cargo is often viewed in economic terms as a commodity wherein competition often centers on price. However, it is also a service, a service where customers recognize a brand name and have a choice in choosing a cargo carrier that meets its needs with differentiated services and products. As such, successful innovation should be part of the strategic repertoire of companies with a services mission and mindset. While the majority of airlines in passenger air transport continue to struggle with innovation incorporation into their business strategies (Franke, 2007), the most successful all-cargo airlines smartly realized long ago that innovation is a necessary path to sustainable competitive advantage.

The purpose of this study is two-fold. The first objective is to examine the dynamics of innovation in the life cycle of the US cargo airline industry specifically comprised of all-cargo carriers as defined by the US Federal Aviation Administration (FAA). This excludes government owned and operated carriers such as those of the military or the US Postal Service (USPS). The second objective is to investigate the level and type of innovation developed by the leading US all-cargo carriers as prima facie evidence of sustainable competitive advantage through innovation. In this study, the authors concentrate on product, process, and marketing innovations. Product innovations are defined as “new products or services introduced to meet an external user or market need” (Damanpour and Gopalakrishnan, 2001, p. 47) and process innovations are defined as “new elements introduced into an organization’s production or service operations to produce or render a service” (Damanpour and Gopalakrishnan, 2001, p. 48). Finally, marketing innovations are defined as the generation and implementation of new, novel elements in the marketing process (Tinoco, 2005), focusing on product, price, placement, and promotion as the variables of interest.

Past studies of innovation in services has been minimal (Gadrey et al., 1995), however the study of innovation in air transport has been nearly non-existent. This study intends to fill that gap by investigating innovation in cargo airlines by careful examination of patents, copyrights, and trademarks filed by cargo airlines and approved by the US Patent and Trademark Office (USPTO) over the industry life cycle. In order to set the stage, a review of the history of the air cargo industry and relevant literature in innovation is presented. This is followed by a description on the data collection and results of data examination. Finally, managerial implications and directions for innovation in air transport are discussed.

2 US all-cargo air transportation industry.

2.1 History

The inception of the US air cargo industry began in earnest approximately 70 years ago when the US Congress passed the Civil Aeronautics Act. At that time cargo transport of goods centered on airmail (Allaz, 2004; Taneja, 1979; Wensveen, 2007). Despite some successes, the efforts expended toward profitable air transport of mail were hindered by multiple factors, including cost disadvantages over ground door-to-door deliveries, limited aircraft range and lift capacities, and lack of air freight facilities and proper infrastructure (Taneja, 1979). Nonetheless, the seed had been planted and carrier interest in air cargo began to grow.

Seeking oversight and control of anticipated growth in the air transportation industry, the US Government founded the U.S. Civil Aeronautics Board (CAB). By 1940, United Airlines offered the first all-cargo service and a year later established with American Airlines, Eastern Airlines, and Trans World Airlines (TWA) an airfreight research organization aptly named, Air Cargo Inc. (Allaz, 2004; Taneja, 1979). In addition to passenger transport, serious attention by incumbent passenger airlines was turning toward the transportation of air cargo, which now included mail, as well as freight and air express (Allaz, 2004).

The freight movement needs of World War II buoyed the birth of new all-cargo airlines, but the ultimate introduction of these new airlines by CAB was measured and slow. By 1949, four airlines (Airnews, Flying Tiger, Slick and U.S. Airlines) were issued certificates for scheduled all-cargo domestic operations by CAB on a limited 5 year, experimental basis. CAB believed that these new all-cargo airlines would facilitate industry growth and would be instrumental in developing and introducing new methods and business improvements to an industry struggling for direction.

Unfortunately, of the four new all-cargo airlines that were granted temporary certificates, only Slick and Flying Tiger survived the early turmoil. Furthermore, passenger airlines were now focused on passenger travel with cargo transport as a by-product of this service. With this continuing lack of attention by the passenger airlines to cargo, CAB approved two more new all-cargo airlines: Riddle Airways (which later expanded to Airlift International, Inc.) and American Air Export and Import (which exited the industry prior to deregulation) (Taneja, 1979).

Price wars, stiff competition by passenger airlines, bureaucracy, and years of tight control of the industry by CAB followed. Finally, in 1977, the first phase of airline deregulation commenced. Eager to stimulate competition through more varied pricing options as well as carrier-developed innovative service, the US Congress removed CAB control of the industry in terms of market entry and exit and significantly reduced CAB control of air freight rates (Allaz, 2004; Taneja, 1979). As a result, the industry grew after periods of turbulence filled with company births, failures, and acquisitions as combination carriers and all-cargo carriers fervently fought for the cargo market. Airlift International (formerly Riddle Airways) expanded and acquired Slick Airways (Ekland, 2008) while Flying Tiger acquired Seaboard, a registered irregular common carrier with international operations. Federal Express Corporation (FedEx) entered the industry in the early 1970s and ultimately purchased Flying Tiger in the late 1980's (Wensveen, 2007). United Parcel Service (UPS) was the original pioneer having attempted air cargo transport in 1929 with a merger with United Air Express (Niemann, 2007). The results were short-term and disastrous. They entered the market again in 1953 with UPS-Air (also UPS Blue Label Air), but not as an all-cargo carrier, instead utilizing cargo hold space in scheduled domestic airlines. Finally, with the competitive success of FedEx looming

large, UPS entered the air cargo market in earnest in the 1990s at approximately the same time as the bankruptcy of Airlift International (Eckland, 2008).

Today cargo includes mail, express, and freight, however the once-held division between express and freight are blurring (Wensveen 2007). The US cargo industry itself can be segmented into three types of airlines: all cargo carriers which provide air transport of cargo from departure airport to destination airport, such as Atlas Air; combination carriers transporting both passenger and cargo, such as United Airlines; and the integrated all-cargo carriers, such as FedEx and UPS, which operate all-cargo aircraft as well as provide door-to-door services. By far, the US domestic market is dominated by the latter category, the integrated all-cargo carriers (Wensveen, 2007). As shown in Figure 1, FedEx and UPS together have consistently captured in this decade approximately 80% of the air cargo market share in terms of revenues from mail and freight. Similarly, with respect to market share based on shipments, FedEx captured 42% of the US air express market while UPS captured 37.5% in 2007 (Aviation Week & Space Technology, 2008). More recently, DHL Worldwide Express has made a play for the US market, acquiring ABX Air (Airborne Express) and Astar Air Cargo, capturing 16.3% of the US air cargo market in 2007 (Aviation Week & Space Technology, 2008). Note that while there are numerous regional, scheduled and non-scheduled all cargo carriers, this study concentrates on scheduled all-cargo national carriers, excluding combination and government carriers.

2.2 Dynamics of innovation and air cargo.

Having established an appreciation of the history of air cargo in the US and its key players from inception to present, we turn our attention toward a better understanding of the dynamics of innovation in service industries. The theory of dynamics of innovation, proposed by Utterback and Abernathy (1975), offers one of the earliest

models in the study of product and process innovation in assembled and non-assembled products. The theory's basic premise is that innovation evolves over an industry life cycle in a series of three phases (Utterback, 1994; Utterback and Abernathy, 1975). The frequency of product innovations and production process innovations change during the course of each phase and throughout the continuum whereby the level of product innovations is high in the early part of the industry life cycle and subsequently decreases as the level of process innovations increases. In the fluid first phase of innovation, there is an increasing rate of radical innovation activity. In the transitional second phase, frequency of product innovations decreases but that of process innovations increases, leading to more efficient operations. In the specific phase, product and process innovations are incremental and the frequency of both declines. Refer to Figure 2.

While the original model has been and continues to be a mainstay in the innovation literature, industry influences with respect to model conformity have been examined, resulting in conceptual and empirical support that reveal the model is not generalizable to services industries (Barras, 1986; Barras, 1990). These industries have been proposed to follow a reverse innovation life cycle which often begins with the adoption of innovative information technology (IT) (Barras, 1986; Barras, 1990). This adoption is designed to increase the efficiency of delivering services as service industries use the IT innovation for incremental process innovations. In the second stage of the reverse cycle, the transitional phase, the IT innovation aids in increasing service quality. Barras (1986) describes this period as one with more radical process innovations. Lastly, in the third stage, the IT innovation is instrumental in generating new service (product) innovations. In addition, these new service innovations "create new demands" on the originally adopted IT, crossing industries and subsequently

becoming a new innovative force in IT (Barras, 1986; Barras, 1990). Thus, the reverse life cycle is the model of interest for this study. Although marketing innovations are also part of this study, no empirical data currently exists on the level of marketing innovations throughout the industry life cycle (Tinoco, 2005).

As aforementioned, air cargo carriers provide a service to their customers and, therefore, the industry is a rich context in which to explore innovations through the industry life cycle to date. While the air transport of cargo is similar in ways to passenger airline service, competition among air cargo suppliers is more sensitive to differences in service than in price (e.g., Taneja 1979). Prior to 1978, advocates in deregulation of cargo transport did not argue that deregulation would instigate price reductions, but instead would advance quality and service at a price customers were willing to pay. Early studies in cargo transport revealed that the top ten values in evaluating air freight providers, ranked by importance to the customer, included not only freight charges (second in importance), but service and quality factors as well, wherein consistent, on-time pick-up and delivery were first in importance, followed by time in transit; points served; frequency of service; loss and/or damage history; timely acceptance of shipments; door-to-door delivery; shipment tracing capability; and prompt claim service (Douglas Aircraft Company, 1978). Quality of service and operations, especially in such an industry, is an “essential precondition to profitability” (Allaz, 2004, p. 192).

Not only is the industry more sensitive to service issues, but its key component, cargo movement, differs from passenger movement in a number of crucial ways. Cargo is non-ambulatory and therefore requires an extensive range of ground handling services, infrastructure, and communication networks (e.g., Schneider, 1973; Taneja, 1979). It is heterogeneous, ranging from mail and small express packages to

large containers (Taneja, 1979). Early on, industry members recognized the impact that these unique characteristics had on the aircraft itself: fuselage, floor strength and tie-downs, door dimensions, interior provisions and movable partitions, among others (Allaz, 2004). Because of the distinctive nature of cargo and the necessity of improved and innovative services while keeping costs reasonable, savvy companies in the industry turned to development and adoption of innovations as part of their forward-thinking strategy. In the following section, analysis of innovation in the industry life cycle ensues, followed by a more in-depth examination of innovation in the most successful all-cargo carriers in the US, FedEx and UPS.

3 Method and Results

3.1 Data collection and categorization

The classic methods of data collection to capture innovative activity are either through executive survey of managerial perceptions (e.g., Chandy and Tellis, 2000; Miller and Friesen, 1982) or through secondary objective data, such as patents (e.g., Ahuja and Katila, 2001; Katila and Ahuja, 2002). Although perceptual measures among managers and objective measures have demonstrated statistically significant correlations (e.g., Pearce et al., 1987), a requirement of the data was to provide a longitudinal, objective, and unbiased depiction of innovation in the industry over time which could not be fulfilled using executive survey data. As such, the latter with respect to intellectual property (IP) was chosen for this study.

Since innovation type changes over the industry life cycle as well as the kind of industry studied (Barras, 1986; Utterback and Abernathy, 1975), patents alone which capture both product and process innovations are insufficient to capture the innovations in service industries where other categories of innovations, such as marketing innovations, may be more prominent. Therefore, the data collection effort

was expanded to include marketing innovations protected by copyrights and trademarks.

Based on the above rationale, a database of patents (design and utility), trademarks (and service marks), and copyrights was developed using the online IP databases available through the US Patent and Trademark Office. Design patents are granted for “new, original, and ornamental design for an article of manufacture” while utility patents are granted for “new and useful process, machine, article of manufacture, or composition of matter, or any new and useful improvement thereof.” Copyright are granted for "original works of authorship" while trademarks are registered for a “word, name, symbol, or device that is used in trade with goods to indicate the source of the goods and to distinguish them from the goods of others.” Finally, a servicemark is the “same as a trademark except that it identifies and distinguishes the source of a service rather than a product” (www.uspto.gov).

The US patent database was searched in its entirety (from date 1790 to present) to capture all patents that were registered by the all-cargo airlines, recalling that the first all-cargo airlines appeared in 1949. Similarly, the trademark and copyright databases were searched with the same criteria where capture was from 1979 to present (start date was limited by the respective online government databases). First, all three databases were queried with generic keyword search criteria (cargo, airlines, freight, mail) with minimal success. Next, the databases were queried with respect to patents, copyrights, and trademarks granted and registered to those all-cargo US airlines we found existed during the known history of the industry: Airnews, U.S. Airlines, Airlift International, Inc. (including Riddle Airways), Atlas Air, Seaboard, American Air Export and Import, FedEx (including Flying Tiger and Slick), UPS, DHL (including Airborne Express, ASTAR, and ABX). We discovered that no IP

protection was granted/ registered to Seaboard, Airlift, American Air Export and Import, Airnews, Atlas Air, U.S. Airlines, Riddle Airways, or Airlift International, Inc.

3.2 Dynamics of innovation in the industry.

Following examination of protected IP by company, the collected data for each entry were recategorized into innovation type: product, process, and marketing innovations. Based on our aforementioned definitions of said innovations, we first examined the type of patent (utility versus design) and then reviewed the patent descriptions which provided detailed information on the specifics of the protected IP. Out of the more than 200 patents granted during the studied time frame, only 12 were labeled as design patents. Examples of design patents included designs for electronic notepads, electronic bar code readers, and package and document receptacles. As these are not product or marketing innovations but are innovations that produce, deliver, or support a service, we categorized these design patents as process innovations. Likewise, utility patents were examined for categorization as product, process, or marketing innovations. Examples of innovations protected by utility patents included mail sorting systems and methods, wirelessly enabled trailer locking/unlocking devices, and inventions to read radio frequency identification (RFID) transponders. These were also categorized as process innovations based on our innovation definitions.

Next, copyright and trademark databases were examined for innovation categorization, specifically process or marketing innovations. Copyrights that were described “recorded documents” and “computer files” were labeled as process innovations and included items such as software for tracking packages and hexagonal information encoding. The remaining copyrights (motion picture, sound

recording/text, serial, and visual material) were categorized as marketing innovations as they largely focused on product packaging (boxes, stickers) and promotion (commercials, advertisements, art work). (Note: A small number of innovations may be better categorized as “organizational” innovations, such as customer packaging seminar materials, however for the purposes of this study were retained as subelements of marketing innovations.) Trademarks and servicemarks were also categorized as marketing innovations.

After thorough review of the IP and the subsequent categorization, no entries were labeled as product innovations. However, it is noted that some process innovations are an indication that product innovations in terms of new services may have been instituted by the associated company. For example, the patent for packaging receptacles points to the service innovation of allowing the customer to drop off packages and letters at secondary sites. The possibility of using IP data to examine these service innovations is path for future study.

In order to provide an overview of innovative activity over the industry life cycle, we replicated the technique by Utterback and Abernathy (1975) whereby we plotted the total number of process innovations and marketing innovations by year to date. Figure 3 reveals that the number of marketing innovations has rapidly outnumbered the number of process innovations from the time of deregulation and continues a steep positive trend to date. Process innovations lagged marketing innovations by approximately 8 years following deregulation, but have continued to grow in number despite decline in more recent years. Using the reverse life cycle model proposed by Barras (1986, 1990), process innovation data imply that the industry may have characteristics of both the transitional phase and the specific phase of the cycle, recalling that in the transitional phase, the IT innovation aids in increasing service

quality with more radical process innovations. Early process innovations centered on automated ground handling systems, order processing, communications networks, and containerization (Schneider, 1973), but transitioned to more radical process innovations, such as the handheld tracking devices. In the specific phase, the IT innovation is instrumental in generating new service (product) innovations, such as that which may result in new and novel mail and freight services. Marketing innovations began in advertisements and print material, such as forms, stickers, and labels, and trade/service marks, and continue in these areas but at a greater number.

Since the capacity to innovate in the marketplace is critical to outpacing competitors in a dynamic environment, it is essential that each business understand the pathways to innovation forged by leading companies. Most companies have a bias in their corporate culture that favors one or another variant of innovation (Magrath and Higgins 1992). Given the overwhelming dominance in the market by FedEx and UPS, a brief breakdown of innovation by company may explain, beyond the dynamics of innovation model, the trends noted above for the industry.

Led by founder, Fred Smith, FedEx was the first all-cargo carrier that employed innovation as the route to competitive advantage. Although hardly novel in today's environment, FedEx was the first company to purchase planes specifically designed for all cargo transport in place of refurbished passenger planes. Furthermore, the company delivered cargo using the innovative hub-and-spoke distribution for a faster, less expensive delivery service to more locations. While initially losing money with growing pains of a novel strategies, by the mid 1970s and into the early 1980s, FedEx was well on its way to becoming the top all-cargo carrier in the US. Fed Ex growth was further fueled by deregulation, allowing for purchase of larger aircraft and expansion in services. More importantly, however, FedEx continued its innovative

line of thinking, developing and implementing information and logistics technology innovations for use in improving customer service and efficiency (Bruner and Carr, 2004; Rivkin, 1998).

FedEx's top domestic competitor, UPS, began in 1907 and became the largest parcel delivery service in the world and by 1929, began air delivery service by use of cargo holds in commercial passenger aircraft. Until the 1980s, UPS ignored new service innovations, such as overnight delivery (Bruner and Carr, 2004). However, FedEx had become a formidable competitor and UPS eventually launched its own overnight delivery service. Slower to change was its low cost provider strategy which was no longer competitive against FedEx's differentiated product offerings based on innovative services and a premium price (Bruner and Carr, 2004). Determined to match its competitor's innovative competence and advantage, UPS made heavy investments in information technology and aircraft, providing the company with resources and capabilities to develop service innovations and move into the second top all-cargo airline in the United States.

Figures 4, 5, and 6 depict the innovative activities of the firms by type of IP. As can be seen by the figures, FedEx prefers copyrights over patents while UPS prefers patents over copyrights. UPS slightly outpaces FedEx in trademarks. IP registered in the US by DHL is low in all innovation categories. With the market dominated by FedEx and UPS, there is a clear one-to-one correspondence between Figure 3 at the industry level and Figures 4, 5, and 6. The increase in industry patent activity shown in Figure 3 was dominated by UPS, likely a result of their significant increase in research and development (R&D). Refer to Figure 4. Between 1990 and 1995, UPS invested \$3B in state-of-the-art technology (Blackmon, 1996) and increased the number of employees in technical, computer, and R&D from 95 in 1984 to over 4,000

by the mid 1990s (Day, 1995). UPS reengineered its strategy and image to morph from the low cost provider to one that offered differentiated products and service. In 1999, UPS went from a private company to public. At approximately the same time frame and for several years following, UPS significantly increased their marketing efforts, reflected in the noteworthy increase in the number of trade/servicemarks shown in Figure 6. Before the 1980s, UPS directed little attention toward marketing the company and services it provided. However, by 1996, the company has invested \$80 to \$100M in advertising alone (Blackmon, 1996).

The significant number of copyrights awarded to FedEx is not only indicative of their process innovation activity, but is reflective of their insistent and innovative marketing. From inception FedEx has supported an aggressive marketing campaign, but, in 1996 alone, company expenditures in advertising were approximately \$138M (Rivkin, 1998). The jump in marketing innovations in Figure 3 corresponds directly with the significant jump in Figure 6 in terms of trademarks awarded to FedEx during this time.

Competition fuels innovation, and, without a doubt, the data indicate that innovation is a key component of sustainable competitive advantage in the industry. Thorough examination of the IP databases developed by the US Patent and Trademark Office did not uncover IP registered by other all-cargo carriers whether they met our the description and criteria of the study (scheduled, non-passenger, non-government national all cargo airlines) or not. Two companies overwhelmingly dominated the database, FedEx and UPS. The fact that these companies also dominate the US market share, holding 80%, is an indication that their strategies involving innovation are successful.

5 Discussion and Implications

The purpose of this study was to examine the pattern of innovation over the industry life cycle of the US cargo airline industry and to investigate the innovative activity of the most successful US companies in this context. As shown, the data lend support to the reverse life cycle of a services industry proposed by earlier researchers and imply the industry has characteristics of both the transitional phase and the specific phase. While the industry is mature, expected growth presents a large number of innovation opportunities available for capture.

The air cargo industry faces a multitude of issues which necessitates a continued strategic drive of innovation by companies desiring growth and sustained competitive advantage. Researchers today believe providers of air cargo transportation must continue to increase efficiencies, streamline operations and develop new products and services while maintaining cost effective solutions (Lobo and Zairi, 1999). Furthermore, they must increase investments in technological innovations that range from IT and communications improvements to aircraft noise reduction and fuel efficiencies (Lobo and Zairi, 1999). Lastly, an organizational culture of innovation must be fostered (Baluch, 2006).

As stated earlier, US transportation activity in air freight is expected to grow to 33,925 millions of ton-miles by 2025 (Trilling, 2008). However, changes in how freight is transported between points and how it is managed are expected. Larger aircraft, but a higher volume of smaller shipments, are anticipated as the trend toward lower inventory and higher express package deliveries is forecasted. Additionally, integrated companies are expected to expand their logistics and transportation services and increase the use of intermodal elements into their transportation strategies (Trilling, 2008).

In the US, we can expect FedEx and UPS to remain the lead competitors in the domestic market, based on their past performance and their visions and strategic plans. FedEx corporate strategy includes a vision to create the most wide-ranging and far-reaching aviation and land network enhanced by development of innovative high value technological solutions (Lobo and Zairi, 1999). They continue the unprecedented levels of innovation in service, product, and process as a result of its deep-rooted innovation culture (Birla, 2005). Likewise, UPS maintains a vision of “moving ahead” and continues investments in technology, new services, and infrastructure (United Parcel Service, 2007). In the 2007 UPS annual report, the company noted the introduction of “industry first product innovations” in paperless invoice, delivery intercepts, and international returns. Finally, the future and direction of the industry is also partially dependent on the strategic moves of the more recent entrant to the US market, DHL. As reported earlier, DHL currently holds 16.3% of the US air cargo market in 2007 (Aviation Week & Space Technology, 2008).

In 1984, John Harvey, then president of the Transport and Distribution Group of the Institute of Marketing, predicted the innovative activity that would ultimately transpire in the cargo transport industry, noting that a significant increase would arise as a result of competitive challenges, customer requirements, and technology (Harvey, 1984). His prediction was not only accurate, but may have propelled successful companies to follow a strategy of innovation toward competitive advantage. Today is no different. Companies should continue to pursue innovation in services, process, and marketing, as well as organization, to remain successful. Customer-led innovations, technological advances, global opportunities, fuel costs, and

environmental concerns are just a sample of variables that will drive the innovation of the future.

Passenger airlines, faced with many of the same challenges, may do well by learning from the most innovative cargo airlines. In the past, passenger airlines relied on marketing innovations (frequent flier programs, APEX fares, etc.) and price adjustments to attain a temporary competitive advantage. Outside marketing innovations, legacy carriers often suffer from the “we’ve always done it this way” mindset which will become a barrier they must overcome for survival (Anonymous, 1998).

Future extensions of this research may include a recategorization of innovations. As noted, some innovations may be better labeled as organizational innovations instead of marketing innovations. Additional study in the connection between process innovations found in the IP data and the associated product innovations may lead to a refinement of innovation over the life cycle, incorporating an estimate of product innovations in service that occur as a result of the process innovations found. Lastly, minimal research exists with respect to marketing innovations despite the level of activity that occurs in the airline industry and beyond this industry context.

6 Conclusion

Centuries ago, Marqui d’Argenson (1694-1757) envisioned the transport of cargo upon “great flying vessels.” While his vision took hundreds of years to be fulfilled, the air cargo industry continues to thrive with a domestic and international market forecast beyond what could have possibly been envisioned by airline deregulation advocates in 1978. Relentless pursuit of innovation, then and now, continues to be a rewarding route to sustainable competitive advantage and subsequent firm survival as

the industry continues to be challenged by new entrants and an intense rivalry among incumbent firms.

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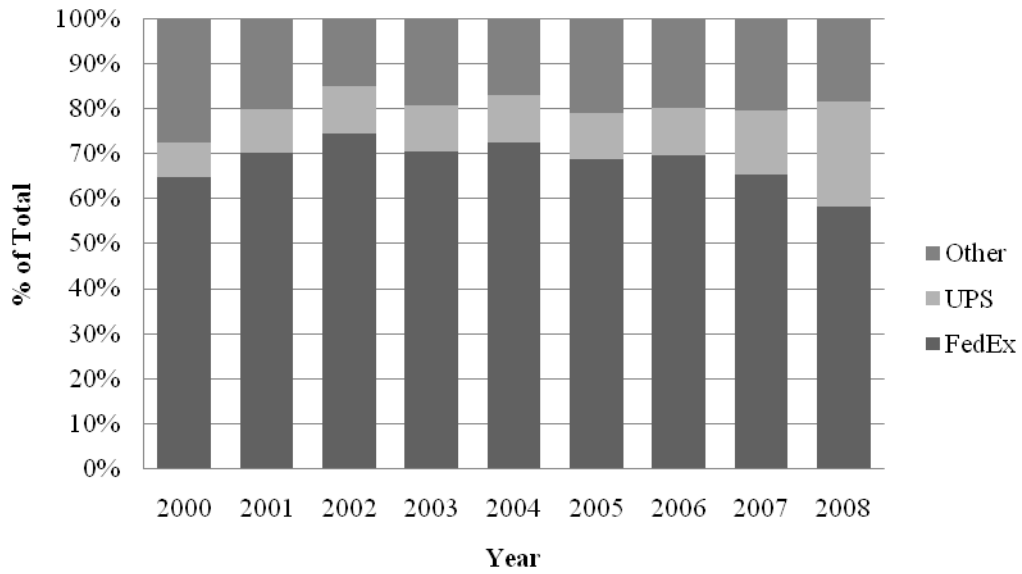
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Figure 1 US Air Cargo Market Share in mail and freight revenue (% of total)



Source: Information extracted from the US Bureau of Transportation Statistics (BTS). Revenues for UPS were not available prior to year 2000.

Figure 2 Dynamics of Innovation (Utterback 1994)

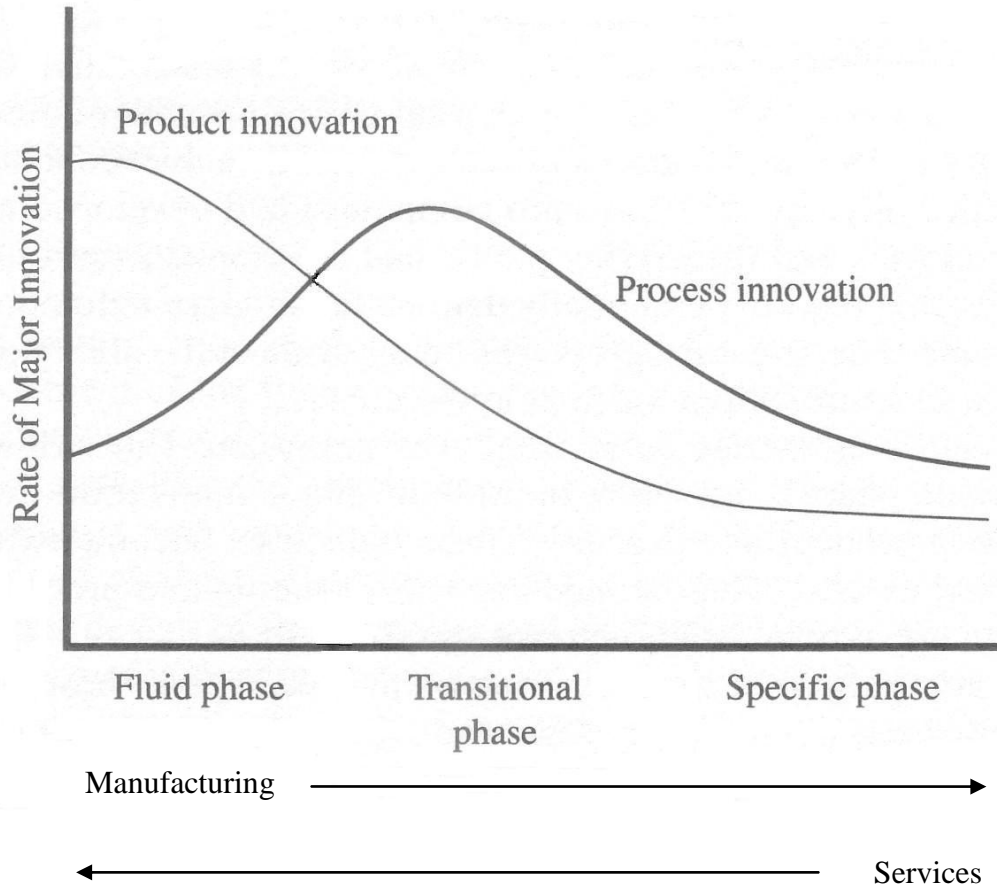


Figure 3 Dynamics of innovation US air cargo industry

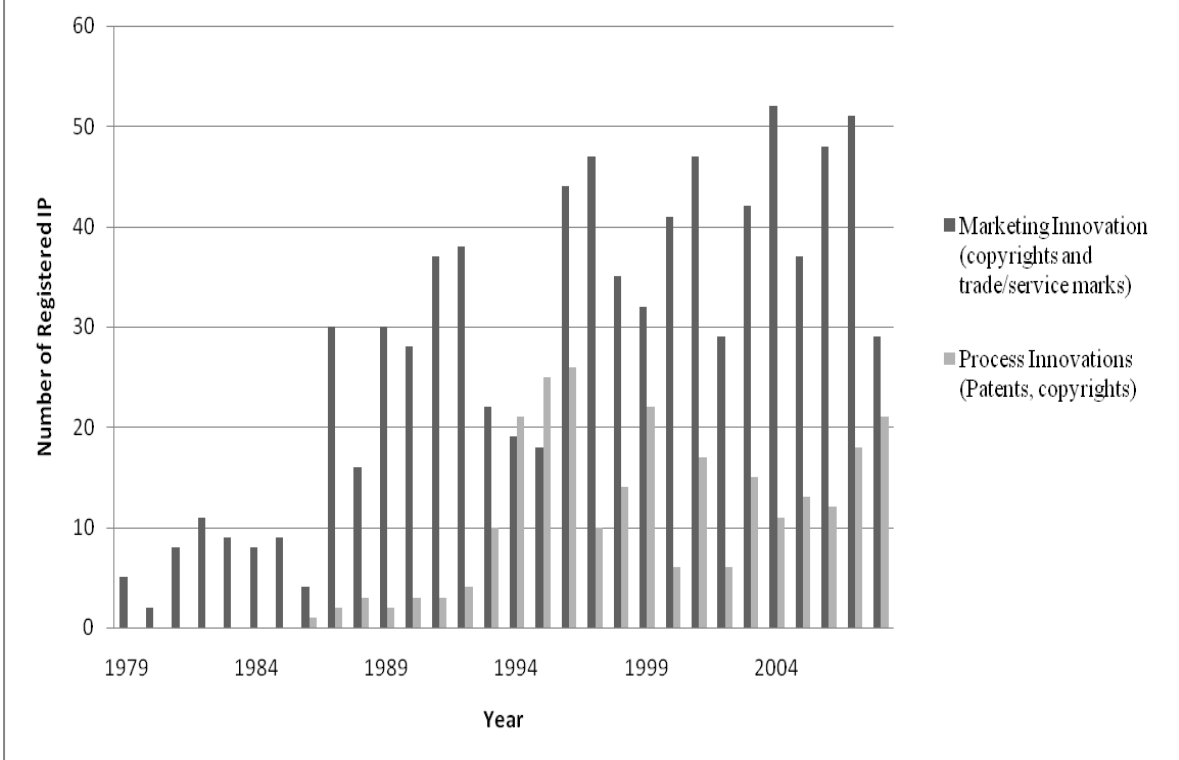


Figure 4 Number of patents per year by company

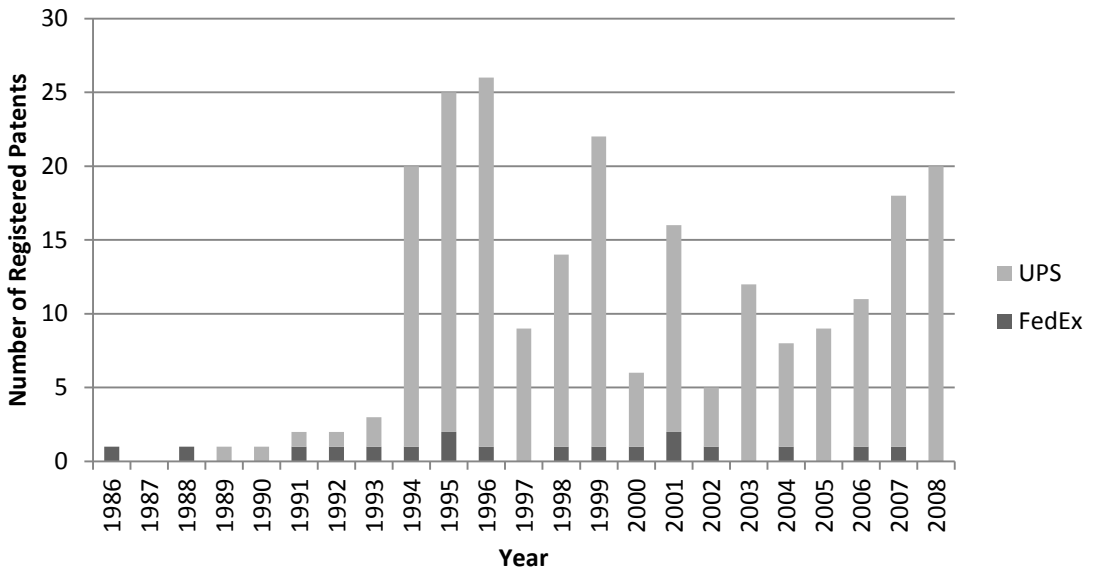
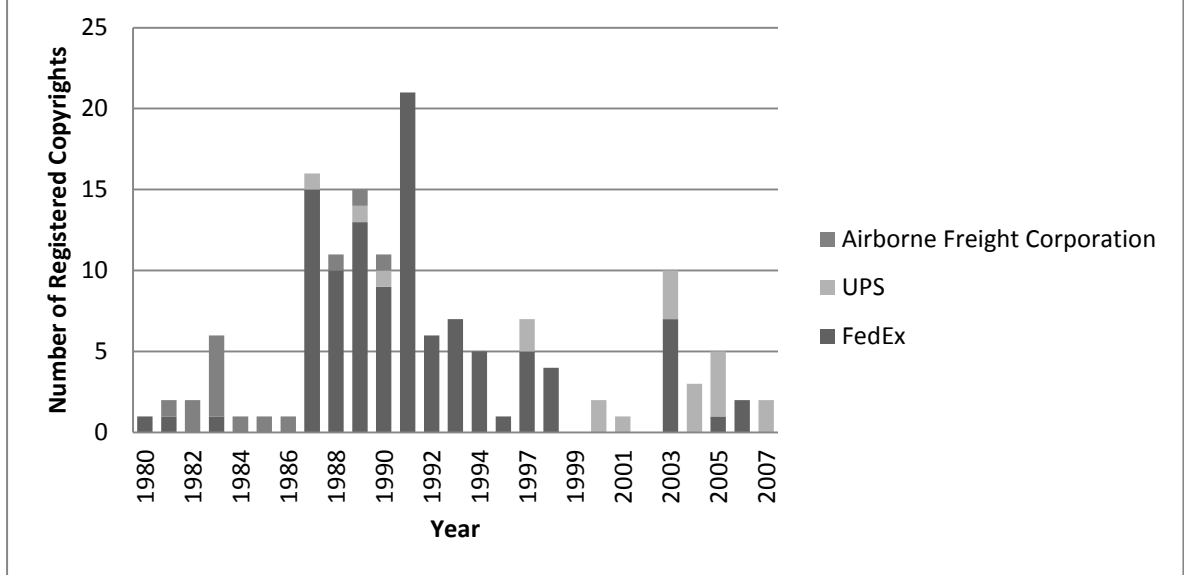


Figure 5 Number of copyrights per year by company



Note: Airborne Freight Corporation was acquired by DHL, Inc.

Figure 6 Number of trademarks per year by company

