

# **ECONOMIC FEASABILITY STUDY INTO THE VIABILITY OF AIR CARGO IN THE PACIFIC NORTHWEST**

by

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## **ABSTRACT**

In British Columbia there is a business opportunity to move airfreight between Vancouver and the Pacific Northwest. At present airfreight is not viewed as a priority by the airlines serving the area. There is sufficient demand for reliable airfreight delivery to the Pacific Northwest of British Columbia to support a viable business opportunity.

This project presents an estimate for the demand of airfreight in the Pacific Northwest, a strategic evaluation of the local air freight industry, a determination of the status quo with regard to existing facilities, and a description of a sample of aircraft suitable for the transport of freight. The project concludes with a financial analysis of an airfreight business opportunity, and offers recommendations for increasing the sustainability of an airfreight operation.

## **DEDICATION**

This paper is dedicated to my wife Marianne and my children Sebastian, Karoline and Frederick. It's finally over. Now we can get on with our lives.

## **ACKNOWLEDGEMENTS**

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# **1 PROBLEM/OPPORTUNITY STATEMENT**

The Terrace Economic Development Association (TEDA) exists to stimulate economic growth for Terrace and the neighbouring areas. TEDA acknowledges that access to a mode of freight transport that is both quick and reliable would aid in the economic development of Terrace. At present there is a lack of timely delivery of freight between Vancouver and the Pacific Northwest Region of British Columbia. This has created a business opportunity for an airfreight business that is willing to invest and commit to serve the Pacific Northwest of British Columbia.

This paper will present an estimate for the demand of air freight in the subject area, complete a strategic evaluation of the local airfreight industry, determine the status quo with regard to existing facilities, describe sample aircraft suitable for the transport of airfreight, perform a financial analysis of the opportunity of getting into the airfreight business, and offer recommendations for increasing the sustainability of the airfreight business.

## **1.1 Introduction**

For the purposes of this paper, British Columbia's Pacific Northwest is comprised of the region bounded by the Queen Charlotte Islands, Kemano, Stewart/Meziadon Junction/Bob Quinn and the Hazelton/Smithers/Houston area. While Smithers and Houston are actually part of the Nechako Regional District, they are very close to Terrace (53 nm)<sup>1</sup>, but four hours by road from the next major centre, which is Prince George. For this reason they are included in this study.

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<sup>1</sup> Microsoft Flight Simulator 2002

The population of the region is approximately 52,000 people<sup>2</sup>. The region has had and continues to have a significant impact on the province's economy. In the past, 2.1% of the province's population has produced up to 11% of British Columbia's GDP<sup>3</sup>, indicating relatively high productivity per capita.

Until November 2004, Westex, an airfreight operator, served the Pacific Northwest. They were forced out of the airfreight business due to bankruptcy. Apparently this was due to their acquisition of a number of new aircraft for air ambulance use. The problem was that they purchased aircraft that did not have certification for use in Canada. Westex had to pay for the lease on aircraft that they could not use and they had to pay penalties for not providing the service that they were contracted to provide. Up until the time that Westex declared bankruptcy, they had been transporting approximately 235,000 lbs. of freight per year between Vancouver and Terrace. On a daily basis the average was 926 lbs. per trip. Westex's aircraft could handle large, heavy equipment due to the aircraft design feature of a large cargo door. This feature was important because the cargo door gave Westex the ability to transport packages that were too large for the airlines to handle. There is no similar service today.

In January 2005 Transport Canada adjusted the weight of the average adult, for flight capacity planning purposes. The weight of average adult males and females was increased by 24 lbs.<sup>4</sup> For safety reasons, the overall weight of an aircraft must be below a maximum weight specified by the manufacturer. In addition to this safety concern, the people, baggage, cargo and fuel must be distributed in the airplane in such a manner that the centre of gravity is maintained within specified limits. Airlines are permitted to calculate the weight of their passengers based on the "official" average weights as determined by Transport Canada. This avoids the need to weigh

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<sup>2</sup> Statistics Canada, Community Profiles [online], 1995.

<sup>3</sup> Message from the Mayor [online]. Kitimat Regional District, 2005

<sup>4</sup> Transport Canada, *AIP Canada*. (Ottawa, 2005), RAC 3-2.

an entire airplane load of passengers prior to departure and simplifies the “weight and balance” calculation procedure.

The implication of this rule change is that for a typical airplane (a Dehavilland Dash-8), with all of its seats full, flying between Vancouver and the Pacific Northwest, would be allowed to carry 888 lbs. **less** baggage and freight than prior to the rule change. Combined, the loss of an airfreight provider and the reduction of freight capacity, have greatly reduced the capacity to transport airfreight. This provides an opportunity for a new airfreight provider to enter the market in an uncontested portion of the market by providing fast reliable transportation of freight.

### **1.1.1 Project Goals**

The goal of this project to provide a feasibility study, to a prospective airfreight provider, that answers the questions related to costs, opportunities and risks associated with operating an airfreight service from Vancouver to the Pacific Northwest of Canada. In addition, the document will present some strategies to increase opportunities and reduce risk.

## **1.2 Methodology**

A demand estimation will provide an approximation of the potential for airfreight into the Pacific Northwest. An industry analysis will be performed to properly frame the concept. An analysis of available land based facilities and a sample of potential aircraft will be analysed. Finally the costs to operate each of the aircraft along the proposed route will be calculated and an estimate of revenue will be calculated. With all of the elements in place, a number of recommendations will be made to improve the sustainability of the venture.

With the problem defined, the first step will be to estimate the demand for airfreight in the Pacific Northwest

## **2 DEMAND ESTIMATION**

One of the key issues surrounding the creation of a profitable airfreight business is an accurate estimate of volume/weight that will use the service. This is very important as the estimate leads directly to the type of aircraft that will fulfil the role and ultimately to providing a basis for projecting the revenue this kind of a venture can produce. This chapter will provide an estimate of the demand for airfreight into the Pacific Northwest and its potential for growth.

### **2.1 Market Size**

For the purpose of this paper, the total market is all freight that has a time delivery constraint of less than six hours. This means that segment of the freight transportation market where time is a significant factor.

A detailed literature search was conducted to find data on airfreight. No detailed information was found on domestic airfreight, in terms of volumes, weights or value. Contact was made with officials in the air transportation industry and they acknowledged that the information was either not available or proprietary. A report was found on the Internet, which contained aggregate data for freight in North America.

The joint U.S.-Canada-Mexico report on transportation entitled "North American Transportation,"<sup>5</sup> stated that in 1990 fourteen ton-miles per capita of freight was transported annually by air in Canada. A ton-mile is one ton of material transported one mile. Assuming that

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<sup>5</sup> Arthur Webster II, *North American Transportation*, (Washington: U.S. Department of Transportation, 1994), 27.

the distance to access Sandspit, Terrace, and Smithers from Vancouver is 600 miles<sup>6</sup> and that the area serviced has a population of 52,000 inhabitants (Prince Rupert, Terrace, Kitimat and Smithers)<sup>7</sup>, one is able to calculate that 1213 tons were flown in and out of the Pacific Northwest annually. Based on 250 working days per year (and one flight into the north each morning and a return flight at night), this works out to 4.85 tons/day or about 2.4 tons per flight. A proxy for freight is economic activity and a proxy for economic activity is population. Given that the combined populations of the towns of the Pacific Northwest have not changed since 1990 and that the type of economic activity has not appreciably changed (the economy is still resource based), the 1990 data is considered sufficiently accurate for the purpose of this discussion.<sup>8</sup> The value calculated above is roughly four times the amount of freight carried by Westex (mentioned in chapter one). The competitors to Westex were, at the time, Hawkair, Air Canada Jazz and Navair. Both Hawkair and Jazz are still in operation, while Navair ceased operation late in 2005 following a fatal crash of one of their aircraft, and Westex went out of business as described in chapter one.

There is one issue that might negatively affect the weight of freight calculated above. The calculation is based on aggregate data for Canada and the United States. Aggregate data does not consider regional differences. A significant regional difference is that the Pacific Northwest is well connected via paved highways to the Lower Mainland. This gives truck traffic good access to the Pacific Northwest. For many isolated communities in Canada, there are times of the year (even year round) when the only viable means of transportation is aircraft. Therefore, towns in the Pacific Northwest, should on average, require less airfreight (as a percentage of all freight) than those isolated communities in Canada. However, in the United States, domestic

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<sup>6</sup> Microsoft Flight Simulator 2002

<sup>7</sup> Statistics Canada, Community Profiles [online], 1995.

<sup>8</sup> Statistics Canada, Community Profiles [online], 1995.



airfreight amounted to 42 ton-miles per capita. This may simply be as a result of the U.S. economy being based less on resources and more on high technology. Rocks and lumber are not typically transported by air. Given that there is a correlation between economic development and freight transportation, it is prudent to conclude that the figure of fourteen ton-miles is a conservative value for the Pacific Northwest.

To improve the accuracy of the ton-mile figure calculated above, officials from a Terrace based charter operator and the Terrace Economic Development Association were asked about the fourteen ton-mile figure. They concluded that the estimate was too conservative (too low), based on their own observations of freight being shipped through the airport in Terrace.<sup>9</sup>

An attempt was made to improve the estimate for airfreight between Vancouver and the Pacific Northwest. A number of telephone interviews were made with the intent of developing a qualitative sense of demand for reliable airfreight service. All buyers of freight services expressed the same sentiment. They stated that, "In the past, airfreight was reliable and fast. Today, airfreight is an expensive method of obtaining unreliable service." Of those contacted, most now operate their businesses as though airfreight service does not exist, though in the past, they did use airfreight services. Only one, a pet shop, had an absolute requirement for regular airfreight. The pet shop has live tropical fish flown to the Pacific Northwest one day each week. Given that there are no alternatives, the owner of the pet shop uses one of the airlines. On many occasions, the fish are "bumped" in favour of passenger traffic. In this situation, pet shop representatives must contact the fish supplier to retrieve the fish from the airport and return them to the fish supplier's premises. This incurs extra cost and results in higher fish mortality (due to excessive handling). Though there did not appear to be a large demand for airfreight from a single buyer, all of the businesses contacted did say that they would use airfreight if it were reliable.

While the total airfreight demand is estimated at 4.85 tons per day, it is reasonable to assume that some airfreight will remain with the less reliable operators for a variety of reasons. These include brand recognition, connectivity with a large network (in the case of Jazz), resistance to change and so on. The time-sensitive material will be advantaged by the proposed reliable service. Therefore for the purposes of this paper, revenues will be based on half of the estimated demand or 2.4 tons per day. Finally, a local air charter operator in Terrace estimates that approximately 80% of the freight moves north and 20% moves south. This means that an estimated 3800 lbs. of freight is available for transport to the Pacific Northwest and 1000 lbs. of freight is available for transport to Vancouver.

## **2.2 Market Growth**

The demand for airfreight is derived from economic activity. The growth of airfreight in the Pacific Northwest varies with the local economy. Boeing Aircraft Company has estimated the expected growth of airfreight in a document entitled “World Air Cargo Forecast”. In North America GDP (Gross Domestic Product) is increasing at about two percent per year and airfreight is expected to increase at a rate of 4.4% per year over the next ten years.<sup>10</sup> According to Boeing, “a strong correlation exists between changes in world GDP and changes in world air cargo traffic.”<sup>11</sup> Their study shows that airfreight growth is approximately double that of the growth in GDP. Based the foregoing, this should apply to regional markets as well.

While it is difficult to predict the growth rate of the local economy, there are a number of positive drivers and proposed projects. A partial list of projects includes: the Prince Rupert

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<sup>9</sup> Discussions with Trev Bowker and Dave Menzies in June 2005.

<sup>10</sup> Tom Crabtree, Tom Huang and Jim Edgar. *World Air Cargo Forecast 2004/2005*. New ed. (Seattle, Washington, U.S.A.: Boeing, 2004), 22.

<sup>11</sup> Tom Crabtree, Tom Huang and Jim Edgar. *World Air Cargo Forecast 2004/2005*. New ed. (Seattle, Washington, U.S.A.: Boeing, 2004), 11.

Container Port, the Cascadia gravel pit in Kitimat, a natural gas regasification plant for Kitimat, an oil pipeline from Ft. McMurray to Kitimat and the eventual rebuild of Alcan's Smelter in Kitimat. In addition, there is a spirit of co-operation between the First Nations groups, the local communities and business that has not existed in the past. This dialogue should foster a positive environment and provide mutual benefit in developing these projects. While it must be mentioned that Alcan and the District of Kitimat are having a dispute over the use of electricity surplus to Alcan's needs, there are projects going forward in spite of the uncertainty that the dispute is creating.

In qualitative terms, while the Pacific Northwest is heavily resource based, many of the functions of business have been greatly affected by advanced technology. Computers for business, communications equipment, and mobile equipment are increasingly high tech along with a demand from the user of higher reliability. Higher reliability is often only possible by the rapid access to replacement parts. Traditionally this has required that parts be stored near to the end user. Countering the need for parts, is the desire to reduce the cost of carrying inventory. This has led to centralised warehousing of spare parts and the use of rapid delivery to provide adequate response times. Fred Smith, the founder of Federal Express, has stated that the idea of over night delivery came from his college days when he worked as a pilot part time.<sup>12</sup> He often spoke with corporate pilots who said that though they were hired to fly people to various destinations, they were instead, flying parts destined for the repair of broken machinery. He reasoned that as society became more and more automated and mechanised, the need to keep the machinery running would become more and more important. He described a situation where a machine that performed the task (processing cheques) of one hundred people suddenly broke down. This created a major "bottleneck" in the process that would cost the bank a lot of money.

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<sup>12</sup> Dean Foust, "Online Extra: Fred Smith on the Birth of FedEx," BusinessWeek Online, September 20<sup>th</sup>, 2004.

The requirements of the business made it worthwhile to spend amounts of money all out of proportion to the value of the part to get a valuable machine running again.

Another, more local example of the same phenomenon derives from the author's experience. The author was part of a team that shipped eight 200-lbs. pieces of a thrust bearing by air to Calgary for machining. These eight pieces were the last parts out of the machine and the first parts that had to be installed upon reassembly of the machine. Therefore, these parts were on the critical path. The parts were sent via helicopter to Terrace, by airplane to Vancouver, then another plane to Calgary, and finally into a waiting pickup truck. The parts were machined overnight and the shipping procedure was then reversed the next day. One thousand dollars for machining time was spent, along with ten thousand dollars spent on airfreight costs. However, the issue is that the money that was spent was very small compared to the costs that were avoided. In this case the money saved was about \$150,000. But the machine in question was losing \$3000/hr. So, airfreight saved about \$150,000. The opportunity for an airfreight operator would be to capitalise on the potential that emergencies such as this create. Customers looking for this kind of service will not be too sensitive to price since their interest is getting their machine put back together and putting it back into service. In other words, eventhough airfreight rates are over ten times the cost of truck freight, the customer will be willing to pay the price, because the extra cost is very small in relation to the money saved. Unfortunately, the airfreight supplier will have no way of knowing that the need is desperate and be in a position to charge a premium above and beyond the regular price.

The point is that where there is a strong economic benefit derived from a certain service, a demand for that service will occur. As society becomes increasingly technologically advanced, the need for services such as airfreight will also increase.

With the demand for airfreight estimated and the potential for growth correlated to GDP, the next step is to perform an industry analysis to determine the attractiveness of the industry. Since the financial analysis depends heavily on which aircraft is being used to transport the freight and the aircraft that can be used depends somewhat on the ground-based facilities available, the financial analysis appears later in the paper.

### **3 INDUSTRY ANALYSIS**

An industry is a “distinct group of productive or profit-making enterprises”.<sup>13</sup> An analysis of an industry requires that the distinct group be defined. First, the air transportation industry will be described in general terms followed by a detailed description of the airfreight industry in the Pacific Northwest of British Columbia. With a precise definition of the subject industry, an analysis will be undertaken using Michael Porter’s “five forces”.

#### **3.1 Industry Description**

This section will provide an overview of the time-sensitive air freight delivery industry between Vancouver and the Pacific Northwest of British Columbia. Presently there are no rival firms and the substitutes include barge, truck and passenger carrying aircraft. To provide perspective the air transportation industry will be briefly described.

##### **3.1.1 Air Transportation Industry**

The air transportation industry is comprised of two segments. The first segment, airlines, (transport, commuter and air taxi) primarily move people by air. The second segment is the movement of cargo by air, known as airfreight. While both segments require the use of airplanes, the logistics regarding their use is quite different. People are able to embark and disembark themselves. When changing from one airplane to another, people are able to find their way from one airplane to another. Finally, people tend to have similar requirements in terms of lighting, air

temperature, humidity, nourishment and entertainment. By comparison, each cargo package must be handled several times. Each package needs to be clearly identified. The process of consolidating a number of packages and pallets into a load for a given aircraft must be done quickly (to save time) and accurately (to avoid sending a package to the wrong destination).

Airfreight can be sub-divided into two major groups. Airfreight that crosses oceans and airfreight that crosses a continent (or a portion of a continent). They are quite different because they have to be competitive in very different markets. In terms of speed, trans-oceanic airfreight is competing against ship borne freight. Since there is a very large difference in the speed of delivery between airborne and ship borne freight, customers do not have much choice if they want their freight quickly. Airfreight within a continent is competing with truck, train and occasionally, ship (and barge) transport. Within a continent, and assuming reasonable road access, customers do have the challenge to determine if paying more for airfreight yields an advantage when compared to slower and less expensive modes of transportation.

In the case of freight delivery to the Pacific Northwest, airfreight is faster than the next quickest alternative; truck. The difference is small: two to three hours for air vs. seventeen hours by truck transport. The travel times given do not include waiting for the next available airplane or truck, do not include the time required to get the freight to (and from) the airplane or truck, and they assume that in either case, the airplane or the truck does not make intermediate stops to drop off or take on additional freight. Practically speaking, comparing services operated once per day, the airplane can have a package delivered to the destination airport overnight, while the truck scenario takes two days. The kinds of material that are required within a very short period of time are quite diverse. Some of the typical items required by industries in the Pacific Northwest that are of a time sensitive nature are industrial machine parts, live animals, whole fish on ice,

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<sup>13</sup> W.S. Avis, P.D. Drysdale, R.J. Gregg and M.H. Scargill, *Canadian Senior Dictionary*. (Canada: Gage Educational Publishing, 1979), 588.

airmail and newspapers. Any of the items listed could be transported by truck at a lower cost. However, parts for a broken piece of equipment are often required immediately and until they arrive the equipment remains idle and non-productive. Newspapers are of value only if they arrive at the retailers on the day they are printed. Airfreight can deliver material quickly enough to justify the added cost under the right conditions. If value is truly added by rapid transportation (as perceived by the customer) then the customer will see the value in paying for rapid transportation.

For a freight business to be successful, one of the things that must be attended to is the need for reliability. Reliability in this context means that if a package is brought to the airfreight operator, the package will get to the destination when promised, in a condition that is acceptable to the receiver at the destination. The need for reliability requires that careful attention be put on the loading of the aircraft. When an aircraft load is comprised of one product destined for one customer, the process is very simple. The logistics become more complicated when the load is comprised of individual parcels that have different destinations along a route. The aircraft must be loaded very carefully so that the appropriate parcel is close to the door at the proper destination otherwise the parcel might not be off loaded at the proper location. Reliability will have a strong bearing on reputation and the securing of repeat customers.

Another segment of the airfreight industry is the freight that is shipped in the unused baggage compartment space on board passenger aircraft. Depending on the route and the type of aircraft, often there is a surplus of baggage space. Airline operators see this surplus volume as an opportunity to increase revenue. By providing the space to shippers willing to pay the price, additional profits can be generated since there is almost no additional cost to take on this additional revenue generating freight. A factor working against the use of surplus baggage capacity has been the tendency towards smaller, fuel-efficient aircraft. Operators have been studying seats filled ratios, the total cost of operating the aircraft, revenue from the filled seats,



likelihood of filling the empty seats, and other economic factors and they have drawn the conclusion that smaller aircraft would be more profitable. A consequence of the use of smaller aircraft is that there is a smaller baggage compartment and therefore less freight capacity. Unless there are significant changes in the demand for air travel in the Pacific Northwest, officials at Terrace Airport feel that the type of aircraft used by the airlines will remain the Dehavilland Dash-8, with its limited capacity for freight. This suggests that there are not likely to be any increases in airfreight capacity from the existing airlines serving the Pacific Northwest. This lack of capacity will limit the airlines ability to deliver parcels in the time frame expected by their freight customers, which means that a package brought to the airport for shipment on the next departing airplane should actually be loaded onto the next airplane, not onto the next airplane with available space. It is because of the lack of baggage capacity, that the airlines do not treat airfreight as a major revenue stream. It is precisely this gap in airfreight capacity that creates a business opportunity for a reliable customer focused airfreight company.

There is a possibility that Westjet or Alaska Airlines may decide to move into the Pacific Northwest. While this idea may appear to be without basis, as recently as seven years ago, Canadian Airlines flew Boeing 737 aircraft into Prince Rupert, Terrace and Smithers. To give some idea of the “surplus” capacity of these aircraft, these same model aircraft were able to fly from Montreal to Vancouver non-stop, so the relatively short flight from Vancouver to the Pacific Northwest left the aircraft with surplus weight carrying capacity, some of which was usable for freight. It is reasonable to assume that the possibility of an operator introducing large aircraft into the Pacific Northwest is remote. The number of passengers going through the airports in the area has decreased about 40% in the last ten years, though the decline appears to have stopped now that a number of significant projects are in various stages of development.<sup>14</sup> The reason that the

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<sup>14</sup> Prince Rupert Airport, Airport Activity [online], 2005.

airlines are using relatively small aircraft is that the number of passengers will not support larger aircraft.

In the next section, the industry that will be analysed is the transportation of airfreight to the Pacific Northwest from the Lower Mainland (Vancouver).

### **3.2 Industry Structure Analysis (Porter's five forces)**

Porter's five forces is a model that estimates threats to rents of incumbents to determine the attractiveness of an industry. These factors are called supplier power, buyer power, barriers to entry, substitutes and rivalry within the industry. Each factor contributes to the overall attractiveness of an industry. While some of the factors may have a positive influence on the attractiveness of an industry, others may be negative. There is no direct connection between attractiveness and profitability. There are profitable companies within unattractive industries and there are companies, which go bankrupt in attractive industries.

As recently as three years ago, there were four companies that were capable of transporting airfreight. Two were airlines whose main business was the transportation of people. The other two were dedicated to airfreight. Since that time, one company, Westex, has gone bankrupt (as described in chapter one) and the other, Navair, withdrew its services subsequent to a fatal accident in late 2005, leaving the Pacific Northwest with no dedicated air freight service. At the present time the airfreight market in the Pacific Northwest is being served by two airlines, both of which are not dedicated to airfreight. Therefore, the industry will be analysed from the point of view of a "first mover" entrant looking at the attractiveness of the dedicated air freight industry.

By virtue of the above definition, the existing airlines should not be considered to be competitors in the airfreight industry, but they are strong substitutes. Both airlines advertise that

they provide airfreight services. For this reason and because there is no alternative, shippers will use these airlines' airfreight services. The use of airfreight (however unreliable) may have a basis in due diligence. A shipper will promise that a package will be shipped as expeditiously as possible. The shipper uses "air" because of its implied speed. When the package fails to arrive as quickly as promised, the shipper can claim to have "tried everything possible" to get the package delivered on time.

### **3.2.1 Rivalry among Competing Firms in the Industry**

Rivalry is competition for market share among the incumbent firms. Competition for market share is affected by concentration, diversity of competitors, and exit barriers.

#### **3.2.1.1 Concentration**

Concentration refers to the number and the size distribution of firms competing within the market. In the Pacific Northwest there are two existing firms that provide some kind of airfreight service. They treat freight as a revenue-generating product, only if there is available space. In this instance a new entrant providing a dedicated air freight service will have the entire market to itself making it the sole service provider. This is called a monopoly and renders the concept of concentration meaningless.

#### **3.2.1.2 Diversity of Competitors:**

The "ability of firms in an industry to avoid price competition also depends on their similarities in terms of origins, objectives, costs and strategies".<sup>15</sup> This is illustrated by comparing the U.S. steel companies of old against OPEC. The U.S. group of steel makers had a "comfortable" arrangement amongst each other (and good prices) whilst OPEC, at the time of the

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<sup>15</sup> Robert Grant, *Contemporary Strategy Analysis*, 3<sup>rd</sup> ed. From class notes, 62.

article, was in severe price competition. The steel makers had similar origins, objectives, costs and strategies. OPEC, comprised of countries with very different situations, had large differences in language, cost of production, politics and religion.

A number of years ago WestJet was rumoured to be coming to the Pacific Northwest. WestJet had said that as long as Hawkair stayed out of WestJet's markets, WestJet would have no reason to invade Hawkair's airspace. This sounds very much like the managers of the U.S. steel companies, mentioned above, with similar backgrounds and beliefs, coming to an understanding about what is good for each other's companies. Hawkair and Westjet have a "comfortable" arrangement. Logic suggests that the Pacific Northwest is not a large enough market for WestJet and their principal equipment, the Boeing 737. And therefore that the current lack of competition is likely to continue.

Given that there are no providers of dedicated airfreight service, diversity of competitors in the Pacific Northwest is non-existent and appears likely to remain so.

### **3.2.1.3 Exit Barriers**

As previously discussed, cargo aircraft are not specialised pieces of equipment and they are not "fixed" assets in the traditional sense of "bricks and mortar". Aircraft can be sold to anyone anywhere in the world. This makes the asset relatively easy to dispose of assuming that a slowdown in the economy is not worldwide. Other than for the legacy carriers (e.g. Air Canada), pilots and mechanics typically do not have any job protection clauses in their contracts. Therefore, the barriers to exit are few and the risk associated with acquiring significant sunk costs is very low.

### **3.2.2 Potential Entry of Competition**

Entry threat is the threat that, if rents appear, new rivals will appear. An industry that earns a return on capital in excess of its cost of capital becomes very attractive to firms outside the industry. As more firms enter into an industry, competition increases and with increased competition, profits fall to the cost of production. Therefore the entry of competition into an industry is of great interest to the existing players. The incumbents regard anything that can be done to restrict or retard the entrance of new players as beneficial. An industry that has no barriers to entry (or exit) is considered to be “contestable”. Contestable means “profits and prices remain at a fully competitive level, regardless of the number of firms within the industry”.<sup>16</sup> Contestability is inversely proportional to sunk costs. See below. Where sunk costs are low (or costs can be recovered upon exit) an industry can be vulnerable to “hit and run” operators whenever established firms try to raise their prices above competitive levels.

Entrants typically cannot enter on equal terms with existing firms. The principal sources of barriers to entry are as follows: capital requirements, economies of scale, cost advantages, product differentiation, access to channels of distribution, and governmental and legal barriers. These will be fully explained in the following sections.

#### **3.2.2.1 Capital Requirements**

The capital required to enter into the airfreight industry can be significant. To enter the airfreight market in the Pacific Northwest requires the ability to secure financing for an aircraft that will cost between one and five million dollars. The basic capital requirements for an operator are: aircraft, hangar space, equipment for loading and unloading and office space. However, leasing is a possible alternative since leasing does reduce the capital required.

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<sup>16</sup> Robert Grant, title, etc., pg. 59

An alternative to purchasing or leasing a new aircraft is a used aircraft. There are many options. The low cost of acquisition and subsequent low interest costs go a long way to offset what are likely to be higher operating costs of an older aircraft, due to higher fuel consumption and higher maintenance costs. The cost to purchase an aircraft has everything to do with the market value (its potential to make money or other intangibles) of the aircraft. An aircraft that could be used in this market is the Douglas DC-3. Such an aircraft has a market value of about \$150,000. This compares with costs of over one million dollars for more modern aircraft of similar capacity. The above is simply to illustrate that low cost alternatives exist for operators who are interested in limiting their financial exposure. These same low cost alternatives allow an operator to enter the market in a manner consistent with creating a highly reliable freight service that can also capture the bulk of the market and still allow for reasonably efficient operations.

The limited financial risk associated with purchasing a used aircraft could entice some operators to enter the market with the intention of determining the strength of the market. This could have negative consequences for existing companies. Therefore, capital requirements are not an impediment to entry into the market.

### **3.2.2.2 Economies of Scale**

While there are economies of scale when it comes to operating larger aircraft, the aircraft must be fully loaded (utilised) to offset the higher cost of operating a large aircraft. Therefore an Airbus 330 (a large airliner) can transport a pound of freight for less than an Airbus 320 (a small airliner). Airbus is in the process of flight-testing the A380. This aircraft will carry more load and at a lower cost per pound than any aircraft in existence. Based on the technology available today in the A380, the minimum efficient scale would require a market large enough to support an A380. Since the airfreight market in the Pacific Northwest is considered finite and of a size

that can be supported by one aircraft much smaller than any of the three aircraft mentioned above, it is fair to assume that the market can only support one aircraft of the proper size.

The concept of economies of scale suggest that the competitor with the largest market share will have the lowest operating costs if the aircraft is properly sized for the application. This will make it difficult for a new competitor to begin with a small operation because the small aircraft will not be as cost efficient.

### **3.2.2.3 Absolute Cost Advantages**

Absolute cost advantages are those that incumbents have over new entrants. These advantages stem from the acquisition of low cost raw materials and/or economies of learning. Raw materials in the air cargo business are airplanes, fuel, pilots and cargo. The first three cost the same regardless of when they are purchased. The purchase of one or two aircraft will not affect the world's resources of viable aircraft and thereby raising the purchase price for subsequent entrants into the market.

The material to be arbitrated (moved from one place to another) is the cargo itself. A new entrant will have to fight for whatever unserved market remains. This is important in a market like the Pacific Northwest, as the demand is limited. Since the market is limited in size, a shrewd choice of aircraft will make it very difficult for a new entrant to find enough volume to justify entering the market.

In any endeavour there are procedures to be developed, contacts with other businesses to be made, arrangements with suppliers to be made, rules regarding air transport to learn, the development of a client base, etc. and all of this has to be learned by each air cargo provider. The first mover will have "the cost of learning" behind it and will have achieved economies of learning prior to the arrival of subsequent providers. Given that there are no providers of

dedicated airfreight, the advantage would go to the first mover who can capitalise on the issues outlined above.

#### **3.2.2.4 Product Differentiation**

Airfreight is an industry where it is traditionally difficult to have product differentiation, in the traditional sense of brand recognition and customer loyalty based solely on brand recognition. The product will have to be differentiated based on what it is: rapid, reliable transport of time sensitive goods that lend themselves to be loaded onto pallets and are of a volume or weight that does not lend itself to loading by hand. The emphasis must be on “rapid” because truck freight is two days from Vancouver to the Pacific Northwest, and it is very reliable. The issue of palletisation is important because the airlines do not handle palletised packages. The problem with the above-mentioned form of differentiation is that it is easily copied by a competitor.

The act of providing good service is a form of product differentiation. An example of this is a pet shop in Terrace had arranged to ship a puppy from Calgary to Terrace. There was to be a two-hour layover in Vancouver. The pet shop requested that the puppy be let out of its travel kennel while in Vancouver and that the kennel be placed up front near the cockpit during the flights. That is an example of good service. An astute airfreight operator could take the knowledge that businesses, like dog breeders, have special needs when transporting their product, and market the specialised service directly to them. A product differentiated this way will command a higher price.

The more similar are the products of competing companies, the greater is the tendency towards price competition and the greater is the tendency for competitors to cut prices. There is nothing particularly unique about an airplane that carries cargo. In larger sized aircraft, it becomes economical to install a large door in the fuselage so that palletised freight can be loaded



using mechanised equipment. This speeds loading, reduces turnaround time and reduces labour intensity. There are a number of specialised cargo aircraft where the front or rear of the aircraft is hinged to provide simplified loading and access for very long pieces of cargo. Differentiation can take the form of schedule, and size (length, width, height) of goods transported. Reputation is another form of differentiation that results from providing good schedule compliance, good dispatch reliability, and a product that arrives in good condition.

In the Pacific Northwest, the airfreight service providers also transport passengers. They have a policy whereby freight is the first to be left behind if conditions warrant. Both airlines have name recognition because of the free advertising associated with transporting the public. With regard to the transport of freight from Vancouver to the Pacific Northwest, they are essentially selling an undifferentiated product.

Though the product offered in the Pacific Northwest is essentially undifferentiated, there is an unused form of product differentiation. The Pacific Northwest is not provided with reliable airfreight. Therefore there is an opportunity in the providing of reliable airfreight.

### **3.2.2.5 Access to Channels of Distribution**

A new entrant will have to overcome lack of access to channels of distribution. A first mover will have to establish access to channels of distribution. An existing firm will have created agreements with local businesses to ship a certain amount or type of product. The new entrant will be faced with breaking down these agreements. In the case of a new enterprise providing dedicated airfreight, by definition the new enterprise would be a first mover. However, the new enterprise would, in effect, be trying to take business away from the existing providers by providing an improved service. The new entrant will also have to convince customers that it is worth trying to use a different airfreight supplier. There will have to be a significant reason for a business to change airfreight suppliers. This could take the form of “reliability”. The first mover,

in this case, may encounter difficulties in gaining access to channels of distribution since a dedicated airfreight business would appear to be the same as the existing non-dedicated airfreight businesses, when this is not the situation.

#### **3.2.2.6 Governmental and Legal Barriers:**

Government regulation creates a barrier to entry by imposing costs that do not provide any direct benefit to the airfreight operator. Transport Canada is moving to a “user pay” system of permits, licensing and regulation. An operating certificate for an air cargo operator under CAR (Canadian Air Regulation) 705 is \$25,000.00.<sup>17</sup>

All aircraft that are purchased are subject to GST (Goods and Services Tax, which is presently 7%). This is based on the aircraft’s assessed value. Similarly, an aircraft imported from outside the country will be required to pay import duties on its assessed value (not the purchase price). Compared to the costs associated with purchasing and operating an aircraft, the government-mandated costs are relatively low. Nevertheless, they are not recoverable and this creates a barrier to entry. An offsetting measure is leasing. The GST in this case would be spread out over the life of the lease reducing “up front” costs and reducing the “height” of the barrier to entry.

#### **3.2.3 Threat of Substitutes**

Substitute threat is a threat that new, close substitute products will appear outside of the client’s business/industry and that buyers will switch to these. In the Pacific Northwest, there are many alternatives for freight transportation: boats, trains, trucks, buses and aircraft. Each has its advantages. None of them are very good substitutes for the other if each is operating at efficient levels. For example, coal can be shipped by truck from Tumbler Ridge to the West Coast.

Shipping the same coal by train makes more sense if the coal is going to be loaded onto a ship and sent offshore. The railroad cannot assume that shipping alternatives do not exist for the coal producer. Therefore, the threat of substitution is legitimate. The airfreight operator has to look at truck, bus and the other airlines as substitutes. While shipping by truck is slower (two days vs. overnight), weight is not as critical an issue. Trucking companies already have a network and infrastructure that has been in operation for many years. Trucking companies have an advantage of reduced handling. All goods have to get to and from the airport if they are going to be shipped by air. Typically this will be done by truck. So, the unloading of a truck and loading of the aircraft (and the reverse at the destination) are added steps that detract from value. Customers have to gauge the cost vs. speed or price-performance characteristics. Businesses in the Pacific Northwest have altered their expectations to accept a slower, but more reliable alternative. A local industrial plumbing wholesaler manages expectations by guaranteeing freight in two days, as opposed to a possibility of delivery in one day when shipped by air. Airfreight, in its present form (as supplied by the airlines), leads to false hopes and expectations. This gives truck transport a chance to be a legitimate substitute for airfreight. Only those items that are highly time-sensitive are important and valuable enough to justify transport by air. For these types of freight, there really is no substitute. Since the principal “substitution” threat will come from trucking, and the cost of truck freight is very low (\$0.08/lb.)<sup>18</sup>, there is little point in trying to compete with trucking.

For the purposes of a dedicated airfreight service (and this paper), all airfreight is considered to be time-sensitive otherwise the freight could be shipped by slower and much less costly means.

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<sup>17</sup> Conversation with Dave Menzies, June 2005.

<sup>18</sup> Conversation with Willie Macneil, YPR Manager, September 2005

### **3.2.4 Bargaining Power of Buyers**

Buyer power is the ability of large customers with market (monopsony) power to negotiate prices that extract potential rents from the firms in the industry. All firms compete in two types of markets. They are either buying inputs (raw materials, components, services) from their suppliers for the firm's own process, or, they are selling their outputs (goods and services) to buyers for their uses, be they distributors, manufacturers or consumers. There are two sets of factors that are important in determining bargaining power: buyer's price sensitivity and relative bargaining power.

Looking first at the bargaining power of buyers of airfreight services, one would believe that the buyers would compare airfreight with truck freight. This implies that buyers would be sensitive to price. Buyer's price sensitivity depends on four major factors. First, airfreight will be more expensive on a unit basis, but when time is factored in, the extra cost may be justified. There are many items that have a low dollar value (but high value due to their importance), but without them a critical piece of equipment is rendered useless. In these cases, the additional cost is of no consequence. So a high item value to incremental cost ratio reduces a buyer's price sensitivity. Second, the less differentiated a product is, the more sensitive a buyer will be to price. If gasoline (a very undifferentiated product) price rises 0.5 cents/litre, drivers begin to look for alternatives. A reliable airfreight service will be differentiated from the airlines that unreliably get the freight to the destination. Third, if the buyers themselves are in intense competition in their own industries, they are inclined to be very fussy about what they are willing to pay. This competitive drive usually gets passed on to the supplier of these buyers. And finally, when the product purchased by a buyer is very important to the buyer's product or service, then the buyer is less sensitive to price. Mushroom pickers are willing to pay generously for airfreight because without rapid transport to market the mushrooms (the buyer's product) loses value very quickly.

Relative bargaining power, ultimately, comes down to refusal to deal with the other party. The key question is “What is it going to cost each party if the transaction does not take place?” A second issue is how well each party leverages its own position through gamesmanship. Several factors influence buyer’s and seller’s relative power.

Size and concentration of buyers relative to suppliers: if all of the firms desiring to use airfreight banded together and used a common freight forwarder (the buyer, in this example) to deal with the airfreight transport companies (the seller), the buyer could get a very good price since the buyers would be highly concentrated (a monopoly). Of course, if the firms dealt directly with the airfreight supplier, they would dilute themselves leaving the airfreight supplier in a more controlling position.

The better informed a buyer is about a supplier’s prices and costs, the better able is the buyer to bargain. For this reason many firms do not display their prices. However, the knowledge about price and cost is a moot point if the quality of the product is unknown. When quality is unknown or not quantifiable, buyer’s bargaining power goes down. In the case of airfreight, the price will be known through a phone call. The cost of moving a given piece of freight to the airfreight supplier (the seller) will not only not be known to the buyer, the costs may not be obvious to the seller. The cost of operating an aircraft is a mixture of fixed and variable costs and this makes it difficult for the buyer to know what the seller’s cost structure looks like.

Finally, what is the ability to integrate vertically? If the buyers of airfreight decide that they are unhappy with paying the going rate or that the rate could radically change or that they fear “hold up” on the seller’s part, the buyer(s) may decide to buy an airfreight company and fly their own freight. If this were a credible threat then the supplier of the airfreight service would have to be very cautious. For a well-organised customer, vertical integration might be a worthwhile endeavour. While the above is a hypothetical possibility, none of the shippers

contacted had enough volume to justify integrating vertically. In the case of airfreight, the buyer of the service has little power, especially in view of the fact that a new entrant would be the only supplier.

### **3.2.5 Bargaining Power of Suppliers**

Supplier power is the ability of large suppliers with market (monopoly) power to negotiate input prices that extract potential rents from the firms in the industry. The determinants of relative power between producers and suppliers in a given industry are the same whether we are discussing the buyers from that industry or if we are discussing the sellers to that industry. Specifically, in the case of airfreight, suppliers to an air operation would be those services that keep the operation flying: fuel, crew, spare parts, maintenance, insurance, taxes, fees, etc. Fuel comes from one supplier at each of the airports in question (except Vancouver). While each fuel vendor has some latitude with regard to fuel price, basically one must pay what the fuel costs. Crews are available for a relatively low price given the training and experience involved. However, to have a dedicated crew, an operator must consider what above average wages will bring in terms of avoided training costs, orientation costs, and upset to the operation when a vacancy must be filled. Spare parts are generally obtained from many sources. Choice of aircraft will have bearing on the number of suppliers of those parts. Old, orphaned (manufacturer no longer exists) or obsolete aircraft are often available for the price of scrap, but parts are usually available through a single source who has amassed all existing stockpiles under one roof. With reasonably modern aircraft or old aircraft that were built in large quantities and are still flying, parts are available through a number of channels and this keeps the prices reasonable. Maintenance in the context of this paper means the labour required to perform the maintenance. Again the same argument regarding crew applies to maintenance people. Generally there are many available who are willing to gain experience at the expense of being well paid for the

purpose of increasing their market value. Lower turnover may be had if maintenance can be performed in the Lower Mainland. An alternative is that maintenance work can be contracted out. For a single aircraft operation, this may be appropriate.

In Vancouver, the individual operator has no power over the Vancouver Airport Authority to negotiate lower fees, but in the Pacific Northwest the local airport operators might be willing to waive certain fees for a period of time as a way of encouraging use of their airport. Arrangements will have to be worked out with each airport to control the effect of these fees (landing, terminal and parking). Fees that are payable to the Receiver General of Canada via Transport Canada for such things as operating certificates are the same for everyone. Again, the type of aircraft and the type of operation can vary what the fees are. In any case selective interpretation of the rules will be necessary to minimise the cost of the fees and taxes. Lastly, insurance costs have gone up dramatically since the events of September 11, 2001. The number of aviation insurance underwriters has gone down dramatically in the last decade. As a result, there may not be too much choice or ability to broker an acceptable insurance rate.

### **3.2.6 Five Forces Summary**

The dedicated airfreight industry in the Pacific Northwest has no participants. In terms of passenger service, the local providers (Hawkair and Jazz) seem to be ready to enter into “agreements” that limit competition. It is reasonable to assume that future local providers of airfreight would take a similar approach. With respect to rivalry given that there are no providers of dedicated airfreight service, the threat to rents is very low.

The threat of entry is considered to be low. Capital requirements are not onerous. Economies of scale provide a problem to a new entrant. Larger is better if the volume exists. The first mover will have the advantage with regard to access to clients, making connections and

learning the system. A new entrant will have high initial costs while catching up and the new entrant may never successfully swing clients over. Product differentiation in the industry is relatively low, thereby potentially creating a threat from new entrants. The successful first mover will have acquired access to most channels of distribution, leaving little for new entrants. The governmental and legal barriers apply equally to all competitors, so there is no issue here. The threat of retaliation by an incumbent is real. A new entrant is a threat and could be subject to predatory pricing strategies. If an operator with a large passenger aircraft (with a very large cargo capacity), such as the Boeing 737, were to enter the market, the aircraft could take all airfreight at very low cost and make it virtually impossible to compete, however this possibility is considered remote. Therefore, with respect to the threat of entry, the threat to rents is low.

The threat of substitutes is significant and takes the form of alternative modes of transportation: barge, truck and rail and other airfreight suppliers. For items suitable for shipment by aircraft, a strong competitor is shipment by truck. Users of an airfreight service will be carefully weighing the extra cost of air shipment vs. the benefit of shorter travel time. With respect to the threat of substitutes, the threat to rents is high.

Buyers of airfreight service have good bargaining power mainly due to there being substitutes that are useable or viable...if not only as a threat to keep the price reasonable. The buyers of airfreight tend not to be "organised" in the sense of a co-op and they therefore do not have the advantage of group strength. With respect to buyer power, the threat to rents is low.

Suppliers generally do not have a great deal of bargaining power except for the insurance companies (oligopoly power) and the governments (at each level). With respect to supplier power, the threat to rents is low.

Overall, in terms of attractiveness, the industry rates as above average.



### **3.3 Key Success Factors**

Once the industry has been analysed using Porter's five forces, Key Success Factors (KSF) can then be determined.

To counter the threat of new competition, the aircraft size will have to be selected to accommodate the entire market volume. This will discourage entry, as a new competitor will be faced with operating a small (and therefore relatively expensive) aircraft or a larger aircraft with small loads. Only a competitor with deep pockets could do this for long. By acquiring early access to channels, new entrants will have difficulty in displacing the incumbent. It would be beneficial to partner with a shipping company in each town to provide a "storefront" for clients to drop off and pick up their goods. By doing so, all traffic will be channelled through one location per town. This gives easy access for the customer and gives the shipper exclusive access to reliable airfreight. This kind of arrangement will eliminate the need for a freight holding area at the airport thereby eliminating concerns about security, protection from weather, rental of storage space, etc.). Of course, such an arrangement would have to be legitimised through an enforceable contract.

While the industry analysis shows that the industry is attractive, this alone does not provide sufficient justification to proceed with a dedicated airfreight service. An analysis comparing estimated demand and revenue with estimated costs to determine the potential viability of the business.

## **4 AIRPORT FACILITIES**

In this chapter the facilities available at each of the proposed airport locations (other than Vancouver) will be described. Any deficiencies with respect to an airfreight operation will be noted. A description of the facilities at Vancouver airport has been left out because it is reasonable to assume that all services that an airfreight provider might require are available.

For the purposes of reliable airfreight service, the ability to operate during conditions of low visibility and low cloud ceilings is necessary. Due to the availability of instrument landing equipment, there are four airports in the Pacific Northwest that deserve consideration. They are located at Sandspit, Prince Rupert, Terrace and Smithers.

### **4.1 Sandspit**

Sandspit is located on the Queen Charlotte Islands approximately 400 miles north west of Vancouver. Sandspit airport is one of only two airports on the Queen Charlotte Islands. The main population centre is Queen Charlotte City which is located in close proximity to Sandspit Airport. Highway 16 connects Queen Charlotte City to Masset at the northern end of the north island. Sandspit Airport is actually on the north-eastern tip of the south island. A ferry is used to cross Skidegate Inlet between the airport and the north island. The population of Queen Charlotte City, Skidegate and Skidegate Mission is approximately 4,000 people.

The Sandspit airport is 21' above sea level and has one asphalt runway 5120' long by 150' wide. For night operations, each approach end of the runway has a pair of uni-directional strobe lights and green runway threshold lights. Runway edge lighting can be adjusted to any of

five brightness levels.<sup>19</sup> During periods of low visibility, Sandspit airport is equipped with an Instrument Landing System (ILS) which permits approaches to within 250' altitude above the airport.<sup>20</sup> One benefit of an ILS is that autopilot equipped aircraft are able to automatically track along the ILS's signal without pilot intervention. The airport has an apron, which is an area used for loading, unloading, fuelling, de-icing and parking of aircraft. Sandspit airport's apron is 300 feet by 500 feet. There are a number of buildings totaling about 20,000 sq. ft. that are suitable for cargo storage and handling. Existing equipment at the airport includes forklift trucks capacity and a self-propelled luggage conveyer belt.

## 4.2 Prince Rupert

Prince Rupert is 79 miles north east of Sandspit.<sup>21</sup> Prince Rupert's airport is located on Digby Island. In a straight line, the airport is 5 miles west south-west of the town.<sup>22</sup> Access to the airport from Prince Rupert's downtown area is via a 20-minute bus ride and ferry crossing.<sup>23</sup>

The airport ferry is the subject of much discussion. The ferry is scheduled to meet the scheduled flights arriving and departing the airport. Clearly there is a cost associated with operating the ferry that must be covered by the users. A cargo operation would either have to schedule its operation to coincide with an existing airline flight or the cargo operation would bear the cost of an additional ferry crossing. It would be more cost effective to co-ordinate with the existing ferry schedule, but any delays of the passenger flights would likely result in delays of the cargo destined for the town. And if the cargo flight was delayed, then the cargo would not leave the island until later or a charter boat would have to be hired on short notice.

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<sup>19</sup> Nav Canada. *Canadian Flight Supplement*, (Ottawa: Geomatics Canada, 2003),B695.

<sup>20</sup> Nav Canada. *Instrument Procedures-British Columbia Canada Air Pilot-CAP 2*, (Ottawa: Geomatics Canada, September 2004), 121.

<sup>21</sup> Microsoft Flight Simulator 2002

<sup>22</sup> Nav Canada. *Canadian Flight Supplement*, (Ottawa: Geomatics Canada, 2003),B612.

<sup>23</sup> Prince Rupert Airport, Ferry Schedule [online}, 2005.

Prince Rupert's airport has a 6000' by 200' paved runway. The runway is 116' above sea level and the weather is typical West Coast: cool and wet. Good for aircraft performance, not so good for visibility. For night operations, the airport has runway threshold and end lighting with high intensity runway edge lights. At each approach end is an array of lights to guide the pilot during the final phase of the landing approach.<sup>24</sup> To compensate for cloudy conditions, Prince Rupert has a number of electronic aids to permit landing operation when visibility is less than optimal, including an ILS.<sup>25</sup> For other than scheduled airline flights, the airport charges landing, parking and "use of terminal" fees.<sup>26</sup> The airport is equipped with snow clearing equipment to keep the airport open all year round.<sup>27</sup>

Prince Rupert has a 500' by 900' apron for loading and unloading aircraft. There is a terminal building with flight planning facilities and refreshment areas. The airport contracts out some of the marshalling, loading, unloading and baggage handling. The airport has an aircraft tug, four baggage wagons, a portable baggage conveyor, two aircraft starting carts (which supply electrical power and compressed air). There is no fork lift truck to assist with heavy loads. The airport does have aircraft de-icing equipment available.

This project's sponsor had initially ruled Prince Rupert airport out as a "stopping off point" reasoning that freight would arrive in Prince Rupert from Terrace approximately 90 minutes after landing. It is reasonable to assume that freight will take 30-45 minutes (ferry ride plus logistical delay to wait for passenger traffic) to get from Digby Island to the main land if an existing ferry is used. And the cost will be extraordinary if a boat needs to be chartered. Prince Rupert Economic Development Commission yielded the opinion that if an air freight business were to by-pass Prince Rupert, the freight would have to be shipped by truck to Terrace to meet

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<sup>24</sup> Nav Canada. *Canadian Flight Supplement*, (Ottawa: Geomatics Canada, 2003),B613.

<sup>25</sup> Nav Canada. *Instrument Procedures-British Columbia Canada Air Pilot-CAP 2*, (Ottawa: Geomatics Canada, September 2004), 121.

<sup>26</sup> Prince Rupert Airport, Fees [online], 2005.

the plane. Given that option, the truck, once loaded, may as well keep going to Vancouver, because essentially no time would be saved. The logic appears weak since an airplane can make the trip from Terrace to Vancouver in approximately fifteen hours less than a truck.

The only piece of equipment that is missing from Prince Rupert's Airport is a forklift truck to handle freight pallets.

### **4.3 Terrace**

The Terrace airport, founded in 1943 as part of an airport system to ferry aircraft to Alaska,<sup>28</sup> is located 66 miles east of Prince Rupert and three miles south of Terrace. Highway 37 connects the airport to the Yellowhead Highway (#16) at Terrace. From there the Yellowhead goes east to Prince George and west to Prince Rupert. The airport has two runways. One has recently been extended to 7500' and is 150' wide and the other is 5373' by 150'. The airport elevation is 713'. The airport has a 1083' by 240' apron in front of the terminal building. There are twenty-six buildings owned by private firms that are presently in use or available for use.<sup>29</sup> In the past a small freight provider used a portion of the pavement in front of an airline's hangar, twice a day for about 10 minutes each time, to unload and load their airplane. There is no reason why this couldn't be done again, unless that airline felt threatened by the new airfreight provider's competition.

The longer runway is equipped with runway edge lighting, an Omni-Directional Approach and Runway Lighting System (a series of sequentially flashing strobes in a line 1500' long), Threshold and End lighting. The shorter runway is not maintained in winter and is not equipped with lighting (for night operations). The long runway, one taxiway and the apron have

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<sup>27</sup> Nav Canada. *Canadian Flight Supplement*, (Ottawa: Geomatics Canada, 2003),B613.

<sup>28</sup> Northwest Regional Airport, Community [online], 2005.

<sup>29</sup> Information from Lane Mitchell of YXT.

a Pavement Load Rating of 12....the highest available in Canada.<sup>30</sup> The airport's surfaces can handle the weight of a 747. The airport society has a contractor performing the tasks of marshalling, loading, unloading and baggage handling. According to the published documents there are no facilities for de-icing except for heated private hanger space,<sup>31</sup> and apart from fees charged to passengers embarking on scheduled airline flights, there are no landing fees.<sup>32</sup>

#### 4.4 Smithers

Smithers' airport is located 2 miles north of town and 53 nm east of Terrace.<sup>33</sup>, on the eastern edge of the Coastal Mountain Range. This gives Smithers a more continental climate as compared to the other airports (hot summers, cold winters). The airport is directly adjacent to Highway 16, giving good access to the surrounding area from the airport. The Smithers Airport is 1712' above sea level. The airport has one runway that is 5000' long by 150' wide.<sup>34</sup> With a Pavement Load Rating of 12, the only limit for aircraft size is the ability of the aircraft to land and takeoff in the length of runway available. The airport has a large paved apron at 1500' by 200'. There are a number of buildings dedicated to aviation services totalling an estimated 20,000 ft<sup>2</sup>.

The runway is lighted for night operations. Along with runway edge lights, there are Threshold and End lights and an Omni-directional approach light system (sequentially flashing strobes) at both ends of the runway. Smithers airport does not have an ILS, though the airport does have instrument approaches that are less precise and therefore do not permit the aircraft to descend as low before visually acquiring the runway.<sup>35</sup> This is apparently due to the expense of

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<sup>30</sup> Pavement Loading Chart-Northwest Regional airport-Terrace.

<sup>31</sup> Nav Canada. *Canadian Flight Supplement*, (Ottawa: Geomatics Canada, 2003),B765.

<sup>32</sup> Conversation with the Northwest Regional Airport Manager, Laurie Brown, September, 2005.

<sup>33</sup> Microsoft Flight Simulator 2002

<sup>34</sup> Nav Canada. *Canadian Flight Supplement*, (Ottawa: Geomatics Canada, 2003),B727.

<sup>35</sup> Nav Canada. *Instrument Procedures-British Columbia Canada Air Pilot-CAP 2*, (Ottawa: Geomatics Canada, September 2004), 141.

an ILS system. Smithers Airport is in the process of acquiring a GPS based Approach using WAAS (Wide Area Augmentation System). The WAAS improves the precision with which the aircraft is guided during the landing approach, compared to a GPS based system without WAAS.

## **4.5 Summary**

The features of each of the airport facilities have been described to illustrate any major deficiencies that might pose an impediment to the provision of airfreight. All of the airports are able to accommodate any aircraft likely to be considered for an airfreight operation in the Pacific Northwest. All of the airports are equipped to allow operation at night and during periods of poor visibility. Very little or no additional equipment is required at any airport to support an airfreight operation.

In spite of the fact that each airport has all of the required equipment, not all allow the aircraft to perform to their potential; there are limitations imposed by the airports' dimensions and their locations. Since these limitations are related to aircraft performance they are described in the next chapter.

## 5 PERFORMANCE OF VARIOUS AIRCRAFT

In a business context, the aircraft is simply a tool that must generate sufficient income to cover its cost of operation and maintenance and enough surplus income to cover the cost of capital, profit and other fixed costs. It is important to choose the correct tool for the particular task. For this reason it is necessary to thoroughly describe the capabilities and limitations of a number of aircraft, to properly evaluate their applicability to the movement of airfreight in the Pacific Northwest.

A range of aircraft of varying sizes and capabilities will be described along with any advantages or disadvantages with respect to cargo transportation. Assumptions have been made regarding what are likely to be the largest and smallest possible aircraft for this kind of work, based on the author's experience and firm suggestions from the project's sponsor. The smallest aircraft described will be the relatively new Pilatus PC-12<sup>36</sup>. The largest, the forty year old Boeing 737<sup>37</sup>. In between, are the Beech 1900, the Basler BT-67 (a turbine powered DC-3), and the Convair 580/5800.

Before describing the performance of each aircraft it is important to understand some of the factors that affect aircraft performance and the measures of performance. The aircraft performance section will begin with a brief description of these factors, and an explanation of why they are related to the question of which aircraft is best suited to delivering freight to the Pacific Northwest. Any one of the performance parameters can prevent a particular type of aircraft from using a given airport so each must be reviewed.

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<sup>36</sup> J. Mac McClellan, "PC-12 Lives the Single Life," *Flying*, Vol. 124, No. 7 (1997): 68.



## 5.1 Introduction to Aircraft Performance

Aircraft operate in a medium that exhibits continuously changing properties. This medium is called the atmosphere. The atmosphere is comprised of air and water vapour. Aircraft performance is greatly affected by atmospheric conditions, and for the data to be meaningful and comparable, the performance data must be referenced to a set of standard atmospheric conditions. A reference standard has been defined by ICAO (International Civil Aviation Organisation), and is called the ICAO standard atmosphere.<sup>38</sup> Since there are not too many places on earth where aircraft can actually operate below sea level, most take off and landing data are based on the conditions that exist on a “standard” day at sea level. At sea level, the standard temperature and pressure is said to be 15°C and an air pressure of 29.92 inches of Mercury hereafter abbreviated: in.Hg. According to the ICAO standard, the temperature decreases, precisely by 1.98°C per thousand feet of altitude and pressure decreases approximately one inch of mercury per thousand feet. In North America, the aviation community measures height in feet and temperature in degrees Celsius. Speed is in statute miles per hour and knots (nautical miles per hour or 1.14 statute miles per hour). Fuel consumption is either in pounds, U.S. gallons or litres per hour.

Regardless of the aircraft chosen, they all have unique operating characteristics that make them more or less suitable for use as cargo aircraft serving the Pacific Northwest. The following characteristics are in no particular order since any one of them, if not meeting the required criteria can be condemning. The characteristics were chosen based on the advice from the project’s sponsor and the author’s experience. They are: takeoff and landing distances, climb gradient, cargo capacity (weight and volume), gross weight, range, speed, cabin pressurisation, weather capability, noise, loading procedure, crew requirements and training and the level of ground support required.

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<sup>37</sup> James Gilbert, *The Great Planes*, (Canada: Grosset & Dunlap, Inc., 1970),246.

<sup>38</sup> Charles Dole, *Flight Theory and Aerodynamics*, (United States: John Wiley & Sons, Inc., 1980),18.

The reasons for the above mentioned characteristics are as follows: the takeoff and landing distances are important given that the lengths of the available runways in the Pacific Northwest are fixed. All of the aircraft, listed above, will be able to operate from any of the available runways, but not under all conditions of air temperature, aircraft loading, runway surface friction and wind. To operate from a given runway under certain conditions, they may be restricted in the amount of cargo that can be carried.

Climb gradient is the altitude gained in a given distance travelled. This is important as Transport Canada specifies that departure procedures require a minimum climb gradient for terrain clearance. Some airports in the Pacific Northwest have more stringent requirements with respect to climb gradient. Aircraft manufacturers rarely give climb gradient as it can be derived from other readily available performance data.

Cargo capacity is the weight and volume that the aircraft can carry. The weight allowed will change with the fuel carried for a given flight. A short flight that requires a relatively small amount of fuel can often carry proportionately more cargo and vice versa. Empty weight and gross weight are the weight of the aircraft without any fuel, people or cargo and the maximum possible weight of the aircraft fully loaded, respectively. Their difference is what the aircraft can carry in “disposable” weight and is called useful load.<sup>39</sup> From the useful load one must subtract the fuel required for the flight. The amount that remains is called payload. This is the weight that can generate revenue. Volume is simply the space available to put the cargo. Low density cargos will fill the cabin without adding much weight to the aircraft, but the cost to operate the aircraft remains essentially the same. Therefore, airfreight operators usually have a pricing formula that compensates for low density cargo.

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<sup>39</sup> A.F. MacDonald, *From the Ground Up*, 28<sup>th</sup> ed. (Canada: Aviation Publishers Co. Ltd., 2000),215.

Range is the distance the aircraft can fly with the available fuel in the tanks. Full fuel tanks give maximum range, but they often restrict cargo. Range can be affected by the speed that the aircraft is flown at, much like driving quickly on the highway decreases fuel economy as compared to driving more sedately. Flying faster requires more engine power and therefore consumes more fuel per unit distance travelled, but arrives at the destination in less time. The relative speed that an aircraft flies at is referred to as airspeed. If the air is in motion relative to the ground, then the aircraft's speed relative to the ground is a function of both the airspeed and the air's velocity relative to the ground. Therefore, wind affects an aircraft's ground speed and so the wind has an effect on range. A tailwind will increase range, while a headwind will decrease range. To illustrate, a canoeist paddling to achieve a certain speed relative to the water will travel more quickly "down river" with the current than against the current "upriver". A pilot can take advantage of a strong tailwind by taking on less fuel, operating the aircraft in a more fuel efficient manner to compensate for the lower fuel load and loading in more cargo.

As mentioned above, the pressure of the atmosphere decreases with altitude. Cabin pressurisation refers to the aircraft having the construction and systems required to raise the air pressure inside the cabin to above the ambient pressure while in flight. This means that the cabin air pressure will remain at a pressure that is close to the air pressure measured at sea level, regardless of the atmospheric pressure outside the cabin. This is important for passenger carrying flights as flight at higher altitudes (above 10,000 ft, longer than ½ hour) either requires supplemental oxygen (via oxygen masks) or cabin pressurisation. In a cargo carrying application, the pilot(s) of a non-pressurised aircraft could use oxygen masks, as most cargo is not sensitive to a lack of oxygen or cabin pressure.

All weather capability typically refers to the aircraft's ability to safely fly in cloud (using instrumentation for guidance) and in icing conditions (essentially, in cloud above the freezing level). The minimum safe altitude in the Pacific Northwest varies, but is over 10,000 feet. The

air at 10,000 feet is an average of 20°C colder than air at sea level. Therefore, icing conditions can exist in the Pacific Northwest at the minimum operating altitudes at anytime of the year. And to be legal to fly in icing conditions, the aircraft must be certified for “flight into known icing conditions”. There are many aircraft that can fly “on instruments” (flight in cloud), but far fewer that can operate in icing conditions. For reliable use in the Pacific Northwest an aircraft will require certification for flight into known icing conditions.

Noise created by the aircraft’s engines and turbulent airflow around parts of the aircraft, during takeoff and landing approach can be irritating to residents who live close to an airport. This is particularly offensive at night. Older models of large jet powered aircraft create a lot of noise and for this reason some airports restrict some types of aircraft from operating at certain times of the day or night.

Small aircraft are typically loaded by hand. This process is slow and labour intensive. Larger aircraft can be equipped to accept pallets, which speeds loading and reduces labour intensity. However, the additional capability adds capital equipment and cost.

The requirements for the cockpit crew vary with aircraft model. Larger aircraft require a minimum of two crewmembers to operate the aircraft. This means that one person cannot legally fly the aircraft alone. This is usually because the complexity and positioning of the controls (especially under emergency conditions) are such that one person cannot reach nor do everything that is required. Typically as aircraft become larger, they become more complex. The increase in complexity requires more initial training time and more refresher training for the crew.

In the following sections that describe individual aircraft, mention will be made of two atmospheric conditions. One of them is at sea level at standard conditions which means an air pressure of 29.92 in.Hg. and 15°C. The other is at an air density that is equivalent to the density

of air at 5000 feet on a standard day. The reason for choosing this value and how the value was arrived at is explained below.

An engine's power output, a wing's lift and a propeller's thrust vary with air temperature and pressure. For example, an aircraft would require considerably more takeoff distance at Calgary's airport on a hot summer day (say 27°C) than given above. A Koch chart<sup>40</sup> is a useful guide for illustrating the change in aircraft performance with atmospheric conditions. According to the Koch chart, one should add 95% to the sea level, standard day data, when calculating the required take off distance. In the United States, 29.92 in.Hg. is the standard sea level pressure. In reality this pressure varies with the weather. A rule of thumb for dealing with the change in pressure is that if the reported barometric pressure is 28.92 in.Hg., then the pressure is the same as if one were 1000' above sea level on a standard day. Similarly, if the pressure were reported to be 30.92 in.Hg., then the pressure (being higher), corresponds to being 1000' **below** sea level. The term used to describe the atmospheric pressure in terms of "standard altitude" is called "pressure altitude". For example, if you were on a mountain at 5000 feet above sea level, on a "standard day" the air pressure around you would be called 5000-ft. pressure altitude. But since you are on a mountain, the weather must be nice, so it is safe to assume that the atmospheric pressure is a little higher than normal. Therefore, the pressure that acts on your body would be a little higher than it would be on a "standard day". Higher pressures are found at lower altitudes. On a very nice day, the pressure acting at 5000 feet might be the same as the pressure at 4500 feet on a "standard day". Pressure altitude is most easily obtained by adjusting the aircraft's altimeter to 29.92 in.Hg., and reading the "altitude". The same argument applies to the density of the air. ICAO has established what "standard conditions" are, but for simplicity, pilots compare the actual conditions to the standard. A day where the conditions are 35°C with a pressure altitude of 2300 ft. will give the same performance as on a standard day at 5000 ft. Pilots would say that the

density of the air, in those conditions is 5000-ft. density altitude, rather than “so many slugs per cubic foot”.<sup>41</sup>

For the purposes of this study a maximum temperature of 35°C and the pressure altitude of 500 ft. above the airport elevation will be used. The highest airport elevation in the Pacific Northwest is 1770 ft. above sea level at Smithers. Thus the highest-pressure altitude that will be considered is 2300 ft'. Combined with a temperature of 35°C, a density altitude of 5000 ft. results. In lieu of aircraft manufacturer’s performance data, the Koch chart, will be used to compute takeoff and climb performance.

Next the descriptions of five aircraft that span the required airfreight capacity of the Pacific Northwest.

## **5.2 Aircraft Descriptions**

The performance of each of the five aircraft will be described below. As previously stated, these performance parameters are required to determine which aircraft will be best suited for use in the Pacific Northwest.

### **5.2.1 Pilatus PC-12**

“Referred to by the company as the Pilatus PC-XII, the PC-12 is a unique attempt at combining a single powerful turboprop engine with a large and capacious airframe of advanced design, resulting in a[n] aircraft capable of a diverse range of tasks. Announced at the 1989 NBAA [National Business Aircraft Association] show, development of the prototype was rapid

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<sup>40</sup> Transport Canada., *Flight Training Manual*, 4<sup>th</sup> ed. (Canada: Gage Educational Publishing Co., 1999),96.

<sup>41</sup> Slug is the unit of measure for mass in the imperial system

and the first flight of P.01 (HB-FOA) [1<sup>st</sup> Prototype] took place on May 31<sup>st</sup>, 1991<sup>42</sup>. The PC-12 has a 53' wingspan, a maximum takeoff weight of 9920 lbs. and an engine that produces 1200 brake horsepower (bhp).<sup>43</sup> The PC-12 has a T-Tail. This arrangement makes it more difficult to damage the aircraft during loading and unloading. The RCMP has thirteen PC-12s in their fleet.

Takeoff and landing distances are relatively short. The sea level required runway length is 2800 ft. While the actual takeoff ground roll is 1475 ft, regulations require that turbine powered aircraft be able to accelerate and stop on the runway if a critical engine were to fail at the most inopportune time...therefore 2800-ft. are required. The landing ground roll is 945 feet. On our typical "hot and high" day (5000 ft density altitude), the takeoff ground roll would be conservatively estimated to be 2655 ft. Adding the distance required to stop, the PC-12 will require approximately 4500 feet of runway. This is very close to the available runway length of 5000 ft. at Smithers.

According to the Koch chart, the rate of climb for the highest elevation airport will be approximately 800 ft./min. Under these conditions the PC-12 will be flying at about 129 knots (True Airspeed). This is equivalent to 13072 ft./min. The climb gradient is calculated to be 372 ft./nautical mile. This is an important number. The required minimum climb gradients for Terrace and Smithers are higher than what the PC-12 can achieve on a hot day. The solution is to carry less weight. On cooler days this limitation will not pose a problem.

The PC-12 has an internal cabin volume of 330 cubic feet and a cabin floor area of seventy two square feet. The maximum cargo capacity is 3229 lbs.<sup>44</sup> The fuel required for the longest leg will be from Sandspit to Vancouver. This is 405 nm.<sup>45</sup> Pilatus claims that the PC-12 has a range of 458 nm when carrying its maximum allowable payload of 3229 lbs. The

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<sup>42</sup> David Donald, *The Encyclopedia of World Aircraft*, (Etobicoke: Prospero Books, 1997), 739.

<sup>43</sup> Pilatus Brochure

<sup>44</sup> PC-12 [online]. Pilatus Aircraft, 2005.

requirement for fuel in IFR operations is to have enough fuel to fly to the destination, then fly on to an alternate airport and then to have another 45 minutes of reserve<sup>46</sup>. The PC-12 achieves this while fully loaded, over the distance between Vancouver and the Pacific Northwest.

The PC-12 has a cruise speed of 260 kts. and consumes slightly less than 400 pph (pounds per hour) of fuel. At low power settings and higher altitudes the PC-12 can obtain very good fuel economy figures. “A typical long-range cruise is just over 210 knots true [airspeed], and fuel flows will fall to 250 pph or less at the higher altitudes.”<sup>47</sup> However, according to Pilatus, the PC-12 will achieve the range required to fly between Vancouver and the Pacific Northwest at its maximum cruise speed. The flight from Vancouver to the Pacific Northwest will require about 25 minutes to climb to 25000’ at 160kts, and then another 70 minutes to complete the flight.

The PC-12’s cabin is pressurised to a maximum of 5.75 psi. This allows the aircraft to maintain a cabin pressure equivalent to 8000 ft. above sea level, when the aircraft is operating at 25,000 ft. In addition, the aircraft is certified for flight into known icing.<sup>48</sup>

The PC-12 has a Pratt & Whitney PT6A-67<sup>49</sup> engine fitted with a four-blade propeller. The propeller is regulated to turn no faster than 1700 rpm.<sup>50</sup> As a result the PC-12 does not create much noise. Specific noise data was not found, but the noise level that the aircraft produces can be estimated. A report from the FAA in 2001 gives “over fly” noise data for various aircraft, but not the PC-12 (the aircraft was not certified in the U.S.A. at that time). The majority of the noise created by an aircraft is from the engines and with propeller equipped aircraft, the number and speed of the propeller blades. The Beech Starship carried two engines of the type used on the

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<sup>45</sup> Microsoft Flight Simulator 2002

<sup>46</sup> Transport Canada , *AIP Canada*. (Ottawa, 2005), RAC 3-9.

<sup>47</sup> J. Mac McClellan, “PC-12 Lives the Single Life” *Flying*, Vol. 124, No. 7 (1997): 70.

<sup>48</sup> Pilatus Brochure

<sup>49</sup> Pilatus Brochure



PC-12. The Starship is rated at 79.8 dBA.<sup>51</sup> Adjusting for the fact that there are two engines, a PC-12 would have a flyover noise rating of 76 dBA.<sup>52</sup> This is about the same noise level that is created by the ubiquitous privately owned piston engine powered “Cessna”.<sup>53</sup>

The PC-12 has a 53” wide by 52” high cargo door.<sup>54</sup> The door opening accepts palletised cargo that permits mechanised loading and unloading. Pilatus claims that the PC-12’s T-tail configuration “minimises the risk of impact damage from forklift operations.”<sup>55</sup> Given that aircraft loading and unloading, at the busy Vancouver airport, will happen at night, this point may be significant. Any damage to the aircraft will have serious consequences on dispatch reliability and customer satisfaction.

The PC-12 requires a minimum of one crew to operate the aircraft. This implies a potential cost saving. While this may be legally feasible, insurance companies require that the sole operator of the aircraft be an experienced pilot. The experienced pilots that accept a job flying the PC-12 will tend to look for a position with an airline that promises promotion to larger aircraft (and, usually, higher salaries). This will cause the aircraft owner to incur repetitive training and familiarisation costs, as pilots transfer within the industry.

A solution is to use a two person crew. Typically this means an experienced pilot teamed up with a junior pilot. In many respects the desire to be a pilot has some of the trappings associated with being an actor. The profession appears glamorous, many people want to be a

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<sup>50</sup> Pilatus Brochure

<sup>51</sup> Federal Aviation Administration, *Noise Levels for U.S. Certificated and Foreign Aircraft*, Aviation Circular No.: 36-1H, 2001, 34.

<sup>52</sup> David Halliday, Robert Resnick, and Jearl Walker, *Fundamentals of Physics*. 4<sup>th</sup> Ed. (U.S.A.: John Wiley & Sons, 1993), 512.

<sup>53</sup> Federal Aviation Administration, *Noise Levels for U.S. Certificated and Foreign Aircraft*, Aviation Circular No.: 36-1H, 2001, 21.

<sup>54</sup> Pilatus Brochure

<sup>55</sup> Pilatus Brochure

pilot, many people are able to pay for the training and flying is, for many people, an enjoyable activity. This inevitably leads to many young people who are new to the industry, with a new licence and very little experience flying outside of the controlled environment of the flying school. These new pilots with a commercial licence are simply seeking a chance to enter the job market. To become marketable, these pilots need experience. To get experience the pilot needs a job flying an aircraft. Eventually the new pilot does find a job and a chance to accumulate flight experience, but often for little or no pay.

A two man crew can be hired for little more cost (perhaps none) than an experienced single pilot. A two-man crew has an advantage: Succession planning. It is unlikely that both members of a flight crew would leave their jobs at the same time. This then leaves one person to “train” the other on the idiosyncrasies of the job. Relatively simple issues such as where to put the freight at a given airport, what time is coffee available, and the combination of the lock on the gate from the parking lot. These simple questions usually have trivial answers, but when one is stranded at a remote airport with a problem, a little local knowledge helps greatly. The attraction for a new pilot to a position that has very low pay, is that in the industry, experience, as the pilot-in-command is more valuable than as a co-pilot. So, once the experienced pilot has accumulated enough experience as pilot-in-command, he/she is then able to leverage their competence and move on to a new job. Ideally the now experienced, still extremely eager, “junior” person is ready to take on “pilot-in-command” duties. And a new junior person will be hired to occupy the right seat while acting as the co-pilot and learning about the intricacies of the airfreight business. While the system is somewhat draconian, it provides for a form of apprenticeship in a safe environment.

All of the subject airports can support (pavement capacity and available area) large turboprop and small jet airliners. The PC-12 will not require any modifications to existing infrastructure. The only piece of equipment required to facilitate the loading and unloading of

palletised loads would be a fork lift truck capable of lifting about 1000 lbs. The PC-12 is self-sufficient for starting the engine and requires no ground-based support.

### 5.2.2 Beechcraft 1900

“The Beechcraft 1900 Airliner is a high performance, pressurised, twin engine, turboprop airplane” designed to carry 19 passengers. With a wingspan of 55’, the 1900 is not much larger than the PC-12, but it has a much longer fuselage. It possesses two 1100hp engines which is about twice the power of the PC-12. Though the 1900 first flew about twenty years ago, it appears to have recently gone out of production<sup>56</sup>

The extra engine power translates into a runway length requirement of 3800 ft.<sup>57</sup> At 5000 ft. and 25°C, the density altitude becomes 7200 ft. and the runway length required is 5913 ft.<sup>58</sup>. At 5000 ft. density altitude, linear interpolation, which is conservative, yields a required field length of 5200 ft. This will require that the aircraft reduces its maximum weight by about 500 lbs. to enable a takeoff from Smithers on a hot day. Since this weight can be from a reduced fuel load, there should not be any reduction in payload capacity. The landing distance, at sea level is 4500 ft.<sup>59</sup>. At a density altitude of 5000 ft., the landing distance is 4800 ft.<sup>60</sup>

For a fully loaded B1900, the climb gradient is calculated to be 972ft/nm at sea level and 729ft/nm at 5000 ft. With a failed engine, the climb gradient diminishes to 237ft/mile<sup>61</sup> at sea level and 152 ft/nm at 5000 ft. Planning for IFR takeoffs out of Smithers and Terrace, after an engine failure will have to take the climb gradient into account. However, poor visibility is usually accompanied by cool temperatures (except during forest fire season), which improve

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<sup>56</sup> 1900 Airliner [online]. Raytheon Aircraft, 2005

<sup>57</sup> 1900 Airliner [online]. Raytheon Aircraft, 2005

<sup>58</sup> 1900 Airliner [online]. Raytheon Aircraft, 2005

<sup>59</sup> 1900 Airliner [online]. Raytheon Aircraft, 2005

<sup>60</sup> Beech 1900C Airliner Pilot Operating Handbook, 5-50

<sup>61</sup> 1900 Airliner [online]. Raytheon Aircraft, 2005

aircraft performance. Smithers Airport instrument departure procedure requires a minimum of 380ft/nm and Terrace will require a minimum of 330ft/nm<sup>62</sup>.

The Beech B1900 has a longer cabin than the PC-12. The cabin length (excluding the cockpit) is almost 34' long. The floor width is 49". The total cargo volume is 652 cubic feet. While the B1900 has a maximum cargo capacity of 5881 lbs., in practical terms it can carry much less. With a payload of 4375 lbs. aboard, the range is only 316nm<sup>63</sup>. To achieve a range of 527 nm., the payload must drop to 3800 lbs.<sup>64</sup> Given that the longest leg will be approximately 400 nm., a payload of approximately 4100 lbs. will be possible.

The B1900 flies relatively quickly for a propeller driven aircraft. It has a high-speed cruise of 263 kts. at 20,000 ft. The aircraft is most fuel-efficient at 25000 ft. where it manages to fly at 231kts.

The cabin of the B1900 is pressurised when in flight. The maximum pressure differential is 4.8 psi. The aircraft is able to maintain sea level pressure to 10,540 ft. The aircraft is certified for flight into known icing. Together, these features allow operations at any time of the year up to 25000 ft..

Complaints due to noise caused by aircraft operations have changed the way aircraft are used. Many airports have restrictions and curfews depending on the aircraft model. The B1900 has engines that are known for their quiet operation. This is not to say that they are quiet, it is just that they are noticeably quieter relative to other jet engine powered aircraft. The B1900 has a

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<sup>62</sup> Nav Canada. *Instrument Procedures-British Columbia Canada Air Pilot-CAP 2*, (Ottawa: Geomatics Canada, September 2004), 143.

<sup>63</sup> 1900 Airliner [online]. Raytheon Aircraft, 2005

<sup>64</sup> 1900 Airliner [online]. Raytheon Aircraft, 2005

noise rating of 77.4 dBA. This is within one dBA of the PC-12 and quieter than the four seat piston engine twin engine Beech Duchess training aircraft.<sup>65</sup>

The B1900 has a 52” by 52” door on the side of the fuselage behind the wing. This feature allows palletised cargo to be loaded by forklift truck. The B1900 is equipped with a T-Tail, which keeps the horizontal stabiliser out of the way during loading and unloading procedures.

The B1900 can legally be operated by one crewmember. The same argument applies to the B1900 as it does to the PC-12 with respect to one vs. two person crews. The B1900 is a larger, heavier, twin-engine aircraft. These attributes combine to require even more experience than on the single engine PC-12. Loading and unloading is more easily accomplished with two crewmembers.

The B1900 has no special requirements for pavement capacity and apron space. The aircraft has sufficient battery capacity so that a ground based power unit is not required. A forklift truck at each destination will suffice for loading and unloading.

### **5.2.3 Basler BT-67**

The Basler BT-67 is an adaptation of the famous DC-3. The DC-3 was first flown in 1935<sup>66</sup>, thirty two years to the day after the Wright Brothers first flew successfully.<sup>67</sup> Defying conventional wisdom, the DC-3 keeps on flying, hampered only by maintenance costs related to the original 14 cylinder radial engines.<sup>68</sup> A number of companies have designed modifications

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<sup>65</sup> Federal Aviation Administration, *Noise Levels for U.S. Certificated and Foreign Aircraft*, Aviation Circular No.: 36-1H, 2001.

<sup>66</sup> David Donald, *The Encyclopedia of World Aircraft*, (Etobicoke: Prospero Books, 1997), 357.

<sup>67</sup> Valerie Moolman, *The Road to Kittyhawk*, (Alexandria: Time-Life Books, 1980), 153.

<sup>68</sup> Hugh Quigley, “Flying the Tri Turbo-3.” *Canadian Aviation*, Vol. 51, No. 5 (1978): 22.

for the DC-3. A modification that does away with the engine problem replaces the 1200 hp 2000 lbs. original engines with a pair of 1425 hp 350 lbs. turboprop engines of modern design. In the process, the empty weight of the aircraft is reduced (increasing payload capacity), gross weight is increased, vibration, as compared to the piston engines, is reduced (reducing maintenance costs), and the new engines can run up to 3500 hours between overhauls (compared to 1200-1500 hrs for the old piston engines). By adding to the fuselage length and changing the wing's profile, one of these companies rebuilds a DC-3 into a turbine-powered aircraft with capabilities beyond the original DC-3.<sup>69</sup>

. The fully loaded takeoff distance over a 35-ft. obstacle is about 4700 ft.<sup>70</sup> On a hot day (35°C) in Prince Rupert or Sandspit, the runway required will be about 5500 ft.<sup>71</sup> This implies that payload will have to be reduced for flights departing Smithers and Sandspit on very hot days. Landing distances are less than 4000 feet at maximum weight. From Terrace (near sea level) the BT-67 has a climb gradient of 450 ft/nm. Out of Smithers on a hot day, the climb gradient will fall to 315 ft/nm. This does not meet the requirement for a departure at maximum weight during low visibility conditions.

Compared to the original DC-3, the BT-67 has its fuselage lengthened by 40 inches. The cabin's volume is 1225 cubic ft., while the floor area is 294 square feet. The payload capacity with sufficient fuel to fly from Sandspit to Vancouver is 10,250 lbs. when flown at 25,000 ft. If required, the BT-67 can carry 7500 lbs. over a distance of 1000 miles. Flights at lower altitude will require more fuel and will fly slower, so some payload will have to be left behind.

As mentioned, the BT-67 airframe is based on the DC-3. Both have similar weights, similar engine horsepower and essentially the same shape. Therefore, the BT-67 is not much

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<sup>69</sup> Basler BT-67 [online]. Basler Turbo Conversions LLC, 2005

<sup>70</sup> Basler BT-67 [online]. Basler Turbo Conversions LLC, 2005

<sup>71</sup> Basler BT-67 [online]. Basler Turbo Conversions LLC, 2005

faster than the DC-3. At 25,000 ft. the BT-67 will cruise at 210 knots. At this speed the flight from Vancouver to Sandspit will require about 150 minutes. Since the BT-67 is based on the DC-3, the cabin is not pressurised. This has the advantage of lower maintenance costs, but the disadvantage of requiring oxygen for the crew. If the cargo is sensitive to cabin pressure, then this will have to be taken into account before accepting the cargo for transport.

The BT-67 is fully de-iced and is capable of flying into known icing. The noise of the BT-67 meets the requirements of today's noise regulations (Stage 3).<sup>72</sup> The regulations are complicated and require that the aircraft demonstrate noise generation below prescribed limits along the takeoff path, off to the side and along the approach path. The BT-67 has noise levels 6.6, 9.6 and 6.1 dBA below Stage 3 limits. This, plus the fact that the BT-67 is not a "jet", will enable the BT-67 to depart Vancouver as dictated by business requirements, not by airport authority imposed restrictions.<sup>73</sup> This could become a source of economic advantage.

The BT-67 has a cabin floor designed to accept pallets and a winch to pull the pallets forward inside the aircraft. A large cargo door at the aft end of the aircraft permits loading of pallets.

Two crewmembers are required. Both will have to be well qualified and experienced, which will increase cost. They will require refresher training once a year.

The BT-67 is self-sufficient and requires no specialised equipment for engine starting.

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<sup>72</sup>Federal Aviation Administration, *Noise Levels for U.S. Certificated and Foreign Aircraft*, Aviation Circular No.: 36-1H, 2001, Appendix 6.

<sup>73</sup> Nav Canada. *Canadian Flight Supplement*, (Ottawa: Geomatics Canada, 2003),B827.

#### 5.2.4 Convair 5800

The fourth aircraft analysed is the Convair 5800. The 5800 is a twin turboprop aircraft with 4300 hp. engines. It has a 105' wingspan and maximum takeoff weight of 63,000 lbs. Therefore, this is not a small aircraft. The Convair series of aircraft began life with piston engine power, as the 240, 340 and 440. They were later converted to turbine power and became the 540 and the 580. Fifteen years ago Kelowna Flightcraft® purchased the rights to these aircraft.<sup>74</sup> They then began to design a “stretch” for the 580, which they called the 5800. This was achieved by lengthening the fuselage by about 13 ft.<sup>75</sup> and other modifications that permitted an increase in payload of 4000 lbs.

The 5800 has a sea level takeoff distance requirement of 5100'. At 5000' D.A., this increases to 7000'. This is 2000' more than is available at Smithers. However at a reduced weight of 54,000 lbs, the 5800 will be limited to approximately 15,000 lbs of payload, with minimal fuel. The crews of the 5800 will have to spend the necessary time balancing payload and fuel for safe operation. The 5800 has a climb gradient of over 1000' per mile, easily exceeding all requirements in the subject area.

The 5800, with its 13 ft. of fuselage stretch and boost in gross weight enables the aircraft to carry 21,500 lbs of payload and carry that load 700 nm.<sup>76</sup> The fuselage has a cargo volume slightly in excess of 3000 cu.ft. which is almost nine times that of the PC-12. The floor area is 518 square feet. This allows nine airline style pallets of 108 in. by 88 in.<sup>77</sup>

The maximum gross weight of the aircraft is 63,000 lbs, but the aircraft has a limitation called “Zero Fuel Weight”. The aircraft cannot weigh more than 55,000 lbs with cargo and crew,

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<sup>74</sup> Convair Stretch 5800 [online]. Kelowna Flightcraft, 2005

<sup>75</sup> Convair Stretch 5800 [online]. Kelowna Flightcraft, 2005

<sup>76</sup> Convair Stretch 5800 [online]. Kelowna Flightcraft, 2005

<sup>77</sup> Convair Stretch 5800 [online]. Kelowna Flightcraft, 2005



but no fuel. This is due to bending forces on the wing. Fuel, which is carried in the wings, does not add to these bending forces. With maximum payload the range is 700 nm. With the maximum fuel option, the range increases to 1475 nm, while the payload drops to 15,900 lbs. The “small” fuel tanks allow a range of 1150 nm. with 18,300 lbs. payload. For the Pacific Northwest there is no need for range higher than 700 nm., so there would be no advantage of paying for the larger fuel tanks.

The 5800 is a very fast turboprop aircraft. It will cruise at 325 kts. This has the advantage of minimising cost through high productivity. Supplementing this productivity are cabin pressurisation and certification for flight into known ice. These features help to preserve pressure, moisture or oxygen sensitive cargo and give the aircraft good dispatch reliability.

According to Kelowna Flightcraft®, the aircraft meets Stage 3 noise regulations, which is the current requirement for aircraft flying in North America and Europe. The regulations are complicated and require that the aircraft demonstrate noise generation below prescribed limits along the takeoff path, off to the side and along the approach path. The 5800 has noise levels below Stage 3 limits. This, plus the fact that the 5800 is not a “jet”, will enable the 5800 to depart Vancouver as dictated by business requirements, not by airport authority imposed restrictions.<sup>78</sup> This could become a source of economic advantage.

The aircraft has a 120” wide cargo door. The doorsill is about 8’ above the ground. Therefore, the 5800 requires equipment for loading and unloading at each destination. Given the size of the pallets, the required equipment may be expensive and will have low utilisation. The 5800 requires two crew members, just like the BT-67. Training requirements will be similar.

The 5800 has an on-board auxiliary power unit (APU). This jet fuel powered machine provides the power necessary to start the main engines.

### 5.2.5 Boeing 737-200

The B737 is a twin engine jet powered aircraft with a 94' wingspan and a 100' long fuselage. The cabin has the same cross section as the Boeing 707 airliner, but in a much shorter package. The first variant of the B737 (the 737-100) first flew on April 9<sup>th</sup>, 1967. Later in the same year, on August 8<sup>th</sup>,<sup>79</sup> a lengthened version, with three extra rows of seats was flown for the first time. This was called the 737-200. This aircraft was suggested as a potential alternative for three reasons: the aircraft is relatively fast, it carries a lot of cargo and there are many examples available at low cost. For example, six 737s were recently sold for an average of \$3.5M each.<sup>80</sup>

A study of the Boeing document "Airplane Characteristics-Airport Planning"<sup>81</sup> reveals that the takeoff distances for the 737 vary substantially with aircraft weight, engine model and altitude. Since the only fixed pieces of information are the runway lengths for Sandspit, Terrace and Smithers (and their elevation), there will be models of the 737 that are better suited for flying cargo to the Pacific Northwest. None of the engine models are able to launch a 737 with maximum possible payload from Sandspit's 5000' runway. Under the best conditions (strongest engine, 15°C), two thousand pounds of cargo will have to be left behind. With the weakest engine model, 19,000 lbs will have to be left behind. There is an alternative that has some merit for the 737. Since Terrace has the longest runway in the Pacific Northwest, it would make sense to make Terrace the last stop before departing for Vancouver. Therefore the flight routing could be Smithers, Sandspit, Terrace and finally Vancouver. From Terrace, three of the engine models will be able to thrust the 737 with a full payload safely into the air, even on a 30°C day. Therefore, for a 737 to carry a substantial payload out of the Pacific Northwest, the aircraft must

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<sup>78</sup> Nav Canada. *Canadian Flight Supplement*, (Ottawa: Geomatics Canada, 2003),B827.

<sup>79</sup> David Donald, *The Encyclopedia of World Aircraft*, (Etobicoke: Prospero Books, 1997), 169.

<sup>80</sup> B737 Sale [online]. AvBuyer, 2005 [cited 10 October. 2005].

<sup>81</sup> "Boeing 737-100, 737-200 Airplane Characteristics" D6-58325, September 1988, 45.

have the -15, -17 or -17R engines. Before leaving this subject, it must be understood that the rules governing the minimum required runway length vary with size of aircraft. Basically, small aircraft may not need to demonstrate that the required runway length includes the necessary distance to stop if an engine fails at a critical point during the takeoff run. Large aircraft (that can carry many people) do have to demonstrate the ability to stop on the available runway after an engine failure. This safety margin requires runway length that usually never gets used, but because this is a legal requirement, runway length can limit size of payload. Note that the 737-200C (Cargo version) has a higher Zero Fuel Weight of 99,000 lbs. compared to the passenger version, which has a Zero Fuel Weight 95,000 lbs<sup>82</sup>.

Landing distance requirements for the 737-200 will only pose a problem in Smithers on a hot day. On such a day, the 737 will only be carrying about 25,000lbs of cargo, so as to keep the total weight of the aircraft low enough so that the aircraft can land and stop in the available distance.

With a rate of climb of near 3000'/minute, the climb gradient easily tops 1000'/nm and is therefore adequate for the any airport in the Pacific Northwest.<sup>83</sup>

The 737 has a cabin volume of 4636 cubic feet.<sup>84</sup> This is half again as large as the 5800. When enclosed cargo containers are used, the usable volume available drops to 3080 cubic feet spread over 7 containers. There is room for an additional 875 cubic feet for bulk (hand loaded) cargo below the floor. The cargo door opening measures 134" wide by 85" high.<sup>85</sup> The floor area is similar to that of a small house: 720 square feet.<sup>86</sup>

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<sup>82</sup> "Boeing 737-100, 737-200 Airplane Characteristics" D6-58325, September 1988, 47.

<sup>83</sup> Conklin and Dedecker Cost Report

<sup>84</sup> B737 Sale [online]. AvBuyer, 2005 [cited 10 October, 2005].

<sup>85</sup> "Boeing 737-100, 737-200 Airplane Characteristics" D6-58325, September 1988, 85.

<sup>86</sup> B737 Sale [online]. AvBuyer, 2005 [cited 10 October, 2005].

The maximum gross weight of the Boeing 737-200 varies substantially. There were at least five variations of the same model of engine available over the years. Data obtained claims that a 737-200 with JT8D-9 engines has a gross weight of 117000 lbs and the ability to carry 35,800 lbs of payload.<sup>87</sup>

With a full payload, the 737 has a range of over 2000 miles. For use into the Pacific Northwest, the 737 will be operating at 10,000 to 20,000lbs below its maximum weight. This will give better rates of climb, which will save fuel and time enroute. The 737 will cruise at 430 kts., which is one hundreds knots faster than the Convair 5800. Typically, the 737 can fly from Vancouver to the Pacific Northwest in 60-70 minutes. The cabin is pressurised and the 737 is certified for flight in all weather.

The 737-200 was designed in the 1960s. As designed and built the aircraft does not meet today's requirements for noise. Since there were many airframes with plenty of useful life remaining, companies specialising in noise reduction have developed noise reducing systems and procedures so that the aircraft could meet the newer, more stringent noise regulations. One of the main methods of obtaining a quieter aircraft is to limit the thrust during takeoff. Of course, this limits performance. Suffice it to say that 737-200s can be purchased with the appropriate noise reduction hardware to be in compliance with the latest Stage 3 requirements. None of the airports in the Pacific Northwest have "noise abatement" requirements, which would limit the performance of the 737. Vancouver does have noise abatement requirements, but the airport has much longer runways to compensate for reduced power takeoffs.

The 737 will require a forklift truck for pallet loads or dedicated container loading equipment. Hand loading will not be a cost effective option given the loads involved and the height of the door sill above the ground.

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<sup>87</sup> B737 Sale [online]. AvBuyer, 2005 [cited 10 October, 2005].

The 737 has an auxiliary power unit that furnishes all ground power requirements. Therefore no additional ground equipment is needed.

The crew of two will require annual simulator refresher training. This is a requirement for this class of aircraft.

### **5.3 Summary**

The performance of a sample of five representative aircraft has been described. The Pilatus PC-12, the Beech 1900 and the BT-67 can operate from any airport in the Pacific Northwest without any significant cargo carrying restrictions. Both the Convair 5800 and the Boeing 737 are limited in cargo weight capacity when the ambient air temperature rises, due to the relatively short runway lengths. The Boeing is a noisy aircraft by today's standards and it will face greater restrictions in operations at Vancouver's airport.

The most important factor in choosing a particular airplane is its cargo capacity. The cargo carried directly determines the potential for revenue. In the next chapter, the estimated demand calculated earlier will be used to derive an estimate for revenue. The revenue will be compared to estimated operating costs of each aircraft and these will be used to create Pro Forma Income Statements. A serious mismatch in cargo capacity and cargo carried will generally result in a business that cannot generate sufficient revenue to cover its costs.

## **6 FINANCIAL ANALYSIS**

In this chapter a financial analysis for operating a scheduled airfreight service between Vancouver and the Pacific Northwest will be performed. Three flight route scenarios will be described and compared. To determine the potential for each of the scenarios, an estimate of revenue will be determined based on the estimated demand, and the prices charged by existing airfreight operators. To acknowledge the weakness in the original demand estimate (presented earlier), revenues will be calculated at three levels of volume: low, medium and high. The reasoning behind the three levels will be given. The costs for operating each of the aircraft will be estimated over each of the three scenarios. The estimated revenue will be compared to the costs. Pro forma income statements will be presented for each scenario to give an indication of the viability of an airfreight service in the Pacific Northwest.

It has to be acknowledged that the calculations presented are preliminary. They illustrate the potential opportunity of an airfreight business operating between Vancouver and the Pacific Northwest at a high level. A potential operator will have to determine for itself what level of risk the firm is willing to undertake and to what level of detail the information gathering process must go.

### **6.1 Routes**

With four possible airports in the Pacific Northwest, each one serving a number of communities, there are a number of possible route combinations. For illustration purposes, only three will be presented. The choice of airport in the Pacific Northwest relates to potential revenue. Terrace has very good potential since it has the highest population within a relatively

short distance of the airport. Sandspit is the major airport on the Queen Charlotte Islands. Therefore, both locations present themselves as hubs for the transportation of people and freight. A logical routing based on this is from Vancouver (YVR) to Sandspit (YZP) and then to Terrace (YXT).

The second scenario is as follows. Smithers is two and half hours by road from Terrace and four hours from Prince George, but only one-half hour from Terrace by air. The population around Smithers is less than Terrace, so it likely does not have the potential of the area around Terrace. However, Smithers is a base for a number of remote mining operations, and there are two substantial sawmills in the area. For this reason, Smithers is included in a second scenario as an additional destination on to the first scenario. The route would be as follows: YVR-YZP-YXT-Smithers (YYD).

Prince Rupert is a community of about the size of Terrace. It has a much lower industrial base and its airport is on an island, separate from the town proper. The town is one and half-hours by road from Terrace and about one hour by air, when one includes the trip by ferry from Prince Rupert's airport to the town itself. A scenario that includes Prince Rupert is presented to illustrate the additional costs of landing there and that unless a strong offsetting revenue stream could be realised, it is unlikely that Prince Rupert would be a viable airfreight destination. A route that included Prince Rupert and Smithers could look like this: YVR-YZP-Prince Rupert (YPR)-YXT-YYD.

For the purposes of this discussion, all three routes would be reversed to collect freight destined for Vancouver.

It is assumed that there would be one round trip per day (five days per week) leaving Vancouver each weekday morning and returning in the evening, five days per week. A greater number of flights per day would increase reliability and timeliness, but would also add significant

cost. The added cost would not be offset by additional revenue since there would not likely be any significant amount of additional freight. There may be times during the year when extra demand may permit an extra flight to be chartered. The cost to operate these “special” flights would be at the variable rate, since all fixed costs would already be taken into account.

## **6.2 Potential Revenue**

The potential revenue of an airfreight business is essentially based on two factors: weight of freight transported and the price per unit weight.

The weight of freight shipped between Vancouver and the Pacific Northwest and available for the proposed operation has been estimated at 2.4 tons/day, based on the populations of Prince Rupert, Terrace, Kitimat and Smithers. To stress test the estimate, two other options were considered. There are a number of projects being proposed for the Pacific Northwest. They include the container port terminal for Prince Rupert and the re-gasification terminal for Kitimat. The assumption is that an increase in economic activity will bring an increased need for airfreight. The assumption for an optimistic estimate will be for a fifty percent increase or a total of 3.6 tons/day.

There is a potential downside to a strong increase in economic activity. Along with an increase in economic activity will be an increase in airline passenger traffic. This effect could be strong enough to induce an airline to begin to utilise a larger aircraft with an excess of baggage capacity. Such an aircraft could take all of the airfreight, with greater frequency and at a very low cost. For this situation, 25% of 2.4 tons/day or 0.6 tons/day is assumed as being available for a dedicated airfreight operator.



As mentioned in chapter two, the total amount of freight travelling north is assumed to be 80% of the total daily figure, or 960 lbs., 3800 lbs. and 5800 lbs., for the low, expected and high estimates, respectively, with the balance of the daily amounts travelling south (“backhaul”).

Given that the freight volume figures calculated above are estimates, no allowance has been made for changes in demand as a result of the different routes of the three scenarios. There would be little or no improvement in the accuracy of freight demand, if one were to subtract an estimated value for freight by not going to, for example, Prince Rupert.

The other major factor in determining revenue is the price per unit weight. Small packages that require more handling command a higher premium. As packages become larger, economies of scale come into effect that reduce the price per unit weight. The prices were compared between the two airlines providing service into the Pacific Northwest, Hawkair and Jazz. Hawkair’s prices appeared much higher, but their price list had been updated in July 2005, whereas Jazz’s prices were from September 2004. The strong change in fuel costs in the past year may explain the difference. For small packages ten pounds or less, Hawkair is charging a flat rate of \$36.00. For a ten-pound package, this calculates to \$3.60/lb. For very large packages over 100 lbs, the price per pound drops to \$1.05/lb. Without having data that gives a distribution of package size, it would be difficult to estimate the potential revenue. For this reason, a conservative approach will be taken by using the lowest value of \$1.05/lb in all calculations.

Based on a freight price of \$1.05/lb., the potential revenues per round trip are for the low, expected and high estimates are \$1260, \$5,040 and \$7560. On an annualised basis, the potential revenues for the low, expected and high volume estimates are \$315,000, \$1,260,000 and \$1,890,000, respectively.

## 6.3 Costs

Accurately determining the total cost of aircraft operation is very difficult. As with a private automobile, quality of assembly and design, age of the vehicle, quality of maintenance, working conditions, luck, driver's habits etc. contribute to a wide difference in the actual cost of ownership. Similarly, relatively minor occurrences such as taxiing over gravel with excessive power may damage a propeller blade or throw gravel against the fuselage structure, leading to extra maintenance costs.

One source of maintenance cost data is from the maintenance departments of operators using the types of aircraft described in chapter five. The problem is that each operator would have aircraft of various ages, they likely would be maintaining their aircraft to different standards, and the actual use of each aircraft type might vary from operator to operator and so on. This would combine to effectively make the data from various sources incomparable. In spite of this, an attempt was made to obtain specific operating cost data from a local operator. They declined citing concerns over confidentiality and safeguarding competitiveness. In the absence of data from an airfreight operator, another approach was found.

Conklin & Dedecker is a company that specialises in providing aircraft operating cost data. They are well known in the aviation industry. Aircraft operators often use the data from Conklin & Dedecker's reports as part of the decision making process prior to deciding on the purchase of an additional or replacement aircraft. Conklin & Dedecker was contacted in September 2005 and asked if they would provide information for this project. They were able to provide data on the Pilatus PC-12, the Beech 1900C, the Convair 580 and the Boeing 737-200. Since the information they have provided is proprietary, it has not been reproduced in this document. However, the data has been modified to suit the needs of an airfreight operator serving the Pacific Northwest and summarised under aircraft operating costs in the figures below.

Conklin & Dedecker was not able to provide any information specific to a turbine powered DC-3. With information available from Basler<sup>88</sup> and using some of the information from Conklin & Dedecker's report on the Convair 580 (a larger, but similar turboprop twin engine aircraft), a cost estimate was created for the BT-67.

Similarly, Conklin & Dedecker was not able to provide information for the Convair 5800. While Conklin & Dedecker's data is directly applicable to the 580, by using data from the builders of the 5800, Kelowna FlightCraft,<sup>89</sup> modifications were made to create an estimate for the 5800 as well.

A number of assumptions were made due to limitations in the data received from Conklin & Dedecker. The data from Conklin & Dedecker assumes flights of 300 nm. (nautical miles) long for turboprop aircraft and 600 nm. long for jet powered aircraft. To be very precise, calculations would have to be made based on one 400 nm. leg and two or three 50-100 nm. legs in each direction. As well, average wind direction and strength would have to be applied to further refine the estimates. Therefore, the performance data for the turboprop powered aircraft were taken as is and the 737's average speed was reduced slightly to take into account the greater proportion of time spent climbing and descending due to the shorter leg lengths. All of the landing fees, parking fees, Nav Canada (air traffic control and infrastructure) fees have been taken from the relevant websites.

Costs will vary depending on the number of destinations visited while in the Pacific Northwest. Three scenarios were analysed to determine the cost of each. The first scenario is to have an aircraft parked overnight in Vancouver from where it would fly to Sandspit and then to Terrace. The aircraft would then spend the day in Terrace (and be available for charter work), and then return to Vancouver at night via Sandspit. The second scenario would have the aircraft

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<sup>88</sup> Basler BT-67 [online]. Basler Turbo Conversions LLC, 2005

fly onto Smithers after landing in Terrace and spend the day in Smithers. At the end of the day, the aircraft would reverse the morning's itinerary and fly back to Vancouver, collecting cargo destined for Vancouver. The third scenario would add a stop in Prince Rupert between Sandspit and Terrace to the second scenario. Each landing adds landing fees, terminal access fees and freight handling fees. In addition, Nav Canada charges extra fees for each descent into an airport.

The cost of operating each of the five aircraft appears consistent with the premise that the largest aircraft is the most efficient in terms of cost per pound moved (assuming the aircraft is full). The only aircraft that does not seem to follow this trend is the Beech 1900. It has a few design attributes that are disadvantages for the flight between Vancouver and the Pacific Northwest. In the cost analysis, the B1900 has two pilots whereas the PC-12 has one. The B1900 must give up cargo capacity to take on enough fuel to be able to fly between Vancouver and the Pacific Northwest. Though the B1900 does not carry much more cargo than the PC-12, it does have two engines that are of essentially the same model as those on the PC-12. Therefore the maintenance costs and fuel consumption are close to twice that of the PC-12. These effects combine to create an aircraft that has close to twice the operating cost per pound of cargo capacity, as compared to the PC-12. The B1900 does benefit by virtue of having the redundancy inherent in two engines.

There is very little difference between the BT-67, the Convair 5800 and the B737-200 in terms of cost per pound. The difference amounts to \$0.01/lb. between each of the three. However, at a cost of about \$0.40/lb., all three aircraft will have to be filled an average of 1/4 full (at an average price of \$1.50/lb) to break even. This suggests that to choose between the three will simply require an accurate estimate of demand.

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<sup>89</sup> Convair Stretch 5800 [online]. Kelowna Flightcraft, 2005

The costs for each of the three scenarios are summarised in the three tables below. The differences in the tables reflect the additional fees that occur as a result of more landings. Their effect is considerable. For any of the aircraft, there must be an expectation of recovering the fees that are incurred due to landing at a given airport.

In Table 6-1 is the cost of operating each of the five aircraft on a route that takes the aircraft from Vancouver to Sandspit and Terrace (and back again). The first five rows are annualised values and are based on data from Conklin & Dedecker. The cost of fuel accounts for approximately one third of the cost of operation of each aircraft. A fifty percent rise in fuel cost would result in approximately twenty percent rise in aircraft operating cost. While this sounds dramatic, it must be understood that higher fuel costs due to higher feedstock prices will impact all modes of transportation. The “Cost per Round Trip” is the “Total Cost” divided by 250 round trips per year. The landing, parking and NavCanada fees are from the respective facilities websites.

**Table 6.1 Total Cost of Scenario #1**

TC per Round Trip Scenario #1 YVR-YZP-YXT	PC-12	B1900	BT-67	CV5800	B737
Utilization-Miles	270,000	270,000	270,000	270,000	270,000
Hours	1,125	1,154	1,350	951	771
Variable Cost	574,549	1,179,727	1,290,600	2,829,220	4,296,171
Fixed Cost	113,372	198,124	214,812	214,812	522,372
Total Cost (no depreciation)	687,921	1,377,851	1,505,412	3,044,032	4,818,543
Cost per Round Trip	2,752	5,511	6,022	12,176	19,274
Landing, Parking, NavCan Fees	358	514	815	1,546	2,827
Total Cost per Round Trip	3,109	6,025	6,837	13,722	22,102
% NavCanada, Landing and Parking	13.0	9.3	13.5	12.7	14.7

*Table created by author*

The second scenario (Table 6-2) involves extending the Vancouver, Sandspit, Terrace “run” to Smithers. The only differences, compared to Fig. 6-1, are more miles travelled, which involves more flight hours, and more landing and NavCanada fees.

**Table 6.2 Total Cost of Scenario #2**

TC per Round Trip Scenario #2 YVR-YZP-YXT-YYD	PC-12	B1900	BT-67	CV5800	B737
Utilization-Miles	295,000	295,000	295,000	295,000	295,000
Hours	1,229	1,261	1,475	1,039	843
Variable Cost	627,748	1,288,961	1,410,100	3,091,185	4,693,964
Fixed Cost	113,372	198,124	214,812	214,812	522,372
Total Cost (no depreciation)	741,120	1,487,085	1,624,912	3,305,997	5,216,336
Cost per Round Trip	2,964	5,948	6,500	13,224	20,865
Landing, Parking, NavCan Fees	522	765	1,243	2,331	4,553
Total Cost per Round Trip	3,486	6,713	7,743	15,555	25,418
% NavCanada, Landing and Parking	17.6	12.9	19.1	17.6	21.8

*Table created by author*

In the third scenario, a landing at Prince Rupert is added to Scenario #2. This additional stop adds aircraft flying time and perfunctory fees. The effect of the landing, parking and NavCanada fees can be seen in the bottom row. With each additional airport added to the itinerary, the percentage increases. These additional costs will have to be taken into account when trying to decide if there is value in making the extra landings.

**Table 6.3 Total Cost of Scenario #3**

Total Cost per Round Trip Scenario #3 YVR-YZP-YPR-YXT-YYD	PC-12	B1900	BT-67	CV5800	B737
Utilization-Miles	300,000	300,000	300,000	300,000	300,000
Hours	1,250	1,282	1,500	1,056	857
Variable Cost	638,388	1,310,808	1,434,000	3,143,577	4,773,523
Fixed Cost	113,372	198,124	214,812	214,812	522,372
Total Cost (no depreciation)	751,760	1,508,932	1,648,812	3,358,389	5,295,895
Cost per Round Trip	3,007	6,036	6,595	13,434	21,184
Landing, Parking, NavCan Fees	701	1,047	1,729	3,389	6,676
Total Cost per Round Trip	3,708	7,082	8,324	16,823	27,860
% NavCanada, Landing and Parking	23.3	17.3	26.2	25.2	31.5

*Table created by author*

With the potential revenues and costs calculated and tabulated, the next step is to transfer this data into a table that shows the revenues against costs for each of the three scenarios for all

five aircraft. The figure below provides for a coarse “filter” with which to decide which aircraft might be suitable for an airfreight business. The figure below shows that the PC-12 generates the greatest gross margin for the expected and high freight weight volumes and that an aircraft smaller and less expensive than a PC-12 will be necessary for the low freight weight volume. The gross margin for the PC-12 has been adjusted to account for the fact that the aircraft’s capacity will not carry the entire expected load of freight when travelling north. The Basler BT-67, the Convair 5800 and the Boeing 737 are unsuitable for the Pacific Northwest airfreight market given that they have too much capacity and therefore are too inefficient to operate.

**Table 6.4 Potential Gross Income**

<b>Gross Income=Revenue minus Cost of Aircraft Operation, dollars per day</b>				
	PC-12	BT-67	CV5800	B737
Scenario #1-Low Volume	-1849.363	-5576.898	-12462.456	-20841.569
Scenario #1-Expected Volume	1,331	-1796.898	-8682.456	-17061.569
Scenario #1-High Volume	1,836	723.102	-6162.456	-14541.569
Scenario #2-Low Volume	-2226.334	-6482.806	-14295.414	-24158.203
Scenario #2-Expected Volume	954	-2702.806	-10515.414	-20378.203
Scenario #2-High Volume	1,459	-182.8057	-7995.4142	-17858.203
Scenario #3-Low Volume	-2447.853	-7064.391	-15562.581	-26599.745
Scenario #3-Expected Volume	732	-3284.391	-11782.581	-22819.745
Scenario #3-High Volume	1,237	-764.3912	-9262.5815	-20299.745
<b>Shaded Area-Aircraft not able to carry corresponding freight weight.</b>				

*Table created by author*

Given that the PC-12 is the aircraft that will generate the highest gross margin in the market of the Pacific Northwest, and that a very low cost aircraft will have to be considered for the low freight weight volume, a series of Pro Forma Income Statements will be shown to develop a sense of the potential profitability (if any) of an airfreight venture.

## 6.4 Pro Forma Income Statement

The calculations shown above have only compared the operating costs of the aircraft against expected revenues. As such, the calculations have left out any of the details related to running a business such as administration, depreciation, cost of capital, advertising and so on. The pro forma income statement is used to show the future revenues and costs including cost of capital and depreciation and how these affect net income. For comparison purposes, the income statement shows the outlook for the next five years. The costs shown below are those from scenario #1, which is the least costly. Revenues are assumed to increase at two percent per year, variable costs (which include fuel) at three percent per year, fixed costs at two percent per year and income tax remains fixed at an assumed forty percent per year. Variable costs are those that are directly attributable to operation of the aircraft. They include fuel, regular maintenance parts and labour, engine overhauls, propeller or thrust reverser overhauls, etc. They can be thought of as the costs that occur every time the “ignition key is turned on”. Fixed costs are those that exist whether the aircraft flies or not. Insurance, pilot salaries, subscriptions to required weather, navigation and computerised maintenance services, hangar rental (if applicable), etc. are included in fixed costs.

An operation that consists of one or two pilots and one airplane will have little need for a human resources department, an accounting department or a full time payroll clerk. Administrative costs are estimated at the cost of one full time employee (whether the tasks are contracted out or not) for the situations where the PC-12 is used. The purchase price of the PC-12 is assumed to be \$3 million. The following two tables (6-5 and 6-6) show that with the expected and high freight weight volumes the PC-12 is not able to make a profit. The low freight weight volume was worse than the other two (and has been omitted).



**Table 6.5 Pro Forma Income Statement-Expected Freight Volumes-PC-12**

PC-12 Income Statement-Expected Freight Volume					
	Year 1	Year 2	Year 3	Year 4	Year 5
Sales	1,110,113	1,132,315	1,154,962	1,178,061	1,201,622
COGS					
A/C Operating Costs	777,341	800,661	824,681	849,421	874,904
Administration	50,000	50,000	50,000	50,000	50,000
Principal Payment	300,000	300,000	300,000	300,000	300,000
Depreciation 10%/yr	300,000	300,000	300,000	300,000	300,000
Interest 7%	210,000	189,000	168,000	147,000	126,000
Expenses	1,637,341	1,639,661	1,642,681	1,646,421	1,650,904
Gross Income	-527,228	-507,346	-487,719	-468,360	-449,282
Income Tax-40%	0	0	0	0	0
Net income	-527,228	-507,346	-487,719	-468,360	-449,282

*Table created by author*

**Table 6.6 Pro Forma Income Statement-High Freight Volumes-PC-12**

PC-12 Income Statement-High Freight Volume					
	Year 1	Year 2	Year 3	Year 4	Year 5
Sales	1,241,363	1,266,190	1,291,514	1,317,344	1,343,691
COGS					
A/C Operating Costs	777,341	800,661	824,681	849,421	874,904
Administration	50,000	50,000	50,000	50,000	50,000
Principal Payment	300,000	300,000	300,000	300,000	300,000
Depreciation 10%/yr	300,000	300,000	300,000	300,000	300,000
Interest 7%	210,000	175,000	140,000	105,000	70,000
Expenses	1,637,341	1,625,661	1,614,681	1,604,421	1,594,904
Gross Income	-395,978	-359,471	-323,167	-287,077	-251,213
Income Tax-40%	0	0	0	0	0
Net income	-395,978	-359,471	-323,167	-287,077	-251,213

*Table created by author*

As can be seen above, the cost associated with debt service make a new or nearly new PC-12 prohibitively expensive given the expected estimated revenue (sales). Given the aircraft's utilisation (low) and the estimated price for airfreight (\$1.05/lb.), there is no way to generate a profit using a new aircraft. Since PC-12s are available for \$1.5-3 million dollars, a lower cost alternative must be found. If the principle and interest could be reduced through the purchase of an older aircraft, then there might exist a formula that will yield a profit. This helps explain why most cargo aircraft tend to be older models. By extension, the low volume situation will require the purchase of a substantially less expensive aircraft to make a profit (if possible).

The high freight weight scenario (Table 6.6) offers an interesting possibility. If debt payments and depreciation were stretched to twenty years, a positive cash flow (gross income plus depreciation) would be generated in year one. The only difference between the expected and the high estimates is the amount of "backhaul" that would be carried from the Pacific Northwest to Vancouver.

To explore the idea of using a low cost airplane, an income statement was prepared using the same values for operating costs as the PC-12, but with an assumed purchase price of \$500,000 paid down over ten years. The estimate for administration costs is based on what would essentially be a sole proprietorship. As a result, payroll issues, benefits, and so on would be non-existent. Accounting chores will be handled by a bookkeeper, with an accountant verifying the books periodically. Advertising costs would amount to gasoline and small ads in a local advertising “letter” on display at local restaurants and hair stylists called the “Sip and Chat”.<sup>90</sup> Office space would occupy a corner of the owner’s home.

**Table 6.7 Pro Forma Income Statement-Expected Freight Volumes-Budget Aircraft**

Expected Freight Weight Volume-Budget Airplane					
	Year 1	Year 2	Year 3	Year 4	Year 5
Sales	1,260,000	1,285,200	1,310,904	1,337,122	1,363,865
COGS					
A/C Operating Costs	777250	800568	824585	849322	874802
Administration	12,500	12,500	12,500	12,500	12,500
Principal Payment	50,000	50,000	50,000	50,000	50,000
Depreciation 10%/yr	50,000	50,000	50,000	50,000	50,000
Interest 7%	35,000	31,500	28,000	24,500	21,000
Expenses	924,750	944,568	965,085	986,322	1,008,302
Gross Income	335,250	340,633	345,819	350,800	355,563
Income Tax-40%	134,100	136,253	138,328	140,320	142,225
Net income	201,150	204,380	207,492	210,480	213,338

*Table created by author*

Table 6.7 shows that a low cost aircraft with operating costs similar to that of a PC-12 will generate good after tax profit. The weakness in the estimate is that the assumption of operating cost is likely to be low. Conversely, operating costs could be as much as 50% higher before eliminating any profit.

<sup>90</sup> “Sip and Chat”- a light reading and advertising publication distributed in the Pacific Northwest.

To test the viability of operating an airfreight business at the estimated low freight volumes, a final pro forma income statement was created. With an estimated freight load of one thousand pounds northbound, the choice of aircraft suited for this type of service is limited. All have a single three hundred horsepower engine and travel at about 150 knots. This size of aircraft would not be amenable to the loading of heavy items by mechanical means. Operating costs for this type of aircraft is about \$250/hr. Given a distance travelled of 600 nm in each direction, the average daily aircraft operating costs will be about \$2000. In spite of using a low cost aircraft and providing relatively slow service, as can be seen below, this option does not provide a profit.

**Table 6.8 Pro Forma Income Statement-Low Freight Volumes-Budget Aircraft**

Low Freight Weight Volume-Budget Airplane					
	Year 1	Year 2	Year 3	Year 4	Year 5
Sales	315,000	321,300	327,726	334,281	340,966
COGS					
A/C Operating Costs	500,000	515,000	530,450	546,364	562,754
Administration	12,500	12,500	12,500	12,500	12,500
Principal Payment	15,000	15,000	15,000	15,000	15,000
Depreciation 10%/yr	15,000	15,000	15,000	15,000	15,000
Interest 7%	10,500	9,450	8,400	7,350	6,300
Expenses	553,000	566,950	581,350	596,214	611,554
Gross Income	-238,000	-245,650	-253,624	-261,933	-270,588
Income Tax-40%	0	0	0	0	0
Net income	-238,000	-245,650	-253,624	-261,933	-270,588

*Table created by author*

Given the available data, a new aircraft of a size and capacity to serve the Pacific Northwest will likely be too expensive. While the daily operating costs are manageable, the cost of servicing the debt will be very high when compared to the potential revenue. With the relatively low utilisation associated with this airfreight route and the low estimated price per pound of freight, the only viable alternative is to use an older, lower priced aircraft. If freight

demand turns out to be 50% greater than expected on the return flight to Vancouver, a PC-12 would be marginally profitable.

Based on the assumptions made above, an airfreight operator will have to choose an older model aircraft with care. The aircraft will ideally have to have a load capacity slightly greater than that of a Pilatus PC-12 to capture the expected freight weight that is northbound, but have a purchase price in the half million dollar range (or less) to keep debt service down. Accordingly, the aircraft will be at least twenty years old, but it will need to have been reasonably well maintained to have good reliability. A detailed cost analysis for each proposed individual aircraft will have to be done. Two aircraft of the same make and model may have similar operating characteristics, but since each aircraft will have had a different history, the expected maintenance costs will have to be estimated for each aircraft, along with daily operating costs. In addition different purchase prices will affect debt service costs and this will affect the bottom line.

In this chapter the potential revenues and estimated costs for an airfreight business were calculated. Three possible routes were described. A number of Pro Forma income statements were assembled with a goal of determining which aircraft/route could provide for a viable business opportunity. The assumption that a new aircraft could be supported by the estimated market size proved false. To develop a viable airfreight operation, either attention will have to be paid to the cost of acquiring and financing and aircraft or a significant increase in freight volume will have to be secured.

In the next chapter the costs, revenues and the three scenarios will be combined into a preferred strategy for operating an airfreight service between Vancouver and the Pacific Northwest.

## **7 DISCUSSION AND RECOMMENDATIONS**

In the preceding chapters no attempt has been made to choose an aircraft that would be optimum for the transportation of freight in the Pacific Northwest. Since all of the elements are interrelated, they must all be “fleshed out” before an optimum strategy can be chosen. In this chapter the information presented in the preceding chapters will be discussed and summarised. Based on the expected income and the key success factors, a suggested strategy to minimise risk and maximise revenue will be offered.

### **7.1 Discussion**

From the demand estimation performed in chapter three, aircraft used in regional service tend to have low utilisation. On the Vancouver-Sandspit-Terrace run, utilisation will be three to five and a half-hours per day depending on the aircraft being used. Any work that can raise the utilisation (i.e. extra charter business), will reduce the annual average operating cost (and generate more income). From Terrace or Smithers to destinations in the north, the majority of runways that service mining activities are narrow gravel runways of lengths less than 5000'. For this application the BT-67 would be better suited than the other aircraft, mainly due to its large tires, good propeller-to-ground clearance and relatively short runway requirements. If a steady client has access to a sufficiently long runway, both the 5800 and the 737 can be operated from gravel runways. The 737 would require a “gravel kit”. However, all of these larger aircraft have been shown to be financially unsuited for use in the Pacific Northwest’s airfreight market.

Another consequence of low utilisation is that as the proportion of money borrowed to purchase an aircraft goes up, the cost of capital becomes a larger proportion of total costs, which explains why many airfreight aircraft are very old and have a low purchase cost.

In the first scenario, the variable fees (landing, parking and Nav Canada) account for 8%-13% of the total aircraft cost. By adding Prince Rupert and Smithers, the variable fees component rises to 18%-32% of the total aircraft cost. This suggests that there would have to be an expectation to regularly cover the fees to justify a scheduled service to Prince Rupert and Smithers.

Given the extremely competitive nature of the air freight business, a way must be found to bar (or increase difficulty of) entry into the market by competitors. A first mover will have the advantage of establishing access to channels and of creating a reputation that a competitor will have to circumvent.

With respect to size of airplane, the lowest risk (in terms of capital spent and load factor) is to buy the smallest airplane and then try to develop the market. The longer-term risk to this business strategy is that if the market turns out to be much larger, then there may be a period of time when another competitor will have an opportunity to get into the market and establish itself. Of course the opposite is also true. If an aircraft that is too large for the potential market is procured, it may never make an economic profit. Depending on the amount of risk that the new operator is willing to take, the safe strategy is to start with a small sized aircraft. A more aggressive approach would begin with an aircraft that can take the entire market.

As discussed in Chapter 2, aircraft are not “fixed” assets in the sense of “bricks and mortar”. Therefore, aircraft are not sunk costs and can be sold anywhere in the world. A way to reduce risk would be to begin with a small aircraft with the intention to charter another aircraft if occasional loads exceed the capacity of the existing aircraft. The point of using charter aircraft to

accommodate days when the amount of cargo exceeds the capacity of the aircraft is to maintain the perception of reliability. It is poor business practice to promise to deliver a package in a specified time and then deliver it twenty-four hours later. Once it becomes clear that additional capacity is required on a regular basis, then enough experience and data will have accumulated to justify placing a larger aircraft into service.

A “key success factor” relates to speed and reliability. The customer expects the shipped product to arrive at a particular time. While the use of an aircraft is expected to be quicker in transporting freight, than by ground based means, if much time is wasted in getting the product from the aircraft to the customer, the customer will rightly question the extra expense of air freight. Strict adherence to a schedule will be necessary. While there is always a desire to depart early if the aircraft is “ready”, an early arrival and subsequent departure will leave doubt (with customers) about if the aircraft actually arrived in the first place. This leads to a perception of unreliability. If the chosen aircraft were to have a distinctive visual shape or engine sound, then this would add to the value for customers. While this is difficult to believe, the number of flights into the airports of the Pacific Northwest are so few that “interested” people know which airline (scheduled or charter) is landing by the sound and the time at which it occurs.

Along with developing a perception of “value add” through timely, reliable service, the air freight supplier will need to find a way to create a way for freight to get to and from the airport in an “effortless” manner. Creating a relationship with a courier or trucking service could do this. A substantial benefit of such a relationship would be the creation of a “store front” where customers could drop off their goods anytime during business hours. The ground-based operator would also stand to gain by having the ability to pick up cargo destined for the airport (for a fee, of course). There is a danger that the ground based operator becomes the de-facto soul supplier of freight to the air freight operator, resulting in hold-up. Terms would have to be thoroughly discussed and understood.



Finally, there is a portion of freight volume that has “gone over” to trucking simply because the air freight supply has been unreliable. Automotive parts, industrial plumbing fittings, and home furnace parts, to name a few, benefit from prompt delivery. A key success factor will be the education of the public that such a fast, reliable service is available. In essence, the buying public must have their expectations changed back to the way they were, with the change being a positive one. A “B to B” advertising campaign will likely yield results as long as merchants are convinced that they can put their reputations “on the line” when advocating the speedier delivery.

The project began with the premise (provided by the sponsor) that an airfreight provider should be based in Vancouver and would fly to Sandspit and Terrace. Ground based transportation would then move the freight to customers. The additional costs of going to Prince Rupert and Smithers were calculated. The analysis shows that there must be a significant potential for additional revenue to offset the additional costs. Given that the population of Smithers and the surrounding area is small, it is fair to expect that the potential is small. However, a customer in Smithers could occasionally utilise the service to get freight to Terrace and then “charter” the same aircraft to fly the freight to Smithers. A targeted “B to B” advertising campaign would be an inexpensive technique to educate businesses as to what is possible. The advertising campaign could be as simple as going through the yellow pages and telephoning businesses, which might have a potential use for airfreight. The “telemarketers” in this case could be the pilots who are on the payroll and have nothing to do while waiting for their return flight to Vancouver. The pilots would have a “vested” interest in doing this, as success would increase their job security. The additional cost would be negligible.

From there the business could evolve into providing scheduled service to Smithers. Given that Prince Rupert is only an hour and half by road from Terrace, it is difficult to justify using Prince Rupert Airport (on an island) as an alternative to Terrace.

## **7.2 Recommendations**

At present the market is able to support an aircraft of appropriate size. While the option of choosing an aircraft that is capable of servicing the entire market is riskier than choosing a smaller aircraft, the benefit is that the operator of a larger aircraft will be able to control costs more effectively and might be able to restrain entry into the market by new entrants. From the sample analysed, the aircraft that best meets the needs of the Pacific Northwest is a used PC-12 sized aircraft. The others are too large and waste resources because of low load factors.

With an investment of five hundred thousand dollars for a used aircraft, the airfreight operator can expect to generate about \$1.2 million in sales per year. After paying the bills, the operator will be left with about \$201,000 in cash. This represents a return of about 40%. While this seems very generous, the margins on each flight are small and this could seriously affect the result.

An important part of the strategy of making a success of an airfreight operation will be to re-educate (advertise to) the buying public and individual businesses of the potential value of airfreight in the target markets. At this time Jazz and Hawkair are handling (for better or for worse) all airfreight. This business will have to be taken away from them by not only providing a better service (more reliable), but also by becoming known for providing a better service. In effect this will require potential customers to avoid sending their freight via the known airfreight providers.

To begin with there are advantages in beginning to serve the Sandspit and Terrace areas first. They are equipped with all necessary loading and covered space for protecting the freight from the elements, requiring no capital from the operator. Once a steady service is established,

specific demand in Smithers and Prince Rupert will have to be determined and judged whether there is sufficient demand to justify providing a scheduled service.

In the worst case that demand is taken over by a large passenger carrying aircraft, the aircraft could easily be sold. Since the concept of capturing the remaining market was shown to be very unprofitable, the best strategy would be to exit the market and dissolve the business.

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