

Airport infrastructure as an instrument for regional economic development

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Abstract: Airport infrastructure is part of the basic underlying foundation of an airport system. The existence of airport infrastructure, and associated ground infrastructure, is an essential factor in regional development. It has been demonstrated that the presence of this infrastructure has a direct relationship on the overall economic functioning of the surrounding area. Historically, industrial and commercial firms have tended to locate in clusters near transportation hubs. With the agglomeration of such firms, economic growth is generated. The role of transport infrastructure in regional development is discussed in this paper through the examination of three case studies of airports that have been successful in effecting regional economic development. The primary case studies are Fort Worth Alliance Airport in Fort Worth, Texas; Dallas-Fort Worth International Airport in Texas; and Huntsville International Airport in Alabama. Some conclusions are drawn on airport infrastructure and the role it can play in regional economic development. Some policy recommendations are made as to how the knowledge gained from this study can be applied to an airport business park near Winnipeg International Airport.

Introduction

Traditionally, industry tends to locate in areas that are considered to be transportation centres, or hubs. This tendency has been the “primary cause for the rapid growth of cities” (FAA 1965). Past studies relating transportation centres and regional economic development have usually focused on seaports, and the ability of the port to stimulate the economy in its hinterland. The

focal point of this study, however, is airports, the new “centres of global commerce” (Infrastructure Technology Institute 1999).

Air transportation impacts economic, environmental, cultural and social ways of life worldwide. More people and more companies depend on air transportation than ever before. How significant is the role played by airports in regional economic development? If a city is equipped with an efficient airport, including extensive passenger and cargo links, how much of a comparative advantage does that provide?

Cities and airports can try to attract economic development through airport business parks. Usually located adjacent to an airport, these parks are attractive to those firms that make frequent use of air transportation, whether passenger or cargo. For instance, executives for companies frequently make multiple business trips per month. For these firms, having an office close to the airport allows for a partial workday before or after a flight. Firms that move goods by air, usually goods with a high value-weight ratio or perishable goods, can reduce total transportation costs by locating near an airport. Business park features such as foreign trade zone (FTZ) status make airport locations even more attractive.

As more firms are attracted to a particular airport business park, the service level rises to meet their demands, thus making the location even more desirable to other firms. At this point, the airport business park is said to have reached its critical mass, whereby it enters a stage of self-sustaining growth. The advantages to the firms are not limited to the passenger and cargo air service. In addition, firms are subject to the positive influences associated with agglomeration economies, including combinations of localization economies, urbanization economies and industrial-complex economies.¹

In Winnipeg over the past ten years, there have been a number of discussions and proposals to create an airport-related business park on lands to the north and west of Winnipeg International Airport (YWG).² Winnport, a consortium of local businesspeople who created an all-cargo airline serving Winnipeg and two cities in China, Shenzhen and Nanjing, made some significant progress. Winnport began flying between Canada and China in the autumn

of 1998, but suspended operations in January 1999 and has not resumed as of December 1999.

Winnport was undercapitalized when it began its operations, and was cursed with unfortunate timing. Just as the airline began serving China, the “Asian flu” hit, negatively impacting nearly every economy in Eastern Asia. Winnport, being solely focused on Winnipeg-China routes with no diversification, had no other revenue-generating traffic, and thus suspended operations under mounting losses. Winnport’s initial difficulties should not necessarily be taken as a sign that a major air cargo operation is not viable in Winnipeg. Rather, it should be a lesson from which future endeavours can learn. Winnport may resume operations in 2000.

This paper is intended to identify some feasible steps required to develop an airport business park in Winnipeg, without having “all the eggs in one basket,” as was the case with Winnport initially. The prime purpose of an airport business park is to promote economic development through the provision of infrastructure. This paper considers how that may be possible in Winnipeg.

This paper explores three airports in the United States that *have* been successful in attracting development, to the benefit of their respective regions. In addition, this study further examines Winnipeg’s airport, which may have the potential to undergo similar development. The successful US airports examined in this study are:

1. Fort Worth Alliance Airport in Texas (AFW);
2. Dallas-Fort Worth International Airport in Texas (DFW); and
3. Huntsville International Airport in Alabama (HSV).

Each of the airports in this study differs from the others. AFW is part of a small classification of airports with no passenger traffic and a dedicated focus on air cargo and nearby industrial development. DFW is a major international passenger hub, with tens of millions of passengers annually. HSV is a smaller passenger hub, with a proportionally larger focus on air cargo. The main focus at YWG is on passenger traffic, but with increasing attention being

Table 1: Case Study Airport Classification

| Airport | Location | Classification |
|---------------------------------|---|----------------------------|
| Fort Worth Alliance | Fort Worth, Texas | Industrial, cargo-based |
| Dallas-Fort Worth International | Irving, Coppell, Euless Bedford, Grapevine, TX | Major international hub |
| Huntsville International | Huntsville, Alabama | Cargo-focus with passenger |
| Winnipeg International | Winnipeg, Manitoba | Passenger-focus with cargo |

given to cargo activity. Table 1 summarizes the classification of the airports in this study.

Initially, the paper outlines exactly what is considered to be infrastructure, with specific reference to airport infrastructure. Next the role of infrastructure in development is examined, followed by an in-depth look at the case-study airports. In determining some of the key attributes of the successful US airports, a set of recommendations is made for Winnipeg.

Infrastructure

The Infrastructure Technology Institute of Northwestern University defines infrastructure as the sum of the physical facilities that move people, goods, commodities, water, waste, energy and information. The main and most basic purpose of infrastructure is to “provide the basis for people and business to access goods, services and activities.” (Department of Transport, Western Australia 1999 p.3)

Infrastructure includes: bridges, canals, railways, wires, cables, pipelines, roads, treatment plants, traffic signals, street lights and most importantly for this paper, airports. According to this definition, airports themselves are considered infrastructure. However, there are a number of smaller components that make up the total that is considered “airport infrastructure.”

The following is a comprehensive list of airport infrastructure:

- runways,
- taxiways,
- aprons,
- terminal buildings,
- cargo buildings,
- maintenance buildings,
- administrative buildings,
- roadways,
- curb frontages,
- rental car areas,
- transit areas,
- taxi areas,
- limousine areas,
- fuelling systems,
- power systems,
- rescue units,
- air traffic control facilities,
- lighting,
- navigational aids,
- boarding devices,
- communications systems,
- security systems,
- parking lots,
- graphics,
- signage,
- landscaping,
- drainage,
- water supply,
- and sewer disposal.

For the purposes of this paper, of prime concern are the actual airfield facilities and the access facilities. The airfield facilities include runways, aprons, taxiways and main buildings, such as the passenger terminal and cargo buildings. The access facilities are primarily the roadways (and rail lines, where applicable) that lead into the airport terminal and cargo areas. These two components

of airport infrastructure are most important in terms of regional economic development. To a lesser extent, this paper also considers municipal infrastructure, such as water and sewer service.

Perhaps the best way to address infrastructure and development is to attempt to answer some key questions.

- Why is infrastructure indispensable to development?
- Could development possibly occur without infrastructure?
- Is transport infrastructure vital to economic functioning?

It is the intention of this paper to demonstrate that development requires infrastructure.

Infrastructure and Development

If infrastructure can attract development, it will positively impact a region.

Even the earliest forms of economic development needed infrastructure. For trade to occur between towns, it was necessary to have a way of travelling between the settlements. In 1964, Fogel related the growth of the American economy to the construction of railways. Railways reduced transport costs for shipping agricultural products compared with the relatively high costs associated with the combination of wagon and water transport. It is well known that the completion of the transcontinental railway in Canada in the late 1800's was a major factor in enabling Canada to function as a political and economic unit.

Transport infrastructure provides defined channels of movement for the physical interaction of goods and people between places. The flow of goods and people is the crux of economic functioning and it is only possible with transport infrastructure. The functioning of an economy requires the use of transport and, as economies develop, relatively more transport is required (Hurst 1974). However necessary it may be for development, transport infrastructure by itself is useless. Resources are also necessary for any kind of economic functioning, growth or development.

Transport infrastructure can have three possible effects on development, positive, neutral, or negative (Gauthier 1970; Hoyle and Knowles 1992; Wilson 1966; Rietveld et al 1993; Hoyle and Smith 1992). There are proponents and historical examples of each.

For transport infrastructure to have a positive effect on development, an improved transport network must directly result in the expansion of productive economic activities. New economic opportunities can be created through improved transport service. Most macro-economic, or industry-wide, studies show that investment in infrastructure has a positive effect on regional economic growth (Kessides 1993). However, it is difficult to attribute economic growth directly to transport infrastructure. There must be complementary growth elsewhere in the economy.

The neutral effect, generally the most accepted, notes the derived demand for transportation alluded to above. The provision of transport infrastructure creates one circumstance of many that are necessary for economic development to occur. Infrastructure is a requisite for development, not a factor in production (Kessides 1993; Hoyle and Knowles 1992; Gauthier 1970). The neutral viewpoint is a more realistic version of the positive viewpoint.

The negative effect can manifest itself in a number of ways. A prime example is the case of misdirected investment, whereby resources allocated to transport may be more useful in promoting development in other areas. This is also true if a region is already well-served by transport infrastructure; further investment could be wasteful (Rietveld et al 1993). The protectionist viewpoint suggests that high transport costs arising from current infrastructure protect a region from lower-cost competition from outside the region. Finally, the best planning intentions can backfire, in which improved transport infrastructure could benefit urban centres at the expense of outlying development centres (Gauthier 1970; Miyoshi 1997).

The next section attempts to decipher the impact an airport has on economic development in its region, and also to determine how the airport affects its region geographically.

Regional Economic Development

Employment and income generation are two key tools used to measure economic development. Apart from the direct employment generated by the airport, there is indirect employment associated with activities that support the airport, airlines or passengers, such as hotels and car-rental companies. There is also induced employment, which is comprised of businesses whose existence depends on people who are directly or indirectly dependent on the airport.

This study is primarily concerned with employment and income that is generated in airport business parks, or commercial and industrial development near the case study airports.

Employment and income are generated by businesses.³ Therefore, increased business activity resulting from new and expanded businesses increases employment and income, thereby positively impacting regional economic development. When considering businesses that locate near airports, infrastructure surely does play a role. As mentioned in earlier, the airfield and ground access infrastructure are most important for regional economic development. If a firm is considering an airport location and the decision rests upon infrastructure issues, then runway length, apron space and road access are of greater importance than lighting, drainage or boarding devices.

The investment in infrastructure leads to agglomeration economies, which makes the location more appealing to other firms, intensifying the spatial concentration until the critical mass is reached. When this point is reached, public investment is not as vital.

Case-Studies

The airports included as case studies are among North America's most successful at effecting regional economic development. After examining the three U.S. cases, this study revisits YWG and suggests how it might benefit from a similar style of planning.



Figure 1: Fort Worth Alliance Airport. (Source; North Central Texas Council of Governments, 1999)

FORT WORTH ALLIANCE AIRPORT (AFW)

Fort Worth Alliance Airport was constructed in 1989 as a reliever airport for Dallas-Fort Worth International Airport. The metropolitan Dallas-Fort Worth area has a population in excess of 5 million, and is home to approximately 30 airports.

Alliance is the result of tremendous cooperation between private interests and various levels of government, hence the name Alliance. Although it has been 96% privately funded, the City of Fort Worth, Denton and Tarrant Counties, the State of Texas, and the Federal Aviation Administration (FAA) have all contributed to the project since its inception in the late 1980s.

Alliance, which has no passenger activity, is chiefly concerned with cargo operations, pilot training and aircraft maintenance. Alliance is more than just an airport, it has been billed as the “international business development of the future” (Hillwood Development Corporation 1999). Alliance combines airport infrastructure with an inland container terminal, an industrial park, a foreign trade zone, and a residential development, spread out over approximately 4000 hectares (9400 acres), although not all of the land is developed.

Between US\$4 and 5 billion have been invested at Alliance, over 20,000 jobs have been created (including construction jobs), and about US\$10 million in taxation is generated annually for the cities, counties, the school district and the state.

Just over a decade ago, the area that is now Alliance was farmland. In fact, there are still cattle roaming the open areas on the airport site. As of now, there are 19 'Fortune 500' companies at Alliance, and over 70 companies in total. The record of development at AFW is unmatched anywhere in North America.

As for the existent infrastructure, the roadways are very wide, designed to handle high volumes of very large trucks, consistent with the concentration of distribution centres. The single runway is 3,000 m (9,840 feet) in length with FAA approval to be extended to 4,000 m (13,120 feet), which would accommodate the largest aircraft in regular use today.

Alliance features direct access to I-35W, which leads north through the Mid-Continent International Trade Corridor to Canada, and south to Mexico. Often referred to as the NAFTA Superhighway, I-35 is the shortest existing route connecting all three nations.

Some of the major companies at Alliance include:

- Federal Express
- American Airlines
- Kraft
- Maytag
- Michaels
- JCPenney
- Galaxy Aerospace
- Nokia
- Nestlé
- Zenith
- Texas Instruments
- United States Immigration and Naturalization Service, and United States Drug Enforcement Agency

Another major tenant is Burlington Northern Santa Fe Railroad (BNSF), which operates one of North America's largest and most technologically advanced intermodal facilities at AFW. Not only does this company add to the Alliance portfolio, but the facility is also one of the strongest drawing forces. Alliance officials have claimed that the BNSF facility has been "as important" as the airport in terms of attracting tenants.

The entire Alliance area is a Foreign Trade Zone (FTZ), making it especially appealing to firms involved in international commerce. FTZ status enables firms to save on duties and taxes on inventory that is in-transit and on parts used in the manufacturing or assembly of other goods⁴

Just north of Alliance is Texas Motor Speedway (TMS). Developers credited the success and drawing power of Alliance for influencing their locational decision. TMS is another economic spin-off benefit from the geographical proximity to the airport, sparking more agglomeration benefits. TMS hosts a number of events each year, the most popular being NASCAR and Indy Racing League events, which can fill the 200,000-seat facility. With events so large, the added economic impact on the region is enormous.

More recently, a number of residential developments are in the planning or construction phases, designed to house the growing work-force at Alliance.

However important Alliance is to the region, it likely will always be less than the region's main airport: Dallas-Fort Worth International, only 15 miles away.

Dallas-Fort Worth International Airport (DFW)

DFW, located equidistant from downtown Fort Worth and downtown Dallas, is unique in this study because it is primarily a major passenger hub. It was the 5th busiest airport in the world in 1998, approaching 60 million passengers annually.⁵ DFW is owned by the cities of Dallas and Fort Worth and is intentionally located equidistant from both downtowns.⁶ It has been generally acknowledged as the "key economic engine" in the region since it opened in 1974 (personal communication with Cynthia Weatherby,



Figure 2: Dallas-Fort Worth International Airport. (Source: Dallas-Fort Worth International Airport, 1999)

Program Manager, Texas Transportation Institute; personal communication with Ed McLaughlin, Vice President, North Texas Commission).

However, it competes with another major passenger airport in the area. Love Field, located right in Dallas, is the national headquarters for Southwest Airlines. However, flights from Love Field are limited to Texas, the states that border Texas (New Mexico, Oklahoma, Arkansas, Louisiana) as well as Mississippi and Alabama, which were added more recently. Apart from Southwest, Continental Airlines and American Airlines also have limited service at Love Field.

It is estimated that the annual economic impact of DFW is approximately US\$11 billion. This includes over 200,000 jobs and US\$6.1 billion in labour income (Dallas-Fort Worth International Airport 1999).

There is an incredible amount of infrastructure surrounding DFW airport. In total, DFW covers about 7000 hectares (17,000 acres), an area larger than the island of Manhattan. The most obvious

infrastructure components are the four terminals and seven runways, with expansion plans for two more terminals and another runway. In terms of ground infrastructure, major freeways surround the airport with direct links to the central urban areas of Dallas, Fort Worth and most of the smaller cities that make up the metropolitan area. One freeway, International Parkway, runs through the middle of the airport with aircraft taxiways crossing overhead. Finally in terms of infrastructure, six major rail lines serve the airport area.

The cargo areas at DFW are to the north. United Parcel Service (UPS) operates a regional hub in the northwest corner of the airport and most other major cargo companies have substantial operations in the northwest and northeast areas of Figure 2. FedEx, despite its regional sorting hub at AFW, also maintains some operations at DFW to take advantage of the international routes which are available. DFW was the 21st-ranked airport in the world in terms of annual cargo volumes in 1998, with just over 800,000 metric tonnes (Airports Council International 1999).

DFW officials claim that the airport has been a factor in the relocation or expansion of over 400 firms (Dallas-Fort Worth International Airport 1999). This study is part of a larger study aimed at determining exactly how important DFW and the other case-study airports are in terms of industrial location, including the relatively large impact of the airport in the smaller city of Huntsville, Alabama.

Huntsville International Airport (HSV)

Huntsville International Airport was intentionally located about 5 miles outside of Huntsville proper in order to mitigate potential negative impacts. The city of Huntsville has a population of approximately 180,000, less than one-third of Winnipeg's population, and just a fraction of the population of Dallas-Fort Worth. The city of Huntsville has the highest per capita income in the southeastern US, nearly twice that of the state's largest city, Birmingham.

The airport and much of the surrounding infrastructure fall under the jurisdiction of the Huntsville-Madison County Airport

Authority. In 1996, the economic impact of the Huntsville airport was assessed at 28,594 jobs generating almost US\$1 billion in labour income. HSV covers 2350 hectares (5800 acres) with potential expansion to 3400 hectares (8400 acres).

HSV has developable land on three of its sides. To the west and south is mainly farmland. Immediately east is the JetPlex Industrial Park, and further east, between the airport and the city of Huntsville is Redstone Arsenal (a US Army installation) and NASA's Marshall Space Flight Center. The city of Madison, just north of the airport, has a population of fewer than 50,000, but represents a major problem for the airport because of aircraft noise.

HSV's two runways are separated by one mile, facilitating simultaneous operations. The terminal is centrally located in the airfield and has a direct ground connection with Interstate-565. The cargo area is to the east, between the airport and the JetPlex Industrial Park. The most important cargo carrier at Huntsville is CargoLux, which currently flies nine 747 freighters per week between Luxembourg, Huntsville and Mexico. Warehouse space at Huntsville is in the process of doubling its capacity. The air cargo center is adjacent to the International Intermodal Center, which is a rail container facility served by the Norfolk Southern. To the east is the JetPlex Industrial Park, home to some major companies, including Chrysler and the Air Defense and Space



Figure 3: *Huntsville International Airport. (Source: Huntsville-Madison County Airport Authority, 1999)*

Divisions of Boeing. Other electronics and aerospace firms are also in the area, including Futaba, TDK, Raytheon and Goldstar. The concentration of firms can be clearly noted by the numbers – each representing a tenant firm in the business park – in Figure 3.

The Airport Authority operates the airport, the intermodal center, and the industrial park. Together, their impact on regional economic development can be difficult to separate from the federal government's impact. Many firms that locate near the airport are government contractors, either for the US Army or for NASA.

Winnipeg International Airport (YWG)

Winnipeg International Airport is located in northwest Winnipeg, only fifteen minutes from downtown. Immediately adjacent to the airport is 1200 hectares (3000 acres) of developable land available for a business park. This land is currently being marketed by the Winnipeg Airport Lands Corporation, a subsidiary of the Winnipeg Airports Authority. Winnport was intended to spur development of an airport business park in the exact same area. YWG's advantages include:

- central location
- developable land near the airport
- 24-hour operations
- uncongested air space, and
- excellent flying weather.

Federal Express and Purolator Courier have substantial operations at Winnipeg, among their most important in Canada. Their facilities are crowded into the area south and east of the airport (Figure 4).

The notion of an airport business park is now being promoted and marketed by a consortium of landowners known as the Winnipeg Airport Lands Corporation (WALCO, a subsidiary of WAA). There are hundreds of hectares of land available for immediate development west of YWG, but very little has even the most basic of services. Upgraded truck routes are also a necessity



Figure 4: *Winnipeg International Airport. (Source: Winnipeg Airports Authority)*

for any substantial distribution activity. Currently, distribution activity from YWG's hinterland to the south and east of the airport must travel along one of the city's most congested arteries (Route 90) to get to the main highway to the United States.

The airfield is adequate, as it is currently underutilized. There are three runways (one of which is for light aircraft only) and sufficient taxiways. Apron space, particularly for cargo, is at its capacity, especially during peak overnight hours. If a business park were to be developed with increased utilization of the airport for cargo, as has happened at AFW, DFW and HSV, new cargo aprons and buildings would be required.

A recent Economic Impact Study pegged YWG's impact at 7220 jobs creating C\$220 million in labour income, and C\$300 million in expenditures (Shurvell et al 1998).⁷ This is clearly a significant impact on the community of Winnipeg. However, with some careful planning, strategic investment of public and private

money, and a commitment from some major firms, the impact could be much greater.

Conclusions

There are a number of key features that each of the successful US case-study airports possess, which have undoubtedly contributed to the positive economic development they have had on the surrounding regions.

1. They are fully multimodal facilities. They incorporate air, road and rail infrastructure, and Huntsville is contemplating a port on the Tennessee River.
2. Much of the development surrounding the airports has taken advantage of tax incentives and abatements. For example, a major tenant at Alliance Airport, the American Airlines maintenance base, may have located in Tulsa, had not the various levels of government agreed to a fifteen-year abatement of taxes.
3. Each airport and each business park is designated as a Foreign Trade Zone. This means that firms do not have to pay duty or taxes on components that are imported into the United States and subsequently re-exported, saving companies millions of dollars annually.
4. Not all firms that locate near airports are dependent on air operations. Other possible reasons may include incentives, proximity to customers or suppliers, and the agglomeration advantages associated with shared infrastructure.
5. The development has followed the provision of infrastructure. In all cases, the initial outlay of capital created excess capacity, but resulted in a powerful ability to attract firms and effect economic development.

In addition, as development occurs at an airport, other firms note the success of those firms locating near the airport and recognize that similar advantages and benefits could accrue to their own firm from an airport location. Soon, as has been the case at each of the three U.S. airports in this study, a critical mass is reached. At this point, the airport business park is able to undergo self-sustained growth.

Recommendations

If planners in Winnipeg were to use the three case studies in this paper as models, then some recommendations should be apparent.

1. Above all, the parties involved (civic and provincial governments, WAA, and Economic Development Winnipeg, for example) must act together to plan and construct infrastructure that is attractive to firms. Industrial quality water and sewage systems must be complemented by wide, multi-lane divided roadways with grade-separation for rail crossings. The roads should provide quick access to inter-city highways, while avoiding congested urban areas.
2. Construct a multi-user intermodal facility. Manitoba would best be served by a container terminal providing access to Canadian National (CN), Canadian Pacific (CP), Burlington Northern Santa Fe (BNSF) and the Hudson Bay Railway (HBR).⁸ Without such a facility, YWG would not be on par with AFW, DFW or HSV as a multimodal transportation centre.
3. WAA, along with the city, provincial and federal governments should work together to provide an attractive incentive package to urge firms to locate, relocate, or expand in Winnipeg, particularly in a new airport business park.
4. Currently FTZs in Canada are very limited in their usefulness. Paperwork is excessive and GST legislation remains a sub-

stantial problem. The federal government is creating a new policy regarding FTZs. Winnipeg needs to be prepared for the impending announcement regarding FTZs in Canada. Local freight forwarders have indicated that an effective FTZ would allow business operations to be carried out more efficiently.

5. There are a number of firms that are good candidates to be the focus of new development. Winnipeg has a core of aerospace firms in Standard Aero, Bristol Aerospace, Boeing and Air Canada's Maintenance Base. High-tech firms are growing quickly in Manitoba and numerous other industries would benefit from an airport location. (For example, local clothing-manufacturer Nygard imports materials for garments from Europe by air. Frequently, there are logistical delays that could, in part, be mitigated by an airport location.)

Following the formulas of the successful US case-study airports will not work everywhere. There are airport business parks in Portland, OR and Kinston, NC that have tried to follow the example of the airports in this study, but have been very slow to develop, despite having large public investments for infrastructure.

Eventually some Canadian airport will take the lead and become the new prototype. Many are trying. Hamilton, Montreal-Mirabel, and Vancouver are definite front-runners. The possibility for such a proposal to work in Winnipeg does exist if it is done effectively. Rather than being strictly concerned with their own interests, individuals and organizations must work together to help Winnipeg's economy diversify and grow, bringing benefits to all local organizations. This is especially true considering that each has the same ultimate goal: economic development. Cooperation is the only way a project of this magnitude will ever be feasible. To date, however, few parties have been willing to work together.

At the risk of being overly optimistic, an Alliance-style development could spur the biggest boom to Winnipeg since the CPR arrived in the 1800s, which was the result of a permanent tax exemption. If an airport business park is going to be successful in Winnipeg, it will undoubtedly be a group effort. No single organization can do it alone.

The cooperative effort has to ensure that adequate infrastructure is available for firms wishing to relocate or expand. This includes: municipal infrastructure such as water and sewer service; rail infrastructure, in the form of an updated intermodal facility; airside infrastructure in the form of runways, taxiways, aprons and warehouses; and ground access in terms of roads and highway connections.

In the US case studies, investment in infrastructure preceded economic development. In Canada, decision-makers wait for the economic development to occur before deciding to invest in infrastructure. Providing the infrastructure will not guarantee development. But providing *no* infrastructure guarantees that *no* development will take place.

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¹ For more information about agglomeration economies, please see Parr (1973) and Yuhn et al (1998).

² Note the open areas to the north and west in Figure 4.

³ Government agencies, educational institutions and other organizations also generate income and employment. For the purposes of this paper, they can be considered to be businesses if they are indeed airport-related.

⁴ For a more detailed examination of FTZs, please see Crockatt (1997), Hillwood Development Corporation (1999), Dallas-Fort Worth International Airport (1999) and Huntsville-Madison County Airport Authority (1999).

⁵ By comparison, approximately 3 million passengers use Winnipeg International Airport each year. Even Canada's busiest airport, Lester B. Pearson International in Toronto, handles fewer than 30 million passengers per year.

⁶ Dallas owns 7/11 of the airport and Fort Worth owns 4/11 based on their populations at the time of construction.

⁷ It is dangerous to compare the results of economic impact studies because each study uses a different methodology, incorporating different elements. The impact figures used in this paper are for rough comparisons only and should not be considered as exact measurements of the economic impact of each airport. For more on this topic see Shurvell et al (1999).

⁸ For more information, see Duncan (1999).