1.0 Introduction

In December 1903, the Wright brothers achieved the first manned, controlled, powered airplane flight. The ensuing development of aviation contributed outstandingly to overcoming the limitations presented by temporal, spatial and topographical barriers. It is fitting in the centennial year of the airplane that this conference examines the impact on our society of this momentous addition to transportation.

In Manitoba, aviation provides a critical link in the transportation network. The air mode provides vital connections between remote northern areas and larger provincial centres. It also connects all Manitobans to international destinations via Winnipeg International Airport.

The contribution by the air mode to facilitating the general economy is widely acknowledged. However, the contribution of commercial aviation to the economy of Manitoba is unquantified. This paper reports on the economic impact of commercial aviation within the Province of Manitoba for the year 2001. The next section outlines the structure of the industry and introduces the methodology. For convenience, the detailed methodology is presented in an appendix. The body of the paper reports the quantification of the aviation industry in Manitoba in terms of direct, indirect and induced economic impacts.

2.0 Industry Structure

Political administrations derive guidance for economic policy formulation from a better understanding of the economic structure of industry. Economic impact studies are a means to facilitate conceptualisation of the often-elusive and complex economic interactions. Economic profiling of a total sector becomes feasible in conjunction with a systematic economic impact assessment (EIA) of cumulative industries. This is made possible by a comparative assessment of economic impacts for industries that constitute the sector (Link, 1996).

Figure 1 provides a schematic representation of the industry structure of commercial aviation in Manitoba. Commercial aviation, as defined for the purposes of this paper, is comprised of certified and specified non-certified aviation related operations.

Certified operations include carriers (airlines, commuters, taxi, specialty, private), airports, air navigation services, flight training units, fixed base operators and those approved maintenance organizations that are part of commercial air services companies. Non-certified operations are registered aerodromes.
The number of operations involved in commercial aviation (217) has a 45/55 percentage split between air services (97) and ancillary services (120).

It is important to note that the numbers of operators for a specific category do not imply size or contribution on total economic impact. For instance, the 12 airlines (certificate 705 operators) make a greater contribution to economic impact than the combined impact of all 85 remaining air services operators.

**Figure 1: Structure of the Manitoba Commercial Aviation Industry (number of elements in parentheses).**

This paper does not include the structure of secondary aviation activity. Ground transportation, indirect aviation activity around the airport, and the aerospace industry, which is engaged in manufacturing and overhaul, are excluded from results. The economic impact of secondary activities is captured in the output of the carriers. The export of the aerospace industry output would not constitute “double-counting”, but it is considered to lie more in the realm of manufacturing than aviation.

### 3.0 Methodology

The contemporary economic environment within which Canadian commercial aviation operates justifies some caveats with the interpretation of economic impact results. Economic impact assessments investigate benefits to society from a specific activity, but do not address economic efficiency or financial viability. Economic efficiency falls within the ambit of benefit-cost analysis and financial viability is the focus of profitability analysis.

An EIA can be visualized as either an ongoing flow in economic activity (commercial aviation regular activity), or a surge in the flow of economic activity (contribution to stock of commercial aviation infrastructure such as aircraft or...
Assessments of commercial aviation general operations represent the first type of EIA. When considering general operations, the EIA allows for only the resources needed to perform ordinary operating activities (Prentice and Bekker, 2002).

The geographical scope of this paper is limited to the Province of Manitoba. Hence, expenses incurred in Manitoba of both Manitoba based as well as non-Manitoba based companies in 2001 are included in results. However, expenses incurred outside of Manitoba, also of Manitoba based companies, are excluded from results.

The economic impact of the much publicized airline terror event in September 2001 was minimal in Manitoba. According to Horner and Prentice (2002) aviation activity in the Prairie & Northern Region (PNR) was less affected by these events than national aviation. Aviation activity tracked previous months consistent with an economic slowdown only two months later in November. To the extent that there was any impact, the results would tend to under-estimate rather than inflate the economic impact of aviation in Manitoba.

A detailed discussion on methodology is presented in the appendix.

4.0 Results

4.1 Response Rate

The response rates to the survey are presented in Table 1. The participation of dominant companies is critical to the reliability of results. The 69 respondents include all the dominant companies that are mentioned in the various categories.

<table>
<thead>
<tr>
<th>Category</th>
<th>Respondents/Population</th>
<th>Estimated Expenses Captured</th>
<th>Estimated Employment Captured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Air Services</td>
<td>38/97</td>
<td>85%</td>
<td>84%</td>
</tr>
<tr>
<td>Commercial Aviation Ancillary Services</td>
<td>31/67</td>
<td>87%</td>
<td>90%</td>
</tr>
<tr>
<td>Total Commercial Aviation</td>
<td>69/164</td>
<td>85%</td>
<td>85%</td>
</tr>
</tbody>
</table>

The positive effect of participation by dominant companies is evident from the high proportion of respondents’ captured values to the population estimated total value. Altogether, 85% of both estimated total operating expenses and estimated total employment were captured from respondents.

4.2 Monetary Impact

Table 2 shows operating expenses and revenues for commercial air services and aviation ancillary services. Total operating revenues of commercial aviation companies in Manitoba are estimated at $551 million in 2001.
The monetary impact of commercial aviation to the economy of Manitoba is presented in Table 3.

<table>
<thead>
<tr>
<th>Category</th>
<th>Air Services</th>
<th>Ancillary Services</th>
<th>Total (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP at Market Prices</td>
<td>435</td>
<td>150</td>
<td>584</td>
</tr>
<tr>
<td>Direct Impact</td>
<td>216</td>
<td>74</td>
<td>290</td>
</tr>
<tr>
<td>Indirect Impact</td>
<td>95</td>
<td>33</td>
<td>127</td>
</tr>
<tr>
<td>Induced Impact</td>
<td>124</td>
<td>43</td>
<td>167</td>
</tr>
</tbody>
</table>

(1) Totals may not add due to rounding.

In total, commercial aviation contributed $584 million to the Manitoba GDP at market prices in 2001. Air services contributed $435 million and ancillary services contributed $150 million to the total impact. The direct impact to the Manitoba economy from commercial aviation was $290 million, the indirect impact was $127 million and the induced impact was $167 million.

4.3 Employment Impact and Labour Income

The impact of commercial aviation on employment in Manitoba is presented in Table 4.

<table>
<thead>
<tr>
<th>Category</th>
<th>Air Services</th>
<th>Ancillary Services</th>
<th>Total (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Employment</td>
<td>6,889</td>
<td>2,368</td>
<td>9,257</td>
</tr>
<tr>
<td>Direct</td>
<td>4,314</td>
<td>914</td>
<td>5,228</td>
</tr>
<tr>
<td>Indirect and Induced</td>
<td>2,575</td>
<td>1,454</td>
<td>4,029</td>
</tr>
<tr>
<td>Labour Income</td>
<td>277</td>
<td>95</td>
<td>372</td>
</tr>
</tbody>
</table>

(1) Totals may not add due to rounding.
(2) Full-Time Equivalent Person Years.

Manitoba direct employment from commercial aviation activity was 5,228 full-time equivalent person years in 2001. A total of 4,314 and 914 full-time equivalent person years resided with direct air services and direct aviation ancillary services respectively.

In addition to the direct employment, air services and commercial aviation ancillary services contributed to an additional 2,575 and 1,454 indirect and induced full-time equivalent person years respectively.
This means that in 2001 a total of 9,257 full-time equivalent person years of employment in Manitoba were consequential to the commercial aviation industry. The total labour income from commercial aviation activities in Manitoba was $372 million.

Figure 2 presents the total direct commercial aviation employment of 5,228 full-time equivalents which was, for the purpose of this study, divided into flight duty workers, flight support workers and administrative workers.

Flight support activities provided most of the direct employment at 2,790 full-time equivalent workers, followed by administration at 1,434 full-time equivalent workers and flight duties at 1,004 full-time equivalent workers.

![Figure 2: Total Direct Employment by Activity Category.](image)

The largest single direct employment category within Manitoba commercial aviation in 2001 was flight support workers in commercial air services at 2,097 full-time equivalent workers.

Figure 3 shows total direct employment of commercial aviation in Manitoba on the basis of full-time, part-time and seasonal workers.

![Figure 3: Total Direct Employment by Time Category.](image)

By far the majority of workers directly employed in Manitoba commercial aviation were employed on a full-time basis. Full-time employment for commercial air services and aviation ancillary services sum to 4,546 full-time equivalents. Part-time and seasonal employment was 448 and 234 full-time equivalents respectively.
5.0 Conclusion

The advent of powered flight a century ago changed forever the way we travel and trade, and the frequency with which we now cross borders so readily. The ease with which modern transportation overcomes previous severe limitations often induces an underestimation of transportation activity, or leads to the assumption that it is the domain of a few large firms. While it is true that it is an industry of extremes, the multitude of small firms sum to provide a significant output. Another easy assumption is that the firms are self-contained. The reality is that a large and diverse support industry exists.

The 217 Manitoba commercial aviation entities that were included in this study had a continued effect in direct economic activity combined with the indirect and induced effects of over $580 million, or 1.67% of Manitoba’s GDP in 2001 (Statistics Canada, 2003a and Statistics Canada, 2003b).

The continued effect of direct economic activity combined with the indirect and induced effect was total employment of 9,257 person years, or 1.66% of Manitoba’s total employment in 2001 (Statistics Canada, 2003c).

Commercial aviation in Manitoba contributed $372 million, or 2.09% to total Manitoba labour income (Statistics Canada, 2003d) and 31.1% to Manitoba transportation and storage labour income (Statistics Canada, 2003e).
Appendix: Methodology: Topics for Special Consideration

(i) **Linkages**
Fundamental to an understanding of economic impact is the concept of interdependence between businesses. This interdependence may be in the format of intra-industry, inter-industry and inter-sectoral linkages.

Total economic impact derives from direct, indirect and induced effects. The model of various interdependently configured links between businesses fundamentally underlies conceptualisation of these effects.

Economic multipliers are used to estimate total, direct, indirect and induced impacts form these effects.

(ii) **Multipliers**
Multipliers are derived from an input-output analysis of economic structural interdependence in the defined geographical jurisdiction. Multipliers are quantitative representations of economic interdependencies that are endogenous to the linkage system (Krumme, 2002).

Strong industry and sectoral linkages in an economy contribute to greater direct, indirect and induced effects and consequently to larger multipliers. Generally, territories with small economies, functioning with a market driven foreign trade regime, have less intra-territorial industry and sectoral linkages and hence have lower multipliers than territories with larger economies. The magnitude of the multiplier is a function of the local value added by the activity. Although general operating expenses may be high, if the amount of value added from that activity is small, then the multiplier will be small. The converse also applies (Prentice and Bekker, 2002).

Economic multipliers for Manitoba were obtained from the Manitoba Bureau of Statistics (MBS) (Manitoba Bureau of Statistics, 1999a).

(iii) **Study Design**

(a) **Target Population**
Non-duplicated economic production is achieved by capturing the value of final transactions. In so far as commercial aviation refers to air services only, the relevant final transactions almost exclusively implicate air carriers. However, within the defined economic scope of this study commercial aviation extends beyond the exclusive relationships with only air carriers.

From an economic impact point of view, the challenge is to capture the effect of these activities without at the same time generating “double-counting” of economic value in the economic impact calculation of “downstream” activities. To this end, certain expenses were “backed-out” of calculations. This allowed inclusion of an estimate of the non-duplicated economic activity of fixed base operators, aerodromes and flight training units under the commercial aviation ancillary services category, while still correcting for “double-counting” by excluding economic activity directly with carriers.

Notwithstanding best efforts to avoid “double-counting” there is a risk that some “double-counting” of economic impact remains between Manitoba based operating certificate holders. However, given the strict definition of the industry for this study it is unlikely that any remaining “double-counting” would exceed commercial aviation activity that was excluded. For example, AMO’s not associated with an air carrier were excluded, due in part, to avoid “double-counting” their sales to Manitoba air service operators. However, many of these are specialty shops, which also perform services for operators outside Manitoba. This economic activity that is exported from Manitoba qualifies as commercial aviation ancillary services that impacts the economy of Manitoba, but, by definition, is not

Bekker & Prentice
included in results. Therefore, the reported results for economic impact of commercial aviation in Manitoba are regarded as conservative estimates.

(b) Multiplier Limitations
MBS multipliers are derived from Statistics Canada Inter-Provincial Input-Output Tables (Manitoba Bureau of Statistics, 1999b). This methodology implies certain limitations.

A major limitation is that multipliers are static. Empirically derived multipliers represent structural relationships between variables in the economic input-output matrix at a given point in time. Therefore, it follows that multipliers pertain to the period for which the underlying relationships were quantified (Krumme, 2002).

The stability of input-output models are affected by a number of factors such as technological change, relative price changes, input substitutions, variations in product mix and changing scales of production (Conway, 1977 as referenced by Krumme, 2002).

Navigation charges were introduced since the last update of multipliers and these charges are now recorded in the expenses of carriers. Previously, the federal government recovered the air navigation system costs from the Air Transportation Tax. Air carriers collected and remitted these funds to the federal government, but it was not part of carriers’ direct expenses. Therefore, a shift probably occurred in the underlying relationships of multipliers, but remains unrecorded.

It is beyond the scope of this study to update multipliers, but the change in navigation charges could be addressed by incorporating those costs as another support structure cost. It could be argued that inclusion of navigation charges would not constitute “double-counting” because the current input-output models do not incorporate these costs and, therefore, inclusion of navigation charges probably results in a lesser error than its omission. Accordingly, Nav Canada charges were included with the commercial aviation ancillary services category.

Given the imprecise reflection of the current nature of industry and sectoral relationships in existing input-output models, this hybrid design has been adopted to adjust for these limitations.

(iv) Survey Procedures and Data Analyses
An important consideration of this study is the concentrated nature of economic activity in aviation. Carrier activity in Manitoba is dominated by Air Canada. Winnipeg International Airport is the only National Airports System (NAS) airport in Manitoba and dominates airport activity. Nav Canada is the sole provider of navigation services. In short, while the methodology was based upon established sampling theory principles, in the case of these three organizations the methodology essentially required a census rather than a sample.

For missing values within partially completed surveys, as well as for complete survey values for non-respondents, data points were estimated by stratified mean-substitution. Where this technique proved impractical best estimates were based on interpolation of data from most similar available substitutes.

(v) Economic Impact Metrics
Intensity ratios were used to determine the total economic impact in terms of Gross Domestic Product (GDP), labour income (both measured in 2001 Canadian dollars), and Manitoba employment (measured in full-time equivalent person-years (FTE PY)). The impact on GDP at market prices represents the net monetary benefit to the provincial economy.
This study uses total operating expenses information and estimates industrial output by applying the inverse of the operating ratio of these expenses. Note that in the case of an operating loss the operating ratio was limited to a maximum value of one.

Operating losses of any company or companies do not diminish the economic impact below that which is incurred from expenses. An operating ratio of one represents an operating breakeven situation where all economic impact originates from incurred expenses and no operating profit remains for distribution and its re-spending.

Operating ratios for specific companies were obtained from annual financial statements where possible. In other cases industry operating ratios were obtained from Statistics Canada (Table 5).

<table>
<thead>
<tr>
<th>Table 5: Commercial Aviation Industry Operating Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Ratio</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Air Canada</td>
</tr>
<tr>
<td>Levels IB-IV Carriers and Other Operators</td>
</tr>
<tr>
<td>Winnipeg International Airport</td>
</tr>
<tr>
<td>Other Airports and Aerodromes</td>
</tr>
<tr>
<td>Nav Canada</td>
</tr>
<tr>
<td>Maintenance and Support Operations</td>
</tr>
</tbody>
</table>

[1] Calculated from Air Canada Annual Report 2001;
[4] Operated on the basis of cost recoveries only, for example Northern Airports;

Acknowledgements
The authors acknowledge the financial assistance of the Manitoba Department of Transportation and Government Services towards this study. The views expressed in this paper do not necessarily represent those of the Department and they provide no warranties as to the validity or accuracy of the information presented herein. We also express our gratitude to Mr. Al Philips and Mr. Fred Petrie for the valuable contributions they provided in their respective fields of expertise.

Bibliography


Link, A.N., 1996. Economic Impact Assessments: Guidelines for Conducting and Interpreting Assessment Studies, National Institute of Standards and Technology, Gaithersburg, MD, USA, p. 3-5.


Bekker & Prentice


***