INTEGRATED TRANSPORTATION MODEL:

A study of Calgary, Edmonton, Red Deer and Lethbridge

Integrated Travels

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SECTION 1: INTRODUCTION

1.0. Introduction

In the realm of modern transportation infrastructure development, the seamless integration of diverse modes of travel has emerged as a critical endeavor to enhance connectivity, accessibility, and sustainability. Within the context of Alberta's transportation landscape, the integration of airline, transit, and passenger rail services stands as a pivotal challenge and opportunity for advancing regional mobility and fostering economic development.

This research paper investigates the preferred integration model between airlines, transit systems, and passenger rail stations in key Alberta cities, namely Calgary, Edmonton, Red Deer, and Lethbridge. The primary objective is to analyze the synergies, challenges, and opportunities inherent in integrating these modes of transportation to create a more efficient, equitable, and sustainable travel network.

In view of increasing urbanization, population growth, and environmental concerns, the need for a comprehensive and integrated transportation system has never been more pronounced. By examining the various interplay between airline, transit, and passenger rail services, this research aims to provide valuable insights and recommendations for policymakers, transportation planners, and stakeholders involved in shaping Alberta's transportation future.

The study adopts a multi-faceted approach, combining quantitative analysis, stakeholder consultations, and comparative case studies to elucidate the complex dynamics of transportation integration advocated by Integrated Travels. By identifying best practices, addressing challenges, and proposing innovative solutions, the research endeavors to contribute to the advancement of transportation policy, planning, and practice in Alberta and beyond.

As we embark on this project, we recognize the significance of collaboration, data-driven analysis, and evidence-based decision-making. Through rigorous research and thoughtful deliberation, we seek to pave the way for a transportation system that not only meets the needs of today's travelers but also anticipates and accommodates the challenges and opportunities of tomorrow.

In the subsequent sections, we will delineate the research methodology, present key findings, and offer recommendations aimed at advancing the integration of airline, transit, and passenger rail services in Alberta. By fostering a deeper understanding of transportation integration, we aspire to contribute to the realization of a more connected, accessible, and sustainable future for all Albertans.

1.1. Introduction to Calgary's Transportation Landscape

Calgary, located in the province of Alberta, Canada, serves as a vital transportation hub, facilitating both domestic and international travel. With a growing population and thriving economy, Calgary's

transportation infrastructure plays a critical role in connecting people and goods within the city and beyond. This report aims to provide a comprehensive analysis of Calgary's transportation landscape, focusing on key areas such as air travel, rail services, transit infrastructure, economic impact, and demographics.

- Population

In 2021, Calgary's population stood at 1,306,780, marking a 5.5 percent increase from the 2016 figure of 1,239,220. Concurrently, the number of private dwellings in Calgary rose to 531,062, reflecting an 8.5 percent increase from the 2016 count of 489,650. Of these dwellings, 502,301 were occupied by usual or permanent residents, while 28,761 were either unoccupied or inhabited solely by temporary residents. Notably, areas within and around the Greater Downtown, alongside certain newly developed communities at the periphery of Calgary, witnessed the most significant population growth between 2016 and 2021. Conversely, numerous areas across Calgary experienced declines in population over the five-year period (Calgary.ca).

In 2021, Calgary boasted 502,300 private dwellings occupied by usual or permanent residents. Of these, approximately 55 percent were single-detached houses, while roughly 24 percent were apartments. The average household size in Calgary remained steady at 2.6 persons in 2021, a figure consistent with data from two decades prior.

Table 1**.** Household Size and Composition in Calgary

Household size	Total Household size	Number of persons in private households	Average Household
Total-Structural type of dwelling	502,300	50,065	2.6

Source: Adapted from data provided by Statistics Canada, 2022

Immigrants, defined by Statistics Canada as individuals who are, or have been, landed immigrants or permanent residents accounted for 23 percent of the total Canada population in 2021. In Calgary, immigrants constituted 33.3 percent of the population in 2021, up from 31 percent in 2016. Recent immigrants, those who obtained landed immigrant or permanent resident status between January 1, 2016, and May 11, 2021, numbered 81,315 in Calgary. They comprised 19 percent of all immigrants, down from 23 percent in 2016. Possible reasons for the decline include the drop in global oil prices in 2014, leading to fewer job opportunities in Alberta, and COVID-19 travel restrictions in 2020 and 2021.

- Transportation

A. Transit

Public transit in Calgary is primarily served by Calgary Transit, which offers a comprehensive network of services including regular bus routes, bus rapid transit (BRT), and light rail transit (LRT). The city's LRT system, known as the CTrain, consists of two lines, the Red Line and the Blue Line, spanning a total of 44 stations and 58.2 kilometers (36.2 miles) of track. It was one of

the first light rail systems in North America, following Edmonton's LRT. The CTrain operates on dedicated tracks with partial grade separation in suburban areas, while also featuring street-level sections across downtown Calgary.

The CTrain is recognized for its sustainability efforts, being North America's first and only rapid transit system powered entirely by renewable, wind-generated energy (Canadian geographic, Accessed, 2024) with approximately 270,000 passengers utilizing the CTrain on weekdays.

In 2020, Calgary approved the construction of the Green Line, the city's third light rail line. Scheduled to operate low-floor trains, the Green Line represents a significant expansion of Calgary's rapid transit network. It is regarded as the largest public works project in the history of Calgary, substantially larger than any previous infrastructure endeavor undertaken by the city.

Transit Ridership Statistics

Calgary Transit, owned and operated by The City of Calgary, has been serving the city for over a century. In 2014, ridership reached its peak at 110.27 million passenger trips. However, the economic downturn in 2015 resulted in a decrease in ridership for the first time in five years, dropping to 109.97 million trips.

The 2016 customer satisfaction survey conducted by Calgary Transit shows 32% of respondents feeling very satisfied with the transit, while 42% expressed satisfaction, representing an improvement from the previous year's figures of 25% and 47%, respectively. Respondents cited that the primary reason for using Calgary Transit in 2016 was convenience, particularly in terms of transportation to and from work or school, thus helping users avoid parking fees and the hassle of driving downtown. Other contributing factors included cost considerations and personal circumstances, such as not owning a vehicle or lacking access to one.

In 2022, Calgary's transit system recorded 56.9 million trips with an average fare of $1.87 per trip, utilizing 150 bus routes and 45 CTrain stations covering 118.1 kilometers of track, while also boasting 2,528 benches, 1,646 passenger shelters, and 6,208 bus stops, operating a fleet of 1,100 vehicles, all of which are accessible, with an average trip length of 14.7 kilometers based on 2019 data.

Table 2**.** Ridership Statistics for Calgary Transit for the Year 2022

S/N	Ridership Data	Figures
1	Ridership	56.9 million trips
2	Average fare	$1.87 / trip
3	Number of bus routes	150
4	Number of CTrain Stations	45 stations
5	Kms of CTrain track	118.1 kms

6	Total number of benches	2,528
7	Total number of passenger shelters	1,646
8	Total number of bus stops	6,208
9	Average trip length	14.7 km (2019)
10	Transit fleet size	1,100 active vehicles
11	Percent accessible vehicles	100%

Source: Adapted from data provided by Calgary Transit. Facts and figures.

Air Travel

The City of Calgary has the largest airport in Alberta, located approximately 17km (10.6 miles) form downtown Calgary. Calgary International Airport (YYC) serves the city of Calgary, Alberta, Canada and southern Alberta, and covers an area of 20.82 square kilometres (8.04 sq mi; 5,144 acres; 2,082 ha)

Calgary International Airport (YYC) ranks as the third- busiest airport in Canada serving as the primary air gateway to the city, catering to a diverse range of passengers and more than 80 destinations. Analysis of YYC's operations reveals a steady increase in passenger numbers over the years, with a wide array of flight destinations offered by various airline carriers. Trends in passenger traffic indicate peak travel times during certain seasons and holidays, with popular destinations including major cities across Canada, the United States, and international destinations. Understanding these patterns is crucial for optimizing airport operations, enhancing passenger experience, and supporting future infrastructure development.

Infrastructure

The Calgary International Airport features two passenger terminals namely; domestic flights and international flights. The Domestic Terminal, originally opened in 1977, is four-stories high. The terminal that has undergone several renovations over the years. At ground level, passengers find the arrivals area equipped with baggage claim and transportation facilities. The second level serves as the departures area, housing airport check-in counters, security checkpoints, and access to departure gates. The basement level houses utilities and tenant storage, while the mezzanine level hosts amenities such as a food court, airline offices, and the airport authority offices (Calgary Airport, Retrieved 2024).

In contrast, the International Terminal was inaugurated on October 31, 2016 and comprises five levels. The basement level accommodates utilities and baggage processing facilities. The ground level features arrivals meet-and-greet areas, Canada Customs, and relevant infrastructure. On the second floor, passengers find departure check-in counters, security checkpoints, US Customs, and the international departures concourse. The third level houses additional space for the international departures' concourse, while the mezzanine level is dedicated to US departure lounges (Calgary Airport, Retrieved 2024).

The Domestic Terminal is connected to the International Terminal by a 620-metre walkway corridor. Additionally, the YYC Link Passengers Shuttles, consist of twenty ten-seat electric vehicles and provides transportation for connecting passengers within the airport premises.

Table 3. 2022 Statistics for Infrastructure and Transportation in Calgary.

Total Land Area	Agricultural Land	Asphalt Roads/Parking	Airfield Taxiway, Runway, Apron Area	Distance to downtown Calgary	Passenger Volume	Cargo Landings
20.82sqkm, 5144 acres 2,082 ha	8.56 sqkm 2,116 acres 856 ha	487,200sqm 0.50sqkm 120acres	2.04 sqkm	17km 10.6miles	14.5million	5362

Source: Adapted from data provided by YYC facts and figures.

Economic Impact of Air Travel and Rail Services in Calgary

Assessing the economic impact of air travel and rail services in Calgary is crucial for understanding their contributions to the city's overall economic health and development. Both modes of transportation play significant roles in stimulating economic activity, supporting industries, and enhancing Calgary's connectivity on regional and global scales.

A. Air Travel Services

Air travel serves as a vital driver of economic growth in Calgary, with Calgary International Airport (YYC) acting as a major gateway for domestic and international travelers. The economic impact of air travel can be assessed through various factors:

i. Job Creation: The aviation industry directly supports a significant number of jobs in Calgary, including airport personnel, airline staff, ground handling services, and security personnel. Indirectly, air travel also generates employment opportunities in related sectors such as hospitality, retail, and tourism.
ii. Tourism Revenue: Air travel facilitates tourism by providing convenient access to Calgary's attractions, events, and business opportunities. Influxes of tourists contribute to revenue generation for local businesses, hotels, restaurants, and cultural institutions. Additionally, business travelers arriving via air travel contribute to corporate spending and investment in the city.
iii. Business Development: Calgary's connectivity to domestic and international destinations via air travel fosters business development and trade opportunities. Efficient air links enable businesses to access markets, participate in conferences and trade shows, and engage in global supply chains. Moreover, direct air routes can attract foreign investment and promote Calgary as a business-friendly destination.

B. Rail Services

Rail services, including passenger rail and freight transport, also play a crucial role in Calgary's economic landscape. The economic impact of rail services can be assessed in the following ways:

- Movement of Goods and People: Efficient rail services facilitate the movement of goods to and from Calgary's industrial centers, supporting trade, manufacturing, and logistics industries. Additionally, passenger rail services provide commuters with an alternative mode of transportation, reducing congestion on roadways and enhancing mobility within the city.
- Enhanced Connectivity: Rail connections to other cities and regions enhance Calgary's connectivity and competitiveness in regional and global markets. Access to efficient rail transportation networks can attract businesses, investors, and skilled workers to the city, contributing to economic growth and development.
- Supporting Industries: Rail services support various industries, including agriculture, energy, and manufacturing, by providing cost-effective transportation solutions for raw materials, products, and equipment. The reliability and efficiency of rail transport contribute to the competitiveness of Calgary-based businesses in national and international markets.

In conclusion, both air travel and rail services play integral roles in driving economic growth, supporting industries, and enhancing connectivity in Calgary. Assessing their economic impact involves examining their contributions to job creation, tourism revenue, business development, and overall competitiveness. By investing in and optimizing these transportation modes, Calgary can continue to thrive as a vibrant economic hub with sustainable and efficient transportation infrastructure.

Calgary's transportation landscape presents opportunities for enhancing connectivity, promoting sustainability, and supporting economic growth. Recommendations for integrated transportation planning and infrastructure development include improving intermodal connections between air travel and rail services, expanding transit coverage to underserved areas, investing in sustainable transportation initiatives, and addressing demographic disparities in transportation access. By implementing these recommendations, Calgary can strengthen its position as a vibrant and livable city with a well-connected and sustainable transportation system.

- Calgary's Demographic Profile for Transportation Planning

Calgary's demographic profile is a critical factor to consider when designing transportation solutions to meet the diverse needs of its population. Analyzing population growth trends, income levels, and travel behavior patterns provides valuable insights into the transportation demand and accessibility requirements of different demographic groups. Tailoring strategies to address the specific needs of these groups can contribute to a more inclusive and equitable transportation system in Calgary.

1. Population Growth Trends:

Understanding Calgary's population growth trends is essential for anticipating future transportation demands and infrastructure needs. Analysis of population data can reveal areas experiencing rapid growth, which may require additional transportation services and infrastructure to support increased mobility. Conversely, areas with declining populations may benefit from transportation initiatives aimed at revitalizing communities and improving access to essential services.

2. Income Levels:

Income levels play a significant role in shaping travel behavior and transportation preferences. Low-income residents may rely heavily on public transit as their primary mode of transportation due to affordability constraints, highlighting the importance of accessible and affordable transit services. Conversely, higher-income residents may have greater flexibility in transportation choices, including private vehicle ownership and alternative modes of transportation. Understanding income distribution within Calgary's population is crucial for designing transportation solutions that are accessible and equitable for all residents.

3. Travel Behavior Patterns:

Analyzing travel behavior patterns provides insights into how different demographic groups move within the city and the transportation modes they prefer. Commuting habits, trip purposes, and travel distances vary among residents based on factors such as age, income, and employment status. For example, commuters may have different transportation needs depending on whether they work in the downtown core or suburban areas. Understanding these patterns helps identify opportunities to improve transit connectivity, enhance accessibility, and address mobility challenges for specific demographic groups.

4. Strategies for Addressing Transportation Needs:

Tailoring transportation strategies to address the needs of different demographic groups is essential for creating a more inclusive and equitable transportation system in Calgary. Some key strategies include:

A. Improving Transit Connectivity: Enhancing transit connectivity in underserved communities and areas with high concentrations of low-income residents can improve access to jobs, education, and essential services. This may involve expanding bus routes, increasing frequency of service, and implementing transit-oriented development initiatives.
B. Enhancing Accessibility: Making transportation infrastructure and services more accessible for seniors and persons with disabilities is crucial for promoting independence and social inclusion. This may include investing in accessible transit vehicles, improving pedestrian infrastructure, and providing door-to-door transportation options for individuals with mobility limitations.
C. Promoting Active Transportation: Encouraging walking, cycling, and other forms of active transportation can improve public health, reduce traffic congestion, and enhance environmental sustainability. Investing in safe and accessible pedestrian and cycling

infrastructure, such as sidewalks, bike lanes, and multi-use paths, encourages residents to choose alternative modes of transportation for short trips and recreational activities.

D. Engaging Communities: Engaging with communities and stakeholders to gather input and feedback on transportation needs and priorities ensures that transportation solutions are responsive to local concerns and preferences. Community outreach initiatives, public consultations, and participatory planning processes facilitate collaboration and consensus-building among residents, policymakers, and transportation agencies.

By understanding Calgary's demographic profile and tailoring transportation solutions to meet the diverse needs of its population, the city can create a more inclusive and equitable transportation system that enhances mobility, accessibility, and quality of life for all residents.

1.2. Introduction to Edmonton's Transportation Landscape

Edmonton, the capital city of Alberta, is a key transportation hub in Western Canada. With a growing population and a dynamic economy, efficient transportation infrastructure is essential for supporting the city's connectivity and facilitating economic growth. This report examines various aspects of Edmonton's transportation landscape, including air travel, rail services, transit infrastructure, economic impact, and demographics.

As of 2021, Edmonton had a city population of 1,010,899 and a metropolitan population of 1,418,118 (Statistics Canada, 2022), making it the fifth-largest city, and sixth-largest metropolitan area (CMA) in Canada. Located on the banks of the North Saskatchewan River, Edmonton sits at an elevation of 671 meters (2,201 feet).

Table 4**.** Household Size and Composition in Edmonton

Population	Household type	No. of persons in private household	Average Household size	Population density per sqkm	Land area in sqkm	Median Income ($)
1,010,899	396,405	996495	2.5	1320.4	765.61	44,000

Source: Statistics Canada. Census Profile, 2021 Census of Population, Edmonton.

A. Transit

The concept of a light rail transit system was first proposed in Edmonton's Transportation Study of 1969, which identified the need for a high-capacity transit network to serve the city's expanding urban areas. Following extensive planning and public consultation, construction of the LRT commenced in the early 1970s, with the initial phase focusing on the construction of a single line connecting downtown Edmonton with the University of Alberta campus.

Edmonton Transit Service (ETS) started Light Rail Transit (LRT) service in 1978 starting with the Capital Line, a 16.1 km line from Clareview station in northeast Edmonton to Century Park station in south Edmonton. The Metro Line opened on Sunday, September 6, 2015 as a 3.3 km extension from Churchill station to the Northern Alberta Institute of Technology (NAIT) station (City of Edmonton, 2020).

The Edmonton Light Rail Transit, commonly known as the LRT, is a light rail network situated within Edmonton, Alberta. It operates under the Edmonton Transit Service (ETS), and comprises 29 stations across three lines, with a total track length of 37.4 kilometers (23.2 miles). As of 2018, it ranked as the seventh busiest light rail transit system in North America, catering to more than 113,000 daily weekday commuters.

Table 5**.** Fare Types and Prices for Calgary Transit

Fare type	Price ($)
Cash fare	3.50
Arc card fare	2.75
Children 12 and under	Free
Day pass (family)	$10.25
Month adult pass	100

Source: Adapted from data provided by City of Edmonton Fares and Passes.

Ridership Data

In 2019, the ridership for the Edmonton LRT system reached 86,715,541, indicating a significant level of usage and demand for public transit in the city. However, due to the impact of the COVID-19 pandemic, ridership figures experienced a decline in subsequent years. In 2020, ridership decreased to 37,410,709, reflecting the effects of restrictions, remote work arrangements, and reduced travel demand during the pandemic.

The trend continued in 2021, with ridership further decreasing to 31,554,322 as the pandemic persisted and precautionary measures remained in place. Despite these challenges, the Edmonton LRT system continued to play a vital role in providing essential transportation services to residents and supporting the city's mobility needs during a challenging period.

Comparison to Bus Ridership

While LRT ridership declined during the pandemic, average weekly passenger bus boardings remained relatively stable, with approximately 715,837 average weekly boardings in 2021.

In 2022, Edmonton Transit Service (ETS) witnessed substantial growth in overall transit ridership following the easing of pandemic-related restrictions.

- Bus and LRT Recovery: At the start of 2022, bus and LRT ridership stood at about 56% of pre-COVID-19 levels, gradually increasing to approximately 80% by year-end.

- On-Demand Transit Surge: On-Demand Transit ridership saw a significant uptick from 17,330 in January to 33,070 in December, reflecting increased demand for flexible transit options.
- DATS Ridership Rebound: DATS, catering to individuals with disabilities, showed steady gains, with ridership climbing from 46% of pre-COVID-19 levels at the beginning of 2022 to 86% by year-end. Annual DATS ridership increased from 388,484 in 2021 to 663,297 in 2022.

These trends indicate a robust recovery in transit demand across various ETS services, signaling a positive trajectory for Edmonton's transportation network.

Table 6**.** Edmonton Transit Service Statistics.

Services	Year (2021/2022)	Year (2022/2023)
Annual Vehicle km (bus)	41,785,363	44,679,536
Annual Vehicle km (Electric bus)	848,611	
Annual Vehicle km (LRT)	7,064,443	2,247,136
Transit Centres	25	24
Bus Stops	5,896	5,270
LRT stations	18	18
Ridership (2019)	86,715,541	
Ridership (2020)	37,554,322	
Ridership (2021)	31,554,322	
Ridership (2022)	N/A	41,960,000
Bus stops in Service	5,267	
Revenue Hours (Excluding DATS)	2,089,752	2,045,819
Garbage Cans	2,629	
Bus Shelters	2,090	2,235
Advertising Benches	2,317	
Garages	6	6

Source: Adapted from data provided by Edmonton Transit Service 2021/2022 and 2022/2023 Annual Services Plan.

- Transit infrastructure

Transit infrastructure forms the backbone of Edmonton's public transportation network, providing essential mobility options for residents, commuters, and visitors. From light rail transit (LRT) lines to bus routes and major transit hubs, the city's transit infrastructure plays a crucial role in facilitating sustainable and efficient travel across the metropolitan area.

A. Light Rail Transit (LRT) Lines:

Edmonton's LRT system consists of multiple lines that serve key corridors and destinations within the city. The Capital Line, Metro Line, and Valley Line provide fast and reliable transit service,

connecting downtown Edmonton with various neighborhoods, post-secondary institutions, and major employment centers. With dedicated right-of-way and high-frequency service, LRT lines offer an attractive alternative to private vehicle travel, reducing congestion and greenhouse gas emissions.

B. Bus Routes:

Complementing the LRT network, Edmonton's extensive bus network covers a vast geographic area and serves neighborhoods, suburbs, and industrial areas throughout the city. Bus routes provide vital connections to LRT stations, allowing for seamless transfers and multi-modal travel options. Edmonton Transit Service (ETS) operates a fleet of buses equipped with modern amenities and technologies to enhance passenger comfort, accessibility, and safety.

C. Transit Hubs:

Major transit hubs, such as Churchill Square, Century Park, and West Edmonton Mall Transit Centre, serve as key transfer points where passengers can easily switch between different transit routes and modes. These hubs offer amenities such as covered waiting areas, real-time arrival information, and accessible facilities, enhancing the overall transit experience for users. Additionally, transit-oriented developments (TODs) around transit hubs promote mixed-use development and pedestrian-friendly environments, fostering vibrant and sustainable communities.

- Accessibility and Inclusivity

Edmonton's transit infrastructure prioritizes accessibility and inclusivity, ensuring that transit services are accessible to individuals of all ages and abilities. Low-floor buses, accessible LRT stations, and priority seating for passengers with disabilities are among the features designed to accommodate diverse needs and promote universal access to public transit. Moreover, initiatives such as Travel Training Programs and Accessible Transit Services provide specialized assistance and support for individuals with mobility challenges, enabling them to navigate the transit system with confidence and independence.

- Future Development and Expansion

As Edmonton continues to grow and evolve, investments in transit infrastructure will be essential for meeting the city's evolving transportation needs. Future development plans may include expanding LRT lines, enhancing bus rapid transit (BRT) corridors, and integrating emerging technologies to improve transit service reliability, efficiency, and sustainability. By prioritizing transit infrastructure investments, Edmonton aims to create a more connected, accessible, and livable city for all residents and visitors.

- Economic & Environmental Consideration

The city of Edmonton, as a key economic hub in Alberta, stands to experience significant economic impacts from improved transportation connectivity, particularly through the integration of rail services. This section provides an analysis of the potential economic implications of enhanced transportation connectivity in Edmonton.

- Job Creation and Business Development

Improved transportation connectivity, including the introduction of regional rail service, has the potential to stimulate job creation and foster business development in Edmonton. Enhanced access to the city via rail transportation can attract new businesses, encourage investment, and create employment opportunities in various sectors, including transportation, tourism, and hospitality. Furthermore, efficient transportation infrastructure can facilitate the movement of goods and services, supporting the growth of local businesses and contributing to economic vitality.

- Tourism Opportunities

Enhanced transportation connectivity, such as the provision of convenient rail access, can bolster Edmonton's tourism industry by attracting more visitors to the city. Increased accessibility for both domestic and international travelers can lead to greater tourism expenditure, benefiting local businesses, attractions, and accommodations. Additionally, seamless connectivity between transportation modes can enhance the overall visitor experience, encouraging repeat visits and positive word-of-mouth promotion, further boosting tourism-related economic activity in Edmonton.

- Regional Economic Growth

The integration of rail services in Edmonton can catalyze regional economic growth by facilitating connectivity with neighboring communities and fostering economic linkages across the region. Efficient transportation networks enable easier access to Edmonton's markets, services, and employment opportunities for residents of surrounding areas. This improved connectivity can spur regional development, encourage investment, and contribute to the overall economic prosperity of the Edmonton metropolitan area and its hinterlands.

- Financial Implications for the Airline Industry and Other Sectors

The introduction of regional rail service to Edmonton is expected to have significant financial implications for the airline industry and other sectors within the region. By providing an alternative transportation option for travelers, regional rail service may impact air travel demand, particularly for short-haul routes connecting Edmonton with neighboring cities. Consequently, airlines operating in the region may need to adjust their services, pricing strategies, and route networks in response to changing demand patterns. Additionally, the integration of rail services may create opportunities for collaboration and partnership between transportation providers, potentially leading to synergies and cost savings for the industry as a whole.

The integration of rail services in Edmonton holds the promise of substantial economic benefits for the city and the broader region. From job creation and business development to tourism opportunities and regional economic growth, enhanced transportation connectivity can drive economic prosperity and enhance the quality of life for residents. Similarly, the financial implications of regional rail service for the airline industry and other sectors underscore the importance of strategic planning and collaboration to optimize the benefits of integrated transportation systems in Edmonton.

- Environmental Considerations

At present, the City of Edmonton is actively participating in the Alberta Zero Emissions Hydrogen Transit initiative, supported by $4.6 million in secured funding from Emissions Reduction Alberta (Edmonton Transit Service Annual Service Plan, 2023). This initiative aims to explore the viability and benefits of hydrogen fuel cell electric buses as a sustainable transit solution. The project involves testing two hydrogen fuel cell electric buses in real-world conditions within Alberta and assessing their suitability compared to other low-carbon alternatives. In 2022, ETS and Strathcona County Transit each received one bus. Through a 23-month pilot starting in 2023, they assessed the buses' feasibility, performance, and cost-effectiveness, aiming to understand hydrogen as a fuel source for transit.

The introduction of regional rail service in Edmonton has the potential to reduce greenhouse gas emissions by providing a more sustainable transportation alternative to traditional modes of travel, such as automobiles and airplanes. Rail transport is inherently more energy-efficient and produces lower emissions per passenger mile compared to other forms of transportation. By encouraging modal shift from private vehicles and air travel to rail, Edmonton can contribute to mitigating air pollution and reducing carbon emissions, thus supporting local and global efforts to combat climate change.

Reducing reliance on automobiles and airplanes through the provision of efficient rail services can lead to improvements in air quality in Edmonton. Decreased vehicular traffic and air travel can help mitigate air pollutants, such as nitrogen oxides (NOx), particulate matter (PM), and volatile organic compounds (VOCs), which contribute to poor air quality and adverse health effects. By promoting cleaner modes of transportation, Edmonton can enhance air quality, protect public health, and create a more sustainable urban environment for residents and visitors alike.

Efficient transportation connectivity, including rail services, can influence land use patterns and contribute to preserving green spaces and natural habitats in Edmonton. By facilitating transit-oriented development and compact urban growth, rail infrastructure can help reduce urban sprawl and minimize the conversion of natural land for development purposes. Additionally, well-planned transportation networks can enhance access to parks, recreational areas, and green corridors, promoting outdoor recreation and biodiversity conservation within the city.

While rail transportation offers numerous environmental benefits, it is important to consider potential noise and visual impacts associated with rail infrastructure in Edmonton. The construction and operation of rail lines and stations may generate noise pollution and alter the visual landscape of affected areas, particularly in residential neighborhoods and sensitive environmental habitats. To mitigate these impacts, careful planning, design, and implementation of noise abatement measures, such as sound barriers and landscaping, are essential to minimize disturbance to communities and preserve aesthetic values.

1.3. Introduction to Lethbridge's Transportation Landscape

Lethbridge is a city in the province of Alberta, Canada, with a population of 106,550. It is the commercial, financial, transportation and industrial centre of southern Alberta. The City of Lethbridge has around 600 kilometers of roads, divided into four main types: Arterial, Collector, Local, and Other (Provincial and County highways/roads). Approximately half of Lethbridge's streets are local roads, while the rest are divided between Arterial and Collector roads (City of Lethbridge, 2023).

Table 7**.** Household Size and Composition in Lethbridge

Population	Population density per sqkm	Land area (sqkm)	Median Income ($)	Household type	No. of persons in private household	Average Household size
98,406	812.5	121.12	41,600	40,225	96,270	2.4

Source: Adapted from data provided by Statistics Canada Census Profile, 2021 Census of Population, Lethbridge.

- Transit Infrastructure

A. Air Travel

Lethbridge has been integral to Western Canadian aviation history, with aviation activities initially taking place at ad-hoc sites like the Exhibition Grounds and later the site of the Lethbridge Collegiate Institute. In the 1920s, the city obtained a license for a public aerodrome, which served as a stop on the Trans-Prairie Air Mail Service. In 1938, airport operations moved to its current site, initially named Kenyon Field, which saw the start of passenger services in 1939 and military use during World War II.

Throughout the 1940s and 1960s, various developments occurred, including the establishment of a military flying training school, the conversion of buildings, and ownership changes. The airport played a crucial role in the regional air carrier industry, notably serving as the base for Time Air, which later became Canadian Regional Airlines. Deregulation in the late 1980s led to operational changes, with Time Air's activities gradually shifting to Calgary. The airport's management structure underwent significant changes in the 1990s with the adoption of the National Airports

Policy, leading to the transfer of ownership to the County of Lethbridge in 1997, and subsequently to the City of Lethbridge in 2018 (Lethbridge Airport, Retrieved 2024).

In May 2022, Lethbridge Airport marked its grand reopening following significant renovations to its terminal and runways. With over $23 million in funding from the Governments of Canada and Alberta, the city has transformed the airport into a key economic asset for Lethbridge and the surrounding areas. The city aims to boost passenger traffic and diversify revenue through land development, with the potential for the YQL lands to generate $10 million annually in lease revenue once fully developed.

B. Public Transit

Lethbridge Transit operates the city's public bus system, providing regular service throughout the city and surrounding areas. The bus routes cover key residential, commercial, and educational areas, offering residents and visitors convenient transportation options.

C. Rail Services

Lethbridge is a significant hub for rail freight transportation due to its strategic location along major railway lines. Freight trains transport goods and commodities to and from the city, connecting Lethbridge to national and international markets.

- Ridership Information

YQL served 116,000 passengers in 1990 when Time Air was in operation. However, by the early 2000s, these figures had decreased to approximately 60,000, a trend that persisted until as recently as 2017. Passenger volumes experienced a swift increase, with 87,302 passengers recorded at the end of 2018, despite WestJet traffic being operational for less than six months.

In 2020, Lethbridge Airport (YQL) experienced a significant decline in passenger traffic volumes, largely attributed to the exit of Air Canada coinciding with the onset of the COVID-19 pandemic. Total passengers numbered only 22,078 in 2020, a stark contrast to the 104,078 passengers recorded the previous year. The decline in passenger volumes became evident early in 2020, with month-to-month percentage changes remaining relatively small until April. By April 2020, traffic had plummeted by 97.6% compared to March, which itself saw a decline of 47.1% from February. While there have been slight recoveries since then, these have been inconsistent, and a sustainable recovery remains uncertain (Lethbridge Airport Business Plan, 2021 – 2024).

- Economic Impact

In 2018, Lethbridge Airport (YQL) generated total revenues of slightly over $1.8 million. By 2019, revenues increased to $2.3 million, driven by a notable 19.2% rise in passenger volumes. However, in 2020, before factoring in grants, revenues dropped to $1.1 million by the end of the year. In 2020, Lethbridge Airport (YQL) experienced a notable 53.1% decline in revenues, offset somewhat by a Municipal Operating Support Transfer (MOST) of $1.2 million. This decline

resulted in a net loss similar to that of the previous year, totaling around a quarter million dollars (Lethbridge Airport Business Plan, 2021 – 2024).

Potential Economic impact of Improved Transportation Connectivity

1. Job Creation: Improved transportation connectivity can lead to job creation in several ways:

- Expansion of transportation infrastructure projects can create jobs in construction and related industries.
- Enhanced accessibility can attract businesses to the area, leading to job opportunities in sectors such as retail, hospitality, and services.
- Efficient transportation networks can facilitate the movement of goods and people, supporting industries reliant on transportation, such as logistics and distribution.

2. Business Development: Improved connectivity can stimulate business development by:

- Attracting new businesses to Lethbridge, particularly those that rely on efficient transportation networks for distribution and logistics.
- Facilitating easier access to markets, suppliers, and customers, enabling businesses to expand their operations and reach new markets.
- Fostering collaboration and innovation by connecting businesses with research institutions, suppliers, and potential partners.

3. Tourism Opportunities: Enhanced transportation connectivity can boost tourism in Lethbridge by:

- Making the city more accessible to tourists, including domestic and international travelers.
- Encouraging the development of tourism-related infrastructure and amenities, such as hotels, restaurants, and attractions.
- Expanding tourism offerings and experiences through improved connectivity to regional destinations and attractions.

4. Regional Economic Growth: Improved transportation connectivity can contribute to regional economic growth by:

i. Strengthening economic ties between Lethbridge and surrounding communities, facilitating trade, commerce, and collaboration.
ii. Spurring investment in infrastructure, real estate, and other sectors as businesses capitalize on improved transportation links.
iii. Enhancing the attractiveness of Lethbridge as a regional hub for commerce, services, and employment.

1.4. Introduction to Red Deer Transportation Landscape

Red Deer's history dates back to the late 19th century when it was initially established as a trading post for the Hudson's Bay Company. The city's growth accelerated with the arrival of the Calgary and Edmonton Railway in 1891, which stimulated agricultural development and attracted settlers to the area. Red Deer was officially incorporated as a town in 1901 and later became a city in 1913.

Over the years, Red Deer has evolved from its roots as a railway and agricultural hub into a diverse and dynamic urban center.

Table 8**.** Household Size and Composition in Red Deer.

Population	Population density per sqkm	Land area (sqkm)	Median Income ($)	Household type	No. of persons in private household	Average Household size
100,844	966.5	104.34	42,800	40,510	98,045	2.4

Source: Adapted from data provided by Statistics Canada. Census Profile, 2021 Census of Population, Red Deer.

- Transit Infrastructure

Red Deer Transit operates the public transportation system in the city, providing bus service to residents and visitors. The transit system consists of multiple bus routes covering various neighborhoods, commercial areas, and key destinations. Red Deer Transit offers accessible transportation options, including low-floor buses and specialized transit services for individuals with disabilities.

A. Air Services

Red Deer Regional Airport (YQF), primarily serves general aviation, corporate, and charter flights and is located about 6 kilometers south of the city center of Red Deer, Alberta, Canada. On September 1, 1999, the Red Deer Regional Airport Authority took over ownership and operation of the airport from the Province of Alberta, with the City of Red Deer and Red Deer County becoming significant stakeholders in the process. The Red Deer Regional Airport does not currently have commercial airline service; however, it provides facilities for private aircraft, air ambulance services, flight training, and aircraft maintenance. For commercial air travel, residents of Red Deer typically use larger airports in nearby cities such as Calgary International Airport (YYC) or Edmonton International Airport (YEG), both of which offer a wide range of domestic and international flights.

1.5. Airport Infrastructure & Investment Opportunities

1.5.1. Calgary International Airport

The expansion and development of transportation infrastructure, along with associated infrastructure enhancements like taxiways and underpasses play a crucial role in shaping regional connectivity and facilitating economic growth. This enhanced connectivity has the potential to influence the integration of various transportation services, including regional rail services, with the airport. Calgary International Airport is a viable case study of how transportation infrastructure impacts tourism and ridership growth.

A significant investment was made by the Calgary Airport Authority to open the longest runway in Alberta, able to accept the largest wide body aircraft from around the world. YYC underwent an expansion of its runway in 2014, specifically the construction of Runway 17L-35R (Bradley, 2014). With planning commencing in the 1970s, the new parallel runway which began in 2011 and opened in 2014 stretched 14,000 feet (4,270metres), marked a significant milestone in Calgary's transportation infrastructure investments, aiming to enhance airport connectivity and accommodate the growing passenger traffic.

The expansion of YYC's runway and associated infrastructure enhancements, such as taxiways and underpasses, has bolstered airport connectivity, and presents opportunities for seamless integration with other modes of transportation, including regional rail services. By improving access to the airport terminal, these developments have the potential to influence the preferred integration model between the airport, transit systems, and rail stations. As announced by the President and CEO, Bob Sartor in the 2022 annual report, YYC forecast 23milliom passengers will travel through its airport annually.

Figure 1. Historical satellite view of Calgary International Airport in the year 2012 from Google Earth Pro. Map shows ongoing construction of the 14,000 feet (4,270m) Runway 17L-35R

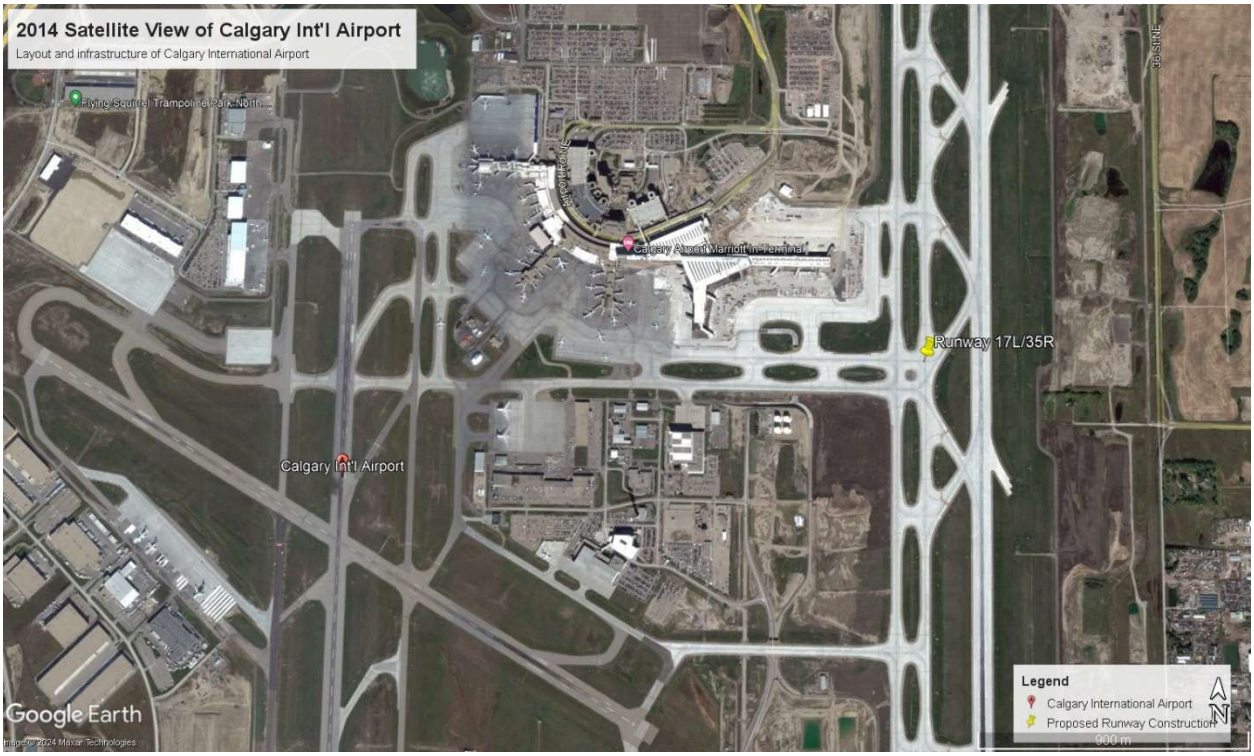


Figure 2. Historical satellite view of Calgary International Airport in the year 2014 from Google Earth Pro. Map shows the newly constructed 14,000 feet (4,270m) Runway 17L-35R

In 2016, YYC opened the International Terminal, adding two million square feet to the terminal building and represented the culmination of YYC's largest expansion project to date, in addition to the construction of a new runway (YYC Calgary International Airport, 2016). By the end of 2016, the airport had facilitated over 4,000 flights, connecting passengers to destinations worldwide. Despite facing economic challenges, Calgary International Airport achieved remarkable milestones and recorded a record-breaking 15.7 million passengers, alongside a 1.7% increase in air cargo volumes, reaching a new high of 137,255 metric tonnes. In addition, new routes, aircraft and airlines were also included.

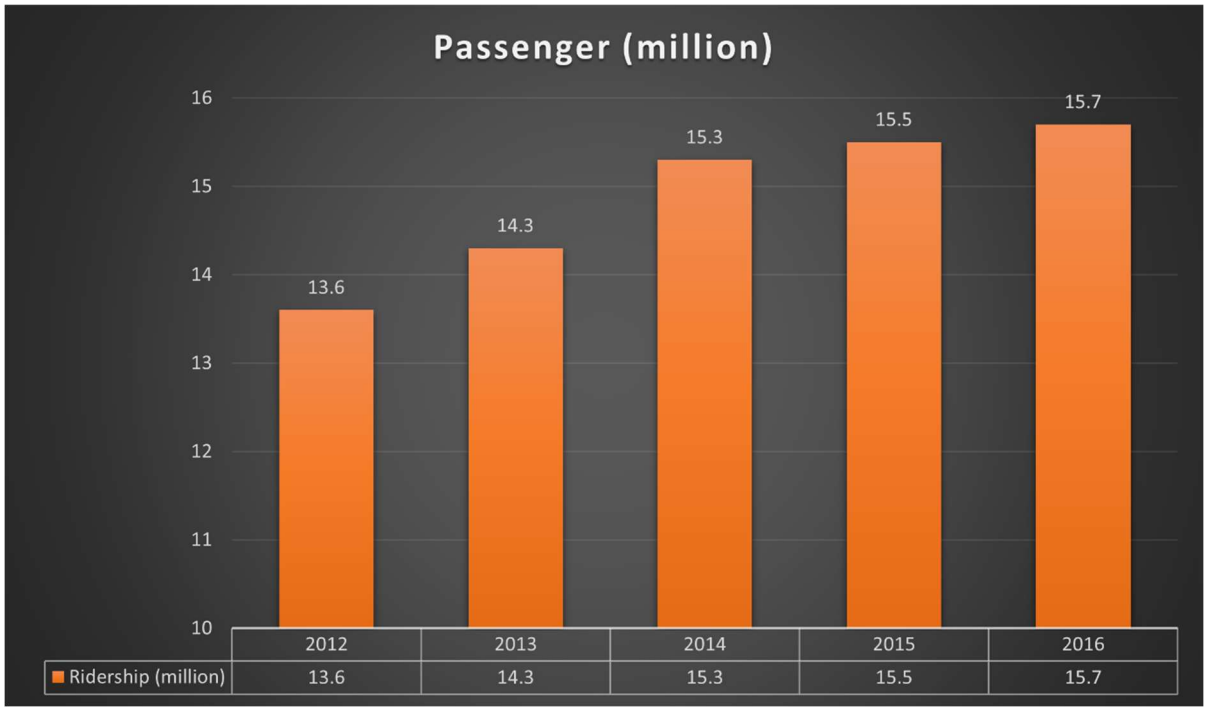


Figure 3. Annual Ridership statistics from year 2012 – 2016.

Calgary's bold investment of billions of dollars to foster its economic development and tourism sector indicates a proactive stance towards infrastructure development. This strategic commitment has contributed significantly to the surge in ridership since 2016, and shows the city's determination to enhance its appeal as a tourist destination.

1.5.2. Edmonton International Airport

The Edmonton International Airport shows potential for significant growth with plans to expand its cargo handling capacity and develop a new international cargo handling hub spanning 2,000 acres. This expansion initiative commenced in fall 2023 and is expected to increase the airport's role as a key logistics hub, facilitating the movement of cargo across Canada, the United States, and Mexico. With $100 million in funding from the Federal government, announced on July 21, 2022 (Alberta, 2023) underlines the strategic importance of this project in enhancing trade corridors and strengthening economic ties across North America. These enhancements signify the

airport's commitment to optimizing its existing infrastructure while laying the groundwork for future expansion and increased operational capacity.

Overall, the development of the international cargo handling hub presents promising opportunities for Edmonton International Airport to emerge as a pivotal player in the global logistics landscape, fostering economic growth, job creation, and enhanced connectivity within the region and beyond.

Figure 4. 2022 Satellite view of Edmonton International Airport (YEG) from Google Earth Pro.

In 2019, in addition to the CPKC's headquarters in Calgary, the Canadian National Railway (CN)'s National Management Center (NMC) relocated to Edmonton showing operational adjustments that is aimed at enhancing efficiency and optimizing resources. The decision to centralize rail traffic control operations in Edmonton, as confirmed by Progressive Railroading (2019), reflects the company's strategic approach to managing its network, continuous assessment of operational needs and its commitment to streamlining processes. This change may have implications for transportation logistics and integration models, particularly in the context of rail-air connectivity.

The implications of CN relocating its rail traffic control operations to Edmonton could potentially affect transportation logistics and integration models in several ways:

i. Improved Efficiency: By centralizing operations in Edmonton, CN may enhance efficiency in managing train movements and coordination across its network. This could lead to

smoother rail operations, reduced transit times, and improved overall transportation reliability.

ii. Regional Impact: The relocation may have regional implications, particularly for communities previously served by the Montreal control center. Communities in northern Ontario, for example, may experience changes in rail traffic patterns and scheduling, which could impact local industries reliant on rail transportation.

iii. Integration Opportunities: The relocation presents opportunities for integrating rail and other modes of transportation, such as air travel. Edmonton's status as a transportation hub could facilitate seamless connectivity between rail and air services, potentially improving intermodal transportation options for passengers and freight.

iv. Economic Development: The relocation could influence economic development in Edmonton and surrounding areas by consolidating CN's operational presence in the region. This may attract investment in transportation infrastructure and related industries, contributing to local economic growth.

The relocation of CN's rail traffic control operations is a classic example of the dynamic nature of transportation networks and presents opportunities for optimizing efficiency, enhancing connectivity, and supporting regional development initiatives.

Figure 5. Canadian National Railway (CN) Headquarter, Calgary.

Source: Shutterstock, 2328608529

1.5.3. Stranded Assets: Lethbridge Airport & Red Deer Regional Airports

Lethbridge and Red Deer airports are often characterized as stranded assets due to several factors that limit their full potential and utilization. These factors include geographical location, limited passenger demand, and competition from nearby airports.

i. Geographical Location: Both Lethbridge and Red Deer airports are situated in regions that may not have sufficient population density or economic activity to support a large volume of air traffic. Additionally, their locations may not be optimal for serving as major transportation hubs or connecting points for travelers.
ii. Limited Passenger Demand: The demand for air travel in these regions may be relatively low compared to larger cities like Calgary and Edmonton. As a result, Lethbridge and Red Deer airports may struggle to attract airlines to offer a diverse range of flights and destinations, limiting their appeal to passengers.
iii. Competition from Nearby Airports: Lethbridge and Red Deer airports face competition from larger airports in nearby cities, such as Calgary and Edmonton. These larger airports often offer more extensive flight options, better amenities, and more competitive pricing, drawing passengers away from the smaller regional airports.

Although Lethbridge and Red Deer airports may provide important aviation services to their local communities, they may be considered stranded assets in terms of their potential for significant growth and development within the broader regional air transportation network.

The decline in passenger numbers at Red Deer Regional Airport since 2010 is an example of how important supporting local passenger service in these stranded assets can improve the potential for rail-air integration. This decline, evident from the decrease in passenger counts from 1,013 to 851 compared to the same period in 2009, posed a significant challenge to the airport's sustainability (Fawcett, 2010).

Figure 6. 2022 Satellite view of Edmonton International Airport (YEG) from Google Earth Pro.

Figure 7. Satellite view of Edmonton International Airport (YEG)

Source: Red Deer Express, 2010.

SECTION 2: LITERATURE REVIEW

2.0. Introduction

There are growing needs for road transport near airports by air travelers, airport staff and businesses offering goods and services. With airport attracting offices and factories, this necessitates tailored transportation integration (Stubs and Jegede, 1998). The significance of public transportation, especially railways due to their capacity to accommodate large passenger volumes, has been re-evaluated for their potential in mitigating traffic congestion near major airports (Local Transport Studies, 1997a; APC, 1997). As a result, there has been a shift from the traditional road-air complementarity towards a new form of transportation integration known as rail-air, which is being explored and, in some instances, already put into practice.

Mandle *et al*., (2000) offered valuable insights into the utilization patterns and influential factors regarding transportation modes, particularly focusing on rail, bus, and van services at airports across various regions in the United States. It's noteworthy that while direct rail services are available at several U.S. airports, their adoption rates pale in comparison to those of airports in Europe and Asia, where rail services are more widely embraced.

Factors affecting the utilization of rail services include the destinations of downtown trips, characteristics of the passenger market, regional travel times, accessibility to stations, and service frequency. Furthermore, airports with single terminal buildings and convenient on-site transportation options tend to attract a higher number of rail passengers. In the United States, bus and van services play a significant role in facilitating airport access, offering door-to-door transportation and express services preferred by passengers seeking convenience and faster travel.

Hence, achieving successful transportation services requires careful consideration of factors such as service frequency, pickup and drop-off locations, and regional coverage. Tailored transportation plans, focusing on efficient access modes like bus or van services, can effectively address the diverse needs of airline passengers.

Therefore, while rail services may not universally suit all airports, there exist opportunities to enhance airport access through a blend of transportation modes. By comprehensively understanding the factors driving transportation usage at airports, the Integrated Travels project can develop strategies to optimize transportation integration in Alberta's airports.

2.1. Strategies to optimize transportation integration

SEPTA's Regional Rail System, Vuchic and Kikuchi (1994)

Transportation integration is crucial for enhancing accessibility and promoting sustainable mobility. This summary explores strategies to optimize transportation integration through a case study of SEPTA's Regional Rail System, shedding light on challenges faced and proposed solutions to improve ridership and financial sustainability.

Case Study

The Southern Pennsylvania Transportation Authority (SEPTA) made significant improvements to its regional rail system, yet encountered challenges such as low ridership and financial constraints. Despite extensive coverage, the system faced a downward trend in ridership and unsatisfactory financial results.

To address the challenges of low ridership and financial constraints, SEPTA proposed a series of short-term solutions. These initiatives included simplifying schedules, enhancing interline transfers, and modernizing fare collection methods. By streamlining operations and improving service efficiency, SEPTA aimed to attract more passengers to the system.

Of particular relevance is the emphasis on marketing efforts to promote transportation services and increase ridership. SEPTA recognized the importance of marketing in aligning with the goal of promoting transportation equity and accessibility. Additionally, the positive impact of previous improvements, such as speed upgrades and increased service frequencies, highlighted the potential effectiveness of integrated transportation strategies.

Conclusion

SEPTA's experience offers valuable insights into overcoming common obstacles faced by regional rail systems. By focusing on lessons learned, transportation agencies in Alberta can develop recommendations to enhance transportation integration in the region. Strategies to improve ridership, streamline operations, and promote awareness of integrated transportation options are essential for achieving sustainable mobility and enhancing accessibility for all travelers and communities.

2.2. Economic Considerations in Rail-Air Integration

Britain Rail and Air Transport: Stubbs and Jegede (1998)

The integration of rail and air transportation systems presents significant opportunities for enhancing connectivity and efficiency in the transportation sector. This literature review aims to explore the economic considerations associated with rail-air integration, focusing on factors such as start-up costs, market size, and passenger preferences. By examining existing research and case studies, this review seeks to provide insights into the economic viability and challenges of implementing rail-air linkages.

Economic Factors

1. Start-up Costs:
- The initial cost of constructing a rail-air link is a critical factor in decision-making.
- Costs include land acquisition and infrastructure engineering, which can be substantial in densely populated urban areas.
2. Market Size and Composition:

- The economic viability of rail-air links depends on the size and composition of the passenger market served.
- Factors such as the size of the airport and adjacent city, as well as the preferences of business versus leisure travelers, influence market dynamics.

3. Heathrow Express Financial Projections:

- Case study of Heathrow demonstrates potential economic benefits of a dedicated rail link to central London, primarily catering to time-conscious business travelers.
- Financial projections indicate the feasibility of recovering capital costs and generating operating profits.

Case Studies

1. Prestwick Airport:

- Example of a rail-air link serving cost-conscious charter flight passengers.
- Collaboration between airport authority, transportation executive, and rail operator to offer free rail travel to passengers.

2. Glasgow Airport:

- Challenges with land clearance and construction have hindered rail link development.
- Consideration of light rail system as an alternative to heavy rail link.

3. Newcastle Airport:

- Success of Metro extension to airport in exceeding passenger and revenue forecasts.
- Proposal for heavy rail link to draw passengers from a wider catchment area.

Conclusion

The literature review highlights the importance of economic factors in the planning and implementation of rail-air integration projects. Understanding market demand, assessing start-up costs, and considering passenger preferences are crucial for maximizing the economic viability of rail-air links. Case studies illustrate the diverse economic considerations and challenges faced by airports and transportation authorities in integrating rail and air transportation systems.

Overall, this review provides valuable insights for policymakers, transportation planners, and stakeholders involved in the development of rail-air integration initiatives. By addressing economic considerations effectively, rail-air linkages can contribute to enhanced connectivity, improved passenger experience, and sustainable transportation solutions.

2.3. Optimizing Transportation Integration

Insights from Beijing Metro Station Passenger Flow Forecast, Lin *et al*., (2003)

Transportation integration plays a pivotal role in enhancing accessibility and promoting sustainable mobility within urban areas. This case study delves into strategies to optimize transportation integration, drawing insights from a research article on the Beijing Metro Station

Passenger Flow Forecast. Through an examination of the challenges faced and proposed solutions, this study offers valuable lessons for improving transportation integration in various contexts.

Case Study

The Beijing metro network serves as a critical transportation artery in one of the world's largest and busiest cities. However, like many urban transit systems, it encounters challenges related to passenger flow management, operational efficiency, and infrastructure planning. The research article on Beijing Metro Station Passenger Flow Forecast addresses these challenges by developing predictive models to forecast passenger flow at metro stations.

Despite the extensive coverage and usage of the Beijing metro network, challenges persist in optimizing passenger flow and ensuring operational efficiency. The research article employs a data-driven approach, utilizing various data sources such as Points of Interest (POI) data, Automated Fare Collection (AFC) data, and population data, to develop predictive models for passenger flow forecasting. These models enable transit authorities to anticipate passenger demand, optimize station design and facilities, and improve overall service quality.

Key initiatives highlighted in the research article include:

1. Predictive Modeling: Implementing advanced predictive modeling techniques, such as multilayer perceptron (MLP), to forecast average daily and peak hourly passenger flows at metro stations.
2. Data Integration: Leveraging diverse datasets, including land development intensity, station connectivity characteristics, and population demographics, to enhance the accuracy and reliability of passenger flow predictions.
3. Operational Optimization: Using forecasted passenger flow data to inform decision-making processes related to station construction, facility parameters, and service planning.
4. Marketing and Awareness: Recognizing the importance of marketing efforts in promoting transportation services and increasing ridership, thereby improving revenue generation and financial sustainability.

Conclusion

The case study of the Beijing Metro Station Passenger Flow Forecast offers valuable insights into optimizing transportation integration through data-driven approaches and predictive modeling techniques. By leveraging advanced analytics and data integration, transit authorities can enhance operational efficiency, improve service quality, and promote sustainable mobility in urban areas.

Lessons learned from this case study can inform transportation agencies in Alberta and other regions seeking to enhance transportation integration and optimize passenger flow management. Strategies focusing on predictive modeling, data integration, operational optimization, and marketing efforts are essential for achieving sustainable mobility and enhancing accessibility for all travelers and communities.

2.4. Maximizing Rail-Air Integration

Case Study: Britain Rail and Air Transport: Stubbs and Jegede (1998)

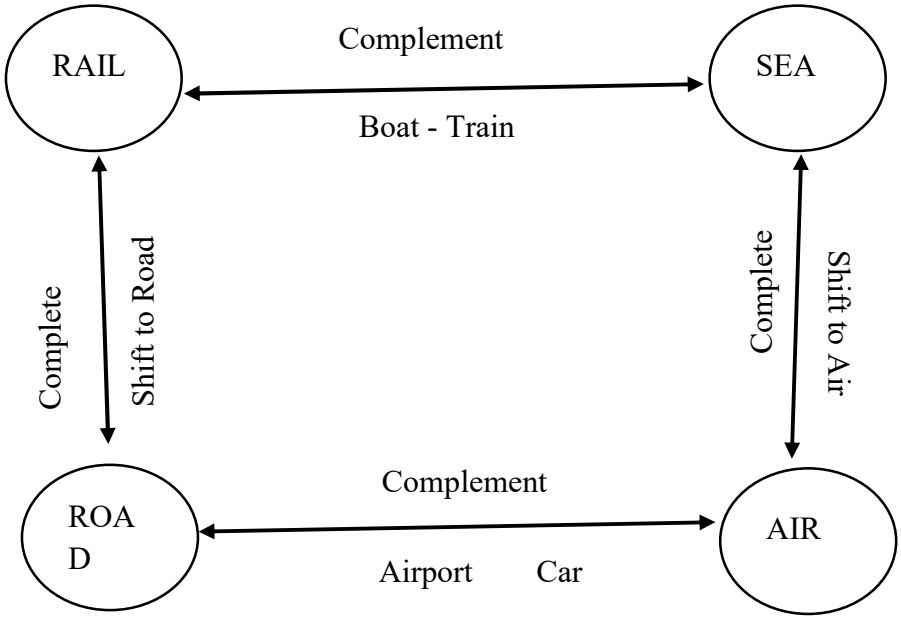
The authors conducted a review on the integration of rail and air transportation in Britain, examining various aspects such as changing dynamics, economic factors, and strategies for integration. Integration in the paper pertains to the smooth and uninterrupted travel experience for passengers, facilitating seamless journeys across the rail network without requiring train changes. This integration is crucial for effective rail-air linkages, ensuring that the airport station is well-connected to the mainline railway network, thereby enabling travelers to complete their entire journey with minimal disruptions.

They highlighted the popularity of road transport, attributing it to its flexible door-to-door nature and the seamless end-to-end journey it offers. In contrast, other modes often require the use of road transport at the beginning and end stages of the journey. To enhance the utilization of rail transport, the authors emphasized the importance of seamless modal transfer points to reduce reliance on road transport for surface journeys.

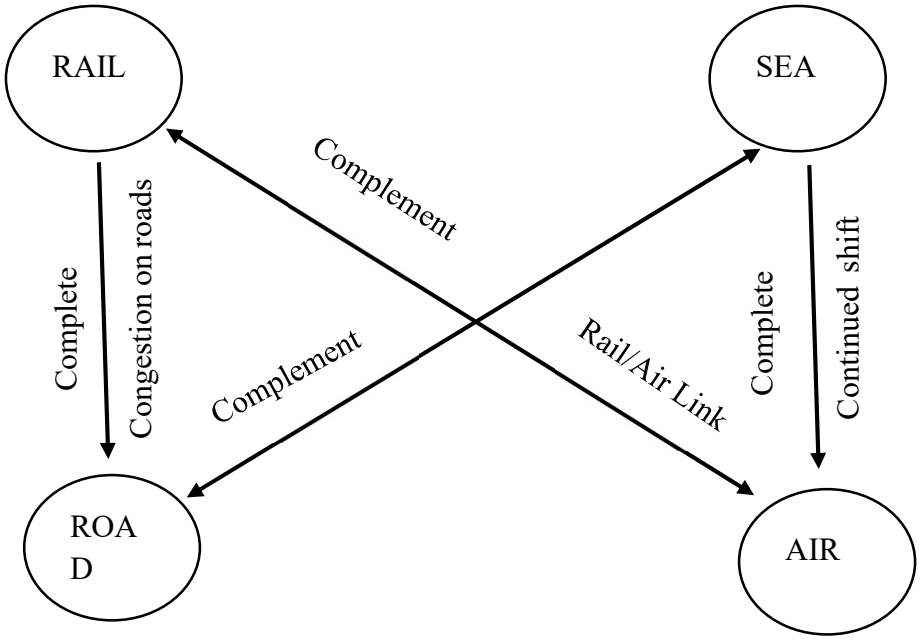
The author provided five classifications of rail-air linkages in Britain base don the nature of the connection between railway stations and airports. Of the five rail-air linkages discussed (Metro Line, Special Line, Spur Line, Branch Line, Main Line), the Main Line option stands out as it offers full integration between rail and air transport. In contrast to other options, the Main Line allows for through running of mainline and intercity trains, enabling seamless access to the national rail network from the airport station. Examples like Gatwick, Birmingham, and Southampton airports demonstrated the effectiveness of the Main Line approach in achieving maximum integration. This option ensures passengers can travel directly to and from the airport without the need for train changes, thus offering the most comprehensive rail-air integration.

As illustrated in Figure 3 from Stubbs and Jegede (1998), the traditional view of competition and complementarity in air, sea, road, and air transport differs significantly from the contemporary perspective.

(a) The traditional View



(b) The contemporary view



(b) The contemporary view

Figure 8. Competition and complementary in air, sea, road and air transport.

Table 9**.** Requirements for rail-air integration for Britain airports.

S/N	Category	Requirements
1	Infrastructure	Rail track into airport terminal Airport terminal station Baggage trolleys, ramps, lifts, covered walkways
2	Train services	High frequency Serving variety of large populations Timed to serve all flights
3	Operational efficiency	Baggage check-in at railway station(s) Air/rail information available in station and terminal Thorough rail-air rail ticketing

Source: Data extracted from Stubbs and Jegede (1998).

2.5. Comparative Analysis of Transportation Modes: Air, High-Speed Rail and Highway

Levinson *et al*., (1999) delved into a comparative analysis of transportation modes, focusing on air, high-speed rail, and highway systems within the California Corridor. Their research evaluates the importance of understanding the full costs associated with each mode to facilitate informed decision-making in transportation investments.

Case Study

The study examines various cost elements, including infrastructure costs, user operating costs, carrier operating costs, and social costs such as air pollution, noise, safety, and congestion. Through a detailed analysis, it evaluates the long-run average costs per passenger-kilometer for each mode, and provided insights on the cost differentials and their implications.

Conclusion

The research concludes that while high-speed rail appears to be the costliest mode overall, its full costs are comparable to highway transportation, with lower social costs. However, highway transportation's lower infrastructure costs offset the higher external costs compared to high-speed rail. Moreover, the study highlights the importance of understanding the linkages between demand, supply, and cost, emphasizing the need for a nuanced approach in transportation planning and investment.

Lesson Learned

One of the key takeaways from the study is the importance of considering the broader social and environmental costs associated with transportation modes. It highlights the need for policymakers and stakeholders to weigh not only the direct monetary costs but also the externalities such as pollution and congestion when making transportation decisions.

Implications for Alberta Transportation Integration

While the study offers valuable insights into transportation cost dynamics and decision-making, it is crucial to recognize that its focus on the California Corridor may not directly translate to transportation planning in Alberta. However, the methodology and findings can serve as a valuable reference point for developing integrated transportation models tailored to Alberta's unique geographical and contextual factors.

In adapting the implications on integrated transportation models in Calgary, Edmonton, Lethbridge and Red Deer, it is essential to consider the region's distinct characteristics, such as population distribution, travel patterns, existing infrastructure, and policy frameworks. Future research endeavors should aim to refine cost estimation methodologies and explore the potential for integrated solutions that address Alberta's specific transportation challenges.

SECTION 3: METHODOLOGY

3.0. Case Studies

3.1.1. John F. Kennedy International Airport Train (AirTrain JFK)

Integration Models

AirTrain JFK is a vital transportation link serving John F. Kennedy International Airport (JFK) in New York City. The AirTrain system integrates various modes of transportation, including regional rail, subway, bus, and car rental services, to provide seamless connectivity for travelers. The integration model involves collaboration between the Port Authority of New York and New Jersey, the Metropolitan Transportation Authority (MTA), and other transportation stakeholders to facilitate convenient access to the airport terminals. AirTrain JFK is operated by Alstrom under contract to the airport's operator, the Port Authority of New York and New Jersey (PANYNJ).

AirTrain JFK comprises of an 8.1mile (13km) double track system, including a 1.8-mile CTA and a 3.3miles guideway to Howard Beach, and three miles to Jamaica station.[1] It connects the passenger terminals and two routes with the New York subway system, airport long-term and employee parking lots, and long Island Rail Road (LIRR) commuter trains at the Jamaica station in Queens.

History of AirTrain JFK

The history of AirTrain JFK dates back to the late 1990s when the Port Authority of New York and New Jersey recognized the pressing need to improve transportation access to John F. Kennedy International Airport (JFK) and alleviate congestion on surrounding roadways. In 1997, the Port Authority released its JFK International Airport Master Plan, which outlined the vision for the airport's development and identified the need for a dedicated rail link to connect JFK with regional transportation hubs.[2]

Following extensive planning and feasibility studies, the Port Authority embarked on the development of AirTrain JFK in collaboration with the Metropolitan Transportation Authority (MTA) and other stakeholders. Construction of AirTrain JFK commenced in 2000, with the project being divided into multiple phases. The first phase involved the construction of an elevated railway system connecting JFK's terminals, parking areas, and rental car facilities.[3]

On December 17, 2003, AirTrain JFK officially opened to the public, marking a significant milestone in the integration of public transit with airport facilities in the New York metropolitan area[4]. The completion of AirTrain JFK represented a major achievement in transportation infrastructure development, providing travelers with a convenient and efficient transportation option between JFK Airport and regional transportation hubs.

Stakeholder Collaboration

AirTrain JFK represents a collaborative effort between multiple stakeholders, each playing a crucial role in its planning, development, and operation. The primary stakeholders involved in the project include the Port Authority of New York and New Jersey (PANYNJ), the Metropolitan Transportation Authority (MTA), local municipalities, transportation operators, and community organizations. This collaborative approach ensured the successful integration of AirTrain JFK into the broader transportation network serving John F. Kennedy International Airport (JFK). By working together, they were able to overcome challenges, leverage resources, and deliver a transportation solution that enhances connectivity and accessibility for passengers traveling to and from JFK Airport

Infrastructure and Services

i. Elevated Tracks and Stations

AirTrain JFK comprises elevated tracks that run underground or at ground level, totalling about 1.5miles (2.4km) across the airport terminals, parking areas, and key transportation hubs[8]. These tracks enable swift and reliable transportation between various airport facilities and external transit links. The system features strategically located stations equipped with amenities such as ticket vending machines, digital displays for real-time information, and passenger seating areas. These stations serve as vital access points for travelers arriving at or departing from JFK Airport.[5]

ii. Intermodal Connections

AirTrain JFK provides seamless intermodal connections to regional transit services, including the Long Island Rail Road (LIRR) and the New York City Subway. Jamaica Station serves as a major transportation hub, offering convenient connections to the LIRR, New York City Subway lines, and bus services. This intermodal facility enhances accessibility for passengers traveling to and from JFK Airport via regional rail and subway networks. Howard Beach Station provides additional connections to the New York City Subway's A train, facilitating transit access for passengers traveling to Manhattan and other parts of New York City.[6]

iii. Complimentary Shuttle Service

Within the airport precincts, AirTrain JFK offers complimentary shuttle bus service to facilitate passenger movement between terminals, parking lots, and rental car facilities. These shuttle buses operate on designated routes, providing convenient and accessible transportation options for travelers navigating the airport grounds.[7]

iv. User Experience

AirTrain JFK offers a fast and easy way to move around JFK airport. Operating 24hours a day all through the year, user enjoys a rail system that connects all passenger terminals to airport parking lots, the hotel shuttle pick-up area, the rental car center, and NYC’s public transportation network

at Jamaica and Howard Beach Stations, which includes the subway, the Long Island Rail Road, and public buses.

Passengers benefit from a seamless and efficient travel experience with AirTrain JFK. The system offers convenient connections to regional transit services, reducing the need for private vehicle travel and congestion around the airport. Signage, wayfinding aids, and digital displays provide clear directions and real-time information for travelers, enhancing the overall user experience.

Impact and Benefits

AirTrain JFK has had a significant impact on transportation accessibility and connectivity in the New York metropolitan area, as evidenced by its impressive ridership numbers. In 2019, AirTrain JFK handled nearly 21 million passengers, surpassing the previous annual record set in 2018.[9] This milestone demonstrates the system's importance as a critical link between John F. Kennedy International Airport (JFK) and regional transit networks, including the Metropolitan Transportation Authority (MTA) subway system and the Long Island Rail Road (LIRR). The high volume of passengers utilizing AirTrain JFK reflects its role in facilitating efficient and convenient travel for millions of travelers each year, contributing to the overall economic vitality and accessibility of the region**.**

3.1.2. Vancouver International Airport - TransLink

Vancouver International Airport (YVR) is one of Canada's busiest airports, serving as a major hub for domestic and international air travel. To enhance connectivity and accessibility for travelers, YVR has established integration initiatives with TransLink, the regional transportation authority in Metro Vancouver. Key components of this integration include:

1. **Canada Line Rapid Transit Service**: YVR is directly served by the Canada Line, a rapid transit service operated by TransLink. The Canada Line connects downtown Vancouver to YVR in approximately 26 minutes, providing passengers with a convenient and efficient transit option to and from the airport terminals.
2. **Bus Routes**: In addition to the Canada Line, TransLink operates several bus routes that serve Vancouver International Airport, providing further accessibility for passengers traveling to and from the airport.
3. **Collaborative Planning**: YVR and TransLink collaborate closely on transportation planning initiatives to ensure seamless connections between the airport and regional transit services. This collaborative approach helps improve the overall travel experience for passengers and promotes sustainable transportation options.
4. **Real-Time Transit Information**: YVR provides real-time transit information and wayfinding signage within the airport terminals, making it easy for passengers to navigate the regional transit network and plan their journeys.

Overall, the integration between YVR and TransLink plays a vital role in enhancing transportation accessibility and connectivity in the Metro Vancouver region. By providing convenient transit

options and fostering collaboration between key stakeholders, YVR and TransLink contribute to a more efficient and sustainable transportation network for travelers in the region.

Integration Model

The first SkyTrain line, later named the Expo Line, was constructed in 1985 in preparation for Expo 86, serving as a prominent exhibit of transit innovation. Since its inception, this automated rapid transit system has evolved into a pivotal component of Metro Vancouver's transportation infrastructure. The Expo Line spans from downtown Vancouver to southern Burnaby, New Westminster, and Surrey, catering to diverse commuter needs across the region.

Subsequent expansion efforts saw the introduction of the Millennium Line in 2002, connecting Coquitlam, Port Moody, Burnaby, and Vancouver. In 2012, construction commenced on the Evergreen Extension of the Millennium Line, further enhancing connectivity by extending service from Lougheed Town Centre to Coquitlam, thereby bolstering accessibility in the surrounding communities (Brown, 2016).

Another significant addition to the SkyTrain network is the Canada Line, inaugurated on August 17, 2009. This line traverses underground through Vancouver before transitioning to an elevated guideway with branches extending to Richmond and Vancouver International Airport. While the Canada Line intersects with the Expo Line at Waterfront station in downtown Vancouver, it operates independently, lacking a direct track connection between the two lines.

The operational oversight for the Expo Line and Millennium Line falls under the purview of British Columbia Rapid Transit Company Ltd., a subsidiary of TransLink. Conversely, the Canada Line is managed by ProTrans BC, a division of SNC-Lavalin, highlighting the diverse administrative arrangements within Metro Vancouver's transit network.

History

TransLink, formerly known as the South Coast British Columbia Transportation Authority and previously as the Greater Vancouver Transportation Authority (GCTA), is the statutory body responsible for managing the regional transportation network of Metro Vancouver in British Columbia, Canada ("South Coast British Columbia Transportation Authority Act". *bclaws.ca*. Retrieved November 17, 2015). This network includes public transit, major roads, and bridges, with its primary operational facilities situated in the city of New Westminster.

It was established in 1998 as the GVTA, and was fully operationalized in April 1999 by the Government of British Columbia to replace BC Transit in the Greater Vancouver Regional District and to assume numerous transportation responsibilities previously administered by the provincial government. In addition to overseeing various transportation modes within the Metro Vancouver region, TransLink also manages the West Coast Express, which extends into the Fraser Valley Regional District (FVRD). Recognizing the need for governance reforms, the province of British

Columbia passed legislation on November 29, 2007, to alter the governance structure and official name of the organization.

Stakeholder Collaboration

Transport 2050 is a new 30-Year Regional transportation Strategy for Metro Vancouver, and it lays out a path for goods movement for sustainable economy in a growing region. By identifying projects, services, and policies for better transportation, it reflects the collective vision for the future of transportation in Metro Vancouver.

The investments in 10-Year Priorities include bus stop improvements, transit exchange upgrades, station upgrades and, station area and corridor planning, in order to make urgent progress on climate actions, reducing congestion, improving travel reliability and traffic safety, as well as improving transport affordability. TransLink plans to work with local governments and other partners to create safer, more accessible, and comfortable bus stops with ample weather protection, seating, and lighting; accessible passenger information and wayfinding; accessible walkways and bikeway connections; and parking for bicycles and shared micro mobility services.

Infrastructure and Services

Key components of the integration include the Canada Line stations at YVR's main terminal and the airport's South Terminal, as well as dedicated bus routes serving the airport. TransLink also provides real-time transit information and wayfinding signage within the airport terminals, making it easy for passengers to navigate the transit network.

Fares depend on how many fare zones a passenger passes through and they differ for those paying with stored value on their Compass cards versus those paying by cash or contactless credit card. Cash and stored value fares are the same for concession riders. Fares were last increased on July 1, 2023(".)

Table 9. TransLink fares from July 1, 2023

Fare Type	One Zone ($)	Two Zones ($)	Three Zones ($)
Adult (cash)	3.15	4.55	6.20
Adult (stored value)	2.55	2.55	4.80
Concession	2.10	3.10	4.25

Source: Pricing and Fare Zones. www.translink.ca.

User Experience

The integration between TransLink and YVR enhances the overall travel experience for passengers by providing seamless connections between the airport and regional transit services. Passengers benefit from frequent and reliable transit options, reducing the need for private vehicle travel and alleviating congestion around the airport.

Financial Viability

TransLink's integration with YVR is financially sustainable, with revenue generated from fare collection, advertising, and other sources. The Canada Line extension to the airport has proven to be a successful investment, attracting high ridership and improving accessibility for travelers while contributing to TransLink's overall financial performance.

Impact and Benefits

The integration between TransLink and YVR has had numerous benefits for passengers, airport employees, and the broader community. These include improved access to employment opportunities, reduced greenhouse gas emissions from private vehicle travel, and enhanced regional connectivity for residents and visitors alike.

Lessons Learned

TransLink's integration with YVR serves as a valuable example of successful transportation integration, highlighting the importance of stakeholder collaboration, strategic planning, and investment in transit infrastructure. The project demonstrates the positive impact of providing accessible and sustainable transportation options for airport passengers and the surrounding community.

3.2. Secondary Data Collection

3.2.1. Proximity of Calgary International Airport to Railway Services

To determine the proximity of Calgary International Airport (YYC) to the CPKC railway, Google Earth Pro's measuring tools were utilized. The following steps were undertaken:

I. Identification of YYC Airport and CPKC Railway: Using the search function in Google Earth Pro, the locations of YYC Airport and the CPKC railway line were identified on the map.
II. Measurement of Distance: The measuring tools within Google Earth Pro were employed to calculate the distance between YYC Airport and the CPKC railway. This involved selecting the appropriate measurement tool and clicking on the starting and ending points to generate the distance measurement.
III. Verification: To ensure accuracy, multiple measurement points were taken along the railway line to capture any deviations in the route and calculate an average distance.
IV. Recording of Results: The measured distance between YYC Airport and the CPKC railway was recorded for subsequent analysis and reporting.

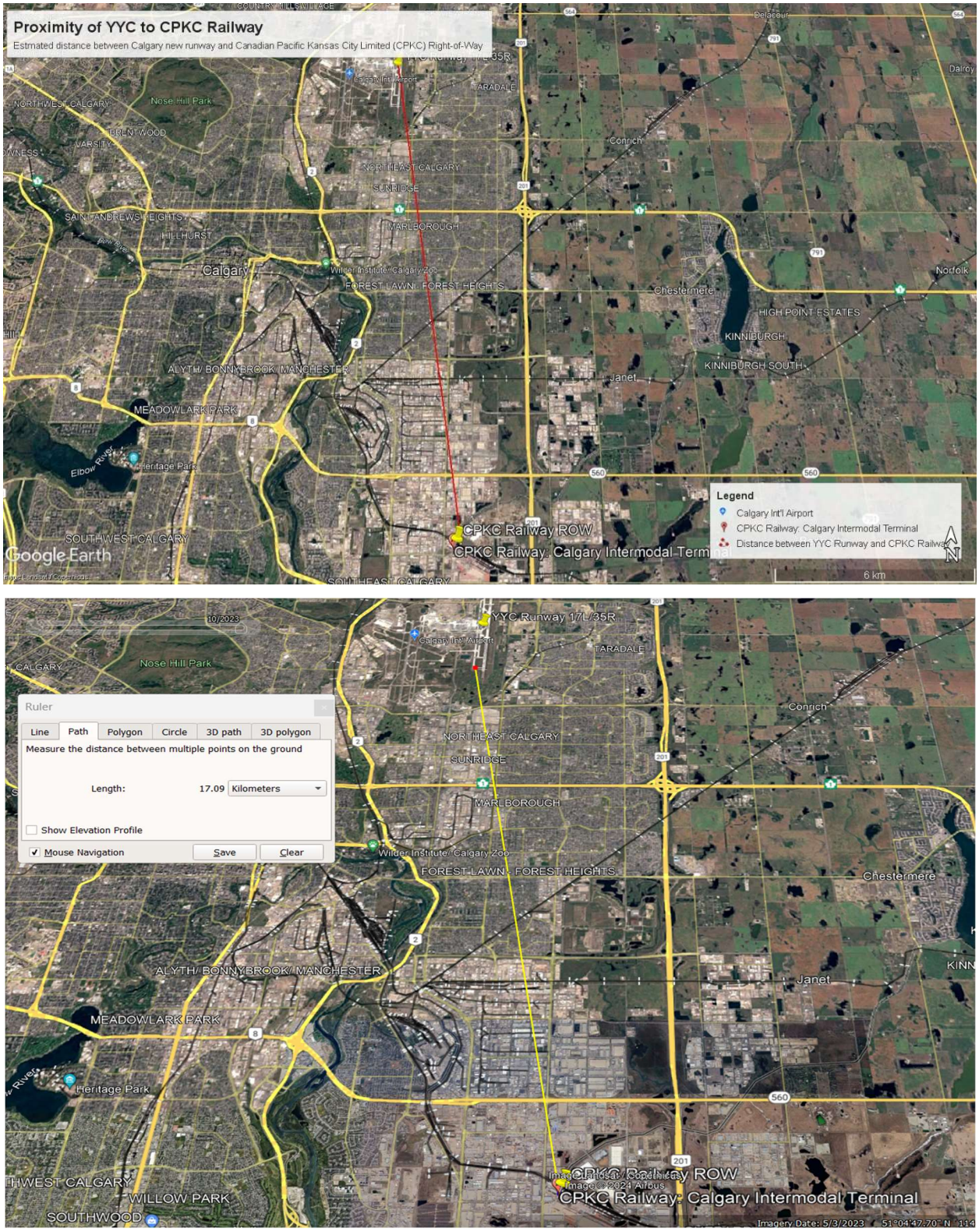


Figure 9. Map showing proximity of Calgary International Airport to Canada Pacific Kansas Limited (CPKC) Railway.

The measurement revealed that the distance between YYC Airport and the CPKC railway is approximately 17.09 kilometers. The close proximity between YYC Airport and the CPKC railway presents opportunities for transportation integration and synergy. Integrating rail services with airport operations could facilitate seamless passenger transfers and cargo logistics, potentially improving overall transportation efficiency and sustainability.

In addition, measured proximity between these air-railway emphasize the importance of considering rail-air integration in transportation planning initiatives. A coordinated integration model could enhance connectivity and accessibility, optimize logistics operations, and contribute to a more efficient and sustainable transportation system in the region. Leveraging this proximity in transportation planning efforts could yield significant benefits in terms of improved connectivity, efficiency, and sustainability in the region's transportation infrastructure.

3.2.2. Proximity of Edmonton International Airport to Railway Services

To determine the proximity of Edmonton International Airport (YEG) to the CPKC railway, Google Earth Pro's measuring tools were utilized. The following steps were undertaken:

I. Identification of YEG Airport and CPKC Railway: Using the search function in Google Earth Pro, the locations of YEG Airport and the CPKC railway line were identified on the map.
II. Measurement of Distance: The measuring tools within Google Earth Pro were employed to calculate the distance between YEG Airport and the CPKC railway. This involved selecting the appropriate measurement tool and clicking on the starting and ending points to generate the distance measurement.
III. Verification: To ensure accuracy, multiple measurement points were taken along the railway line to capture any deviations in the route and calculate an average distance.
IV. Recording of Results: The measured distance between YEG Airport and the CPKC railway was recorded for subsequent analysis and reporting.

The measurement indicates that the distance between Edmonton International Airport (YEG) and the CPKC railway is approximately 19.56 kilometers. This close proximity offers opportunities for transportation integration and collaboration. By integrating rail services with airport operations, seamless passenger transfers and streamlined cargo logistics can be achieved, potentially enhancing overall transportation efficiency and sustainability.

Furthermore, the measured proximity highlights the significance of considering rail-air integration in transportation planning endeavors for the City of Edmonton. A cohesive integration model has the potential to augment connectivity and accessibility, optimize logistics operations, and contribute to a more efficient and sustainable transportation network in the region.

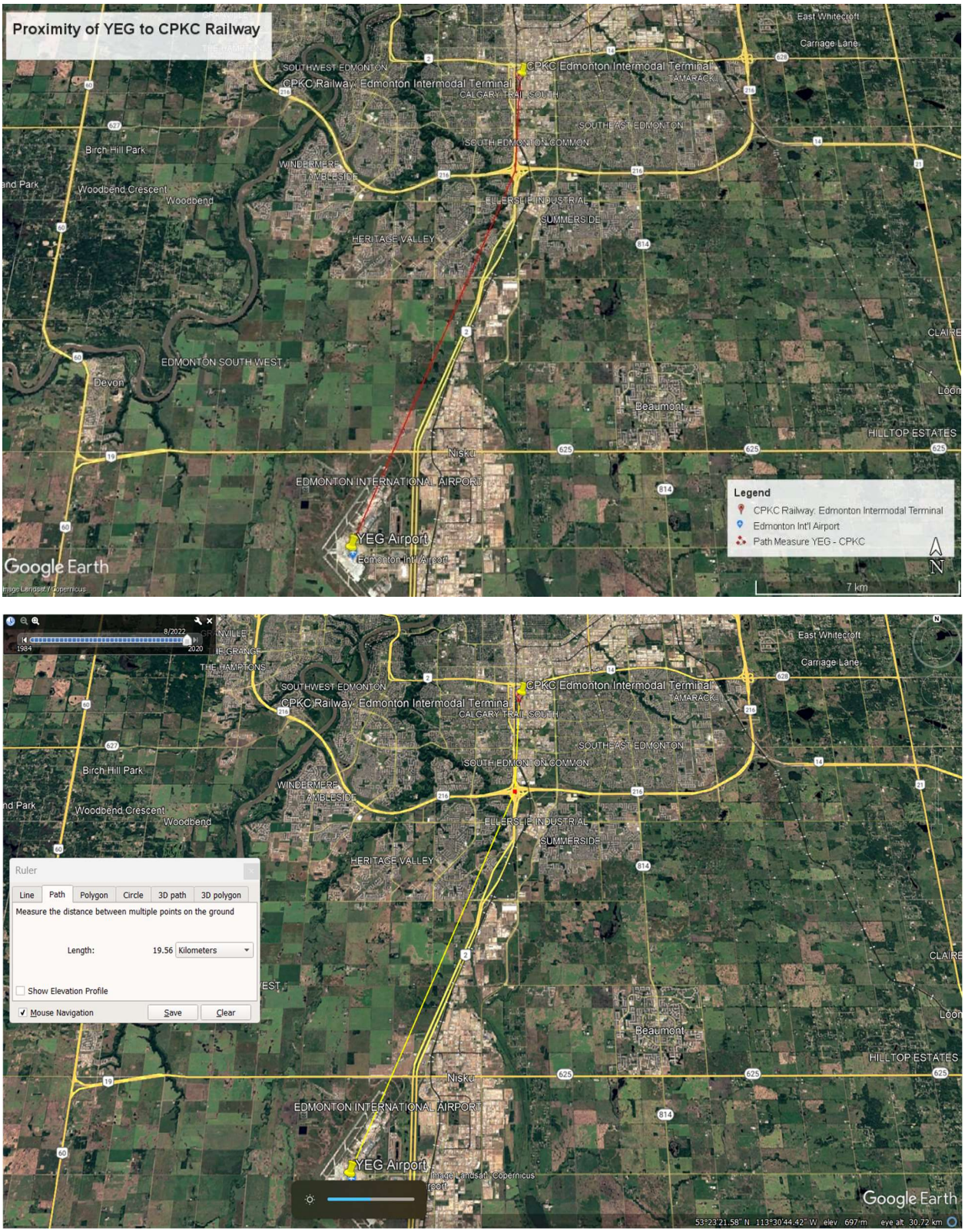


Figure 10. Map showing proximity of Edmonton International Airport to Canada Pacific Kansas Limited (CPKC) Railway.

3.2.3. Comparative Distances to International Low-Cost Airline Hubs

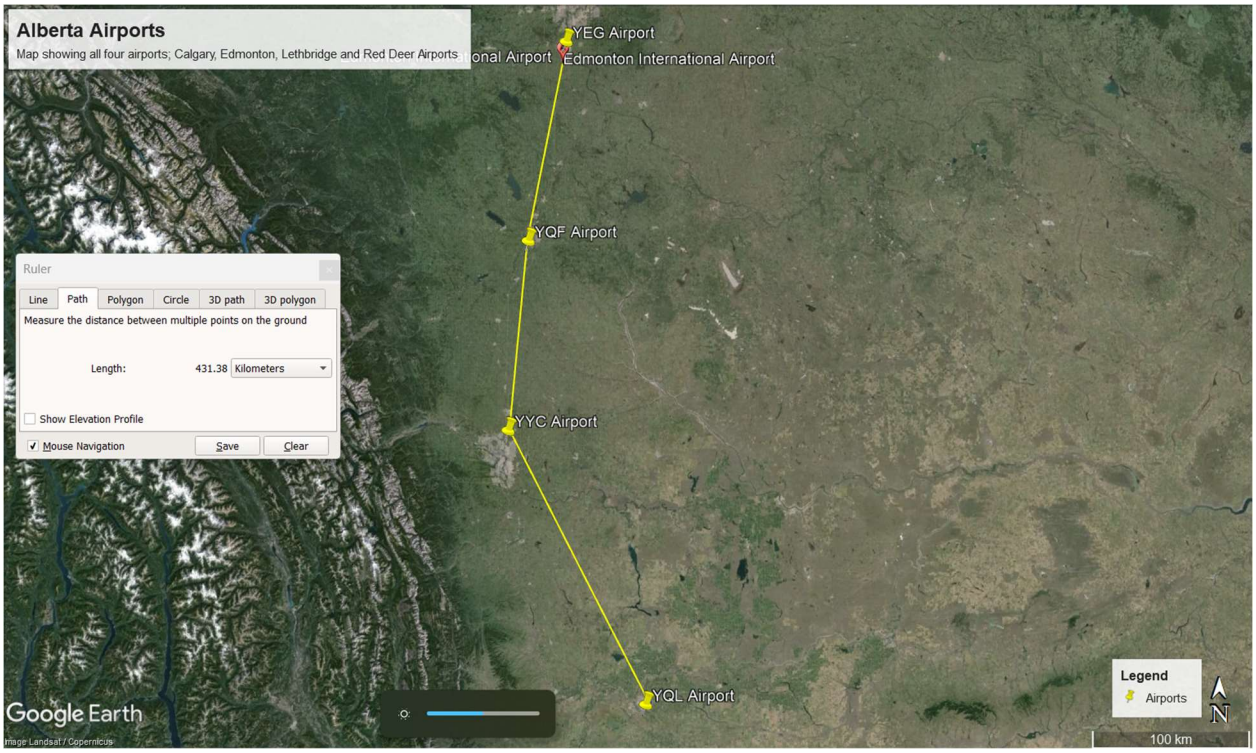
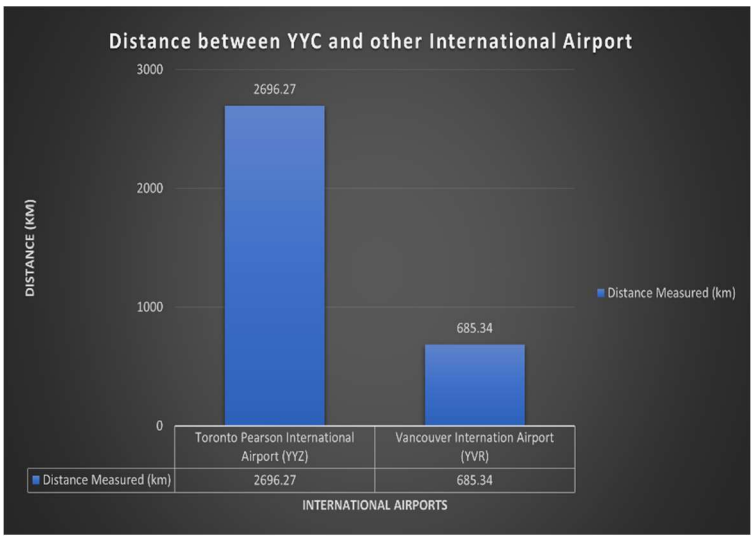


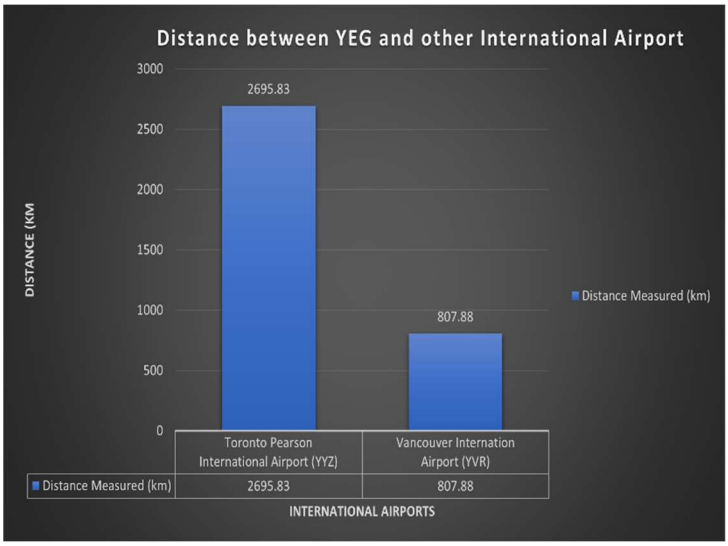
Figure 11. Estimated Distances in kilometres between all four airports is 431.38.

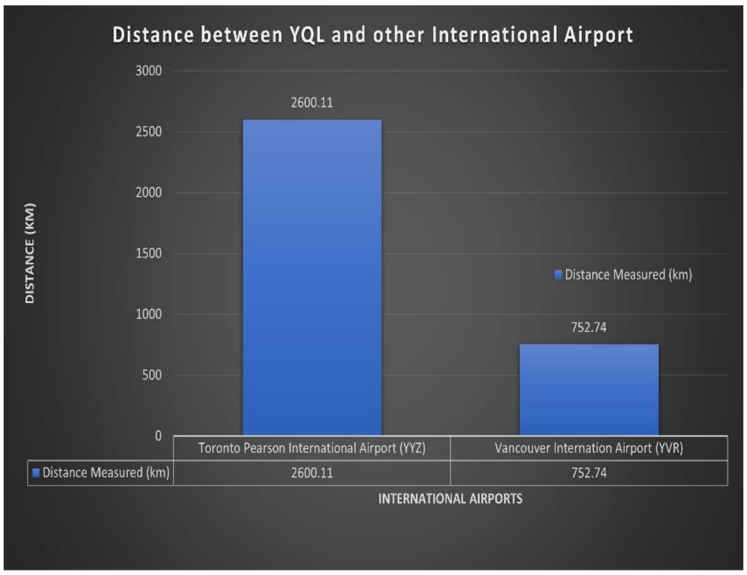
In Canada, there are several airports that serve as hubs for low-cost airlines, offering domestic and international flights at affordable prices. Some of the key low-cost airline hubs in Canada include:

i. Toronto Pearson International Airport (YYZ)
ii. Vancouver International Airport (YVR) - A major hub for low-cost carriers serving destinations within Canada, the United States, and internationally.
iii. Montréal–Trudeau International Airport (YUL) - Another important hub for low-cost airlines offering flights to various destinations in Canada, the United States, and abroad.

To understand the distances between key Alberta cities and their implications for transportation, it is essential to compare them to international low-cost airline hubs. Ryanair, for instance, has strategically utilized Stansted Airport as a primary hub despite its distance from other major London airports (Ryanair, Accessed 2024). Ryanair Ltd. (ISEQ: RYA, LSE: RYA, NASDAQ: RYAAY) is an Irish low-cost airline headquartered in Swords, Dublin, Ireland, with its biggest focus cities in Dublin and London. Similarly, Stansted Airport, located approximately 103 kilometers from Heathrow and 126 kilometers from Gatwick, offers Ryanair cost advantages and operational flexibility. Ryanair's case highlights the significance of factors beyond proximity in hub selection. Similarly, when considering Alberta's transportation infrastructure, the distances between Lethbridge and Calgary, Red Deer, and Edmonton play a crucial role in determining accessibility and connectivity. Comparing these distances provides insights into potential transportation solutions and opportunities for enhancing regional connectivity.







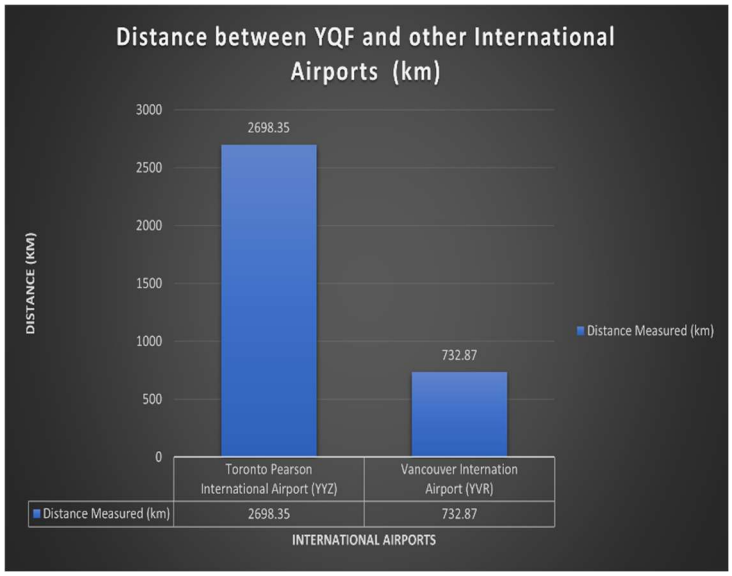


Figure 12. Distances between Airports

Source: Estimated measured distances using Google Earth Pro Software V.7.3.6.9796 (64-bit)

3.2.4. Strategic Adoption for Enhanced Transportation Connectivity

Through the following potential strategies, Calgary, Edmonton, Red Deer, and Lethbridge can adopt strategies similar to Ryanair's utilization of Stansted Airport, while considering the unique characteristics and needs of each city:

i. Calgary: As a major transportation hub in Alberta, Calgary can focus on optimizing its existing infrastructure, including the airport and rail connections. The city can explore partnerships with low-cost airlines to increase accessibility and affordability for travelers. Additionally, investing in efficient transit options to connect the airport to downtown and surrounding areas would enhance connectivity.
ii. Edmonton: Similar to Calgary, Edmonton can prioritize improving airport connectivity and transit options. Collaborating with low-cost airlines to expand routes and attract more passengers can help stimulate economic growth and tourism. Additionally, investing in infrastructure projects such as light rail transit (LRT) connections to the airport would improve accessibility for residents and visitors.
iii. Red Deer: Although smaller in size compared to Calgary and Edmonton, Red Deer can still benefit from adopting strategies to enhance transportation connectivity. The city can explore partnerships with regional airlines and rail service providers to improve access to major transportation hubs. Investing in infrastructure upgrades, such as improved road networks and public transit systems, would facilitate smoother travel for residents and visitors.
iv. Lethbridge: Lethbridge can leverage its strategic location and proximity to major transportation routes to attract low-cost airlines and enhance connectivity. The city can collaborate with regional partners to promote the development of transportation infrastructure, including rail connections and airport facilities. Investing in marketing and promotional efforts to attract air travelers and tourists would also contribute to economic growth and development.

By adopting strategies that prioritize accessibility, affordability, and collaboration with transportation stakeholders, each of the four cities in Alberta can enhance their transportation networks and contribute to regional connectivity and economic development.

3.2.5. Air Travel and Rail Services

Below is the estimated number of air travelers (YYC 2024 and YEG 2019) who would use rail service to travel to each airport terminal. This data provides information on the potential demand for regional rail travel and the implications for transit service providers at each airport.

A. Calgary International Airport Passenger Statistics

CALGARY INTERNATIONAL AIRPORT
LOCAL E&D PASSENGER STATISTICS[1]

	% D 2020	% D 2021	2022	% D	2023	% D	2024	% D
January	-2.9%	-81.0%	653,700	155.1%	1,226,098	87.6%	**1,320,799**	**7.7%**
February	-0.5%	-85.6%	698,846	264.2%	1,190,423	70.3%	**1,333,487**	**12.0%**
March	-45.1%	-72.7%	951,136	327.2%	1,392,200	46.4%	-	-
	-17.0%	-80.8%	2,303,682	243.5%	3,808,721	65.3%	**2,654,286**	**9.8%**
April	-95.2%	208.1%	1,061,544	406.2%	1,385,673	30.5%	-	-
May	-94.4%	134.5%	1,276,655	571.9%	1,557,941	22.0%	-	-
June	-91.0%	123.8%	1,412,400	343.3%	1,735,533	22.9%	-	-
	-93.5%	146.5%	3,750,599	422.1%	4,679,147	24.8%	-	-
July	-83.8%	121.3%	1,551,331	142.8%	1,933,998	24.7%	-	-
August	-79.3%	157.6%	1,586,758	65.7%	1,953,924	23.1%	-	-
September	-78.7%	150.5%	1,395,842	70.8%	1,727,936	23.8%	-	-
	-80.7%	144.6%	4,533,931	87.9%	5,615,858	23.9%	-	-
October	-77.3%	143.9%	1,404,179	74.6%	1,624,131	15.7%	-	-
November	-78.1%	177.3%	1,213,230	54.5%	1,336,681	10.2%	-	-
December	-80.1%	225.5%	1,246,438	33.5%	1,428,985	14.6%	-	-
	-78.5%	180.4%	3,863,847	53.1%	4,389,797	13.6%	-	-
Total (YTD)	**-68.40%**	**11.47%**	**14,452,059**	**128.44%**	**18,493,523**	**27.96%**	**2,654,286**	**9.84%**
					12 Months Ended Feb '24 »		*18,731,288*	*20.72%*

[1] E&D (enplaned & deplaned) statistics include non-revenue passengers. Figures are subject to change and may contain estimates (2.70% of the February 2024 results have been estimated).

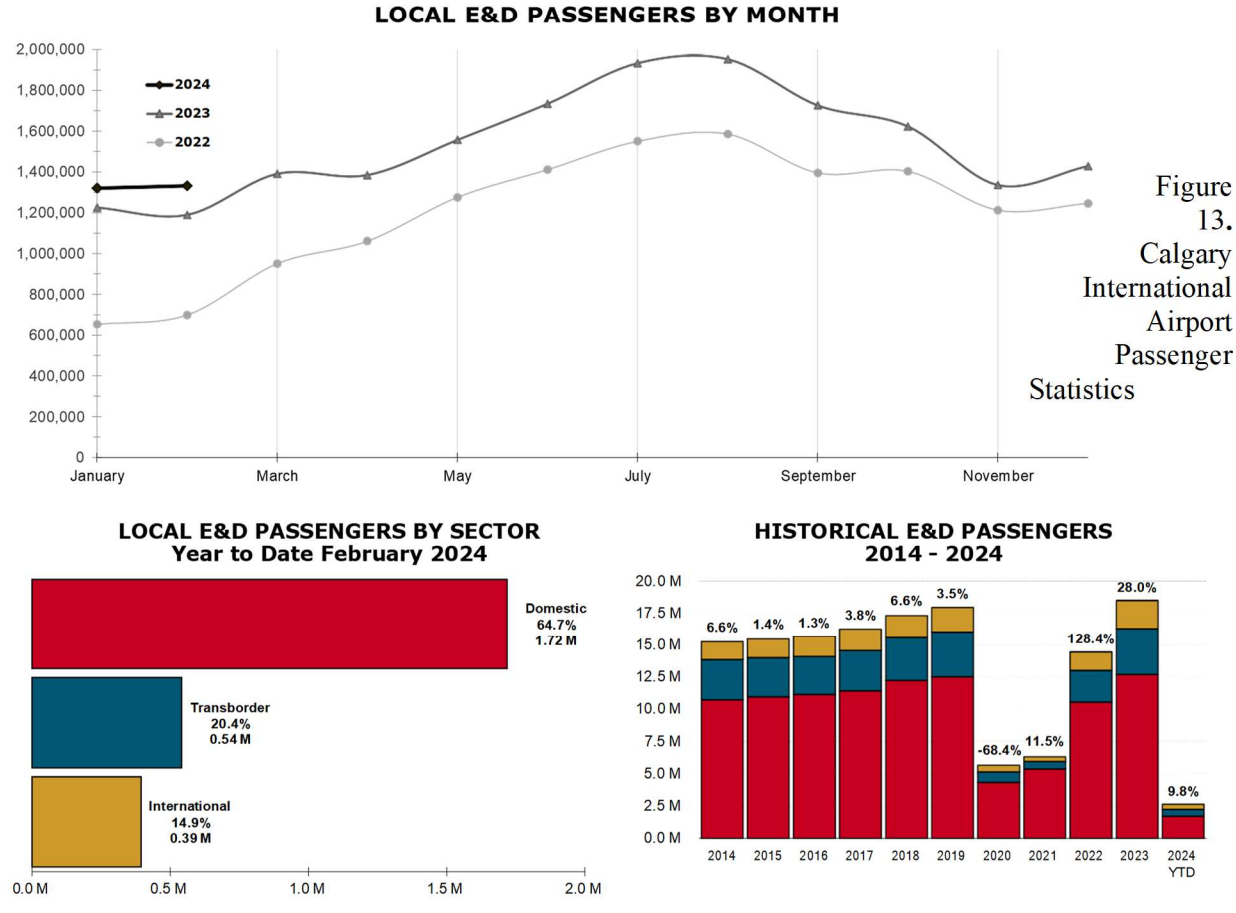


Figure 13. Calgary International Airport Passenger Statistics

Figure 14. Calgary International Airport Passenger Statistics

	% D 2020	% D 2021	2022	% D	2023	% D	2024	% D
A. Domestic Passengers								
January	-5.1%	-76.8%	475,444	130.0%	813,222	71.0%	**855,036**	**5.1%**
February	-1.4%	-79.8%	501,424	183.7%	788,360	57.2%	**863,324**	**9.5%**
March	-43.5%	-61.6%	657,659	211.6%	926,220	40.8%	-	-
	-17.3%	-74.3%	1,634,527	174.9%	2,527,802	54.7%	**1,718,360**	**7.3%**
April	-93.1%	194.7%	738,831	279.4%	938,902	27.1%	-	-
May	-92.6%	120.6%	964,978	457.8%	1,113,094	15.3%	-	-
June	-87.6%	115.7%	1,068,983	258.2%	1,207,140	12.9%	-	-
	-90.9%	135.5%	2,772,792	316.2%	3,259,136	17.5%	-	-
July	-78.3%	113.8%	1,174,145	97.2%	1,353,196	15.2%	-	-
August	-72.5%	144.2%	1,211,198	38.6%	1,383,272	14.2%	-	-
September	-71.5%	127.2%	1,036,016	46.7%	1,196,742	15.5%	-	-
	-74.2%	129.7%	3,421,359	57.3%	3,933,210	15.0%	-	-
October	-70.6%	111.8%	1,040,937	59.6%	1,132,140	8.8%	-	-
November	-71.4%	133.8%	846,260	43.8%	899,207	6.3%	-	-
December	-76.4%	199.1%	845,089	20.8%	948,213	12.2%	-	-
	-72.8%	144.5%	2,732,286	40.8%	2,979,560	9.1%	-	-
Total (YTD)	**-65.32%**	**23.91%**	**10,560,964**	**96.42%**	**12,699,708**	**20.25%**	**1,718,360**	**7.29%**
					12 Months Ended Feb 2024		**12,816,486**	**14.6%**

B. Transborder Passengers								
January	5.5%	-89.4%	95,549	220.0%	222,742	133.1%	**265,893**	**19.4%**
February	3.5%	-96.1%	116,817	971.4%	226,197	93.6%	**275,331**	**21.7%**
March	-51.3%	-93.9%	178,831	1802.9%	273,482	52.9%	-	-
	-16.2%	-93.0%	391,197	679.9%	722,421	84.7%	**541,224**	**20.6%**
April	-99.4%	654.1%	202,532	1535.7%	269,749	33.2%	-	-
May	-99.0%	418.3%	205,545	1417.6%	275,920	34.2%	-	-
June	-98.7%	244.9%	233,139	1589.3%	340,159	45.9%	-	-
	-99.0%	381.1%	641,216	1514.1%	885,828	38.1%	-	-
July	-97.5%	244.9%	258,419	808.5%	382,788	48.1%	-	-
August	-97.2%	479.9%	248,477	371.4%	373,680	50.4%	-	-
September	-96.8%	623.3%	239,478	251.7%	342,910	43.2%	-	-
	-97.2%	457.9%	746,374	400.1%	1,099,378	47.3%	-	-
October	-95.3%	615.7%	243,292	147.8%	324,218	33.3%	-	-
November	-92.8%	490.2%	218,052	86.1%	273,820	25.6%	-	-
December	-89.1%	333.5%	217,968	61.4%	280,622	28.7%	-	-
	-92.4%	441.3%	679,312	93.9%	878,660	29.3%	-	-
Total (YTD)	**-76.81%**	**-27.92%**	**2,458,099**	**316.95%**	**3,586,287**	**45.90%**	**541,224**	**20.56%**
					12 Months Ended Feb 2024		**3,678,572**	**36.5%**

C. International Passengers								
January	-3.6%	-89.0%	82,707	321.5%	190,134	129.9%	**199,870**	**5.1%**
February	-2.3%	-97.6%	80,605	1792.1%	175,866	118.2%	**194,832**	**10.8%**
March	-43.2%	-98.0%	114,646	5161.4%	192,498	67.9%	-	-
	-17.0%	-94.4%	277,958	966.6%	558,498	100.9%	**394,702**	**7.8%**
April	-99.8%	648.4%	120,181	4554.6%	177,022	47.3%	-	-
May	-100.0%	#DIV/0!	106,132	29.6120565	168,927	59.2%	-	-
June	-100.0%	#DIV/0!	110,278	1625.5%	188,234	70.7%	-	-
	-99.9%	3505.8%	336,591	2605.7%	534,183	58.7%	-	-
July	-98.8%	662.5%	118,767	687.4%	198,014	66.7%	-	-
August	-97.2%	554.1%	127,083	312.8%	196,972	55.0%	-	-
September	-95.8%	606.7%	120,348	179.8%	188,284	56.4%	-	-
	-97.3%	596.0%	366,198	312.0%	583,270	59.3%	-	-
October	-93.1%	568.1%	119,950	122.7%	167,773	39.9%	-	-
November	-91.5%	585.4%	148,918	86.9%	163,654	9.9%	-	-
December	-86.8%	355.3%	183,381	85.0%	200,150	9.1%	-	-
	-90.1%	461.2%	452,249	94.4%	531,577	17.5%	-	-
Total (YTD)	**-72.97%**	**-30.50%**	**1,432,996**	**297.98%**	**2,207,528**	**54.05%**	**394,702**	**7.84%**
					12 Months Ended Feb 2024		**2,236,230**	**36.7%**

Figure 15. Calgary International Airport Passenger Statistics

Figure 16. Calgary International Airport Passenger Statistics

Source: Adapted from data provided by Calgary Airport Authority Annual Report

B. Edmonton International Airport

December

	Domestic			Transborder			International			Terminal Total			FBO Passengers			Total Passengers		
	2019 Actual	2018 Actual	% Change	2019 Actual	2018 Actual	% Change	2019 Actual	2018 Actual	% Change	2019 Actual	2018 Actual	% Change	2019 Actual	2018 Actual	% Change	2019 Actual	2018 Actual	% Change
January	460,191	456,765	0.8%	96,390	87,827	9.7%	59,154	62,573	-5.5%	615,735	607,165	1.4%	38,336	32,552	17.8%	654,071	639,717	2.2%
February	444,140	441,598	0.6%	101,373	91,125	11.2%	56,662	57,741	-1.9%	602,175	590,464	2.0%	34,508	30,412	13.5%	636,683	620,876	2.5%
March	491,921	477,687	3.0%	104,070	95,184	9.3%	61,167	61,846	-1.1%	657,158	634,717	3.5%	37,302	32,846	13.6%	694,460	667,563	4.0%
1st Quarter	1,396,252	1,376,050	1.5%	301,833	274,136	10.1%	176,983	182,160	-2.8%	1,875,068	1,832,346	2.3%	110,146	95,810	15.0%	1,985,214	1,928,156	3.0%
April	491,402	492,889	-0.3%	90,965	90,247	0.8%	52,284	54,916	-4.8%	634,651	638,052	-0.5%	39,584	30,570	29.5%	674,235	668,622	0.8%
May	540,983	556,731	-2.8%	72,205	74,315	-2.8%	25,960	27,960	-7.2%	639,148	659,006	-3.0%	46,984	35,576	32.1%	686,132	694,582	-1.2%
June	556,228	553,160	0.6%	59,682	64,901	-8.0%	18,794	19,250	-2.4%	634,704	637,311	-0.4%	39,090	35,924	8.8%	673,794	673,235	0.1%
2nd Quarter	1,588,613	1,602,780	-0.9%	222,852	229,463	-2.9%	97,038	102,126	-5.0%	1,908,503	1,934,369	-1.3%	125,658	102,070	23.1%	2,034,161	2,036,439	-0.1%
July	629,292	642,152	-2.0%	58,197	67,814	-14.2%	19,741	22,987	-14.1%	707,230	732,953	-3.5%	46,534	34,948	33.2%	753,764	767,901	-1.8%
August	648,535	693,596	-6.5%	60,928	68,759	-11.4%	21,135	23,745	-11.0%	730,598	786,100	-7.1%	43,766	37,244	17.5%	774,364	823,344	-5.9%
September	528,694	558,894	-5.4%	62,156	64,780	-4.1%	15,862	18,710	-15.2%	606,712	642,384	-5.6%	47,606	42,856	11.1%	654,318	685,240	-4.5%
3rd Quarter	1,806,521	1,894,642	-4.7%	181,281	201,353	-10.0%	56,738	65,442	-13.3%	2,044,540	2,161,437	-5.4%	137,906	115,048	19.9%	2,182,446	2,276,485	-4.1%
October	504,236	541,999	-7.0%	81,057	72,770	11.4%	14,425	19,611	-26.4%	599,718	634,380	-5.5%	44,576	41,918	6.3%	644,294	676,298	-4.7%
November	444,736	470,745	-5.5%	93,437	90,537	3.2%	47,869	43,172	10.9%	586,042	604,454	-3.0%	41,904	38,806	8.0%	627,946	643,260	-2.4%
December	496,167	509,141	-2.5%	90,435	99,112	-8.8%	56,599	54,990	2.9%	643,201	663,243	-3.0%	34,270	30,220	13.4%	677,471	693,463	-2.3%
4th Quarter	1,445,139	1,521,885	-5.0%	264,929	262,419	1.0%	118,893	117,773	1.0%	1,828,961	1,902,077	-3.8%	120,750	110,944	8.8%	1,949,711	2,013,021	-3.1%
Year To Date Total	**6,236,525**	**6,395,357**	**-2.5%**	**970,895**	**967,371**	**0.4%**	**449,652**	**467,501**	**-3.8%**	**7,657,072**	**7,830,229**	**-2.2%**	**494,460**	**423,872**	**16.7%**	**8,151,532**	**8,254,101**	**-1.2%**
Rolling-12-Month Total	**6,236,525**	**6,395,357**	**-2.5%**	**970,895**	**967,371**	**0.4%**	**449,652**	**467,501**	**-3.8%**	**7,657,072**	**7,830,229**	**-2.2%**	**494,460**	**423,872**	**16.7%**	**8,151,532**	**8,254,101**	**-1.2%**

Figure 17. Edmonton International Airport 2018 - 2019 Enplaned and Deplaned passengers

December

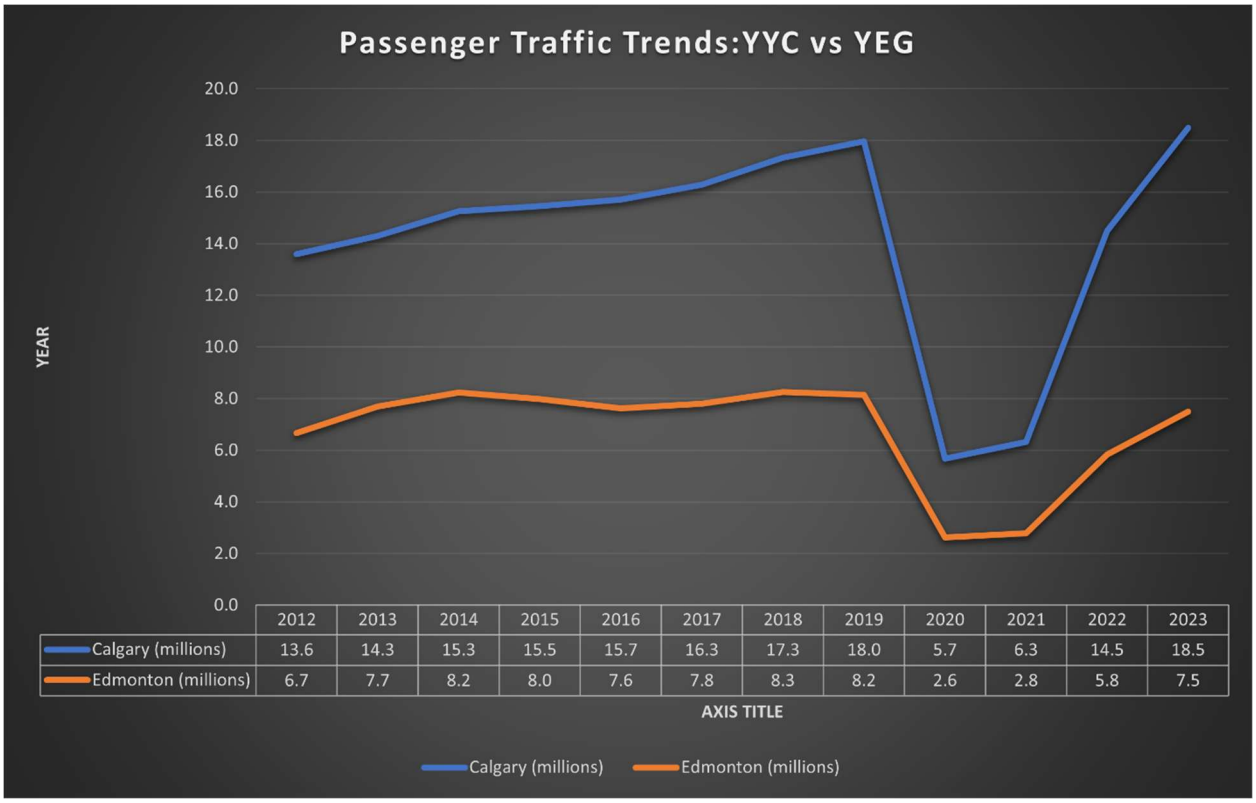
	Domestic			Transborder			International			Terminal Total			FBO			Total Passengers		
	2020 Actual	2019 Actual	% Change	2020 Actual	2019 Actual	% Change	2020 Actual	2019 Actual	% Change	2020 Actual	2019 Actual	% Change	2020 Actual	2019 Actual	% Change	2020 Actual	2019 Actual	% Change
January	436,482	460,191	-5.2%	81,643	96,390	-15.3%	65,146	59,154	10.1%	583,271	615,735	-5.3%	41,556	38,336	8.4%	624,827	654,071	-4.5%
February	424,459	444,140	-4.4%	82,338	101,373	-18.8%	62,177	56,662	9.7%	568,974	602,175	-5.5%	38,024	34,508	10.2%	606,998	636,683	-4.7%
March	271,751	491,921	-44.8%	41,747	104,070	-59.9%	30,615	61,167	-49.9%	344,113	657,158	-47.6%	32,808	37,302	-12.0%	376,921	694,460	-45.7%
1st Quarter	1,132,692	1,396,252	-18.9%	205,728	301,833	-31.8%	157,938	176,983	-10.8%	1,496,358	1,875,068	-20.2%	112,388	110,146	2.0%	1,608,746	1,985,214	-19.0%
April	21,686	491,402	-95.6%	403	90,965	-99.6%	-	52,284	-100.0%	22,089	634,651	-96.5%	17,384	39,584	-56.1%	39,473	674,235	-94.1%
May	27,042	540,983	-95.0%	421	72,205	-99.4%	-	25,960	-100.0%	27,463	639,148	-95.7%	16,870	46,984	-64.1%	44,333	686,132	-93.5%
June	56,758	556,228	-89.8%	753	59,682	-98.7%	-	18,794	-100.0%	57,511	634,704	-90.9%	20,380	39,090	-47.9%	77,891	673,794	-88.4%
2nd Quarter	105,486	1,588,613	-93.4%	1,577	222,852	-99.3%	-	97,038	-100.0%	107,063	1,908,503	-94.4%	54,634	125,658	-56.5%	161,697	2,034,161	-92.1%
July	115,125	629,292	-81.7%	403	58,197	-99.3%	-	19,741	-100.0%	115,528	707,230	-83.7%	26,950	46,534	-42.1%	142,478	753,764	-81.1%
August	138,998	648,535	-78.6%	-	60,928	-100.0%	-	21,135	-100.0%	138,998	730,598	-81.0%	25,236	43,766	-42.3%	164,234	774,364	-78.8%
September	117,043	528,694	-77.9%	-	62,156	-100.0%	-	15,862	-100.0%	117,043	606,712	-80.7%	32,198	47,606	-32.4%	149,241	654,318	-77.2%
3rd Quarter	371,166	1,806,521	-79.5%	403	181,281	-99.8%	-	56,738	-100.0%	371,569	2,044,540	-81.8%	84,384	137,906	-38.8%	455,953	2,182,446	-79.1%
October	119,040	504,236	-76.4%	146	81,057	-99.8%	382	14,425	-97.4%	119,568	599,718	-80.1%	27,120	44,576	-39.2%	146,688	644,294	-77.2%
November	100,202	444,736	-77.5%	657	93,437	-99.3%	1,095	47,869	-97.7%	101,954	586,042	-82.6%	27,194	41,904	-35.1%	129,148	627,946	-79.4%
December	95,136	496,167	-80.8%	643	90,435	-99.3%	1,766	56,599	-96.9%	97,545	643,201	-84.8%	29,114	34,270	-15.0%	126,659	677,471	-81.3%
4th Quarter	314,378	1,445,139	-78.2%	1,446	264,929	-99.5%	3,243	118,893	-97.3%	319,067	1,828,961	-82.6%	83,428	120,750	-30.9%	402,495	1,949,711	-79.4%
Year To Date Total	**1,923,722**	**6,236,525**	**-69.2%**	**209,154**	**970,895**	**-78.5%**	**161,181**	**449,652**	**-64.2%**	**2,294,057**	**7,657,072**	**-70.0%**	**334,834**	**494,460**	**-32.3%**	**2,628,891**	**8,151,532**	**-67.7%**
Rolling-12-Month Total	**1,923,722**	**6,236,525**	**-69.2%**	**209,154**	**970,895**	**-78.5%**	**161,181**	**449,652**	**-64.2%**	**2,294,057**	**7,657,072**	**-70.0%**	**334,834**	**494,460**	**-32.3%**	**2,628,891**	**8,151,532**	**-67.7%**

* Data may contain estimates and is subject to change

Figure 18. Edmonton International Airport 2019 - 2020 Enplaned and Deplaned passengers

3.2.6. Comparison of Passenger Traffic

This section shows the annual passenger traffic (in millions) at Calgary and Edmonton airports from 2012 to 2023.



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Calgary (millions)	13.6	14.3	15.3	15.5	15.7	16.3	17.3	18.0	5.7	6.3	14.5	18.5
Edmonton (millions)	6.7	7.7	8.2	8.0	7.6	7.8	8.3	8.2	2.6	2.8	5.8	7.5

Figure 19. Annual Passenger Traffic Comparison between Calgary and Edmonton Airports (2012-2023).

Source: Data adapted from Calgary and Edmonton airport authority annual report.

Overall Trend:

- Both airports have experienced an overall increasing trend in passenger traffic over the years, with some fluctuations.
- Calgary consistently shows higher passenger volumes compared to Edmonton throughout the period.

Calgary Airport:

- Passenger traffic at Calgary Airport has shown steady growth from 2012 to 2019, with a notable increase in 2017 and 2018.
- There is a significant drop in passenger numbers in 2020, likely due to the impact of the COVID-19 pandemic on air travel.
- A sharp rebound is observed in 2021 and 2022, with passenger numbers surpassing pre-pandemic levels.

Edmonton Airport:

- Passenger traffic at Edmonton Airport has also shown overall growth but at a slower pace compared to Calgary.
- Similar to Calgary, Edmonton experienced a decline in passenger numbers in 2020 due to the pandemic.
- The rebound in passenger traffic in 2021 and 2022 is evident, but the growth rate is relatively lower compared to Calgary.

Disparities and Fluctuations:

- There are noticeable fluctuations in passenger numbers for both airports, reflecting various factors such as economic conditions, airline operations, and global events.
- Despite fluctuations, Calgary consistently maintains a higher level of passenger traffic compared to Edmonton, indicating its status as a busier airport in the region.

In summary, while both Calgary and Edmonton airports show growth in passenger traffic over the years, Calgary consistently outpaces Edmonton in terms of passenger volumes, with 2021 and 2022 witnessing significant rebounds following the COVID-19 pandemic.

3.3. Stakeholder Engagement and Data Collection

To gather insights on transportation integration and assess the feasibility of passenger rail services at airports in Alberta, outreach efforts were undertaken to engage key stakeholders, including airport authorities and airlines. The methodology employed for stakeholder engagement and data collection is outlined below:

1. Initial Contact: The research team initiated contact with Calgary Airport Authority, Red Deer Regional Airport, and Edmonton Airport Authority, including TransLink, the transportation authority for Metro Vancouver via email and phone calls. Contact details were obtained from publicly available sources and official websites.
2. Follow-Up Communication: Follow-up emails and phone calls were conducted to remind airport authorities of the survey and encourage participation. Additional information about the research objectives and the importance of their input was provided during follow-up communication.
3. Documentation of Efforts: All communication attempts, including emails sent, phone calls made, and responses received were documented for transparency and accountability purposes.

3.3.1. Feedback from Airports

- Limitation

Despite diligent efforts to engage airport authorities and solicit their input, no responses were received from Calgary Airport Authority, Red Deer Regional Airport, or Edmonton Airport

Authority. The lack of feedback from airport authorities poses a limitation to the depth of analysis in certain areas of the research, as detailed in the analysis section.

- Implications

Without airport feedback, certain aspects of the analysis may be incomplete or speculative.

The absence of input from airport authorities may impact the accuracy and reliability of projections related to air travel demand, ridership numbers, and infrastructure requirements.

- Mitigation Strategies

While the absence of airport feedback is acknowledged, alternative sources of information, such as publicly available data, industry reports, and insights from other stakeholders, were leveraged to inform the analysis and recommendations presented in this report.

3.3.2. Learning from TransLink

While direct feedback from airports was not obtained, insights from TransLink provided valuable guidance on best practices for integrating transportation modes and optimizing schedules and route coordination. TransLink's experiences provided insights on the areas of interest below:

1. Integration Models and Strategies: TransLink emphasizes convenience and reliability in its regional transportation strategy. A notable example is the Canada Line, a private-public partnership that connects the airport to Downtown Vancouver, demonstrating seamless integration with the TransLink network.
2. Best Practices for Integration: TransLink's integrated transportation authority model allows for greater control over schedule coordination, fare structure, and customer experience across various modes of transportation, including rail, bus, and passenger-marine ferry.
3. Coordination of Schedules and Operations: TransLink prioritizes high-frequency service and simple fare structures to facilitate seamless transfers for passengers. The overarching objective is to enhance the customer experience through comfort and convenience.
4. Community Engagement: TransLink engages with communities and stakeholders in integration initiatives by identifying impacted areas, developing engagement plans, and conducting surveys. They also optimize bus networks to eliminate duplication and enhance connectivity.
5. Ridership Satisfaction and Data: TransLink tracks ridership satisfaction and maintains records of ridership numbers through Transit Service Performance Reviews, which are released annually and date back to 2011. Interactive data on ridership is also available.

These insights from TransLink provide valuable considerations for enhancing transportation integration in Alberta, particularly in the areas of convenience, reliability, community engagement, and ridership tracking.

SECTION 4: ANALYSIS & RESULTS

Two surveys were conducted to gather insights from airport employees, passengers, and residents in Alberta on transportation integration in Alberta.

Links to survey:

- General Public / Non airline employees - https://arcg.is/0bKu8j
- Airport / Airline employees - https://arcg.is/jyLzi

4.1. Results

Lack of Survey Respondents and Potential Factors

Despite concerted efforts to gather insights through a survey on transportation integration in Alberta, the response rate was unexpectedly low. This section explores the reasons for the lack of respondents and discuss potential factors contributing to this outcome.

i. Limited Engagement: Despite extensive promotion through various channels, including social media, email outreach, and direct communication with stakeholders, the survey failed to generate significant interest or engagement among potential participants.
ii. Timing and Relevance: The timing of the survey administration may not have aligned with the availability or interests of target audiences. Factors such as competing priorities, seasonal fluctuations in travel patterns, or limited awareness of the survey's relevance to their experiences may have contributed to low response rates.
iii. Accessibility Barriers: Issues related to the accessibility and convenience of the survey platform may have presented barriers to participation for some individuals. Technical difficulties, language barriers, or perceived complexity of the survey questions could have deterred potential respondents from completing the survey.
iv. Incentives and Motivation: The lack of tangible incentives or clear motivation for participation may have reduced the willingness of individuals to engage with the survey. Without perceived value in sharing their perspectives, potential respondents may have been less inclined to invest time and effort in completing the survey.

Mitigation Strategies

i. Revisiting Outreach Strategies: Future survey efforts will involve reviewing and refining outreach strategies to enhance visibility and reach among target audiences. Collaboration with relevant stakeholders, leveraging additional communication channels, and optimizing messaging to highlight the importance of survey participation will be prioritized.
ii. Enhancing Incentives and Motivation: Exploring options to provide incentives or rewards for survey participation will be considered to increase motivation among potential

respondents. Offering gift cards, discounts, or entry into prize draws may incentivize engagement with future survey initiatives.

iii. Streamlining Survey Design: Simplifying the survey format and questions to improve accessibility and user experience will be a focus for future survey design. Ensuring that the survey is easy to navigate, mobile-friendly, and available in multiple languages will help reduce barriers to participation.

iv. Timing and Frequency: Assessing the timing and frequency of survey administration to align with the availability and interests of target audiences will be crucial. Conducting periodic surveys at strategic intervals and incorporating feedback from previous survey efforts will help optimize engagement and maximize participation rates over time.

Despite the challenges encountered in obtaining survey responses, we remain committed to gathering valuable insights on transportation integration in Alberta. By acknowledging these challenges and implementing mitigation strategies, we aim to improve future research efforts and enhance our understanding of transportation needs and preferences in the region.

Future Research Directions

While efforts were made to obtain feedback from airlines servicing the region, unfortunately, responses were not received within the timeframe of this study. However, the absence of airline input highlights potential areas for future research and inquiry. Future studies could consider the following avenues:

i. In-depth Airline Engagement: Despite attempts to solicit feedback, further efforts could be made to engage airlines directly through targeted surveys, interviews, or workshops. This would provide valuable insights into airline perspectives on transportation integration and the potential impact of regional rail service.

ii. Longitudinal Analysis: Conducting a longitudinal study could track changes in air travel patterns, passenger volumes, and market dynamics over time. This would help to assess the evolving demand for air travel and the potential influence of factors such as transportation infrastructure improvements and economic trends.

iii. Comparative Analysis: A comparative analysis with other regions or cities that have implemented similar transportation integration projects could offer valuable lessons and best practices. This comparative approach could provide insights into the potential benefits, challenges, and strategies for successful implementation.

iv. Economic Impact Assessment: A comprehensive economic impact assessment could delve deeper into the potential financial implications of regional rail service on various sectors, including the airline industry, tourism, and regional economic growth. This would require detailed modeling and analysis to quantify the direct and indirect effects of transportation connectivity improvements.

v. Stakeholder Consultation: Further consultation with a broader range of stakeholders, including government agencies, industry associations, and community groups, could

provide additional perspectives and support for transportation integration initiatives. Engaging stakeholders early in the planning process can help to build consensus and identify shared goals.

vi. Technological Innovations: Exploring the potential role of emerging technologies, such as autonomous vehicles, electric vehicles, or hyperloop systems, in shaping future transportation networks could be an area of interest for future research. Understanding the implications of technological advancements on transportation infrastructure and service delivery is essential for long-term planning.

vii. Policy Analysis: Examining the policy frameworks and regulatory environments governing transportation integration projects could shed light on potential barriers and enablers. Policy analysis can help identify opportunities for policy reform or intervention to support sustainable and equitable transportation systems.

While this study provides valuable insights into the potential integration of transportation services in the region, further research is important to explore the topics outlined above. By addressing these areas of inquiry, future studies can contribute to a deeper understanding of transportation dynamics and inform strategic decision-making for sustainable and inclusive transportation systems.

SECTION 5: DISCUSSION

5.1. Feasibility of High-Speed Rail Transit System in Alberta

The Edmonton-Calgary corridor has long been identified as a potential candidate for high-speed rail development due to its economic significance and growing population. In 2014, the Standing Committee on Alberta's Economic Future conducted a feasibility study, which concluded that investing in a high-speed rail system was not recommended at that time due to population considerations and other factors 'not sufficient to support the profitability operation of such as system'. However, with population growth continuing and technological advancements, a re-evaluation of the feasibility is warranted.

This section assesses the feasibility of implementing a high-speed rail transit system Alberta, specifically in the Edmonton-Calgary corridor as part of our research to determine the preferred integration model between airlines, transit, and passenger rail stations in Alberta. This draws upon findings from the 2014 Standing Committee on Alberta's Economic Future on "Comprehensive Feasibility Study for High-Speed Rail Transit System in the Edmonton-Calgary Corridor", population trends, and multi-factor analysis to evaluate the potential role of high-speed rail in the transportation network of Alberta.

5.2. Population Trends and Travel Demand

Population growth in Alberta, particularly in cities such as Calgary and Edmonton, has led to increased travel demand between these urban centers. Population data from 2014 indicated that Edmonton had approximately 877,926 residents, while Calgary had approximately 1,195,194 residents (Statistics Canada). However, as of 2022, the population of Edmonton has increased to an estimated 1 million people, and Calgary to approximately 1.4 million people (Statistics Canada, 2021). This growth in population suggests a potential increase in travel demand and the need for efficient transportation infrastructure between the two cities and other regional hubs.

In addition to population size, several other factors influence the feasibility of a high-speed rail system. These include economic viability, infrastructure availability, environmental impact, technological feasibility, and government policies. A multi-factor analysis is essential to assess the overall feasibility and sustainability of the project.

1. Economic Viability and Infrastructure Planning

The feasibility study conducted in 2014 examined various factors influencing the economic viability of a high-speed rail transit system, including capital and operating costs, financial structure alternatives, technology options, and ridership forecasts. While the study concluded that investing in a high-speed rail system was not recommended at that time, population growth and technological advancements warrant a re-evaluation of its feasibility.

2. Environmental Impact and Technological Feasibility

An important consideration in evaluating the feasibility of a high-speed rail system is its environmental impact and technological feasibility. Advances in rail technology, environmental concerns and the need for sustainable transportation solutions, highlight the potential benefits of a high-speed rail transit system in reducing greenhouse gas emissions and alleviating traffic congestion along major corridors.

3. Government Policies and Stakeholder Engagement

Government support, policies, and stakeholder engagement are critical factors in the successful implementation of a high-speed rail transit system. Collaboration between government agencies, transportation authorities, and private stakeholders is essential to address regulatory challenges, secure funding, and ensure alignment with broader transportation strategies and goals.

The feasibility of implementing a high-speed rail transit system in the Edmonton-Calgary corridor requires further analysis and consideration, and population trends, technological advancements, and environmental concerns shows its potential role in enhancing transportation connectivity and sustainability in Alberta. As part of Integrated Travel research to determine the preferred integration model between airlines, transit, and passenger rail stations, further investigation into the feasibility of high-speed rail and its compatibility with existing infrastructure and services is crucial.

5.3. Inter-Alberta Air Routes

Inter-Alberta air routes serve as vital conduits for transportation and economic growth within the province. However, while their significance is acknowledged, this report endeavors to explore and illuminate the multifaceted impact of these routes more comprehensively. Although the initial analysis did not identify profitable routes, there remains an opportunity to delve deeper into the broader implications of inter-Alberta air travel on economic development, regional connectivity, and sustainability.

Future research and recommendations are essential to further understand and leverage the potential of these air routes fully. By expanding our scope of inquiry and exploring additional dimensions, we can uncover actionable insights and strategies to optimize the efficiency, profitability, and overall societal benefit of inter-Alberta air travel.

Here, we outline potential avenues for future research and provide recommendations to address existing gaps in understanding and practice. Through collaborative efforts and a commitment to continuous improvement, we can enhance the role of inter-Alberta air routes as tools for prosperity and progress within the province.

5.4. Stakeholder Partnerships and Government Collaboration

Key stakeholders

1. Regional Airlines:
- Flair Airlines
- Air North
- Central Mountain Air
- Sunwest Aviation

2. Airports:
- Calgary International Airport (YYC)
- Edmonton International Airport (YEG)
- Red Deer Regional Airport (YQF)
- Lethbridge Airport (YQL)

3. Transit Agencies:
- Calgary Transit
- Edmonton Transit Service
- Red Deer Transit
- Lethbridge Transit

4. Rail Service Providers:
- Alberta Prairie Railway Excursions (offers heritage train experiences, not regular passenger service)
- Alberta RailNet (freight railway operator)

5. Local Governments:
- City of Calgary
- City of Edmonton
- City of Red Deer
- City of Lethbridge
- Regional municipalities and counties surrounding these cities

6. Passengers and Communities:
- Local residents and communities surrounding the airports and rail stations
- Travelers using air and rail services in the region
- Business owners and workers in airport-adjacent areas

7. Businesses and Economic Development Agencies:

- Calgary Economic Development
- Edmonton Economic Development Corporation
- Regional economic development agencies
- Local chambers of commerce and industry associations

8. Environmental and Advocacy Groups:
- Environmental organizations focused on transportation and sustainability
- Community advocacy groups interested in transportation equity and accessibility

9. Government Regulators and Authorities:
- Transport Canada
- Alberta Transportation
- Municipal and regional regulatory agencies overseeing transportation and land use planning

10. Technology and Infrastructure Providers:
- Companies providing technology solutions for transportation management, passenger information systems, and infrastructure development

The success of the Integrated Travels project to determine integration model between airline, transit and passenger rail stations in the Calgary, Edmonton, Red Deer and Lethbridge hinges significantly on fostering strong stakeholder partnerships, particularly with various provincial government ministries. These partnerships are not only instrumental in driving project implementation but also hold the key to unlocking a multitude of benefits for communities across Alberta.

5.5. Partnerships and Community Benefits

One of the primary objectives of the Integrated Travels project is to introduce frequent inter-city transportation services, including busing and passenger rail, to connect communities across Alberta. These services will not only enhance transportation accessibility but also bring about numerous socio-economic advantages for the province. By collaborating closely with provincial ministries, Integrated Travels aims to align its objectives with the broader priorities of the government, thereby maximizing the project's impact and ensuring its sustainability.

Aside from policy makers, stakeholder partnerships are key to the success of this project. Partnerships will assist many communities once frequent inter-city transportation services are operating. The benefits to Alberta are numerous. The introduction of frequent inter-city busing and passenger rail will benefit the following provincial government ministries.

1. Advanced Education - to provide post secondary opportunities to low-income Albertans living in rural and indigenous communities
2. Affordability and Utilities - to alleviate pressures on housing, food cost and insurance expenses by making it easier for Albertans to identify lower cost housing, allow those without a vehicle to be able to travel to an adjacent community for groceries and services, and offer rural residents an opportunity to remove the need for a second vehicle and its costs of insurance, fuel and maintenance.
3. Arts, Culture and Status of Women - to make it easier for Albertans and visitors to attend cultural events and institutions and to support the participation of women in Alberta's economy.
4. Children and Family Services - improve access to young people struggling with mental illness to the 4 new wellness centers and provide greater access to affordable daycare for parents working outside their local municipality.
5. Education - Offer greater choice to specialty education in Alberta. Offer greater educational support for children with complex needs. Provide greater access to young Albertans seeking apprenticeship experience within skilled trades.
6. Energy and Minerals - Offer large emitters an opportunity to invest in Alberta and obtain Carbon Offsets towards their road to net-zero.
7. Environment and Protected Areas:
    - Work with all levels of government, First Nations and industry to reduce passenger vehicle impacts on the environment.
    - Offer Albertans an opportunity to develop and improve a new land-use plan for municipalities and counties by decreasing the need of private automobiles which induce road building, sprawl and loss of habitat.
    - Alleviate the environmental costs associated with “The High Cost of Free Parking” (Donald S., 1980) where each additional car per household that is parked 95% of the time, requires a considerable amount of space for storage.
    - Reduce the percentage of parking necessary in municipal downtown areas and reclaim the land for new greenspaces.
    - Reduce "Roadkill" by private automobiles.
    - Recognize that a train can move the equivalent of hundreds of cars from the roadways,
    - Last but not least, improve the walkability of all communities serviced by frequent passenger rail and inter-city busing services.
8. Forestry and Parks - Improved access to Provincial and Regional Parks. Enable expansion of bike and walking paths to transportation hubs.
9. Health:
    - Improved access to lab and diagnostic services.
    - Improved access to Urgent and Emergency Care by balancing the patient loads at Alberta hospitals.

- Offer better care to seniors which may allow a senior to stay within his or her local community and receive support from family and friends.
- Address the affordability of healthcare services to rural and indigenous communities.
- Improve health workforce planning - by offering better access to healthcare practitioners - who may be scheduled within a larger regional area.
- Improve access to Mental Health and additional services

10. Immigration and Multiculturalism - Improve access to settlement services including English language training. Provide immigrants increased access to tourism and hospitality jobs.
11. Infrastructure - increase utilization of schools and hospitals in Alberta by offering students and patients an option to attend or visit a regional service provider. Decrease the wear and maintenance on public roadways by switching private vehicle trips to passenger rail.
12. Jobs, Economy and Trade - Increase the attractiveness of Alberta and all communities, by removing barriers to growth caused by the lack of frequent inter-city mobility services.
13. Justice - Improve access to court services. Improve access to support services to help those released from incarceration.
14. Mental Health and Addiction - Improved access to recovery community centers. Decrease transportation costs to and from mental health appointments. Offer same day, no wait list, emergent care.
15. Municipal Affairs - Improved Equity between Urban and Rural communities to government services and employment opportunities.
16. Ministry of Public Safety and Emergency services - Offer safe transportation of mental health and addiction patients to appropriate health services.
17. Seniors, Community and Social Services - To attract Transit Oriented Design and increase affordable housing options in Alberta. Provide disabled residents equitable access to public services including physiotherapy, etc. Offer the province flexibility while implementing the affordable housing strategy. Provide lower cost transportation to low-income Albertans.
18. Technology and Innovation - Improve attractiveness to large corporations seeking a net-zero workplace by decreasing the reliance on passenger vehicles while decreasing the carbon footprint.
19. Tourism and Sport - Provide greater access to world class community recreation centers. Improve access to Alberta Tourism locations for both residents and visitors to the province.
20. Transportation and Economic Corridors:
    - Offer an inter-city transportation alternative to 10% of Albertans without access to a private vehicle and/or without a driver's license.
    - Increase employment opportunities within Rural Alberta and to offer Rural Albertans improved access to jobs outside their local communities.

- Offer a cost-sharing arrangement with the municipalities served by improved busing and the re-introduction of a frequent and affordable regional passenger "heavy" rail network.
- Funnel Regional rail passengers into public transit.
- Connect regional communities between Calgary and Edmonton.
- Offer tourism trains into Alberta and to Banff and Jasper National Parks and decrease environmental impacts of passenger vehicles to the parks.

SECTION 6: CONCLUSION

This research aimed to assess and determine the preferred integration model between airlines, transit systems, and passenger rail stations in key Alberta cities, including Calgary, Edmonton, Red Deer, and Lethbridge. Through a comprehensive analysis of transportation infrastructure, passenger demographics, and market demand, we have gained valuable insights into the challenges and opportunities associated with achieving seamless connectivity and accessibility within the province.

Our findings indicate that the integration of transportation modes presents significant potential for enhancing regional mobility, reducing environmental impact, and promoting economic development. By leveraging innovative technologies, stakeholder collaboration, and evidence-based planning, we can create a transportation network that caters to the diverse needs of residents and visitors in Alberta cities while advancing sustainability goals.

Key recommendations arising from our study include prioritizing transit-oriented development, optimizing route networks, and investing in infrastructure upgrades to facilitate smoother intermodal transfers. Additionally, fostering partnerships between public and private stakeholders and engaging with local communities will be crucial for ensuring the success and sustainability of integrated transportation initiatives.

It is important that policymakers, transportation authorities, and industry stakeholders work collaboratively to implement strategic interventions that address the evolving needs of Alberta's transportation landscape. By embracing a holistic and progressive approach to transportation planning and investment, we can build a more resilient, equitable, and sustainable future for all Albertans.

Going forward, continued research, monitoring, and evaluation will be essential for tracking progress, identifying emerging trends, and refining strategies to meet evolving transportation challenges. By remaining proactive and adaptive in our approach, we can pave the way for a transportation system that serves as a catalyst for prosperity, connectivity, and well-being across Alberta.

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