DEVELOPMENT OF AN INTERMODAL FREIGHT TRANSPORTATION INFORMATION SYSTEM FOR POLICY ANALYSIS AND PLANNING IN THE MANITOBA CAPITAL REGION

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INTRODUCTION

Intermodal freight transportation has grown significantly over recent years and has revolutionized the way in which freight moves in and around urban areas. Transport Canada states that "to be effective, public investments in intermodal freight transportation must rely on sound analytical tools to assess demand for intermodal facilities, public benefits from intermodal investments and private financial viability of projects, environmental impacts, and performance of the transportation system."[1] Yet, there is a lack of knowledge about intermodal freight transportation to allow governments to properly evaluate economic and policy options involving freight investments both regionally and nationally. In many jurisdictions, particularly in urban areas, the understanding of intermodal freight transportation is in its infancy.[2] Most policy analysts and engineers know there is intermodal freight moving in a region, but few understand its characteristics and impacts on regional development.

[1] Transport Canada (2004), "Literature Review on Intermodal Freight Transportation," Policy Research Branch, Report TP 14502E.
[2] Rempel G., Isaacs C., Regehr J., Montufar J., and Clayton A. (2007), "An Integrated Information System for Intermodal Freight Transportation Planning in Winnipeg and the Manitoba Capital Region," University of Manitoba Transport Information Group (UMTIG), Department of Civil Engineering, University of Manitoba for Transport Canada.

With increased demands for the movement of freight in many urban areas, it is important to have good data and information readily available to facilitate policy analysis and planning regarding this large sector of the transportation system. However, our information sources and systems are often dated, inconsistent, proprietary, incompatible, and nearly always incomplete. This has significant impacts on the quality and timeliness of decision-making.

This paper is based on work conducted by the University of Manitoba Transport Information Group (UMTIG) for Transport Canada as part of Canada's Strategic Highway Infrastructure Program. The paper describes an initiative to design, develop and implement an integrated web-based information system to better service policy analysis and planning involving metropolitan intermodal freight transportation. The resulting intermodal freight transportation information system (IFTIS) converts intermodal freight data into information that can facilitate understanding and decision-making related to intermodal freight transportation in an urban area.

The specific objectives of this paper are to: (1) discuss the methodology used to develop the system; (2) discuss how integrating these components can be used as a tool to assist in policy analysis and planning involving intermodal freight transportation; and (3) discuss constraints in developing such a system.

For the purpose of this research, the definition of intermodal freight transportation was adopted from several sources; primarily Statistics Canada and Bureau of Transportation Statistics (BTS). Statistics Canada defines intermodal as "operations that involve more than one mode of transport to complete the movement of shipments. Goods are carried in a highway trailer or freight container, which is transferred between a rail car and some other mode, usually a truck or ship."[3] BTS uses intermodal to "denote movements of cargo containers interchangeably between transport modes, i.e. motor, water and air carriers, and where the equipment is compatible within the

[3] Statistics Canada (2006). Retrieved June 2006, from http://www.statcan.ca

multiple systems."[4] To capture the essence of each data source, the definition of intermodal used in this research is "any freight transportation involving the use of domestic or international containers." Although the movement of freight in a container does not necessarily involve intermodality, all intermodal freight movements between truck and rail involve containers. Therefore this definition encompasses intermodal freight transportation as interpreted by Statistics Canada and BTS.

AN IFTIS FOR THE MANITOBA CAPITAL REGION

Freight transportation is at the core of the economy of almost every region, and the Manitoba Capital Region is no exception. The region (Figure 1), which generates, attracts, distributes and processes large quantities of freight, is a major node in road and rail infrastructure. It is also an established centre of rail and trucking freight operations and is located in several major national and international freight corridors. This region is home to several of Canada's major freight transport equipment companies and is extensively involved in sustainable transportation research and development.

Winnipeg's freight transportation system is highly influenced by the visions, plans, programs, regulations and investments of three levels of government, adjacent rural municipalities, major railways, the trucking industry, major industrial and shipper groups and entities, and the private sector generally. Facilitating and improving integration, efficiency and sustainability of the freight transportation system in this important urban context is critical to its growth and development.

Many public and private decisions and actions in the region impact intermodal system performance and prospects. However, because of the many and varied interests of different parties to different aspects of freight transportation, such decisions are often made with limited consideration for their interactive effects on infrastructure costs, operating efficiencies, safety, or sustainability. In addition to the

[4] Bureau of Transportation Statistics (2006). Retrieved June 2006, from http://www.bts.gov

different interests of different parties, knowledge of the available data to make more informed decisions is limited.

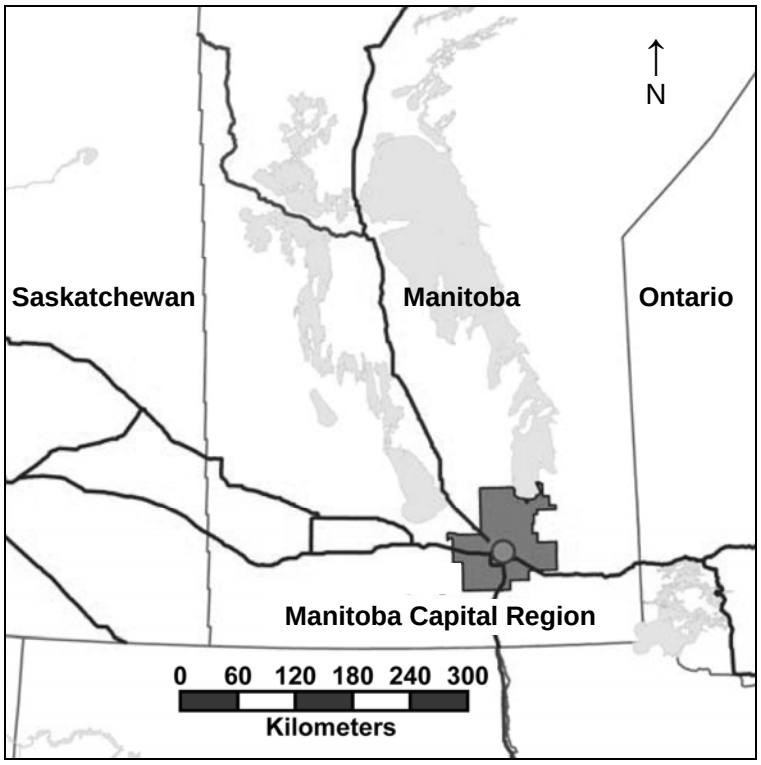

Figure 1. Manitoba Capital Region

There are several new and publicly-available data and information sources which could assist planners, engineers, regulators, and policy analysts in considering and implementing their plans, programs, regulations and investment decisions impacting the region's freight transportation system generally, and the existing and potential intermodal components of it in particular. The integration and dissemination of these information sources into an IFTIS could be a useful contributor to a more informed decision-making process.

DEVELOPING AN IFTIS

The IFTIS is comprised of four elements that characterize the intermodal freight transportation system: (1) transportation system; (2) demand system; (3) commodity flows; and (4) traffic flows. The IFTIS is within a framework that is dynamic in nature and becomes stronger with time owing to additional and better data sources (Figure 2). The IFTIS integrates the three fundamental components (transportation system, activity system, and flow system) required for transportation system analysis and responds to changes over time. Although the IFTIS developed for Winnipeg and the Manitoba Capital Region only utilized readily-available data sources, other jurisdictions may have additional public and private sources of data that can strengthen the information system.

Establishing the transportation system

The transportation system defines and characterizes highway and rail transportation networks, network elements, and intermodal facilities and services relevant to understanding and analyzing intermodal freight transportation policy and development opportunities.

The transportation system is important for the IFTIS because all elements feed into this system. The transportation system is valuable for policy analysis because it determines where intermodal freight can travel, how much freight can be moved in terms of infrastructure capacity, and what modes can transport intermodal freight between origin-destination pairs. Changes to the transportation system directly affect activity and the flow characteristics of intermodal freight.

A firm understanding of the intermodal freight transportation system allows decision-makers to assess the strengths and weaknesses of local systems and compare to neighbouring jurisdictions. This capability can be used to make improvements to weak elements in the intermodal transportation infrastructure and capture intermodal freight traveling through competing jurisdictions as well as attracting and promoting new intermodal freight transportation flows through

the region. Figure 3 illustrates the road transportation system elements of this IFTIS.

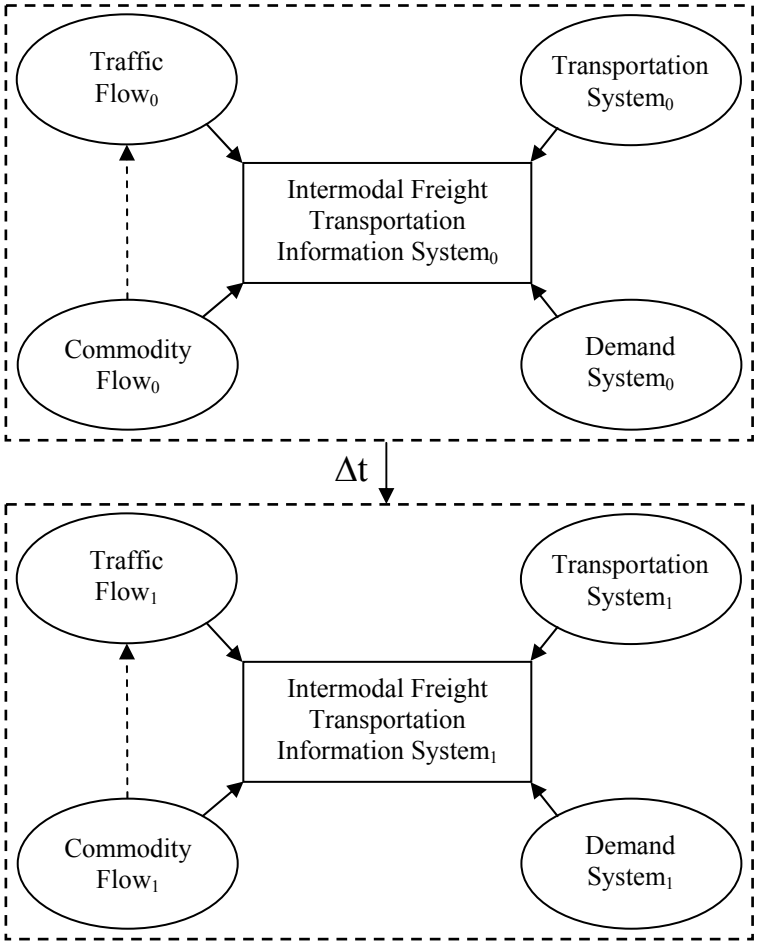

Figure 2. IFTIS framework

Establishing the demand system

The demand system defines and characterizes actual and latent major generators and attractors (including distributors) of intermodal freight movements. Understanding the demand for freight movement is needed to develop improved transportation networks and formulate policies to properly accommodate users of the system and optimize benefits to these users.

Establishing the demand for intermodal freight in a region is important for determining who, where, and how much intermodal freight is being generated and attracted. This information can be used to set policies instructing where intermodal terminals are located, establish land use zones, and determine which businesses benefit from intermodal freight transportation and are consequently affected by intermodal freight policy.

Data used to establish the demand system was obtained through interviews with industry and government officials, industry profiling in Manitoba using online government sources, field investigations, and previous research work conducted for various agencies.

Industrial and commercial zones in Winnipeg were developed using zoning data obtained from the City of Winnipeg. The demand for containers for each zone was determined by summing the containers handled by each business within that zone as discovered through the data collection process outlined above.

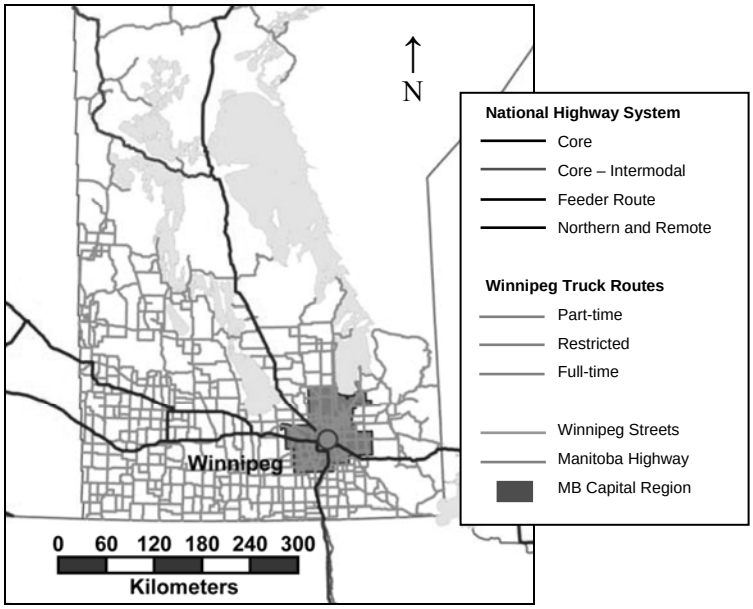

Figure 3. Road transportation system component of the IFTIS

Establishing intermodal commodity flows

Intermodal commodity flows were established to understand the origins and destinations of existing and potential commodity flows considered susceptible to intermodal transportation operations in the region. Understanding commodity movements and trade flows is critical for appreciating the impact of intermodal freight transportation in a region and for developing policies that can attract intermodal freight.

A comprehensive analysis of sources providing commodity flow data was conducted concerning regional, national, and international freight movements relevant to the study region and to intermodal operations, including movements on Canada's National Highway System and major rail routes through Winnipeg. These flows were characterized in terms of commodity type, quantity of movement, origin-destination patterns, seasonal patterns, and special conditions concerning their

susceptibility to intermodal servicing. As the availability of commodity flow data increases, a better understanding of intermodal freight transportation activity can be achieved.

Establishing intermodal freight traffic flows

Intermodal freight traffic flows are required to understand container flows in the region and to characterize container activity along major truck corridors in Winnipeg and major rail routes through Manitoba. This information was derived from the Transborder Surface Freight Database and/or Statistics Canada by applying conversion factors to weight data.

Since vehicle flows were not available from readily-available data sources a conversion factor was used to relate commodity flows with traffic flows. These conversion factors took the tonnage of intermodal commodity flows and determined the number of equivalent fully loaded trucks or trains required to haul these commodities. This research used conversion factors developed by UMTIG where a fully loaded five axle truck and fully loaded 100 car train is assumed to carry 25 and 9,070 tonnes of freight, respectively. However, even if traffic flow data is available, these conversion factors can provide supporting evidence for the data and strengthen the IFTIS.

Understanding the traffic flows generated by intermodal freight can be used to prioritize infrastructure improvements and the level of improvement required. Traffic flow produced from intermodal freight can help model congestion levels in cities and predict future levels of traffic expected on a region's infrastructure.

Integrating freight transportation elements into an IFTIS

The IFTIS was developed by integrating the transportation system, demand system, intermodal commodity flow, and intermodal traffic flow data into a web-based geographic information system. The IFTIS is interactive and allows users to obtain various types of information regarding the intermodal freight transportation system

including origin-destination pairs of intermodal freight, routes used to transport intermodal freight, quantity and type of intermodal freight moving on routes between origins and destinations, quantity of intermodal freight generated and attracted by industrial zones, and traffic generated as a result of intermodal freight. An example of the IFTIS user interface for Winnipeg is provided in Figure 4. This figure illustrates the volume of intermodal freight traffic on major Winnipeg streets.

HOW CAN AN IFTIS BE APPLIED FOR POLICY ANALYSIS AND PLANNING?

Informed decision-making by all stakeholders contributes to the establishment and management of an efficient and effective intermodal freight transportation system. The IFTIS is an interactive, analytical tool that enables both public and private stakeholders to gain ready access to intermodal freight information, and supports policy and planning decisions for a variety of intermodal freight transportation applications in the Manitoba Capital Region.

Effective and continuous communication and information sharing between the public and private sectors is important for intermodal freight transportation. Intermodalism is a multi-party undertaking, and as such, the planning, design, and operation of intermodal infrastructure must also involve the full range of stakeholders. In the context of the Manitoba Capital Region, these stakeholders are:

- *Public sector:* Federal, provincial, and municipal transportation departments and agencies, academia, and others.

- *Private sector:* Transportation engineering and planning consultants, trucking associations, trucking companies, railways, third party logistics companies, freight forwarders, and others.

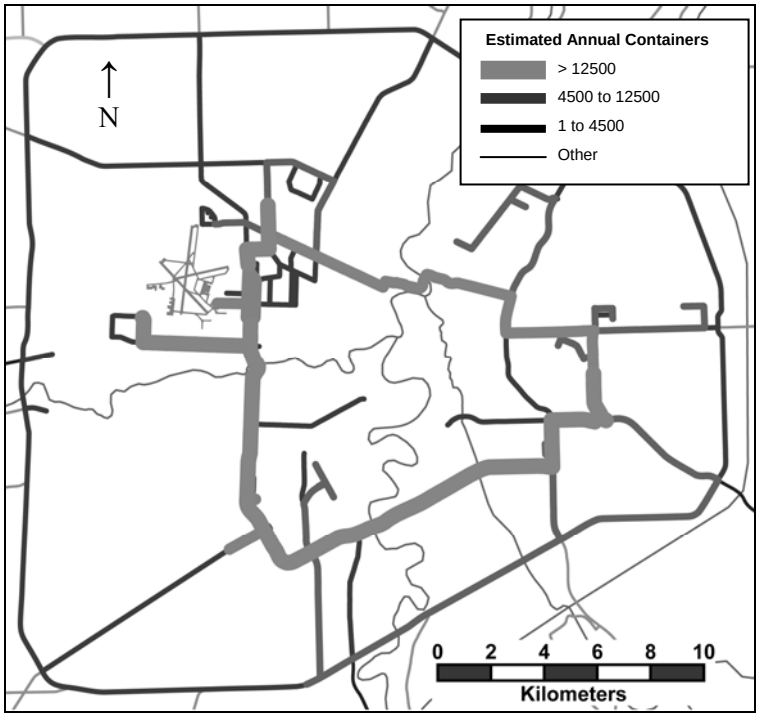

Figure 4. Intermodal freight flow on major Winnipeg streets

Some examples of policy and planning issues that the IFTIS can address are:

- The positioning and relocation of intermodal freight terminals
- Truck route considerations
- Regulatory activities
- Land use planning
- Freight corridor development
- Targeting investments on critical links and nodes
- Broader transportation engineering and planning decisions regarding highway design, freight systems analysis, safety analysis, environmental assessment, economic evaluation, asset management, performance measurement and enforcement.

As an illustration, an IFTIS can be used to evaluate the strengths and weaknesses of intermodal freight system characteristics for local and surrounding jurisdictions. From this evaluation, priorities can be developed for improvements to the intermodal freight system and strategies can be formulated to capture market share of intermodal freight flows from competing jurisdictions. In the context of Manitoba, intermodal freight originating in Vancouver or Prince Rupert and destined to Chicago can be routed several ways. Using an IFTIS, Winnipeg can obtain a better understanding about the operating characteristics of these freight movements, and hence create a means to attract this freight through the city. Conversely, several jurisdictions such as Calgary, Regina, Winnipeg, and others could work together with an IFTIS and develop a unified strategy to create a freight corridor capable of attracting intermodal freight away from competing corridors such as those that may exist in the United States.

An IFTIS can also be used for land use planning within a city by understanding where intermodal freight activity is occurring and what types of businesses are using intermodal freight transportation. The zoning of land and the development and location of intermodal freight terminals can be determined to maximize the efficiency of freight transportation and reduce delays, greenhouse gas emissions, and congestion.

LESSONS LEARNED IN DEVELOPING AN IFTIS

Based on research conducted for this project, it was learned that the development of an IFTIS for Winnipeg and the Manitoba Capital Region is the first of its kind in Canada. Since this project was an exploratory case study and serves as a first step towards a mature IFTIS, numerous lessons were learned and constraints encountered with its development. However, these constraints will be overcome with time as technologies improve and data sources become stronger. Unique lessons for each component of the IFTIS (the transportation system, demand system, commodity flows, and traffic flows) were discovered including issues with data quality and availability, data source definitions, and comparability between data obtained from different sources.

Issues with data quality and availability were common because only readily-available data sources were employed in the development of this system. As a result, limited data was obtained for rail infrastructure and specific generators/attractors of intermodal freight.

Another issue with the data is the level of aggregation. Origins and destinations in most readily-available databases are provinces, states, or countries which creates difficulty when trying to understand intermodal freight transportation in the context of a city or a region within a province. Data aggregation issues also pose problems when trying to understand international freight movement. For example, intermodal freight originating in the U.S. and destined for Manitoba may not cross the Manitoba/U.S. border. This can be illustrated by considering that freight originating in Montana may enter Alberta and then proceed from Alberta to Manitoba.

The ability to update the IFTIS is another area where lessons can be learned. Since static data was used from raw data sources, changes in raw data will not be automatically updated in this IFTIS. This is a major concern because full time monitoring and manual updating of the IFTIS is necessary for providing useful, timely, and relevant information. The best way to achieve this is to establish a cooperative agreement with providers of raw data to connect the IFTIS database with the raw data base whereby any changes in the raw data base will be reflected in the IFTIS.

Since the IFTIS uses several data sources, issues arise concerning definitional consistency. This issue is most noticeable when trying to define "intermodal" freight transportation. Often the definition of intermodal is confused or combined with the definition of multimodal. To help overcome this predicament, consideration was given to analyze only international and domestic container freight. Although the definition of a container is much more rigid than intermodal, constraints with this approach were also encountered due to how data was collected for different databases.

Another lesson learned from the development of this IFTIS, which is closely related to definitions, is the comparability between databases. Aside from the fact that different databases collect different types of data, various timeframes for data collection may be used. This was evident for the creation of the IFTIS for Winnipeg and the Manitoba Capital Region where 2004 Statistics Canada data was used with 2005 BTS Transborder Surface Freight data and phone interviews with local industry conducted in 2006. Although the IFTIS is intuitive and can easily be navigated to obtain a variety of useful intermodal freight information, it is important to have a strong understanding of the transportation system and how it changes over time to overcome differences in data source years. The IFTIS is not intended to give answers to intermodal freight transportation problems, rather to serve as a tool for experienced, knowledgeable professionals to help make decisions. Therefore only those with the ability to draw the right conclusions from the IFTIS should use it as a tool for policy analysis and planning.

Lastly, in-depth knowledge of GIS applications and how to integrate an IFTIS with the internet can be a large obstacle to overcome. Although many agencies have experienced staff capable of operating many GIS software applications and creating websites, the development of a web-based IFTIS requires staff fully conversant with GIS software and in-depth knowledge of website creation using web-mapping applications, maintenance, and design. This high level of expertise is absolutely essential for the development and application of an IFTIS.

CONCLUDING REMARKS

Intermodal freight transportation has grown significantly over recent years and has revolutionized the way in which freight moves in and around urban areas. And although the amount of freight moving through these urban areas has increased significantly, there is a lack of knowledge about intermodal freight transportation to allow governments to properly evaluate economic and policy options involving freight investments both regionally and nationally. This paper described the design, development and implementation of an

integrated web-based information system to better service policy analysis and planning involving metropolitan intermodal freight transportation. The resulting IFTIS converts intermodal freight data into information that can facilitate understanding and decision-making related to intermodal freight transportation in an urban area.

The development of this information system will establish the foundation for future information updates, as well as for future similar systems. There are at least seven information systems in the U.S. currently available for intermodal freight transportation planning either at the metropolitan level or beyond, but none in Canada. The system presented in this paper can serve as the "springboard" for future modal integration initiatives involving industry and government.

When developing an IFTIS, it is important to realize that any information system is only as good as the data used to create it. Therefore, understanding the strengths and limitations of the databases used in its creation is critical as that will impact the quality of the conclusions drawn from it.

This particular IFTIS has certain limitations that are directly related to the types of databases used in its development. However, since this is the first system of its kind in Canada, there is an opportunity for future system developments to draw on the lessons learned from this one, and significantly enhance the quality of new intermodal freight transportation information systems.

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