Network Evolution:

The Origins, Development and Effectiveness of

Manitoba's Railway System

by

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ABSTRACT

This thesis examines the changing characteristics of railway infrastructure development and associated issues in the province of Manitoba, Canada. The period under consideration dates from when the first tracks were laid in 1878 through to the completion of the Hudson Bay Railway in 1929. Setting the scene is a template for railway development in general, one that allows hypotheses to be drawn that are specific to Manitoba. In order to test those hypotheses it is necessary to first provide a comprehensive overview of the historical evolution of the railway network. Next, the tools for testing the hypotheses as to how that network emerged have to be reviewed. That review examines aspects of graph theory, identifying the methodology most appropriate for a spatial analysis of railway networks. With the fundamental assumption in mind that no railway system of any real complexity can be effectively understood without considering the process of its creation, this analysis attempts to draw conclusions about the relationship between the railway companies and the governments, people and geography that they were compelled to deal with. Given that objective, an emphasis is placed during hypothesis testing on a set of geographic forms developed by prominent geographer Donald Meinig, who set the precedent in the field of railway-network geography. The testing of these forms revealed that while the Manitoba railway network is very complex, it never arrived at the maximum complexity that can be reached.

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LIST OF ABBREVIATIONS

AVF – Provincial Archives of Manitoba Vertical File

BNSF – Burlington Northern Santa Fe Railway

CEMR – Central Manitoba Railway

CNoR – Canadian Northern Railway

CN – Canadian National Railway(s) (plural until privatization, now singular)

CPR – Canadian Pacific Railway

CPRR – Central Pacific Railway

GIS – Geographic Information System

GNR – Great Northern Railway

GTP – Grand Trunk Pacific Railway

GTR – Grand Trunk Railway

GWWD – Greater Winnipeg Water District Railway

HBC – Hudson's Bay Company

HBR – Hudson Bay Railway

HBRY – Hudson Bay Railway Company (since 1997)

ICR – Intercolonial Railway

KR – Keewatin Railway Company

LRT – Light Rail Transport System

MHS – Manitoba Historical Society

M&NWR – Manitoba and North-western Railway

NP – Northern Pacific Railway

NT – National Transcontinental Railway

NP&MR – Northern Pacific and Manitoba Railway

PAC – Public Archives of Canada

PAM – Provincial Archives of Manitoba

RRV – Red River Valley Railway

UP – Union Pacific Railroad

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CHAPTER ONE

Introduction

Developing transport systems is a constant challenge to societies that are committed to meeting mobility needs of people, supporting economic development across the board, and ensuring community participation in the worldwide economy. Accordingly, the primary purpose of transport is geographical in nature, because it facilitates movement between different locations. Rail transport, historically and currently a leading element of transport plays an impressive role in the structure and organization of space and territories. The degree to which it influences spatial organization varies according to the level of development. In the late 19th century Manitoba, the central purpose of the emerging modern forms of railway transportation was to expand coverage, and create a nation.

Traditionally, transportation systems have been an important factor behind the economic representations of the geographic space, namely in terms of the location of economic activities and the monetary costs of distance (Jackman 1935, Fogel 1964, Fishlow 1965). Beginning in the 1960s, transport costs were recognized as key factors in location theories and transport geography began to rely increasingly on quantitative methods, particularly over network and spatial interactions analysis (Haggett 1977 and Abler, Adams and Gould 1971). However, from the 1970s globalization challenged the centrality of transportation in many geographical and regional development investigations. As a result, transportation became underrepresented in economic geography in the 1970s and 1980s, even if mobility of people and freight and low transport costs were considered as important factors behind the globalization of trade and production.

Since the 1990s, transport geography has received renewed attention due to the fact that researchers now use the multidisciplinary approach (Taaffe, Gauthier, O'Kelly 1996). Such an approach informs this thesis, since it incorporates methodologies developed by other disciplines such as history, economics, and mathematics.

The Definition of Origins, Development and Effectiveness

This thesis examines what some have referred to as the “golden era” of the *development* of the railway transport system (Rodrigue 2009) in Manitoba. This period from its earliest *origins* in 1878 up to 1929, was a time where railway networks expanded remarkably quickly and became the dominant land transport mode for both passengers and freight. The year 1915 represents a peak of Manitoba’s railways, as it is the year of highest total rail mileage with the existence of three major privately-owned railway companies in operation (and not to mention American penetration lines and minor railways).

Table: 1.1: Total Railway Mileage in Manitoba (in kilometres), 1912-1918:

1912	1913	1914	1915	1916	1917	1918
5,665	6,426	6,560	7,239	6,934	6,750	6,708

Source: Canada Year Book Historical Collection, 1920

In this thesis, 1915 is seen as a pivotal moment in Manitoba Railway history as it was the last year before an entire reorganization took place in Canada, with a number of rail companies entering bankruptcy. Up to 1915, three large privately owned railway companies existed in Manitoba. The government was "obliged to take over the Canadian Northern and Grand Trunk Systems along with other bankrupt lines and merge them into the publicly-owned Canadian National Railways." (Report of the Royal Commission on Transportation, Volume II, December 1961, p. 186-7) After this, only two major companies remained in Manitoba, one of which was the Canadian National, which came to be an important Crown corporation.

In this thesis, *effectiveness* refers to the spatial efficiency in the location of routes within the Manitoba network. This spatial efficiency is based on factors such as the minimization of distance or route length with a maximization of activity (Gauthier 1974). Gautier also says that efficient movement means maximum possible movement with minimum possible effort in travel.

As the speed and power of locomotives improved and as the market expanded, rail services became increasingly specialized with trains entirely devoted to passengers or freight. A notable feature of this era is the use of the railway as a true pioneering tool for Canadian colonization in Manitoba and the rest of the prairies. Geographer Donald Meinig of Syracuse University, a leading student of spatial aspects of railways, has been intrigued by how in many areas of the world railway systems have been a decisive instrument in the creation of many of the most important patterns in human geography.

Meinig[1] studied two railway systems that were developed during the same time that the Manitoba one was being built. One is in the Columbia Basin of the American Pacific Northwest and the other is in a portion of South Australia. Both of these railway systems have many broad characteristics in common with the Manitoba network,

[1] Meinig, D.W., A Comparative Historical Geography of Two Railnets: Columbia Basin and South Australia. *Annals of the Association of American Geographers*, Vol. 52, No. 4 (Dec., 1962), pp. 394-413.

including having their prime function to link farming districts with tidewater to serve the export grain traffic. While the Australian system was under complete government control the American one was mainly built, owned and operated by private corporations. These examples serve as a basis of comparison for the Manitoba system owing to the fact that the Canadian example featured a blend of the two control systems. One piece of Meinig's work that is of critical importance to this thesis is the formulation of four geographic forms that rail networks can assume:

1. **Linear Segmentation**: a series of linear segments, each served by one railway line.
2. **Linear Duplication**: almost complete duplication of service in a narrow section of land.
3. **Multiple Point Duplication**: largely linear segments with duplicate service to most larger towns.
4. **Complex Web**: a true web composed of overlapping branches of three or more railway systems. Nearly all towns enjoy duplicate railway service, and many are endowed in triplicate or more.

One finding that Meinig established in his analysis is that where competition was free and allowed to flourish, such as in the Columbia Basin, there was a great amount of *duplicate* intercity and port linkages. In contrast, a complete absence of such duplication occurred in the government-controlled South Australia case. Additionally, he found great effects upon both the construction strategies and patterns of amalgamations and dissolutions among private companies in America and the absence of such changes in Australia.

Similar to how Meinig started his study, this thesis begins (in Chapter two) with a detailed description of the historical development of the Manitoba railway system and the companies involved. This is accomplished by using a mixture of resources, including the Manitoba Provincial Archives in Winnipeg, the digital version of the Public Archives of Canada, old theses from previous researchers in the field, and path-breaking works from various historians, geographers and economists. Some emphasis in this chapter is given to the role that the provincial and federal governments played in the construction of the lines in addition to international influences such as competition from American railroads. Finally, some effort in this chapter has gone into the identification of people responsible for the design and construction of the system.

Chapter three outlines the network analysis tool most widely known as graph theory. The theory itself is intimately related to many branches of mathematics, including group theory, matrix theory, numerical analysis, probability, and topology. While today graph theory is known for its interdisciplinary applications, the earliest recorded example of the subject was in fact a transport geography problem (Harary 1969). Since the real world is so complicated, graphs take an abstraction of reality so it can be simplified as a set of linked nodes. In other words, graph theory is concerned with how networks can be encoded and their properties easily measured. In this chapter, knowledge gained from usage of graph theory will allow the testing of spatial hypotheses concerning the evolution of Manitoba railways. As well, this chapter will display a contemporary working example of graph theory so as to validate its general suitability.

In Chapter four a series of six null and alternative hypotheses are justified in a systematic fashion. The chapter highlights information from all previous chapters in the generation of testable hypotheses. Attention is given to the theories derived by prominent researchers in the field as well as identifying the relevant tools from the graph theory tool kit.

In Chapter five the series of the six null and alternative hypotheses are either proved or disproved in methodical fashion. This consists of empirical confirmation of these hypotheses, resorting in most instances to use of graph theory. In short, it produces a spatial analysis of the entire Manitoba railway network. It also contains an overview of the effectiveness of the entire rail systems of the different companies, the ultimate gauge of the mode's usage in the province. Additionally, the last section of this chapter is devoted to contemporary issues within Manitoba's railway system.

In Chapter six, conclusions are drawn from the research and testing that has been performed on the Manitoba railway network. This research is presented in terms of its overall impact in the field of Geography and is couched to highlight potential problems that have been encountered during the research. Finally, I will share my thoughts and recommendations as to how this thesis can serve as a starting point for future research.

All in all, this thesis provides a comprehensive study of the origins, development and effectiveness of Manitoba's railway system.

CHAPTER TWO

The Historical Foundations of the Manitoba Railway Network

Introduction

Prior to 1600, transportation in Canada was largely accomplished by aboriginal canoes and flat-bottom bateaux developed by French Canadian fur traders. The first roads and even first railways (including their tramway predecessors) in Canada were portage trails around rapids and falls, or short connections between waterways. For instance, the first use of steam locomotives was on a 23-km railway, the Champlain and St. Lawrence, constructed in 1836 just across the St. Lawrence River from Montreal. This railway provided a connection between Montreal and the waterways of Lake Champlain, leading eventually to New York City and thus giving Montreal easier access to a year-round port.[2] Thus, railways are clearly marvels of prime geographical interest, fully consistent with the proposition that "each means of transport has its own technological characteristics and its spatial layout" (Berry 1959, pg 341). It must be said from the outset, however, that the understanding of the geographical implications of these characteristics and networks is a necessary, but far from sufficient condition for appreciating the entire significance of railways. That insufficiency can only be overcome with the application of certain historical, functional and theoretical models, the *modus*

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[2] The Champlain and St. Lawrence Railway was the first railway built in Canada. Montreal entrepreneur and brewery owner, John Molson, financed the C&SL. It was intended as a portage road to connect the St. Lawrence River valley with Lake Champlain, reducing time from the trip between Montreal and New York. Construction began in January 1835 when surveyors determined the line would run from St. John (St. Jean now) on the Richelieu River to the nearest point on the St. Lawrence at La Prairie, 23 km upriver from Montreal. Until 1837 many of the railway carriages were horse-drawn before more locomotives were brought in and at first the line was used only in the summer months. In 1856 the line was leased to the Grand Trunk Railway Company (Wallace 1948).

operandi of this thesis. The following attempts to further our understanding by focusing on the early railway network of Manitoba. By looking at the history we will see how the railway was used as a pioneering tool to force the way into new regions, creating a vast array of new possibilities. This section will serve as a preface for a detailed analysis of the unique characteristics of the Manitoba railway network, the object of succeeding chapters.

The Early Days

Early settlers in Manitoba came to the Selkirk Settlement either by way of Hudson Bay and the system of lakes and rivers, or overland from the Great Lakes and Prince Arthur's Landing. By the 1870s, the need for a suitable transportation link from the east to west was of primary importance in the minds of many eastern Canadians. Moreover, the issue of the railway became a major problem in relations between British Columbia and the federal government. "Canada had promised to begin the railway within two years of B.C. entering confederation and finish it within ten, the project had barely even begun by 1878. Ironically, Amor De Cosmos, a man who had fought so hard for Confederation, rose in the House of Commons in May 1878 and announced that if the railway project did not move along more quickly, British Columbia would seek annexation to the United States" (Library and Archives of Canada, http://www.collectionscanada.gc.ca/confederation/023001-3030-e.html).

Before the railway, the only way to get to the prairies through Canada was the "Dawson Route" from Prince Arthur's Landing on Lake Superior to Fort Garry on the Red River. Created by Simon Dawson in 1857-58, the Dawson Route extended to the Lake of the Woods. Along with its continuation, the Fort Garry Road, it required a threeweeks' trip from Toronto to reach Fort Garry. The first leg was accomplished by train to Collingwood on Lake Huron, where carriage switched to steamer to Prince Arthur's Landing; then to open boat and wagon from Prince Arthur's Landing, through Lake Shebandowan, to the northwest angle of Lake of the Woods and finally by ox cart or wagon – or on foot, when the track was impassable to wheeled vehicles – over the remaining distance from Lake of the Woods to Fort Garry (PAM, AVF, Moore 1975). Granted the obstacles presented by the Dawson Route, it is not difficult to understand why many early settlers elected to make their way westward by other routes, particularly those to the south in the neighbouring United States.

The route through the northern United States was of no help in ensuring the settlement of the Canadian mid-west, since American citizens did their best to lure potential settlers off the trains and boats, urging them to stay in the central and northern United States rather than continuing to western Canada.[3] Many immigrants from Europe, in particular, were overwhelmed by hard-selling land agents and were talked out of completing their journeys to central and western Canada (PAM, AVF, Moore 1975).

The Pembina Branch Railway

Manitoba's first step towards transportation by iron rail came in 1874 when a charter was granted to the Pembina Branch railway. Under this charter, the Dominion Government agreed to construct sections and branches of the "Pacific Railway". The first attempt at designing the "Pacific Railway" system included running the line north of

[3] Samuel A. Stouffer's **Theory of Intervening Opportunities** can be applied perfectly to this example. Stouffer hypothesizes that, "the amount of migration over a given distance is directly proportional to the number of opportunities at the place of destination, and inversely proportional to the number of opportunities between the place of departure and the place of destination. These intervening opportunities may persuade a migrant to settle in a place along the route rather than proceeding to the originally planned destination" (Stouffer 1940).

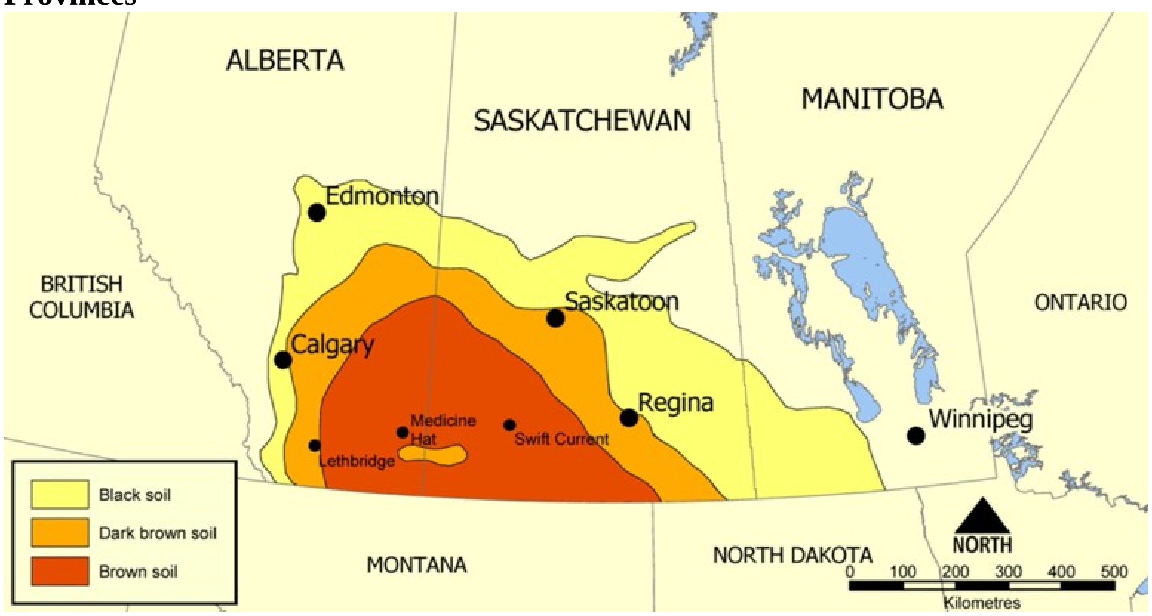
today's route through Winnipeg and instead crossing the river at the town of Selkirk. Beginning in 1871, Sandford Fleming[4], appointed as Chief Engineer, undertook surveys to determine the best route for the line. On the basis of these surveys, together with other surveys previously carried out by John Palliser and Henry Hind[5] and information from local people, he proposed that the railway be built west of Lake Superior from Fort William to Selkirk, there to cross the Red River, then cross Lake Manitoba at the Narrows and proceed northwesterly towards Edmonton. The crossing of the Red River at Selkirk was dictated by physical geography. A railway bridge built across the Red at Selkirk would have the benefit of more stable banks than those at Winnipeg. More importantly, the bridge and railway would be safe against flooding if built at Selkirk. The site of Winnipeg, it was known, had been flooded seven times during the previous

[4] Sandford Fleming (1827-1915). Born in Fifeshire, Scotland, Fleming studied engineering and emigrated to Canada in 1845. "He served as chief engineer of the Intercolonial Railway while it was under construction. He was then appointed engineer-in-chief for the surveys of the Canadian Pacific Railway, providing the surveys on which that railroad's route was based. In 1879, he investigated early flooding in Manitoba in order to decide where to place bridges across the Red River. Fleming developed daylight saving time and the 24-hour method of time keeping. He also worked on cable communication." His major publications include *A Railway to the Pacific through British Territory* (1858) (Government of Canada, Dictionary of Canadian Biography online, http://www.biographi.ca/009004-119.01-e.php?BioId=41492).

[5] John Palliser, a wealthy Irish landowner, led the British scientific expedition into the Prairies from 1857 to 1859. "Supported by the Royal Geographical Society and the British government, Palliser's expedition collected scientific data, provided information on native peoples, and considered the early possibilities for constructing transportation facilities in the area. Palliser claimed that while the semi-arid area was ill suited for civilization, a northerly fertile belt could maintain stock raising and agriculture. The contemporary Canadian expedition of Henry Hind and Simon Dawson, 1857-1858, however, made a more positive assessment of the region's agricultural potential than did Palliser's. Henry Hind, geology and chemistry professor, collected the scientific data on the expedition, while Simon Dawson studied the transportation possibilities. While the existence of a semi-arid region remained an inhibiting factor, the possibility of good land fuelled the expansionist goals of a new nation" (University of Calgary, The Applied History Research Group, http://www.ucalgary.ca/applied_history/tutor/calgary/palliser.html).

century. Selkirk, situated on a high ridge of land, had never been flooded. During the great flood of 1826, when the site of Winnipeg had been completely inundated, the land at Selkirk was fifteen feet above the highest level attained by the flood waters. The selection of a northwesterly route towards Edmonton was dictated by Palliser's report in 1859 that the central prairie area, “Palliser's triangle”, (see Figure 2.0) was too arid for proper agriculture. In actual fact, this area supports brown and black soil types which are very fertile and produce high agricultural yield, but is semi-arid and prone to frequent and severe droughts which is what was occurring when Palliser was doing his survey (Bellan 1961).

Figure 2.0: Map of Palliser’s Triangle with the 3 main soil types across the Prairie Provinces



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With its high organic matter and mineral content, the grassland soils of the triangle are among Canada's most fertile. Canada's production of wheat, oats, flaxseed, and barley come mainly from this parkland area that spans the three Prairie Provinces.

The Canadian Pacific Railway

The people of Winnipeg did not like this plan, expressing their dissatisfaction in the creation of a citizens' committee which petitioned Ottawa against it. Debate over this issue lasted for seven years, only being resolved in 1881 when the Canadian Pacific Railway Company was formed and agreed to construct the line through Winnipeg, the capital of Manitoba. This decision would help pave the way for Winnipeg to become the "hub of commercial activity in the northwest" (Manitoba Historical Society, Centennial Business: Canadian Pacific Railway Company). Over the next 16 months, people migrated to the city in search of employment, and this resulted in the population increasing from a few hundred to 14,000. Following this influx, the CPR announced 2,000 new jobs at their shops (Manitoba Historical Society, Centennial Business: Canadian Pacific Railway Company).

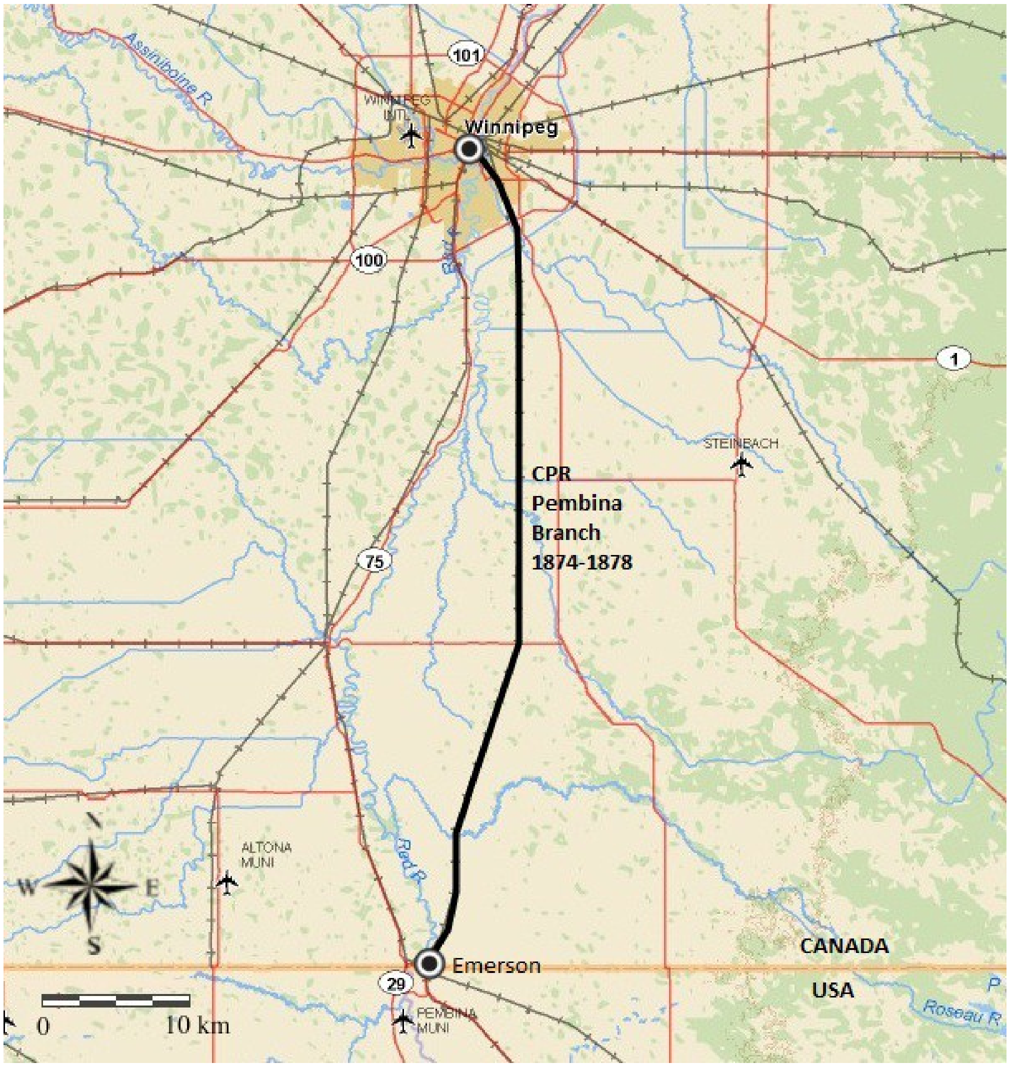
The first section of rail to be laid was from Fort Garry to Emerson/Pembina at the Canadian – North Dakota border. In November 1878 Manitoba's first operating railway opened for business, connecting with J. J. Hill's[6] and D. A. Smith's[7] St. Paul, Minneapolis and Manitoba Railroad (Jackson 1973) (Figure 2.1).

[6] James Jerome Hill (1838-1916) was a railroad executive and financier. "In 1867, he became an agent for the St. Paul and Pacific Railway Co., which company was to be the nucleus of the Hill railway empire. He became a director of the CPR in 1880-1883, and it was he who recommended William C. Van Horne to the directors as the man best qualified to carry out the construction of the transcontinental line from Montreal to B.C." (MHS, http://www.mhs.mb.ca/docs/people/hill_jj.shtml)

[7] Donald Alexander Smith [Lord Strathcona] (1820-1914) was a fur trader and businessman. "Smith became chief commissioner for the HBC, serving until 1874 when he became land commissioner for the

Continued…

Figure 2.1: The Pembina Branch line



Source: Created May 2011 by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute.

Although the Pembina Branch through Emerson gave some relief to the transportation issues in the region, by 1880 most of the homestead land in and about the Red River valley was partly in crop and the mounting pressure of unsold grain increased (PAM, AVF, Winkler). However, Manitoba was still dependent for its connection to the

company. During his years as commissioner, Smith spent much time in Manitoba. He became one of the original organizers of the CPR, and was chosen to drive the last spike on November 7, 1885 at Craigellachie, B.C." (MHS, http://www.mhs.mb.ca/docs/people/smith_da.shtml)

East on the American railway system. What was wanted was an all-Canadian line such as that envisaged by Sir John A. Macdonald, but which had been a casualty of his fall from office in the 'Pacific Scandal.'[8]

When Macdonald was re-elected at the end of 1878, he wasted little time in reviving the plan for an all-Canadian line. Beginning in 1873, the Dominion Land Survey[9] had already begun sub-dividing prairie land in advance of the coming railway system. By statute, on February 15, 1881 a new Canadian Pacific Railway Company (CPR) was chartered to build a steel spine to connect the western-most province in the Dominion of Canada. Since the line north of Lake Superior - essential to an all-Canadian route - could not be expected to produce any revenue from local traffic, freight rates must be set high enough to cover its expenses. The CPR’s high rates could attract American competition in the West where lines such as the Northern Pacific - and shortly after the Great Northern Railway - ran close to the Canadian border[10] and enjoyed local revenues over their entire networks, which could permit lower rates than those offered by the CPR (Jackson 1973). The signing of the syndicate for the CPR was not greeted with joy in Manitoba; an outcome hardly surprising when it was realized that the people of the

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[8] The Pacific Scandal involved allegations of bribes being accepted by members of the Conservative government in the attempts of private interests to influence the bidding for a transcontinental rail contract. Two groups competed for the contract to build the railway, Sir Hugh Allan's Canadian Pacific Railway Company and David Lewis Macpherson's Inter-Oceanic Railway Company. The Pacific Scandal ultimately led to the resignation of Macdonald, and the transfer of power from his Conservative government to a Liberal government led by Alexander Mackenzie (Berton 1970).

[9] The Dominion Land Survey (DLS) is the method used to divide most of Western Canada into one-square-mile sections. The survey was started in 1871, shortly after Manitoba and the Northwest Territories became part of Canada. Covering about 800,000 km^2 the survey system and its terminology are deeply integrated into the rural culture of the Prairies. The DLS is the world's largest survey grid laid down in a single integrated system (Western Land Grants, 1870-1930, http://www.collectionscanada.gc.ca/databases/western-land-grants/001007-130-e.html)

[10] See the endnotes on the GNR and the NP at the end of this section for more information on how these lines where encroaching on the Manitoba territory and harvesting regions.

prairies would be expected – by virtue of a freight monopoly scheme - to pay for the extremely costly route through the Rocky Mountains and muskeg north of Lake Superior.

The 1880s

The normal procedure adopted by railway companies in setting rates is to estimate both the expenses of operating the system and the amount of traffic to be carried. Once these figures are known it is relatively easy to set a rate that will yield at least a moderate rate of return on the investment. When the first CPR rates were published in January 1883, they were designed to meet the needs of the company and were not seen as exorbitant by the company's officers. These rates, however, were not received favourably by prairie farmers. Their case seemed compelling. It cost the farmer 36 cents to ship 100 pounds weight of wheat from Winnipeg to what is now Thunder Bay. From Moose Jaw, it was 51 cents per hundred pounds. To this an additional 15 cents per bushel[11] (a measure of volume, as opposed to weight) had to be added for shipping from Thunder Bay to the eastern seaboard (PAC, Van Horne Letterbook, No. 1, 211-12). During this time, prairie farmers would commonly receive as little as 40 cents per bushel of wheat, making the cost of transport entirely prohibitive (Regehr 1976).

Due to clause 15 of the CPR Charter, "the railway was given a monopoly of all rail construction in the West, south of its main line, for a period of twenty years. This, the CPR hoped, would relieve it of the danger of losing essential traffic to the Americans by effectively preventing them from building feeder lines into the Canadian West. Clause 15 also restricted the building of increasingly needed branch lines in the south and west of

[11] One bushel is the equivalent of 27.2 kilograms of wheat.

the newly enlarged Manitoba.[12] Lack of rail facilities greatly impeded the movement of grain to market and produced an immediate and active demand for branch lines" (Jackson 1973). One of the lobbyists active in requesting branch-line connections at this time was Dr. D. Wilson, the resident physician in Nelsonville (now a ghost town, Nelsonville moved to the Morden site in 1885). He was also the local representative in the Norquay government and a minister in the Cabinet. Another important advocate of branch lines was the Mayor of Winnipeg, Mr. E. Conklin, a former paymaster for the CPR (PAM, AVF, Winkler).

Manitobans trying to prosper in the early 1880s saw their hopes for affordable transportation dashed as a result of high freight rates. Under government rules, the freight rates could not be changed until the annual earnings of the CPR amounted to 10 percent of the capital called on for construction purposes (PAM, AVF, Winkler). To the Manitoba farmer this seemingly could be a lifetime away. Regardless of the mixed reception of Manitobans, by December 1882 there was a continuous line of Canadian Pacific Railway from Winnipeg to Maple Creek, Saskatchewan, a distance of nearly 800 kilometres (Moore 1975). During this time, construction of the railway was supervised from offices in Winnipeg. These and marshalling facilities were located near the Point Douglas area of the city. During the early part of the 20th century, this marshalling yard was one of the largest in the world.

The decade of the 1880s was an intensification of the expansion of the mid-1870s on a scale that was unprecedented in Canadian history. For a short time, economically

[12] The Province of Manitoba grew to its current size after 1881 and before this time was referred to as the "Postage Stamp Province", being a small piece of the vast expanse of Canada's undeveloped Northwest. The Province came into existence officially with the passing of the Manitoba Act on May 12, 1870 (Moore 1975).

speaking, the sky was the limit. Winnipeg was "the new Chicago" (MHS, Centennial Business: Canadian Pacific Railway Company) and speculation drove the prices of lots on Portage Avenue or Main Street above the going rate for similar frontage on Michigan Avenue or State Street in the "Windy City" (MHS, Centennial Business: Canadian Pacific Railway Company). Emerson and West Lynne were touted in local and eastern newspapers as improved versions of Minneapolis and St. Paul. Crystal City, Rapid City, Nelsonville – a long list of metropolises-to-be - clamoured for the attention of settlers and received that of speculators (MHS, Centennial Business: Canadian Pacific Railway Company).

In 1883 the monopoly clause was blamed for the high freight rates and the lack of branch lines. Yet, in spite of the monopoly clause, the provincial government began to charter lines of railway with the clear intention of connecting to the American rail system. The hope was for more rail facilities and lower rates. These Manitoban charters were consistently barred by Ottawa because they were in violation of the CPR charter and hence contrary to the guidelines of the Government of Canada (Dominion Government). In addition, the lines proposed by Manitoba infringed on the special power of the Dominion Government to regulate international means of communication under Section 92, subsection 10(c) of the British North America Act. These barriers notwithstanding, the Norquay government, under increasing pressure from its constituents, persisted in its efforts to obtain rail rate competition (Jackson 1973).

Manitoba Premier John Norquay[13] knew that the public was disgruntled at Ottawa over the issue of rail transportation. Thus, the Manitoba Legislature passed an Act to incorporate the Winnipeg and South Eastern Railway (Victoria 44, Chapter 37) and the Emerson and North Western Railway (Victoria 44, Chapter 39). The former met its fate when an Order-in Council disallowed it on January 11, 1882. This project was especially important to Manitobans as it was proposed to connect Winnipeg to the international boundary in a south-easterly direction. There, it would link up with the CPR's great potential competitor, the Northern Pacific. Winnipeg's Mayor E. Conklin and his council members had appealed in advance against the disallowance, yet they were first to receive the rejection. The Emerson and North Western Railway was disallowed on November 3, 1882 (PAM, AVF, Winkler).

Although Premier Norquay initially gave support to many entrepreneurs who tried to develop local rail lines in order to reduce transportation costs, the opposition later accused him of having made a secret deal with the CPR and Prime Minister John A. Macdonald to ensure that the lines never came to fruition.[14] One of the lines involved in this controversy was the Manitoba Central Railway Company. The Manitoba Central was incorporated in 1883, its directors intending to build a competing line from Portage la Prairie to Winnipeg. When the incorporation documents were forwarded to Ottawa for approval, the Dominion Government chose to "disallow" the company in 1884, claiming

[13] John Norquay (1841 – 1889) was the Premier of Manitoba from 1878 to 1887. "He was born near St. Andrews in what was then the Red River Colony, making him the first Premier of Manitoba to have been born in the region. He is considered a Conservative Party Leader, although at this time there was no official opposition" (Government of Canada, Dictionary of Canadian Biography online, http://www.biographi.ca/009004-119.01-e.php?&id_nbr=5737).

[14] The statute books of Manitoba and the Dominion of Canada show that during the 1870s no fewer than fifteen railway companies incorporated in Manitoba, but only four of these laid any track, one of which was the CPR. While from the period from 1880 to 1889 there were a massive forty incorporations, only six were actually built (Moore 1975).

competition with the CPR was not in the best interests of the country. Outrage among Manitoba farmers led the provincial government to re-incorporate the company that now promised to build an additional rail line to the U.S. border. Since the incorporation documents took much longer to reach Ottawa this time, it would seem evident that Norquay did not want the Manitoba Central to build the line to either the border or Portage La Prairie.

Red River Valley Railway

In 1885 the Manitoba Government passed the Red River Valley Railway Act to contract the building of a line to the border as a government works project, rejecting the alternative of allowing any one company to build and operate the line. The government had plans to begin to actively promote the Red River Valley Railway (RRV), even though the Manitoba Central claimed they could build the railway to the border for half the cost of the RRV. Indicative of the invective voiced about the line is correspondence between the President of the Manitoba Central, Duncan MacAurthur, and Manitoba Premier Norquay detailing the proposal. This is cited in its entirety below.

Winnipeg, 11th May 1887

The Hon. John Norquay,

Sir,
Since the interview of Monday last, when the delegation from our Board of Directors exchanged their views with members of the Government, I have had the opportunity of calling our Board together, and now beg to draw your attention, unofficially, to their opinion of the situation. In doing so I would refer to the past history of our organization and especially to an interview held with you personally, in May 1884, when, through your assistance, the charter of the Manitoba Central Railway was extended from Morris to the Boundary. I would recall to your recollection that had the "Act to amend the Act to incorporate the Manitoba Central R. R.." been forwarded immediately to Ottawa that popular feeling ran then as high as now, and that the Company I then represented was prepared to build the road in question. But after waiting a year, and supposing that the Federal Government had passed over our Act, or had designedly left it to its operation, we found that it had not been sent to Ottawa until within a short time before the expiration of the year within which the Dominion Government has the power to disallow the Provincial Acts of Parliament. The work of construction was therefore postponed until the intention of the Dominion Government was definitely understood. You are aware that means were taken to keep alive the popular interest in the enterprise, and that the organization of the Manitoba Central Railway has been maintained and actively at work since 1883.

It was, consequently, with some surprise that the Company found that their claims to recognition by the Government were being postponed to those of a body of men who have no past organization and no present object other than to obtain the work of construction of the Railway. On the other hand, the Manitoba Central Railway Company has for years been in touch with and elicted the sympathy and assistance of some of the most powerful railway organizations of the United States and Canada, with a view to the operation of the proposed line - not with a mere contractor's view - but as a permanent advantage to the City and Province, with whose prosperity and future their own prosperity and future is so largely involved.

Personally, I may confidently say the Board of Directors of the Manitoba Central Railway have no expectations of profit from the construction of the road. They have already made arrangements for carrying on the work in the most economical manner consistent with efficiency, as a link in a future trunk system. The desideratum aimed at by the Company was to build the road as cheaply as possible so that low rates of freight could be maintained without loss.

The Manitoba Central Railway Company has always had in view the connection with the Manitoba and Northwestern Railway at Portage la Prairie, not only as a means of giving an outlet to that system, but also as a means of reaching the Northwest angle of the Province and extending to it as well as to the immediate vicinity of Winnipeg, the benefits of competing rates. By the extension of a line from Rapid City to Brandon competition is carried into the western centre of the Province, and by extending a line from Brandon southwest (and either the C. P. R. must do it or another organization will do it) railway facilities and cheap rates will give new life to the entire Province.

This end cannot be accomplished by a line which will simply connect Winnipeg with the Boundary. Such a line will emancipate Winnipeg, but will do little for the more remote portions of the Province. This will give a local caste to the enterprise which will do much to discredit it outside the Province, where the agitation is supposed to be confined to Winnipeg. The delegation from our Board of Directors has already discussed this matter with members of your Government and I need not dilate upon the importance of this view of the case.

Our delegation proposed, on behalf of the Company, that the Government should guarantee the bonds of the Company to the extent of $8,000 per mile, the Company building 65 miles of road, from the City of Winnipeg to the Town of Portage la Prairie, and that the Government should construct the Red River Valley R. R. and lease it to the company at a rental of 5% on $8,000 per mile.

So far as the term for which bonds are to be issued, I have made inquiry from good authority and am informed from one source that "No market can be found for five-year 5% guarantee bonds except at heavy discount". From another source I learn that "Guarantee bonds for Provincial aid to Railways should run at least twenty years to be profitable for investors. No market for short term bonds." I find also that some difficulty might be experienced in placing so small an amount of guaranteed bonds as it is proposed to the Government shall be issued to the Manitoba Central R. R. Company.

The directors of the Manitoba Central Railway Company therefore propose an alternative to the scheme for guaranteeing twenty-five year five per cent bonds, as proposed by the Government as follows:- Section 33 of the Red River Valley R. R. Bill proposes that $1,000,000 shall be raised for the construction of a road from Winnipeg to the Boundary line. This sum is more than sufficient for the purpose. One half of the sum will be sufficient to build the road for operations as follows:

earthwork - 65 miles at 14c	$125,000
ties at 14c per tie	70,000
rails at $40.00 per ton	228,800
fastenings	21,450
tracklaying, $300.00 per mile	19,500
bridges, culverts & waterways	14,400
Engineering & other expenses	20,850

$500,000

The other half million to be devoted to similar construction on the Manitoba Central Railway to Portage la Prairie. On completion of the Red River Valley line for operation, the Manitoba Central Railway to purchase the line for $500,000 and to give five-year five per cent bonds over the whole line, at the rate of $10,000 per mile to the Provincial Government as security for the million advanced by them.

The Manitoba Central Railway Company will then have to pay no large discount for the money required for construction, and will have five years in which to place their bonds, by which time the value of the road will have developed itself, and the Government may realize upon their bonds, handing the surplus over to the Company.

The Company would issue the balance of the bonds ($6,000 per mile) to complete and equip the road. Supposing that the Government decline to accede this proposition, which has the merit of being economical and practical, the Directors of the Manitoba Central Railway think that the proposed amendment to the Railway Act should be further amended, so as to admit of the Government issuing their bonds instead of guaranteeing the Company's bonds, receiving as security therefor the Company's bonds in the ratio of $10,000 for every $8,000 of Provincial bonds so advanced.

The Manitoba Central Railway Company will then agree to purchase the completed and equipped Red River Valley Railway line for $750,000, upon terms suggested by the Government.

The Manitoba Central Railway Company feels that it has a claim upon the consideration of the Government which should not be postponed or ignored. If these claims are acknowledged, they are prepared to act heartily with the Government in carrying out the scheme for bringing
competing railways into the Province, by which the prosperity of the people and of the Province will be so immediately and beneficially affected.

I need only say that I coincide personally with everything set forth here, and shall be prepared to submit the matter to the judgement of the Legislature and of the people, if the Government does not see its way clear to accede to the wishes of the Company. As time is of so much importance, I shall feel obliged by receiving a reply to this communication as soon as possible.

Yours very truly,

(signed)

Duncan MacArthur

Source: Courtesy of the Provincial Archives of Manitoba, Norquay Papers, May 1887. This work is considered to be in the public domain as per Canadian copyright law as it was created over 75 years ago.

When Macdonald disallowed Norquay's railway legislation back in 1882, a coherent local opposition began to form around Thomas Greenway[15], whose "Provincial

[15] Thomas Greenway (March 25, 1838 – October 30, 1908) was a politician, merchant and farmer. “He served as Premier of Manitoba from 1888 to 1900. A Liberal, his organization formally ended Manitoba's non-partisan government, even if a de facto two-party system had already existed for some years” (Government of Canada, Dictionary of Canadian Biography online, http://www.biographi.ca/009004-119.01-e.php?BioId=40876).

Rights" group would soon become the Liberal Party of Manitoba. Although Sir John A. Macdonald was sometimes critical of Norquay in private correspondence (PAM, Macdonald Papers), he supported the Norquay administration for most of its nine years in power.

Macdonald took Norquay's side in a boundary dispute with Ontario, and personally visited Manitoba in 1886 to ensure Norquay's re-election on December 9 of that year: Norquay's Conservatives won 21 seats whereas Greenway's Liberals won 14, with the popular vote almost evenly split. After two more railway charters had been vetoed, Norquay was only able to keep the House in line by a motion demanding an end to disallowance as soon as the line north of Lake Superior was in full operation. In the meantime, he suggested that railways could be built under existing legislation. All candidates, of whatever political hue, were pledged to the immediate construction of railways wherever necessary and in defiance of the federal veto. Norquay led all the rest, he had broken completely with the federal leadership, but would suffer for it, since his alliance with Macdonald ended in the summer of 1887 when the provincial government reversed its previous policy and began to actively promote the RRV. Macdonald and the CPR would both play leading roles in Norquay's downfall later in the year (Jackson 1973).

As soon as the new Legislature met in 1887, it passed a bill entitled, "An Act Respecting the Construction of the Red River Valley Railway" (Jackson 1973). It received Royal Assent from Lieutenant-Governor J. C. Aikins on June 1, 1887 and was disallowed, as expected, on July 4, 1887. The RRV was to build south along the west bank of the Red to West Lynne where a connection would be made with the Northern

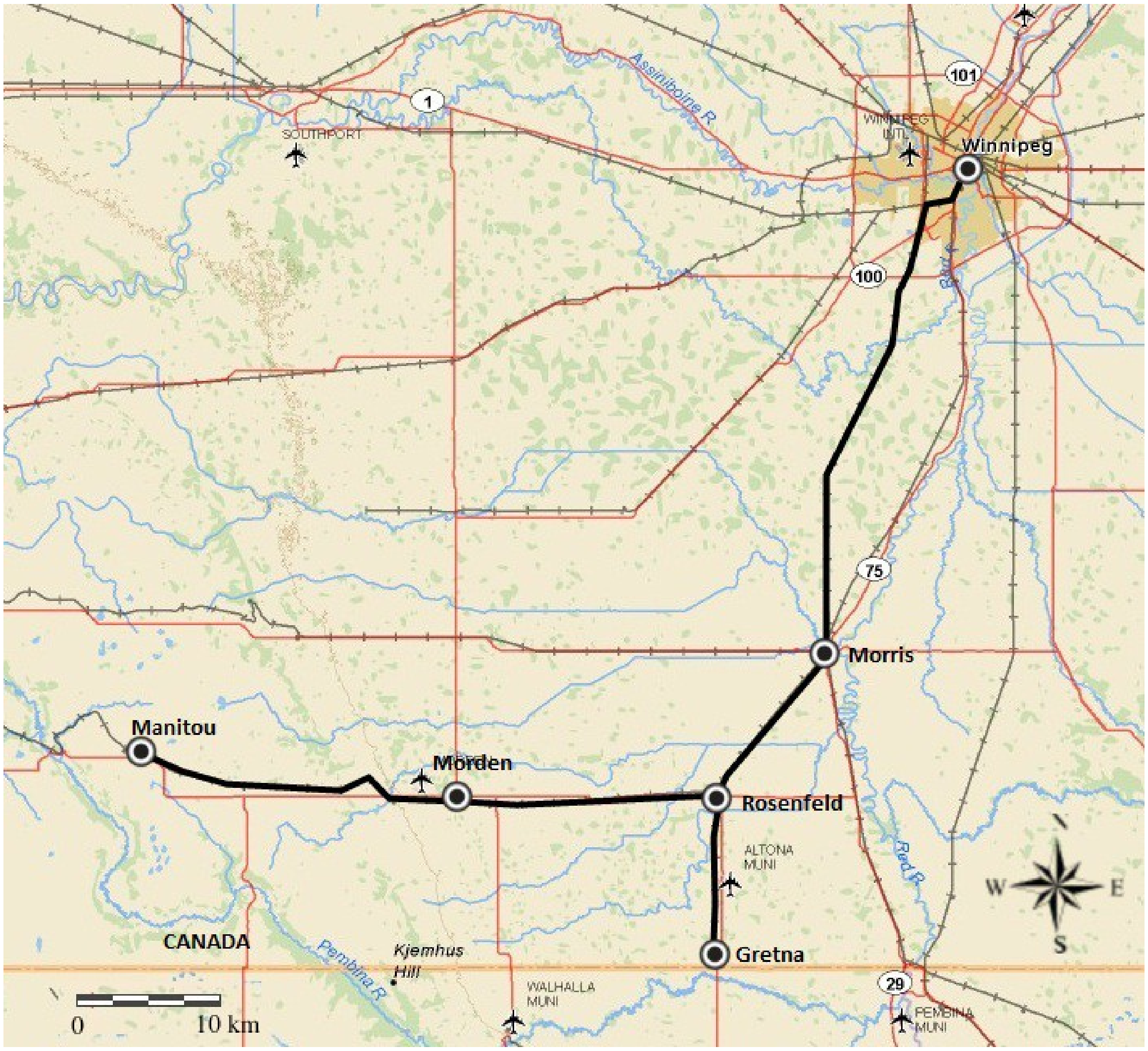
Pacific at Pembina, North Dakota. Undeterred by the federal veto, “Norquay proceeded with construction under the provisions of the Public Works Act, 1885, which, since it had been in force for more than a year, could not be disallowed” (Jackson 1973).

The RRV became the sign of a unified Manitoba's determination to be done with disallowance and the CPR monopoly. The Winnipeg Board of Trade went on record, “as favouring a withdrawal from Confederation if the disallowance policy did not come to an end” (Jackson 1973). There were difficulties, however, which Manitoba soon found itself confronting as problems in the way of RRV construction. Concisely stated, “there was little local capital available and provincial credit was low in New York and London, becoming lower on the reports to those centres of the Dominion Government and the CPR” (Jackson 1973).

In spite of this, the entire anti-disallowance disturbance was finally having an effect on the CPR and the company’s President, George Stephen, threatened in May 1887 to completely “remove the railway's maintenance and repair shops from Winnipeg” (Jackson 1973). Furthermore, the CPR obtained an order, “forbidding the RRV to cross its Gretna Branch while the Minister of Justice, John Thompson, obtained an order from the Court of Queen's Bench forbidding construction on the grounds that the RRV was being built on Dominion Government lands” (Jackson 1973). Norquay persisted, maintaining that he would not halt construction, "unless prevented from so doing by legal or military means" (Jackson 1973). Norquay was finally brought down by the use of political trickery on the part of Macdonald. The provincial government had charter rights to the land grants earned from Ottawa on the basis of miles of track laid by the Winnipeg and Hudson Bay Railway. These grants amounted to 103,600 hectares (256,000 acres) and when turned over to the province could be used as collateral for a bond issue to complete the RRV. Provincial Treasurer, A. Lariviere, went to Ottawa and was personally assured by Macdonald that the transfer of lands would be made. Lariviere then wired Norquay and the bonds were issued. However, the land transfer was not made and Norquay and Lariviere found themselves in the dreadful position of having issued bonds without collateral. They had no choice but to resign, which they did on December 22, 1887 (Jackson 1973).

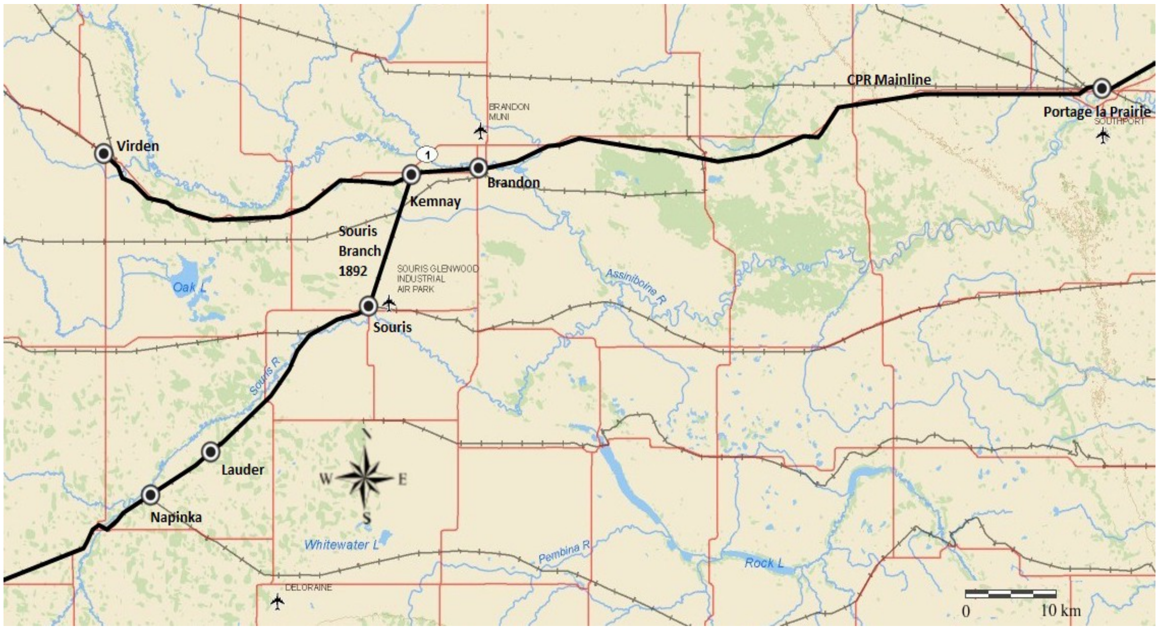
During this time, various branch lines were being constructed around the province by the CPR and the work continued through the 1880s. The lines in question were the Southwestern and Pembina Mountain Branch, running from Rugby Junction to Rosenfeld, and the Manitou and Gretna line, both opened in 1882 (Moore 1975), (Figure 2.2). For its part, The Souris Branch from Kemnay, Manitoba, to Estevan, Saskatchewan, began operation in 1892 (Figure 2.3).

Figure 2.2: CPR Red River branch lines, 1882.



Source: Created May 2011 by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute.

Figure 2.3: CPR, The Souris Branch, 1892.



Source: Created May 2011 by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute.

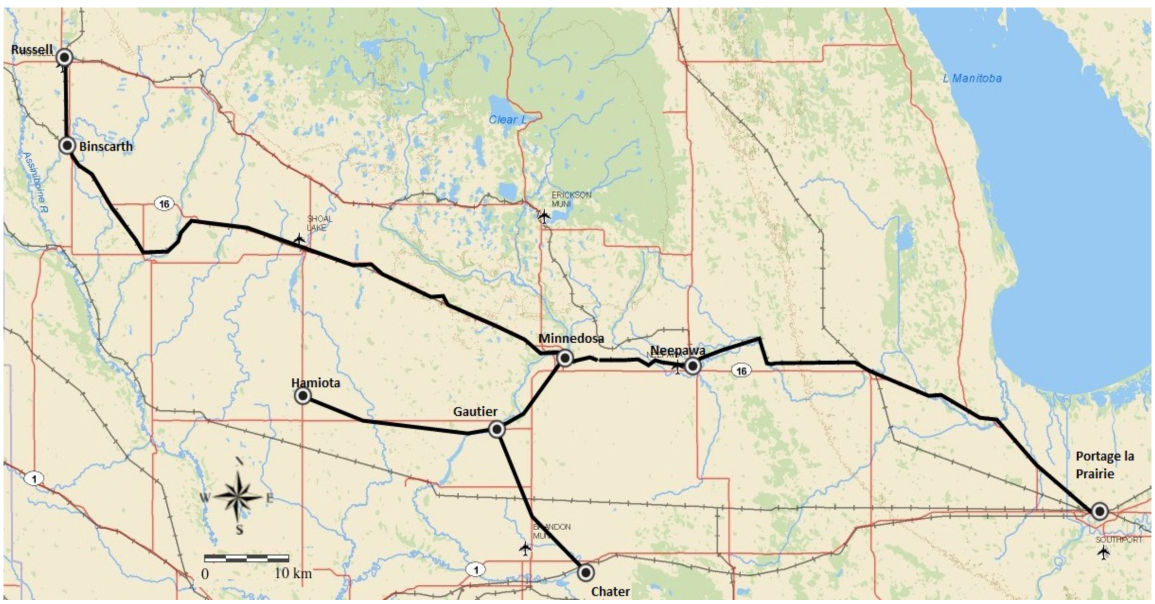
There were, in addition, some private railway companies chartered, which were quickly absorbed by the CPR, either through lease or purchase. The Manitoba South Western Colonization Railway Company constructed lines from Rugby Junction to Glenboro, Manitou to Deloraine, and Elm Creek to Carman (Figure 2.4).

For its part, the Manitoba and Northwestern Railway Company of Canada started in Portage La Prairie and built a line to Yorkton, Saskatchewan, and a branch from Binscarth to Russell. Separately, the Great Northwest Central Railway Company was chartered in 1880 as the Souris and Rocky Mountain Railway Company. A change in corporate title occurred in 1886 and, in 1900, the lines from Chater to Gautier and Gautier to Hamiota were leased in perpetuity to the CPR (Figure 2.5).

Figure 2.4: The Manitoba Southwestern Colonization lines, 1886.

Source: Created May 2011 by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute.

Figure 2.5: The Great Northwest Central lines, 1891.

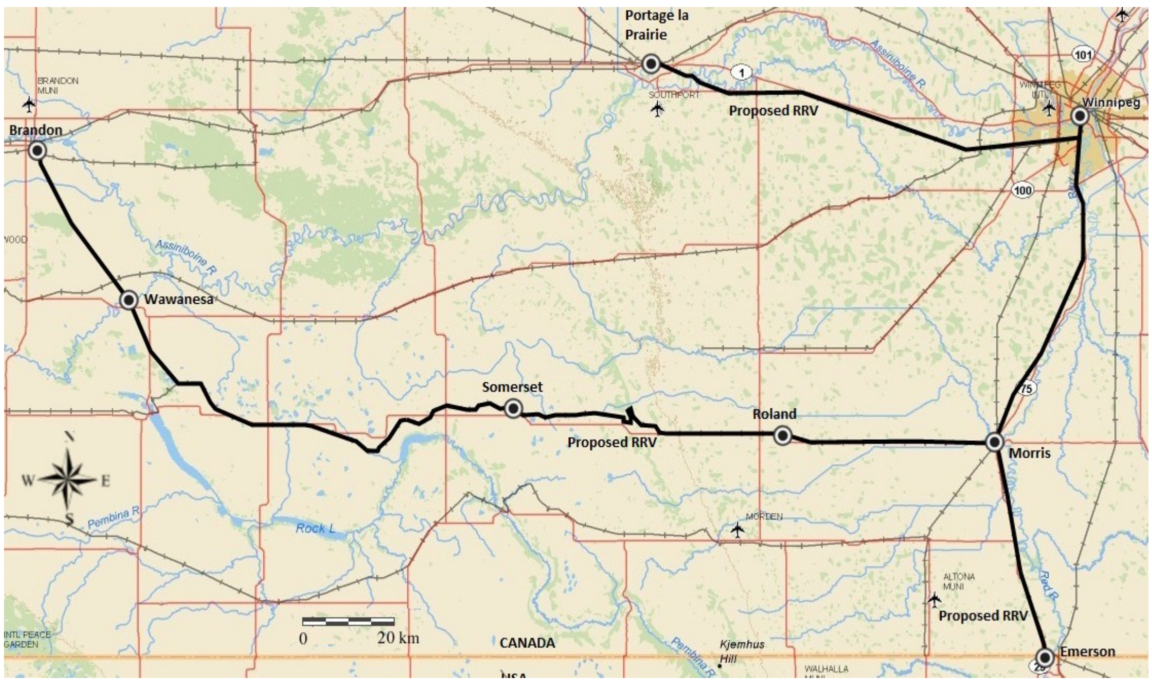


Source: Created May 2011 by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute.

The degree of confidence expressed in the titles of these independent railway companies reflected the great optimism of the promoters at this time of railway construction. For the complete list of lines created under the CPR see Addendix I.

After some time, Premier Greenway achieved the withdrawal of the monopoly clause. It cost the Dominion Government the guarantee of $15,000,000 in CPR bonds for rolling stock and branch-line construction. The Legislature was reconvened, passed an amended Red River Valley Railway Act empowering the line to build not only to the U.S. border, but also to Portage la Prairie, and to Brandon, and, in fact, to wherever it might have to build in order to provide competition for the CPR (Jackson 1973).

Figure 2.6: The proposed RRV, the competition to the CPR.



Source: Created May 2011 by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute.

The CPR applied pressure, threatening to cut back on branch-line construction if the RRV proceeded. Greenway replied to this by dissolving the House and winning 33 of the 38 seats on the strength of his claim to be the breaker of monopoly and the destroyer of disallowance. In the campaign he promised not only more branch lines, but also lower freight rates. Immediately following this election Greenway and Martin, in spite of further attempts at interference by the CPR, struck a deal with the Northern Pacific Railway (see End-Note 1) whereby the RRV was leased to a new venture, the Northern Pacific and Manitoba Railway, on September 4, 1888.

Northern Pacific and Manitoba Railway

The Northern Pacific and Manitoba Railway (NP&MR) would not only complete the line to Emerson but would also build from Winnipeg to Portage la Prairie and from Morris to Brandon. The line to Emerson opened to traffic on September 1, 1889. Practically, it was clear that the NP&MR was a wholly-owned subsidiary of the Northern Pacific Railway, and as such controlled from the USA (Moore 1975). As a concession to Manitoba opinion, rates were to be fixed favourably for the farmers of the province. In the event, however, the savings to the farmers were small while the grief to the government was great.

The decision to award control of a Manitoba railway to a American corporation brought a storm of protest from citizens and corporations alike. The *Manitoba Free Press*, up until then a strong supporter of Greenway, turned on him aggressively, accusing him and Martin of a dishonest bargain with the Northern Pacific and pointed out that Martin had become a director of the NP&MR. The whole mess drew in the affairs of other lines such as the Manitoba Central Railway (a Canadian company that later went bankrupt in the 1890s), one in which W. F. Luxton, *Free Press* editor, had an interest

(Jackson 1973). A Royal Commission of Inquiry cleared Greenway and Martin of any corrupt action, for the charges could not be substantiated. The fact remained, however, that by early 1889 the Greenway Government, which had started with such great promise, was in serious trouble as its railway policy had produced little in the way of results (Jackson 1973). The turmoil arising from the issue of American competition from the Northern Pacific and Great Northern Railways (see end-note 2) was just beginning.

The following excerpts from Company President George Stephen's statement to shareholders best illustrate the response from the CPR to this new competition emerging on the prairies (September 12, 1888):

> It was deemed absolutely necessary to the procuring of the necessary capital, to the safety of the capital invested and generally to the success of the enterprise, that the traffic of the territory to be developed by the railway should be secured to it for a reasonable period; and the term of ten years from the time fixed for the completion of the railway was agreed upon. Without this provision for protection, the necessary capital could not have been secured and the railway could not have been made…
>
> The same protection was insisted upon by the government in respect of the C.P.R. when it was commenced as a public work, long before the company was thought of…
>
> Winnipeg at the time (mid-1870s) was a mere village, and the settlements in Manitoba were mainly confined to a narrow fringe along the Red River. The province hailed the signing of the contract, and hardly a voice was raised in objection to the so-called 'Monopoly Clause'…
>
> The inevitable consequences of over-speculation have been mistaken by people in Winnipeg and some other towns in Manitoba for the need of railway competition… The local political parties have vied with each other in securing to themselves the support of the malcontents and this has resulted in the undertaking by Provincial government to construct a line of railway to the International Boundary, where it has agreed to make a connection with a line advancing northward from the Northern Pacific Railroad… The acts of the local government providing for the railway in question are in direct violation of the British North America Act…
>
> It would be absurd to urge that the completion of the sixty-six miles of railway undertaken by the Government of Manitoba would ruin the vast Canadian Pacific system, but its construction would be a violation of the contract with this company, and the directors feel it to be their duty to maintain the rights of the company in the matter, in every legitimate way…

Source: Gibbon, 1935. This work is considered to be in the public domain as per Canadian copyright law as it was created over 75 years ago.

The NP&MR received its provincial charter in 1888, with authority to construct and operate the RRV from Winnipeg to Emerson, from Winnipeg to Portage la Prairie and from Morris to Brandon. Before it was complete, the railway would be the cause of the "Battle of Fort Whyte" (Moore 1975).

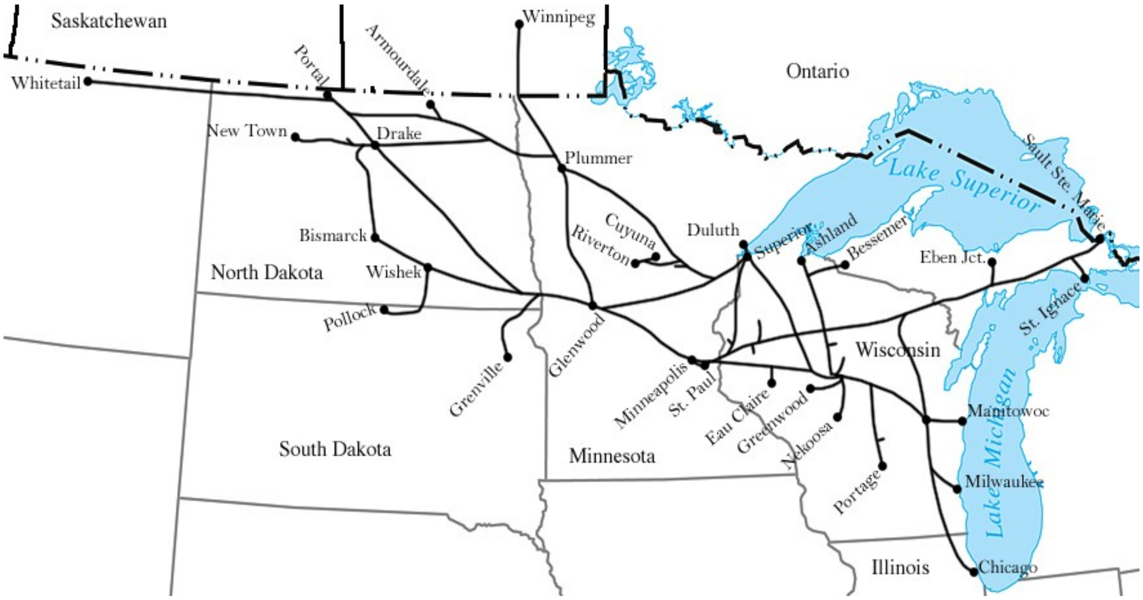
This interesting conflict between the CPR and the NP&MR happened where the new NP&MR line had to cross the CPR main line. Normally a railway would apply to the Railway Committee of the Federal Cabinet for permission to cross a line. In this case the Manitoba government advised the NP&MR contractors to go ahead without permission. Relations between the province and the Dominion were strained as a result of the provincial stand on the CPR's freight rates, and provincial officials expected an outright rejection for any provincially supported line wishing to cross the CPR line. The NP&MR construction crew installed a crossing diamond under cover of darkness during the night of October 24, 1888. The site was left under the protection of a small force of provincial constables, specially recruited for the occasion. The next morning CPR crews, supervised by CPR superintendent William Whyte, confronted the constables, tore up the diamond and repaired their track. In addition they derailed an unused CPR engine onto the NP&MR track and left another CPR locomotive on the site of the crossing. The NP&MR lawyers searched the legal precedents and discovered that it was illegal to abandon railway equipment on road allowances, so a new crossing site was found across a road allowance. The CPR countered by constantly running a locomotive back and forth across the allowance, ringing its bell (Moore 1975). Injunctions between the railways flew thick and fast. The provincial and Dominion governments fought. The Railway Committee and the Supreme Court got involved. However, by January 1889 the crossing was approved and completed, signalling the end of the monopoly and the true beginning to railway competition in Manitoba.

By the end of the 1880s, the CPR had completed its main line to the Pacific coast in addition to many lines throughout Manitoba and thus had opened the West. It had not, however, provided transportation services at a cost Prairie farmers could afford. Many of the rail lines were still too far away to make farming economically feasible. As a result, the effective settlement of Manitoba proceeded at a slow pace.

By the end of 1889, the NP&MR had 428 kilometres of railway in operation within the province, but the great advantage of competition and cheapening of the rates, promised by the company, did not amount to much at all. It was found that the small section of the country served by the system did derive some benefit from the new lines, but the country at large was not the beneficiary of much development (Begg 1895).

Meanwhile, the Dominion Government awarded the CPR a new guarantee now that it had lost its monopoly status. This guarantee allowed it to buy the Soo Line on June 11, 1888. This was an undertaking which took the Minneapolis, Sault Ste. Marie and Atlantic Railway, and consolidated it with the Minneapolis and Pacific Railway, Minneapolis and St. Croix Railway, and Aberdeen, Bismarck and North Western Railway to form the Minneapolis, St. Paul and Sault Ste. Marie Railway (Dorin 1979). At a stroke the CPR could now compete with the big American roads that had extensive track laid in the Northern U.S. states. (See Figure 2.7).

Figure 2.7:The CPR owned Soo Line, circa 1910.



Source: Created May 2011 by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute.

The 1890s

The early 1890s proved to be a rough time for Manitoba railways. In the United States, the Northern Pacific (NP) entered bankruptcy in 1893 and remained in financial difficulty for the remainder of the century. Its rival the Great Northern Railway (GNR) struggled to avoid the same fate, an endeavour in which it was successful. Canadian Pacific stocks hit an all-time low in 1895. Other locally chartered lines on the Prairies made no progress towards construction, and from 1893 to 1895 not a mile of track was laid in Western Canada. The rate issue with farmers stayed unresolved with rates unchanged from 1888 to 1897. Manitoba farmers operated on very small profit margins and those more than 16 kilometres (10 miles) from the nearest railway station could ship their goods only at very high cost and great effort (Moore 1974).

In 1891, Clifford Sifton[16], a young provincial Cabinet member from Brandon North, recognized the need for new railway initiatives. Members of his own Brandon constituency urged the CPR to build new branch lines in this area, but the company refused, arguing that "it was a very bad time to propose to the shareholders any new branch lines in the North West in view of the bad showing the existing branch lines have made and the present un-satisfactory state of affairs generally" (PAM, Greenway Papers, Folio 10336).

Settlement possibilities in the North had long been recognized. As previously mentioned, John Palliser's expedition of the Canadian prairies spoke of the northern parklands as the "fertile belt" and the southern regions as merely an extension of the "Great American Desert". Additionally, Canadian surveyor J. B. Tyrell had declared publicly that if he were choosing a farm he would go to the Dauphin area (Hanna 1919, pg 528-9). As previously noted, the CPR disregarded these surveys and built across the south in an attempt to counter American railways encroaching on Canadian territory.

It took an all-new plan initiated by Sifton in 1895 to get railway construction finally restarted in Manitoba. Instead of the traditional method of offering land or money to railway companies, he suggested that, "the local government underwrite or guarantee the payment of interest and principal on construction bonds issued by new railway companies" (Regehr 1976). This meant that the government committed itself to pay

[16] Sir Clifford Sifton, (1861 –1929) was a Canadian politician. "Sifton served in the cabinet of Thomas Greenway from 1891 to 1896 as Attorney General and Provincial Lands Commissioner. In 1896 Sifton was elected a Member of Parliament and served as Minister of the Interior. As Minister of the Interior he started a vigorous immigration policy to get people to settle and populate the West. Sifton established colonization offices in Europe and the United States. Thus, between 1891 and 1914, more than three million people came to Canada, largely from continental Europe, following the path of the newly constructed transcontinental railway" (Government of Canada, Dictionary of Canadian Biography Online, http://www.biographi.ca/009004-119.01-e.php?&id_nbr=7864).

interest and principal on specific bonds in case the railway itself was unable to meet these obligations. The guarantee made the bonds a safe investment. Safeguards were implemented to ensure that all monies were used for actual railway construction; that is to say, the funds would only be turned over to the railway company on presentation of vouchers or other evidence that the appropriate amount had actually been spent on construction (Regehr 1976).

Getting a railway company to commit to this new plan was another matter altogether, however. Neither American roads (the NP and GNR) nor the CPR showed it much interest. Sifton, representing the constituency of Brandon North, expressed considerable frustration at this inaction. Meanwhile, Greenway, representing southern Manitoba where both the NP and CPR had already built branch lines, adopted a different stance. He wanted a competitive through line to Duluth, which, it was hoped, would help to bring a reduction in freight rates (Regehr 1976). Sifton had considerably less faith in the American lines than Greenway, and for some time there was discernible tension between the two on this issue (PAM, Greenway Papers, Folio 10551). Sifton had to look elsewhere if he wanted built the rail lines that he desired. He came across a temporarily unemployed railway contractor who saw some merit in the new Manitoba plan. This person was Donald Mann[17], and together with his partner William Mackenzie[18], they

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[17] Sir Donald Mann (1853 - 1934) was a Canadian railway contractor and entrepreneur. "During the 1880s, he worked as a contractor building sections of the CPR across the prairies and through the Rocky Mountains. In 1895, together with William Mackenzie, he began the process of purchasing and building the lines in western Canada that would later become the Canadian Northern Railway (CNoR). Mann was knighted for his railway efforts in 1911" (Government of Canada, Dictionary of Canadian Biography Online, http://www.biographi.ca/009004-119.01-e.php?BioId=42393).

[18] Sir William Mackenzie (1849 – 1923) was a Canadian railway contractor and entrepreneur. "He entered the railway business as a contractor, working on projects in Ontario, British Columbia, Maine,
Continued…

were instrumental in initiating the second major wave of railway construction in Manitoba (Regehr 1976).

Lake Manitoba Railway and Canal Company

In April 1889 the Lake Manitoba Railway and Canal Company was given a Dominion charter to build a railway from a point in or near the town of Portage la Prairie running in a northerly direction to deep water at the southern boundary of Lake Manitoba. This line was to link with existing lake and river steamers to Prince Albert in the Saskatchewan Territory, and to improve and connect the water communication, for the purpose of traffic and navigation, between Lakes Manitoba and Winnipegoosis and the North Saskatchewan River by the construction and maintenance of canals. The charter included a 6400 acre-per-mile federal land grant to be made on the completion of the railway portion. The original company could not find financing and the project lay dormant for several years. In 1895 Mann purchased the charter for the Lake Manitoba Railway and Canal Company, including the land grant, paying $38,000 cash for it (Hanna 1924). By this time, the Manitoba government had become interested in opening the fertile farming area west of Lake Manitoba and offered to finance the line. The Lake Manitoba Railway and Canal Company was the first collaboration between future railway giants, Mann and Mackenzie (Stevens 1960).

Mann and his new partner were awarded a construction contract in May 1896 to construct a line from Gladstone to Dauphin. Before coming to a final agreement on provincial funding, they explored the idea of getting additional funding from the ill-fated

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Saskatchewan and Alberta between 1874 and 1891. In 1895, together with Donald Mann, Mackenzie began to purchase or build rail lines in the Canadian Prairies which would form the CNoR. Mackenzie was knighted in 1911 for his efforts in the railway industry" (Government of Canada, Dictionary of Canadian Biography Online. http://www.biographi.ca/009004-119.01-e.php?&id_nbr=8258).

enterprise of building the Hudson Bay Railway (which will be discussed later in this chapter). Although the route they had planned was not the most direct to the Bay, it might produce considerably more traffic and thus effect a lowering of costs. Mackenzie and Mann wanted the funding that had been allocated for this project even though they did not intend to take it all the way northward to the Bay (Regehr 1976). After considerable lobbying in Ottawa, they were promised $8000 per mile plus the federal land grant plus the lure of a $40,000 federal transportation contract if the line ever reached halfway to the Saskatchewan River (PAC, Arbitration, 2674-5, Porteous Papers, IV).

The first 160 km were completed by the winter of 1896 while the remaining 40 km were completed the following spring. Gladstone was a connection point with the Manitoba and North Western Railway and Mann and Mackenzie had arranged running rights on this road as far as Portage la Prairie, where running rights had been negotiated with both the CPR and the NP&MR (PAC, Sifton Papers, 1895). From its first year, the Lake Manitoba Railway and Canal Company was profitable, although no one had expected this early success.[19]

In 1896 Mackenzie's friend Sam Hughes led an expedition which reported enthusiastically that no less than 90 per cent of the lands adjacent to Mackenzie and Mann's new railway were suitable for agriculture and would be settled once the railway provided the necessary transportation facilities (Regehr 1976).

[19] These railway accounts were kept in accordance with accounting principles of that time. "Business historians have demonstrated that these accounting procedures were flexible and accounts were often adjusted in order to produce favourable account statements. There was always much preoccupation with the ratio of total revenues to operating costs. In the interests of a good annual statement, accountants sometimes deferred some maintenance and other costs from a poor year to the next and hopefully more profitable year of operation. Many North American railways kept no depreciation accounts for tracks and right of way, and the depreciation accounts for equipment and building were kept at a minimum. The figures nevertheless provided information that the Department of Railways and Canals regarded as generally reliable" (Regehr 1976).

In 1897 the line was pushed to Sifton Junction and Winnipegosis, activating the federal transportation grant. Mann and Mackenzie went on to many other railway projects over the next few years[20] when they formed and operated the Manitoba and South Eastern Railway, and bought the Winnipeg Great Northern Railway (Figure 2.8).

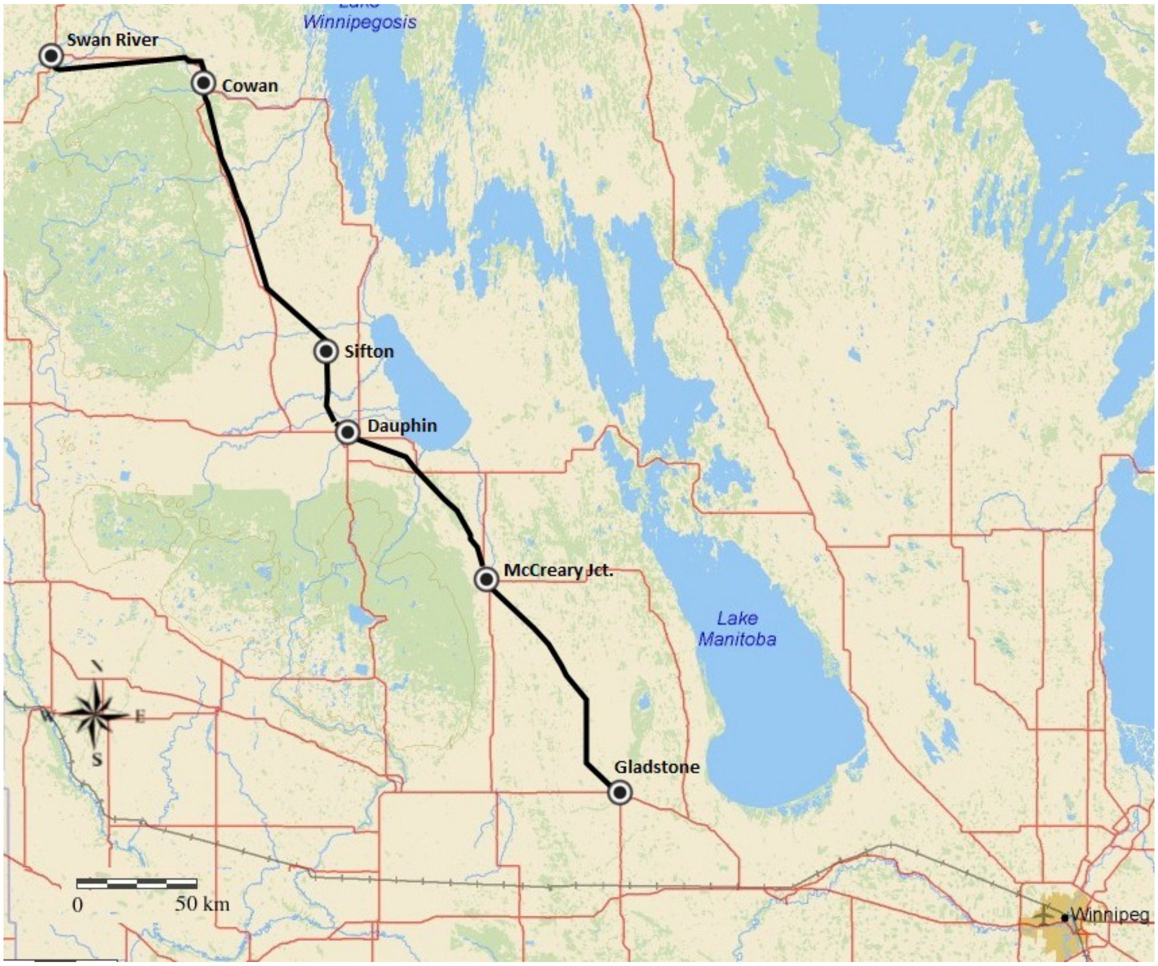
Manitoba and South Eastern Railway

The Manitoba and South Eastern Railway was incorporated in May 1889. The provisional directors of this railway had been unable to put together the financing, so the charter and accompanying land grant agreement almost lapsed (PAC, Sifton Papers, CCXCI, 150-2, 1897). Their intention had been to build a line to the US border near Lake of the Woods to connect with an unnamed US line. Mann and Mackenzie bought the charter on February 11, 1898 and gained Dominion Government financial support on the basis of their past building performance of railway projects.

The original line was 72 kilometres from St. Boniface (across the Red River from Winnipeg) east to Marchand with the intention of eventually reaching Rainy River. Although the line seemed to go nowhere, Mann and Mackenzie's superintendent, D.B. Hanna, managed to form a cordwood company supplying Winnipeg with firewood and paying the interest on the line for its first crucial years. Hanna explains this venture in his own words below:

[20] Mann and Mackenzie were in on the first negotiations for the Vancouver, Victoria and Eastern Railway and the Crowsnest Pass Railway, projects that pressured the CPR to begin a southern Crowsnest route. (Stevens 1960).

Figure 2.8 Mackenzie and Mann's First Manitoba Line.



Source: Created May 2011 by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute.

> "I organized a cordwood company, which was a logical thing to do, for the benefit of the railway itself. I put men in the bush, arranged with the Dominion Government to get permits to cut, and at various times we had as many as 40,000 cords of wood cut and piled on the track waiting to move it to Winnipeg. The point I make about this is that we made business for the road, we made money for the lumberjacks, who moved up and down day after day, when we ran that little service and the result of it was that I earned enough out of all these things to pay the interest charges of the forty-five miles for two years".

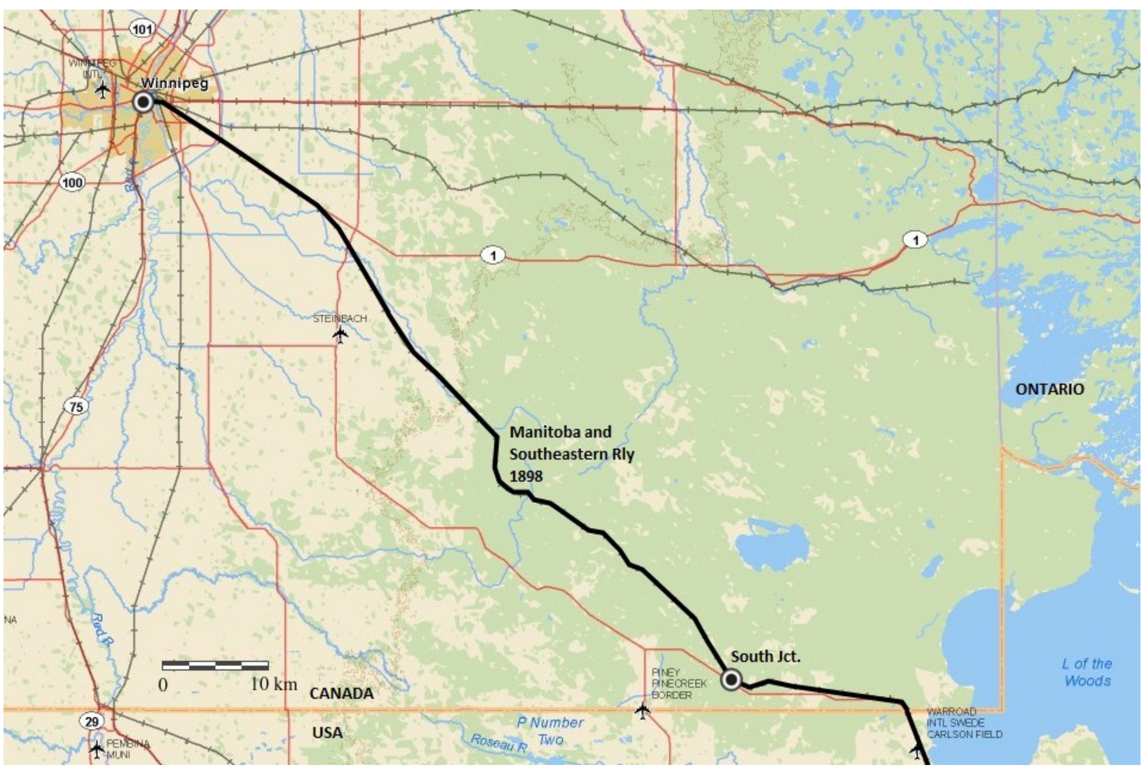
Source: (D. B. Hanna, Arbitration, 404-5.) This work is considered to be in the public domain as per Canadian copyright law as it was created over 75 years ago.

In short, the Manitoba and South Eastern Railway (Figure 2.9), like the Lake Manitoba Railway and Canal Company's line in Northwestern Manitoba, "was a pioneer line, which succeeded in identifying its policies with the interests and needs of local farmers and settlers" (Regehr 1976).

The Canadian Northern Railway

The first indication that a new railway company would emerge came in December 1898 when the Lake Manitoba Railway and Canal Company and the Winnipeg Great Northern Railway and Steamship Company (the HBR under its 1898 title) were amalgamated to form the Canadian Northern Railway Company (CNoR). A new federal charter was obtained in July 1899 with rights to build extensive new track. The Manitoba and South Eastern Railway was amalgamated into the CNoR as soon as the federal charter was passed in Ottawa (Regehr 1976).

Figure 2.9 The Manitoba and South Eastern Railway (1898).



Source: Created May 2011 by McCombe, C.G.L. using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute.

Mann and Mackenzie began to make serious plans to connect the two Manitoba railways in the northwest and southeast and to extend the eastward part of their system in Ontario. This growth ethos was best described by Hanna himself in 1899: "From a series of disconnected and apparently unconnectable projections of steel, hanging in suspense, a continuous track was formed, trains ran on it, and all the organs of a great commerce began to function" (Hanna 1924).

The line in the Northwest continued on from Sifton Junction to Cowan and was completed in 1898. An additional 51 kilometres to Swan River was completed in 1899 (Figure 2.8), while in 1900 this line was extended a further 145 kilometres to Erwood, just outside the then northwest corner of Manitoba. Here, of course, was where all provincial funding stopped for the northern line. The Manitoba government was willing, however, "to grant additional assistance for a line running westward from Dauphin through the fertile and partially settled Gilbert Plains area" (Regehr 1974). Thus, a bond guarantee for a 40-km extension to Grandview, Manitoba, was approved and was completed in 1902 (PAC, CNR records, MMCCCXXV, 202, 207).

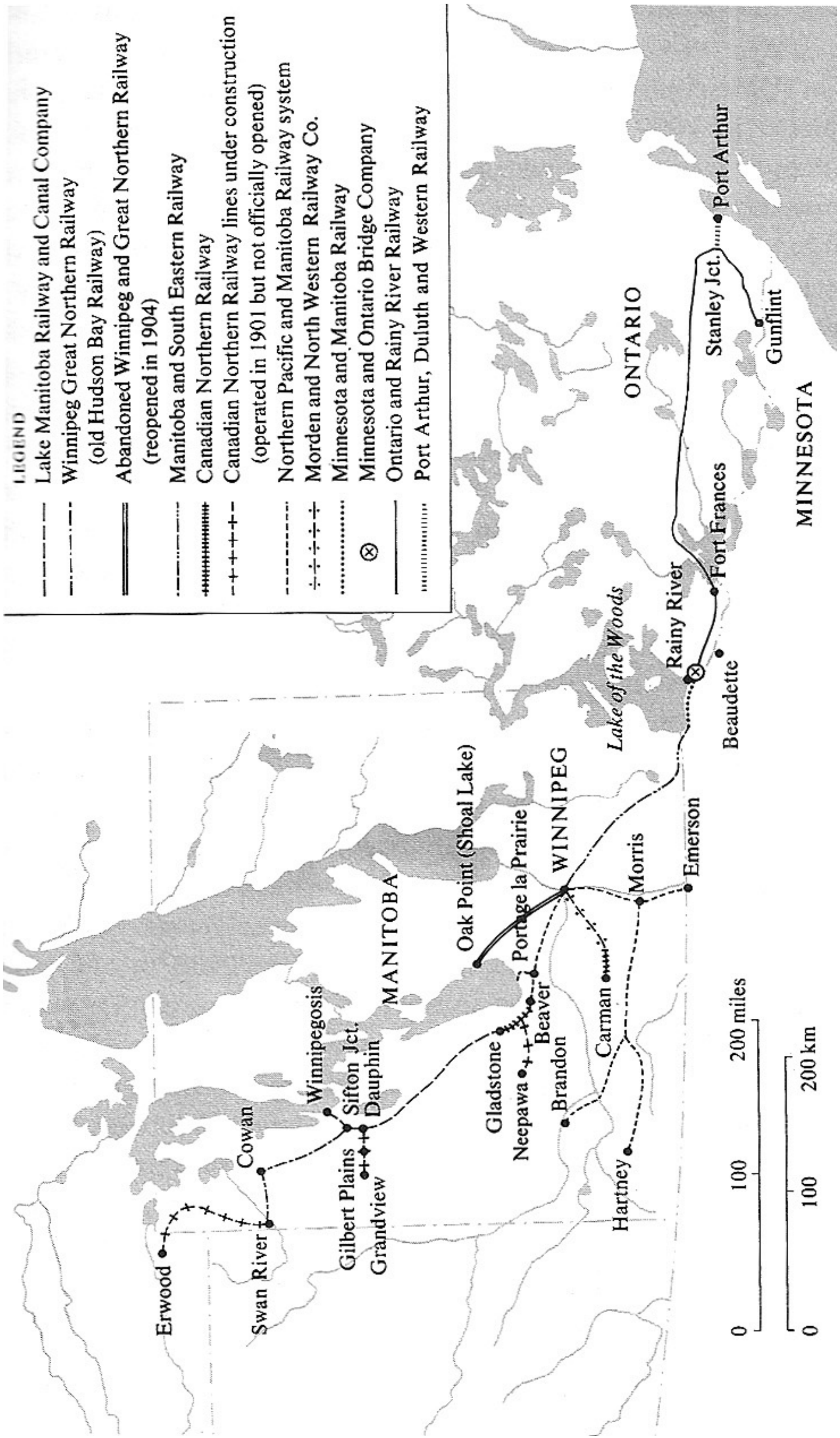
In constructing their system, Mackenzie and Mann had a basic policy of building up their branch and feeder lines before building the long transcontinental connections that they would need sooner or later. Most of the traffic that was needed to make their railways profitable would either originate on, or be destined for, the Prairies. Their priority was, "to build the main trunk lines on the Prairies first, then to develop an extensive branch-line network around these trunk lines, and finally to build the transcontinental connections" (Regehr 1974).

In 1901, the plan was to build a through line from the northwestern corner of

Manitoba to the Lakehead at Port Arthur. After much political turmoil with both the federal and provincial governments, Mann and Mackenzie were able to acquire the entire Northern Pacific and Manitoba Railway system complete with all its branch lines. Basically, the mileage acquired from the NP provided the CNoR with the branch lines it needed to compete with the CPR in southern Manitoba. By the end of 1901, Mann and Mackenzie extended the line, bought existing charters for the Ontario and Rainy River Railway Company, the Minnesota and Manitoba Railway and the Port Arthur, Duluth and Western Railway and were operating a line from Port Arthur to Winnipeg. The Canadian Northern now had 824 kilometres of track in operation and an additional 1,127 kilometres under construction ready to be added to the system in 1902 (Arbitration, 412). Thus, a new major railway system capable of competing with the CPR was being created with Manitoba as its point of origin (Figure 2.10).

The Canadian Northern Railway's new agreement with the Manitoba Government solved its immediate financial problems and allowed it to complete the line to Port Arthur and consolidate its position in Manitoba (for a complete list of Manitoba's CNoR lines see Appendix II). Before Mackenzie and Mann could formulate their next plan, the Grand Trunk Railway (GTR) had formulated its own. The GTR wanted to extend its eastern system into the Prairie Provinces and, if possible, take over the existing CNoR line. Mackenzie and Mann were very confident, however, that Western settlement and development would soon make their CNoR a very profitable railway and had no intention of selling out (Stevens 1960). This led Mackenzie and Mann to rush their own plans for expansion into the East – CPR and GTR controlled areas – thus avoiding being bottled up in the West.

Figure 2.10 The Canadian Northern Railway System, 1902.

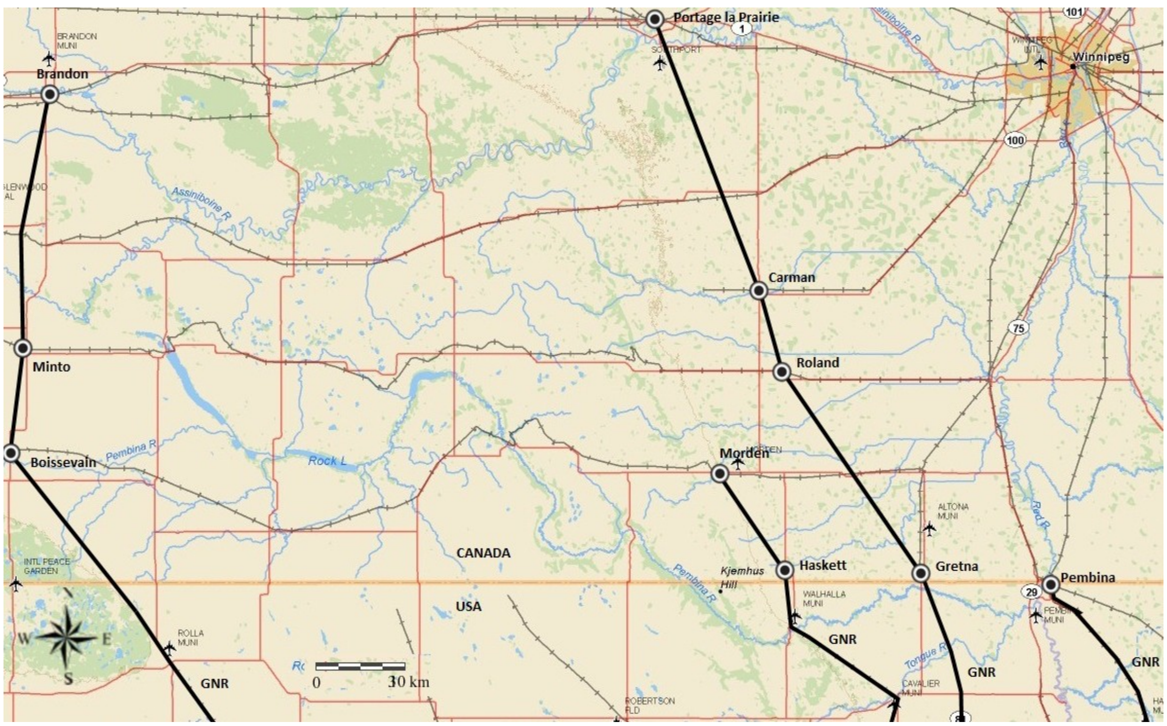


Source: Regehr 1976. Used with permission (granted 08/05/2011), © John-Wiley & Sons.

The Great Northern Railway (USA)

The Midland Railway Company of Manitoba, incorporated under provincial charter in 1903, was a venture jointly owned by two American companies, the Great Northern (GNR) and Northern Pacific (NP). Lines were built from Portage la Prairie to the US border (Gretna), and from Morden to the US border (Haskett). On July 1, 1909 the Midland Railway Company was purchased by the GNR. The Brandon, Saskatchewan and Hudson Bay Railway had been chartered at about the same time as the Midland.[21] This line was also owned by the GNR and was extended from the U.S. border through Boissevain and Minto, stopping in Brandon (Figure 2.11) (Moore 1975).

Figure 2.11: American Railways In Manitoba: The Great Northern Railway.



Source: Created May 2011 by McCombe, C.G.L. using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute.

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[21] Alphabetical list of Private Acts — Railways, Department of Justice Canada, http://laws.justice.gc.ca/eng/TablePrivateActs/railways.html, Accessed in January 2011.

The Grand Trunk Pacific Railway

The GTR had previously been very cautious and indifferent about expansion into the Canadian Northwest. In 1880 it declined all government invitations and allowed the CPR to complete the transcontinental rail link. In 1902, however, the new management of the GTR thought the opportune time had come to create their own transcontinental line. Charles Rivers Wilson and Charles Melville Hays[22] – the men in charge at the GTR – both assumed that Grand Trunk expansion would force Mackenzie and Mann out of the game, although they differed on the ways and means of dealing with the CNoR (PAC, Hays Papers, Wilson to Hays, I, 1, 14-24).

Wilson, who had met with Mackenzie in London in March 1902, was impressed with him and with what he had accomplished. He immediately wrote to Hays on the issue, "From what I have heard of these people [Mackenzie and Mann], the work they have already done and the work they are likely to do in the future, I believe they may be valuable allies, and I shall be glad to know whether you share this opinion, and if… we can make some practical development." (PAC, 1, Wilson to Hays, 20 March 1902). Hays had already decided, however, that he was not willing to co-operate with Mackenzie and Mann. He wanted CNoR lines to be all his and he replied, "My own preference, would be the acquisition of a controlling interest in the Canadian Northern line either by purchase of a majority stock by the GTR, or by formation of a syndicate which should do so in the

[22] Charles Melville Hays (1856 – 1912) was a railway executive. "Born at Rock Island, Illinois, Hays began working for the Atlantic and Pacific Railroad in St. Louis, Missouri, at the age of 17. In 1878, Hays became secretary to the general manager of the Missouri Pacific Railroad and took a similar position in 1884 with the Wabash, St Louis and Pacific Railroad. Hays became president of the entire Grand Trunk system in 1909, a position he held until his death. Hays sought to restructure the management and operations of the GTR and implemented a more aggressive, American railroading approach that is credited in part for a period of unprecedented railway growth during the first decade of the 20th Century. Charles Hays died in the sinking of the RMS Titanic on its maiden voyage while returning from a visit to England" (Government of Canada, Dictionary of Canadian Biography Online, http://www.biographi.ca/009004-119.01-e.php?&id_nbr=7430).

interests of this company" (PAC,1, Hays to Wilson, 3-9). This matter, as appeared to Hays, required quick and aggressive action.

Wilson had serious doubts about the aggressive policy proposed by Hays, since he knew from meeting with Mackenzie in London that he had no intention of selling; on the contrary, Mackenzie and Mann were looking to operate and expand the CNoR. In fact, in 1902 the CNoR was in a very comfortable position when gross receipts totalled $1,400,973.43. After all operating costs, fixed charges, and rentals were paid, a profit of $79,992.83 remained (Arbitration, 427-30). Thus, Wilson urged Hays to seek a friendly accommodation with the CNoR. Hays, on the other hand, had gained his railway experience in the rough world of American railroading during the time of the "robber barons",[23] and was ready to force Mackenzie and Mann out of Manitoba and the Prairies. If they were unwilling to accept his terms he was quite willing to build his own lines paralleling the CNoR and engage in a fight to the finish (Regher 1974). Thus, Hays went ahead with his plan to crush the CNoR without Wilson on his side. He approached George Cox, president of the Canadian Bank of Commerce – Mackenzie and Mann's principal creditor - and put pressure on him to try and get Mackenzie and Mann to sell at Hays' price.

After much deliberation, Mackenzie and Mann suggested an alternative plan for the two railways whereby the CNoR would control western Canada while the GTR

[23] Robber baron is a term that was revived in the 19th Century in the United States as a reference to businessmen and bankers who dominated their respective industries and amassed huge personal fortunes, typically as a direct result of pursuing various anti-competitive or unfair business practices. The term derives from medieval German lords who illegally charged exorbitant tolls against ships traversing the Rhine river. U.S. political and economic commentator Matthew Josephson popularized it during The Great Depression in his 1934 book. He attributed its first use to an 1880 anti-monopoly pamphlet in which Kansas farmers applied the term to railroad magnates (Josephson 1934).

maintained its influence in the East. A traffic interchange between the CNoR and GTR would create a transcontinental system capable of meeting CPR competition (PAC, Hays Papers, 15-16, 109-11, Hays to Wilson, March 1903). However, when the two companies came together in a meeting to discuss this plan it ended unsuccessfully as GTR management still regarded the CNoR as a weak "backwoods" line. The GTR completely dismissed the proposed partnership as being impossible, citing the perceived inadequacies of the CNoR in comparison with the much sounder Eastern railway. Wilson was said to be, "acting in a most tactless manner and showing a complete ignorance of the political situation as well as that of the railroads in the North West" (University of Toronto Archives, Walker Papers, Walker to Robert Stewart, 30 April, 1903). It was clear that Hays and Wilson had become high-handed. This behaviour, however, agitated the Canadian Bank of Commerce. Its managers were at last becoming convinced that Western railways, particularly the CNoR, might be a very good thing after all and began to fear that they would lose Mackenzie and Mann as customers if they continued to pressure them to sell to the GTR. Thus, the Bank issued a statement making it clear that they would not only continue, but would increase their support of Mackenzie and Mann and the CNoR.[24] With the banks and governments on their side, Mackenzie and Mann were victorious and Hays had failed in his attempt to starve the CNoR into submission.

Hays was convinced, however, that the GTR would win in an all-out fight with the CNoR and went ahead with his scheme, asking the Dominion Government for financial assistance in creating an all-new transcontinental line from the Atlantic to the

[24] This statement of November 18, 1902 by B. Walker, general manager of the Canadian Bank of Commerce, was a turning point for the Bank. Before this date, the Bank had granted Mackenzie and Mann credit because they were wealthy and were willing to pledge their personal credit. After this, the Bank saw the railway system in the West to be a most promising venture (Regehr 1974).

Pacific. This, the federal-government-funded National Transcontinental Railway (NT) in its eastern section, would eventually run from Winnipeg through northern Ontario (with a branch to the Lakehead) and Québec to Québec City and on to Moncton in New Brunswick (see End-Note 3). Its Western manifestation, the Grand Trunk Pacific (GTP), unlike the NT, was a direct subsidiary of the Grand Trunk, and would eventually link Winnipeg to the Pacific at the new port of Prince Rupert, British Columbia. The genesis and construction of these transcontinental lines was nothing if not problematical. The plan was prepared and put forward by Hays, George Cox, and William Wainwright, another American railroader recruited by Hays (PAC, Laurier Papers, CCXLIII, 67887-9). It was appreciated by the GTR management that Hays would encounter serious difficulties in having his proposals accepted.

By the beginning of 1904, Wilson became convinced that it would be better to allow the entire GTP project to fall through than to compete with Mackenzie and Mann. At the same time, however, Prime Minister Wilfrid Laurier was coming round to the idea that the GTR should expand in the West, for he thought it would be good for his Liberal Party in the same fashion as the CPR had been beneficial for the fortunes of the Conservative Party a decade earlier.

Ultimately, the construction of the GTP began in Manitoba in 1905. The GTP devoted most of its funds to the construction of a very high standard (for the time) main line from Winnipeg to the Pacific coast. It was to be the shortest and most direct route to Asia, built to a so-called “British” standard which would make it “the best long railway ever to be built in North America” (Stevens 1960). The GTP main line was located with an eye to geographical advantage so that grades of more than 0.5 percent, compensated for curvature, could be eliminated later at relatively low cost. This meant that resistance to forward motion, taking both grade and curvature into account, should not exceed the equivalent of a 26-feet rise in one mile of track (Regehr 1974). The prairie portion of the GTP had a maximum eastward grade of only 0.4 percent and a westward maximum of 0.5 percent. D. B. Hanna at the CNoR had become very conscious of grades as a result of his experience on the Manitoba and North Western Railway where grades up to 3.1 percent had contributed to very high costs on certain sections of track. On the GTP line, 85-pound rail was used throughout, instead of the more generally used 65-pound (per yard) type of the day (Moore 1975).

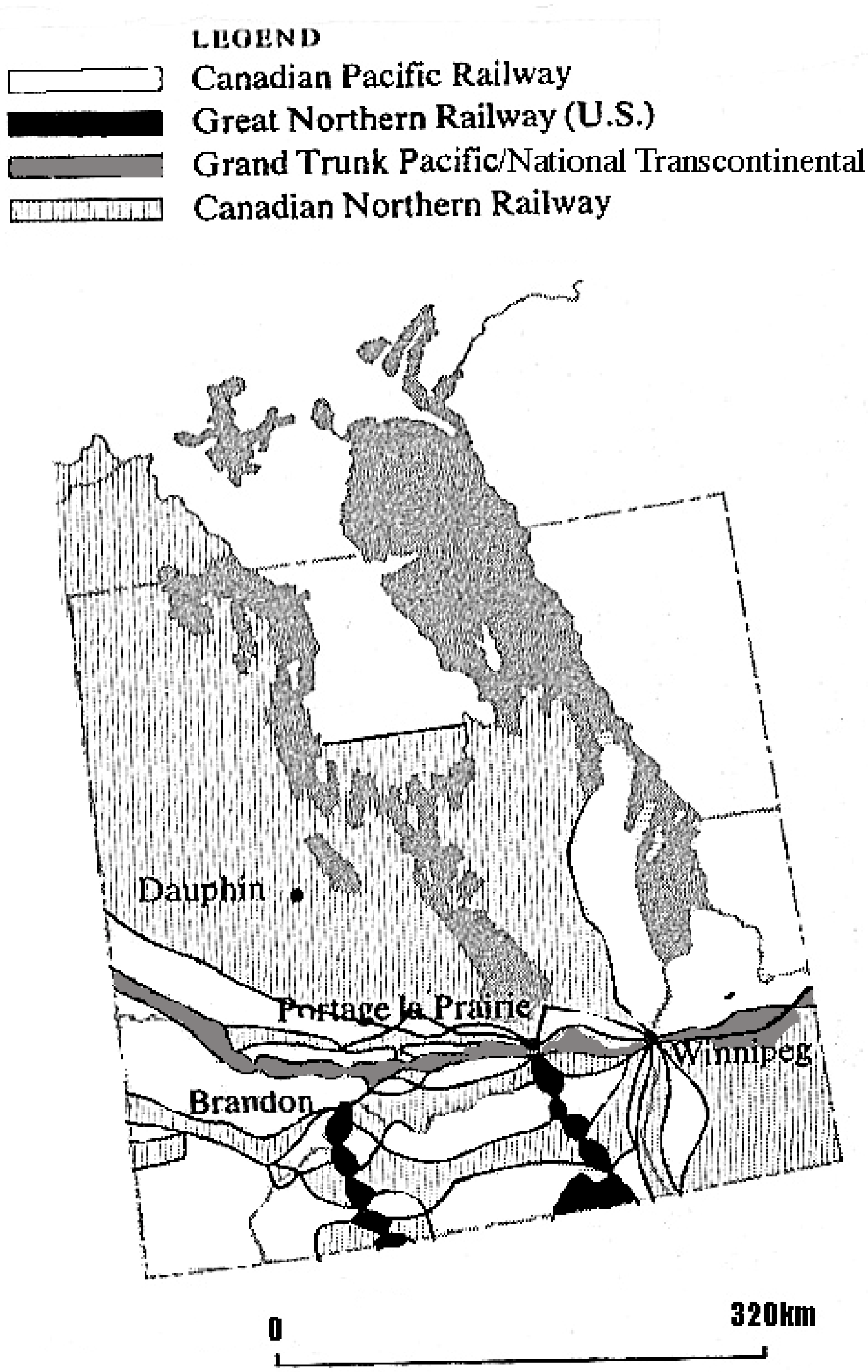
A rather wide strip of land in western Manitoba, between the CPR main line and the CNoR main line, proved to be heavily contested territory (Figure 2.12), leading to one of the best examples of how some competitive aspects of railway development were beginning to become both too expensive for the companies behind them and redundant to the districts through which they traversed. The GTP constructed its main line between the CPR main line and the old Manitoba and North Western Railway (M&NWR, which had been absorbed by the CPR) (Regehr 1974).

GTP officials did not expect anyone to build immediately north of their main line. The CNoR, however, did just that. A local service line running as far west as Beulah, Manitoba, was built. The CPR then decided to build a line of its own between this new CNoR and the GTP main line. In consequence, the CNoR, not to be outdone, built another line just north of the CPR's M&NWR line. Thus, slightly to the east of Brandon, one could find no fewer than eight east-west lines in the space of only 64 kilometres. No fewer than fourteen lines crossed the Manitoba/Saskatchewan border, of which seven belonged to the CNoR and six to the CPR with the remaining one as the GTP main line. Thus, the potential for future railway development in this section of Manitoba had become very limited (Moore 1975).

Railway development was so limited in fact that the GTP could be said to have been closely crowded or bracketed about by its competitors, the CPR and CNoR. Despite earlier promises, the GTP built no branch lines in Manitoba; in part, because of this evident ‘over developed’ rail mesh. Instead, co-operation was resorted to in certain instances. For example, the GTP shared the CNoR’s extensive terminal facilities in Winnipeg, the present “Union Station” being completed in 1911. The GTP main line went from Winnipeg, through Melville, Edmonton, and Jasper, terminating at Prince Rupert. It was completed on April 9, 1914. Just one year later, the last spike for the CNoR was driven on the transcontinental line in Basque, B.C. (Regehr 1974)

With all three transcontinental lines now complete, tight competition was beginning to ensue in the area of Manitoba east of Winnipeg. This area now contained the three rail companies vying with each other to carry Prairie grain to the Lakehead and off to the Atlantic Ocean. The CPR erected western Canada's first terminal grain elevator at Port Arthur in 1883. The CPR later chose to move its operations to the nearby Fort William along the lower Kaministiquia River. The GTP chose this location as well when they constructed their line here from Winnipeg and a northern line to connect with the NT at Sioux Lookout. When Mackenzie and Mann acquired the Ontario and Rainy River Railway and the Port Arthur, Duluth and Western Railway, they chose Port Arthur as the Lake Superior headquarters for the CNoR.

Figure 2.12: Railway territory rivalries in Manitoba, 1915.



Source: Regehr 1976. Used with permission (granted 08/05/2011), © John-Wiley & Sons.

Thus, the twin communities thrived as a transshipment and Prairie grain-handling port for the various railways after the transcontinental railway lines were completed. Thunder Bay was a location where grain could be quickly loaded onto lake steamers and head off to Montreal and the St. Lawrence (Scollie 2000). For its part, the NT main line was built far to the north of the other lines, providing a "straight-line" route through Northern Ontario and Québec to terminate at Atlantic ports.

In 1912, a prosperous, optimistic, and highly expansionist era in North America was beginning to come to a close. Some feared that an international depression was in the offing. That anticipated depression never materialized, however, due to the outbreak of World War I in 1914. However, the war wreaked havoc in its own right, further undermining the financial situation of the promoters of any non-military projects such as the railways. Thus, the London money market that the railways relied on so heavily entered a phase of severe tightening, causing trouble for all the lines in Manitoba.

Nationalization of the Lines

The expansion in the West proved to be too much to be sustainable for the economy of the time. Three long-term solutions to the CNoR's financial problems were considered in 1916 and 1917. One was a refinancing agreement in New York, which would allow Mackenzie and Mann to stay in control. The second was a scheme where the CPR would purchase the common shares from Mackenzie and Mann and amalgamate the CNoR lines with the CPR's own lines. The third involved the acquisition and operation of the CNoR system, together with other lines, by the Dominion Government. Yet Ottawa did not want to intervene prematurely in the so-called "Canadian railway situation" according to the then Finance Minster Thomas White. He said, "[the situation] is so grave as to require that it should be dealt with not in a haphazard manner but comprehensively. This can only be done after we have received a report from the ablest experts that can be obtained and this, of course, will require time." (PAC, Borden Papers, File oc 143, White to Borden, 6 Jan. 1916).

Ottawa was, in fact, already very seriously considering nationalization of the two newer transcontinentals as the only possible solution. When White advocated an inquiry into this option, he said the experts "might conceivably recommend the amalgamation of the Canadian Northern, the Grand Trunk and the Grand Trunk Pacific into a system in which the government might be interested" (PAC, Borden Papers, File oc 143, White to Borden, 6 Jan. 1916). The resulting inquiry was both thorough and far-ranging. Engineers travelled the length and breadth of the CNoR system, and accountants scrutinized the company's accounts, while traffic experts sought to ascertain its future traffic resources and earning capacity (Arbitration, 1238-9, 1064).

The Drayton-Acworth Report was released on May 2, 1917, containing the findings of two of the three members of the Royal Commission that had been established in 1916 to look into the matter. The two members in question were Sir Henry Drayton, Chairman of the Board of Railway Commissioners for Canada and William Acworth, a noted London-based railway economist. The third member, who produced a minority report, was Alfred Smith, President of the New York Central Railway. The report recommended that the government take over the GTR, GTP and CNoR companies and operate them as one system. Together with the Intercolonial (see End-Note 5) and the NT government lines, this would potentially establish a single efficient railway system.[25] Officials from the CNoR and GTR were understandably displeased when they read the Drayon-Acworth Report. Mackenzie and Mann in particular were firmly convinced that they could run a railway system much more efficiently than any government agency. Mackenzie – whose wife had fallen very ill – travelled overnight to Ottawa to meet with Prime Minister Borden to consider the report. Upon his arrival, Mackenzie realized the apparent willingness of Borden to accept the report, even though there had been significant errors made in the calculation of the CNoR's financial situation. Borden later wrote in his diary that Mackenzie then broke down "into audible sobs", which he found to be most distressing.[26] Borden tried to comfort the distraught man and agreed to review the financial statements (Regehr 1976).

The detailed and specific listing of errors in the Drayton-Acton Report that emerged forced the government to review the entire situation. An external accounting company did confirm that the report had omitted considerable assets. Despite its errors, however, the Dominion Government accepted the recommendations of the Drayton-Acworth Report.[27] The final ruling did not come until December 1917, permanently signalling the end of the privately owned CNoR system. This ruling, however, did not include the nationalization of the Grand Trunk lines. There was little doubt that any attempts to build a balanced public railway system must include the GTR and GTP railway systems. The Dominion Government was not ready at this time to acquire the

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[25] *Drayton-Acworth Report*, XLIV, published as Canada, *Sessional Paper No. 20,* 1917.

[26] In the PAC, Borden Diary, there are numerous references in May and June 1917, particular entry for 14 June 1917.

[27] These errors were not fully documented until after the decisions had already been made and the lines nationalized (Regehr 1976).

still-solvent GTR. Ottawa therefore advanced yet another loan to the GTR to keep the struggling GTP lines open.

However, it was not long before the GTP faced bankruptcy. In March 1919 the GTP went into receivership, and was taken over by the Dominion Government. Acting as receiver, Ottawa could then force the GTR to maintain its GTP operations, and in November 1919 legislation was passed to allow the acquisition of the GTR. As in the case of the CNoR, a Board of Arbitration was set up to assess the value of the company. The Board declared all non-guaranteed shares of the GTR valueless. The GTR's representative on the board, ex-U.S. President Taft, strongly disagreed with this assessment. Regardless of this opposition, the GTR passed under federal government control and a new Board of Management was put in place. On January 19, 1923 Order-in-Council P.C. 114 incorporated the GTR into the system. By that juncture, the state had amassed a collection consisting of: the Canadian Government Railways (embracing the Intercolonial, the Prince Edward Island and the NT railways); the Hudson Bay Railway (also state owned); the CNoR and its subsidiaries; the GTP; and the GTR (including the Grand Trunk Western and the Grand Trunk New England lines, both in the United States). In so doing, it had inaugurated the massive government-owned Canadian National Railways (CN) (PAC, Towards CN, from Portage Railway to a National System, 1972).

Upon the completion and reorganization of the large railway systems discussed in this chapter there was still one entity that had been in the works from the very beginning of Manitoba railway history in the 1870s, but whose completion took an inordinate amount of time. This was the storied Hudson Bay Railway, and its evolution warrants consideration here.

The Hudson Bay Railway

The Hudson Bay route was the historic link between Western Canada and the British Isles. It was the Hudson's Bay Company (HBC) that pioneered the Bay as a trade route. The HBC built York Factory[28] on what was to become Manitoba's coastline in 1684, and this post became the "gateway" for a very busy trade route after the union of the HBC and North West Company in 1821. The Selkirk settlers used this route for passage to their new home on the Red River. Eventually, however, farmers rather than trappers and traders shaped the economy of the West.

Practically if not geographically, the Canadian Prairies are landlocked between the Rocky Mountains to the west and the Canadian Shield to the east. It was seen that the Hudson Bay route would bridge, at comparatively low cost, the productive wheat fields of the Prairies to the consuming areas of the world, for it would win access to low-cost marine transport. From the economic point of view the route was shorter, required fewer transfers than by rail to Montreal, and was thus seemingly cheaper. The prospect of reducing transportation costs on wheat shipments and thereby increasing the Prairie farmer's income was very appealing (Government of Manitoba, The Hudson Bay

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[28] "Between 1684 and 1957, York Factory served as a trading post, distribution point and administrative centre for a vast network of fur posts throughout the West. In 1810, York Factory became the headquarters for the HBC's newly established Northern Department. Aside from administrative and financial functions, York Factory also served as the entry point for most Europeans bound for Rupert's Land. Over the next century, York Factory changed from a fur-trade post to a warehousing and transshipment depot with considerable administrative responsibilities. At its peak in the mid-19th Century, it boasted over fifty buildings and a large complement of officers, clerks, tradesmen and labourers, as well as a seasonal workforce of Native traders and hunters. York Factory's role as headquarters was terminated in 1873 and the post continued to decline until it was closed in 1957. The former company complex is now owned by the Canadian Government and operated by Parks Canada as the York Factory National Historic Site of Canada. York Factory's residents were relocated to York Landing Cree Nation" (Parks Canada - York Factory National Historic Site. http://www.pc.gc.ca/eng/lhn-nhs/mb/yorkfactory/index.aspx).

Railway, Historic Resources Branch, 1982). For a full breakdown of HBR distances from producer to market see Appendix III.

Dr. Robert Bell[29] conducted a survey of the region over the years from 1875 to 1880 and, as a result, compiled a list of advantages that were repeated constantly by proponents of a rail line. After seventeen years' experience in northern waters, Bell stated that he saw no trouble or difficulty, in his own experience, in passing through the waters of the Bay itself (Innis 1930).

In 1878, the HBR acquired political influence with Norquay's Conservative government. Although Norquay presented this railway idea to Prime Minister Macdonald, his main commitment –as noted above- was to the completion of the CPR transcontinental line. As mentioned earlier, most Manitoba rail charters had been disallowed in the early 1880s due to the CPR and its treasured monopoly clause. Interestingly, Macdonald approved two charters in 1880, one for the Nelson Valley Railway and Transportation company to build a line from Lake Winnipeg to the mouth of the Churchill River, the other for the Winnipeg and Hudson Bay Railway and Steamship Company to build from Winnipeg to Port Nelson. However, since neither of the companies enjoyed any government assistance, they were forced to merge in 1883 under the latter name. In 1887 the name was changed to The Winnipeg and Hudson Bay Railway Company and, seven years later, to the Winnipeg and Great Northern Railway

[29] Dr. Robert Bell (1841 – 1917) was a scientist, professor, physician, and geographer. "In 1863, Bell led many extensive explorations in northern Quebec, Ontario, Manitoba, the eastern Arctic, Saskatchewan prairies, and Athabasca oil sands. He is credited with mapping the rivers between Hudson Bay and Lake Superior. Bell's work was appreciated because he collected specimens and made notes on geology, flora and fauna, climate and soil, indigenous populations, and exploitable resources. Survey colleagues dubbed him the father of Canadian place-names because estimates credit him with naming over 3,000 geographical features in Canada" (Government of Canada, Dictionary of Biography of Canada Online http://www.biographi.ca/009004-119.01-e.php?&id_nbr=7201)

Company.

During the 1880s and 1890s all these putative companies were led by Hugh McKay Sutherland of Winnipeg. Sutherland's attempts to obtain financing from the province and the Dominion as well as European Banks were frustrated by political manipulation. As a result, only 64 kilometres of track were laid to Shoal Lake. In the event, construction never resumed along the Interlake route from Shoal Lake (Regehr 1976).

The construction of these 64 kilometres to nowhere brought into the picture the railway duo Mackenzie and Mann. Their CNoR had already built the first successful line in the northern direction, the one that reached Dauphin in 1896, and Winnipegosis in 1897. By 1908 their northern initiatives had laid down track from Hudson Bay Junction in Saskatchewan to The Pas. The line terminated in this isolated Manitoba settlement. Only very substantial government subsidies would induce them to build further, for Mackenzie and Mann did not think highly of the Hudson Bay project (Arbitration, 2674-5). Once this impasse became clear, the matter became the subject of hot political dispute between federal and local politicians. After much dispute, Mackenzie and Mann agreed to build the line towards Hudson Bay – but at a very steep price. In one historian's view this amounted to "government construction, with the road being handed over as a gift to Mackenzie and Mann" (Stevens 1960, pg 433).

Exorbitant demands from Mackenzie and Mann combined with a situation in which the people of the Prairies united in their demand for the northern link left the Dominion Government in an uncomfortable position. Many in the West urged Ottawa to build the line as a government project, arguing that no existing railway aligned along major east-west lines would give the north-south route a chance, fearful that it would divert traffic from the lines to the St. Lawrence (PAC, Sifton Papers, CXCIII, 154612-15, J. Dafoe to Sifton, 16 Aug. 1910). But Prime Minister Laurier was personally opposed to government construction, for he said the road needed all the elasticity of operation which a company can, and the government cannot, provide (PAC, Laurier Papers, Laurier to Cameron, 16 April 1906).

A decision was finally reached in 1908 when Clifford Sifton recommended a new plan wherein 3 million acres of land would be held back and sold, with the proceeds going to a special fund used to finance the construction of the Hudson Bay Railway. This meant, however, that construction would be delayed until the reserve fund was established and sufficient lands had been sold to permit construction. Because of these delays, the plan was not popular in the West and its implementation strained relations between Sifton and other Liberals. The government nevertheless decided to adopt this plan. On September 18, 1908, Laurier made the first public promise to build the HBR with this statement:

> We have undertaken the construction of another railway, the Hudson Bay Railway… Now, we have come to the conclusion that this railway is a necessity, owing to the conditions in which our fellow citizens of the West are placed. This railway will give an alternative or optional route… We have been asked: 'Are you not going to hurt the trade of the St. Lawrence, if you do that?' Oh ye of little faith! The trade of Canada is too great even for these two outlets. What we see coming will be more than sufficient for both the St. Lawrence and Hudson Bay routes… The Government will build the railway, or rather, somebody will be entrusted for building it for us, but whatever we do, all the terminals and all the elevators shall be built by the Government, and retained under all and every circumstance by the Government so as to ensure the largest measure of benefit possible to the Canadian people in the Northwest provinces.

Source: (PAC, Laurier Papers, 18 Sept. 1908). This work is considered to be in the public domain as per Canadian copyright law as it was created over 75 years ago.

With this, Mackenzie and Mann were relieved of their charter to build the 724 kilometres of track and the HBR became a public enterprise to be financed by public funds (Fleming 1957).

When the government finally decided to begin construction in 1910, the contractors who submitted the lowest tender for the first section were none other than Mackenzie and Mann. In this case, the CNoR promoters were more interested in the construction contracts than the promotional opportunities that they claimed underwrote their other Manitoba lines. Between 1910 and 1914, 345.2 kilometres of line were laid, and when World War I began the line had reached Kettle Rapids, a mere 161 kilometres from the Port Nelson terminus. Port Nelson had been selected not for its harbourage, but for its shorter and easier access. During and immediately after World War I, construction was halted to divert men to the war effort and materials were sent to the newly formed CNR (Government of Manitoba, The Hudson Bay Railway, Historic Resources Branch, 1982).

For several years little happened to the HBR under CNR control. The mid-1920s witnessed an upsurge in public opinion in favour of completing the railway. In addition to the grain farmers quest for a northern port, ore discoveries at Mandy, Flin Flon and Sherritt, coupled with increased interest in pulp and paper, hydro-electric, marble and other resources in northern Manitoba, increased the desirability of this rail link. Finally, in 1926, a parliamentary vote removed the HBR from CNR control and placed it directly under the Department of Railways and Canals. Due to the presence of a natural harbour at Churchill, it was substituted as the terminus of the line following the recommendation of Frederick Palmer (Government of Manitoba, The Hudson Bay Railway, Historic

Resources Branch, 1982).

On April 3, 1929 the railway (without its roadbed)[30] reached the port of Churchill, and the last spike, wrapped in tinfoil from a tobacco package, was driven to symbolize completion (Figure 2.13). With the coming of the railway, the town site of Churchill was laid out, port installations were completed, and a huge grain elevator and wharves were built. In September 1931 all buildings were completed and the HBR was officially declared open (Government of Manitoba, The Hudson Bay Railway, Historic Resources Branch, 1982).

It appears that Mackenzie and Mann's early skepticism about this line has turned out to be correct. It did not become the major grain-handling transportation link to the consuming areas of the world that its proponents had hoped for. The HBR has, however, helped in the development of northern resources, throwing off spur lines to mineral developments at Flin Flon, Thompson and Lynn Lake, lines which carry people and supplies to areas still inaccessible by any road network.

Moreover, the town of Churchill has developed to some extent around the activities conducted in the harbour. In short, the HBR continues to play an important role, being Manitoba's only land connection to the entire Northern half of the province[31] [32]

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[30] The last 96.8 kilometres of track were laid right atop the muskeg during the winter of 1928-29. As sinkholes would swallow modern mechanical grading equipment and steam shovels and the permafrost could not be excavated, hand pick, hand shovel and wheelbarrow were the only tools available to the workers. The gravel bed was dumped under the tracks during the summer of 1929 and the line was finally ready for use on September 13, 1929 (Frederick 1981).

[31] CNR subsequently built resource railways from The Pas to Flin Flon, opening in 1928, followed by an extension of this line from Cranberry Portage, Manitoba, to Lynn Lake, opening November 9, 1953. Following the privatization of the CNR in 1995, an all-new company, Hudson Bay Railway (HBRY), was formed in 1997 to purchase the line from CNR. The HBRY is owned by railroad-holding company OmniTRAX, based in Denver, Colorado. VIA Rail also operates remote services on HBRY using its Hudson Bay passenger train between Winnipeg and Churchill. Major customers for HBRY include Continued…

(Frederick 1981).

Figure 2.13: The completed Hudson Bay Railway shown from Hudson Bay Junction to Churchill.

Source: Created May 2011 by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute.

HudBay Minerals, Tolko Manitoba, Vale Inco, Gardwine North, Stitcco Energy, and the Canadian Wheat Board. (OmniTRAX, Pride in Excellence, Hudson Bay Railway, http://www.omnitrax.com/rail_hbry.aspx)

[32] The rail line between Sherritt Junction and Lynn Lake was part of the HBRY system, and VIA Rail had operated trains between The Pas and Pukatawagan under an agreement with HBRY. On April 1, 2006, the HBRY sold the line to the three aboriginal tribes in the area, who now own and operate the railway under the title The Keewatin Railway Company (KR). The KR is the second railway fully-owned by aboriginal people in Canada. VIA Rail still operates its twice-weekly passenger trains through an agreement with the new company ("The Pas-Pukatawagan train - Description". VIA Rail Canada. http://www.viarail.ca/en/trains/prairies-and-northern-manitoba/the-pas-pukatawagan).

Conclusion

This chapter has attempted to show from a historical perspective how the rail companies and governments alike tried to open up Manitoba to extensive settlement. Both devised policies to realize the objective of economic growth and development, while at the same time advancing their own political or financial interests. In the end, Manitoba owes its extensive railway network to the provincial government's willingness to guarantee construction bonds of CNoR lines and to provide small cash subsidies for local lines built by the CPR that refused the provincial bond guarantees. The federal government followed Manitoba's example when it guaranteed railway extensions in the Northwest Territories (now Saskatchewan and Alberta) and ensured that effective export links were established to the Atlantic (via the St. Lawrence and Hudson Bay). It is clear that Western Canada, and Manitoba in particular, simply could not have been settled and developed without rail service, and despite some of the errors that may have been made during this time, the CPR, CNoR and GTP all provided a necessary and valuable service.

Since the Manitoba rail network reached its peak in 1915, the advent of newer technology, such as the internal combustion engine along with government construction of roads and highways, has led to a great decline in rail service. Although the Prairie trunk lines remain viable, many previously essential branch lines became very unprofitable and perhaps even redundant, leading to a great number of branch lines being closed. The sad upshot left some areas with no rail service and a phenomenal number of ghost towns.[33]

This chapter has endeavoured to shed some light on the development of the Manitoba railway system, revealing a highly complex path of development underlying the network configurations. D.W. Meinig once said that to truly understand how a spatial network was created, extensive archival research must be done, which has been the objective of this chapter. Further, Meinig also claims that "it is very likely that the application of certain theoretical models will contribute much to our understanding of such spatial systems" (Meinig 1962, pg. 394). This exhortation to engage in modelling has not been lost on this student; indeed, it is the substance of the next few chapters. In order to bring this aim to fruition, it is necessary to begin by examining the application of graph theory to transportation systems, and that leads us into the next chapter where the methodological underpinnings of this analysis will be presented.

[33] Ghost towns are towns that once had a considerable population, but that have since seen that population dwindle causing some or all business activities to close, either due to rail lines being removed, the rerouting of a highway, or exhaustion of some natural resource.

End-note 1

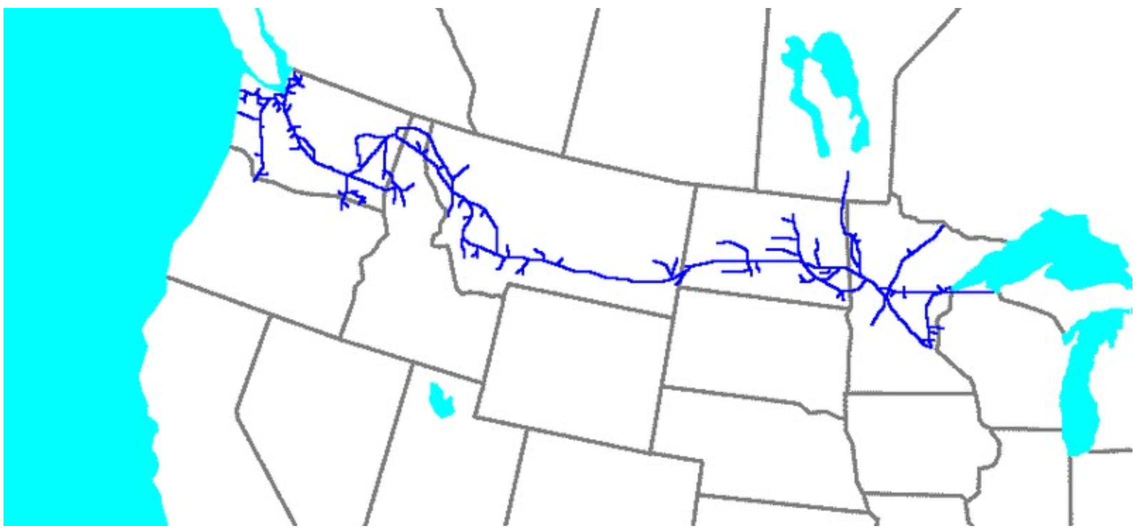
Greater Winnipeg Water District Railway

The Greater Winnipeg Water District Railway (GWWD) is a 164-km long industrial railway from Winnipeg, Manitoba, to Shoal Lake near Manitoba's eastern boundary. The GWWD is Canada's longest industrial railway line. "Work began on the railway in 1914 with the rail line advancing along the right of way of the proposed aqueduct, building up the grade from bed material, with gravel for ballast and lumber for ties. The line was completed in 1915, and serviced the construction of the aqueduct, which began the same year. The GWWD attempted to reduce overall costs by working for other customers and bringing in revenue. Freight included firewood, pulpwood, poles, railway ties, ice, mail, milk, gravel and sand. Today, the railway is owned by the City of Winnipeg and used only for Winnipeg water-supply needs. It is also used to provide security and surveillance along the aqueduct while still being the only means of reaching the intake" (City of Winnipeg, Water and Waste Department, The Greater Winnipeg Water District Railway: http://www.winnipeg.ca/waterandwaste/dept/railway.stm Accessed in December 2010).

End-note 2

The Northern Pacific Railway (NP) was created on July 2, 1864 when U.S. President Abraham Lincoln signed an Act of Congress creating the entity. It was granted some 190,000 square kilometres of land in exchange for introducing rail transportation into undeveloped territory. It would connect its eastern terminus of Lake Superior to the western terminus of Puget Sound. Much of its route was to follow the path of the prominent 1804-1806 Lewis and Clark expedition across the uncharted West. It was not until 1870 that groundbreaking took place near Duluth, Minnesota. The first rails on the west end of the projected transcontinental were laid at about the same time. The completion of the first of the northern transcontinental railways was at Gold Creek, Montana Territory, where tracks met from the East and the West on September 8, 1883. President Ulysses S. Grant and Henry Villard, president of the NP, drove the ceremonial "last spike". The railway served a large area, including extensive trackage in the states of Idaho, Minnesota, Montana, North Dakota, Oregon, Washington and Wisconsin, with international lines to Winnipeg and southeastern British Columbia. The company was headquartered first in Brainerd, Minnesota, then in Saint Paul, Minnesota. The Northern Pacific Railway operated from 1864 to 1970 with its immediate successor being the Burlington Northern (Martin 1976).

Figure 2.14: Northern Pacific network map

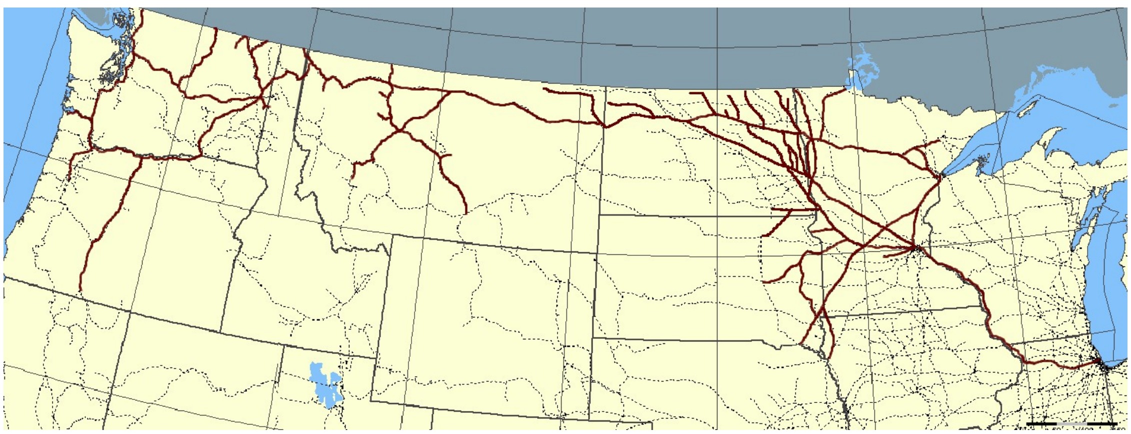


Source: Central Data Bank, 2009. Used with permission © from Creative Commons Attribution 3.0 License, http://creativecommons.org/licenses/by/3.0/ Accessed May 2011.

End-Note 3

The Great Northern Railway (GNR) (Figure 2.15), running from an eastern terminus of Saint Paul, Minnesota, to the western terminus of Seattle, Washington, was the creation of J. J. Hill and was developed from the St. Paul and Pacific Railroad. The GNR route was the northernmost transcontinental railroad route in the United States and was north of the NP route. The GNR was a privately funded transcontinental railway, though some of its predecessor roads received land grants. It was one of the few transcontinental railways to avoid bankruptcy in the early 1890s (Martin 1976).

Figure 2.15: Great Northern Railway network map



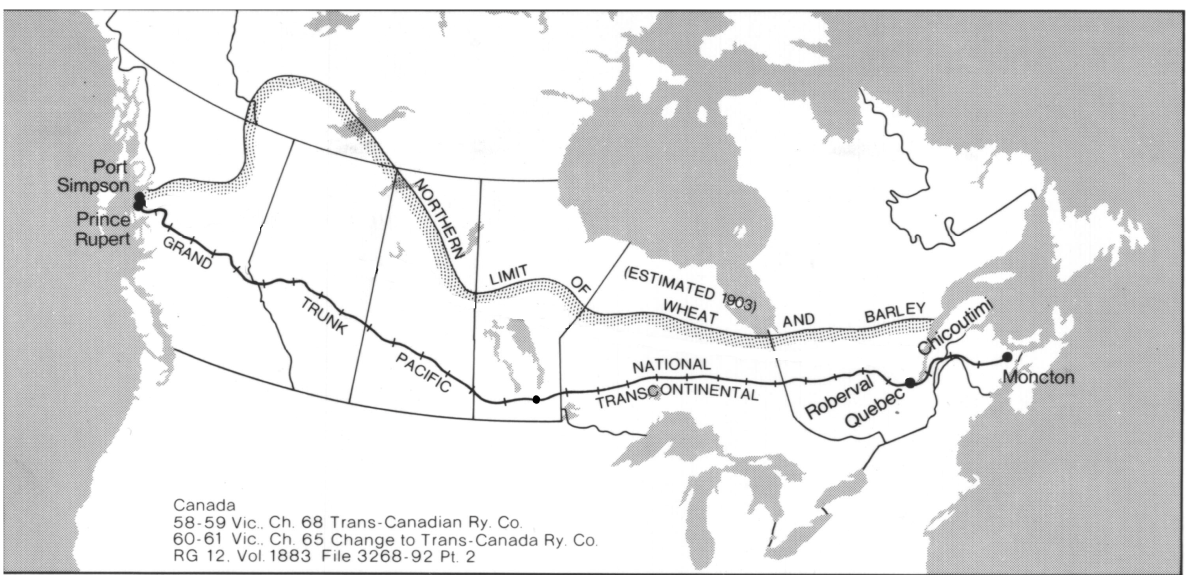
Source: Elkman, 2006. Used with permission © from Creative Commons Attribution 3.0 License, http://creativecommons.org/licenses/by/3.0/ Accessed May 2011.

End-Note 4

The National Transcontinental Railway (NTR) (Figure 2.16) was a government-built railway from Winnipeg, via Sioux Lookout, Kapuskasing, Cochrane and Québec City, to Moncton. In October 1903 the government of Wilfrid Laurier committed itself to the construction of a third transcontinental railway, despite the existence of the CPR and the CNoR. Its purpose was to provide western Canada with direct rail connection to Canadian Atlantic ports, and to open up and develop the northern frontiers of Ontario and

Québec. Mutual jealousies precluded logical co-operation between the GTR and CNoR in constructing the transcontinental line, and, realizing its importance to national development, the federal government opted to build the line. Thus, the government itself would build the eastern section (Winnipeg to Moncton) and eventually turn it over to the GTP for operation. The NT was never incorporated and the financial problems of the GTP prevented it from taking over the NT as agreed. It remained under government management until 1918, when operations were entrusted to the recently nationalized Canadian Northern Railway. In 1923 it became a part of the Canadian National Railways (Stevens 1960).

Figure 2.16: National Transcontinental network map

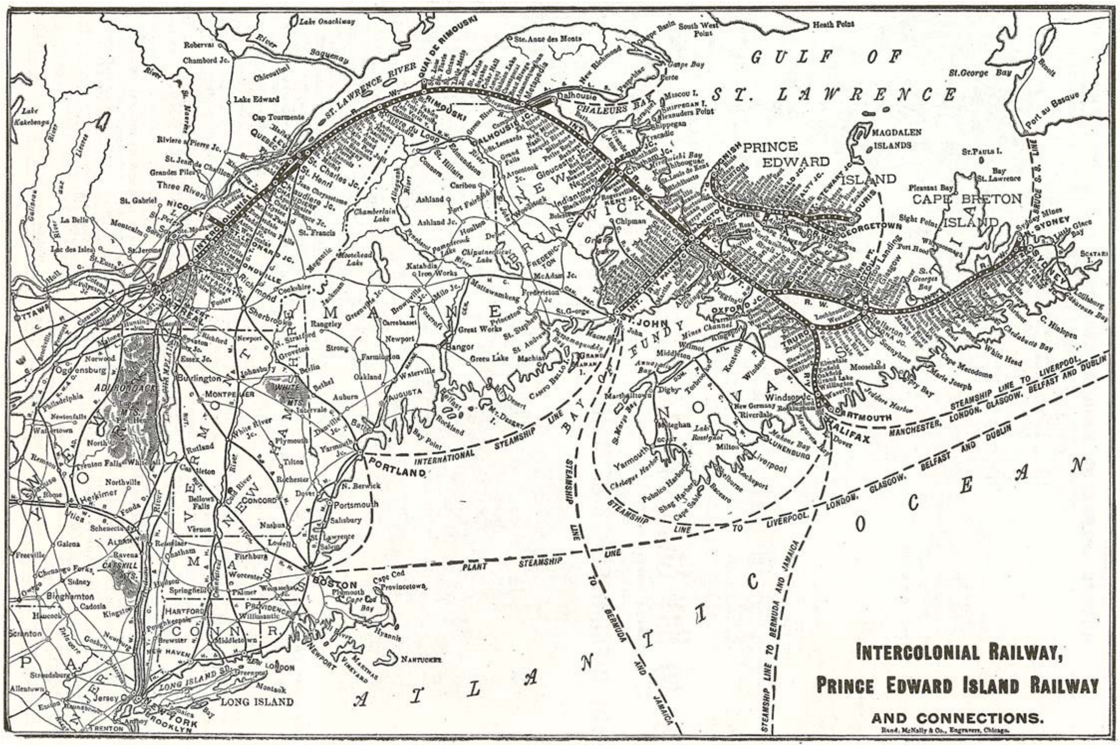


Source: Public Archives of Canada, RG 12, Vol. 1883, File 3268–98, pt. 2. This work is considered to be in the public domain as per Canadian copyright law as it was created over 75 years ago.

End-Note 5

The Intercolonial Railway (ICR) was one of Canada’s first railways. “Completion of the railway was made a condition of Confederation, in 1867, and construction began shortly after. The first section between Truro and Amherst, NS, was opened on 9 November 1872, and that between Rivière-du-Loup and Ste-Flavie [Mont-Joli], Québec, in August 1874. The link between Campbellton and Moncton, NB, was completed in 1875 and the gap between Campbellton and Ste-Flavie was closed in 1876. Construction of the railway did not require spectacular engineering feats but did present numerous difficult challenges. The railway was also built to high standards. At Fleming's insistence, all but three of the bridges were built of iron. Built to fulfill the terms of Confederation, the Intercolonial was never a commercial success. Nevertheless, it provided employment, developed towns and villages along its route, and was a customer for Nova Scotia coal. The ICR was the first significant crown corporation in Canada. During the 42-year life of the ICR from 1876 to 1918, the railway had grown to a monopoly position in land transportation. The ICR had been called the "People's Railway" and this slogan was similarly applied to the CNR for a period. Freight rates were kept low in order to promote trade, and deficits were met by the government. In 1919 the Intercolonial became part of the Canadian National Railways” (Underwood 2005).

Figure 2.17: The Intercolonial Railway, Prince Edward Island Railway and Connections.



Source: Public Archives of Canada. RG 12, Vol. 1885, File 3270–91. This work is considered to be in the public domain as per Canadian copyright law as it was created over 75 years ago.

CHAPTER THREE

Analysis of Graph-Theory and its Application to Transport Systems

Introduction

As a cardinal rule, transport exists for the purpose of bridging spatial gaps between places on both large and small scales. That bridging function renders trade possible. By the same token, the evolution of rail transport systems has been a catalyst for development all over the globe. It has allowed people and goods to be moved from place to place in a cost-efficient manner, and be moved to a place where their utility is higher. As was hinted earlier, transport as a fundamental human activity full of developmental benefits may be studied in spatial terms with graph-theory methods. These can be readily adapted to find the solution to many of the issues associated with the rail transport industry. While at first glance, graph theory presents itself as the ideal tool for investigating the evolution and use of rail transport systems, its use is not so straightforward. In short, a multitude of factors influencing the evolution and design of rail systems must be taken into consideration when studying them, factors not easily subject to "averaging" on account of their often unique historical circumstances. Besides demonstrating such factors, this chapter will consider a contemporary working example of graph theory so as to endorse its general validity notwithstanding the reservations attaching to the methodology. First, though, a general overview of the methodology is in order.

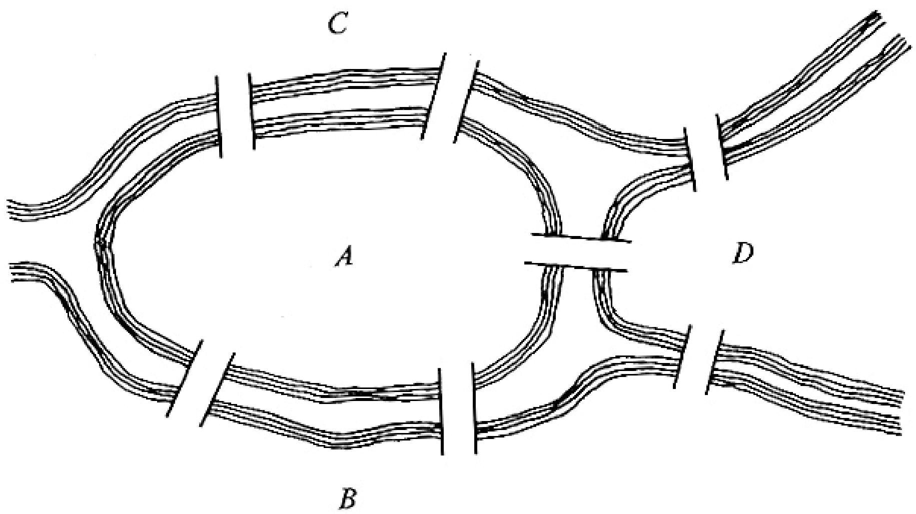
There are applications of graph theory to some areas of physics, chemistry, computer science, electrical and civil engineering, architecture, genetics, psychology, sociology, economics, anthropology and linguistics. The theory itself is intimately related to many branches of mathematics, including group theory, matrix theory, numerical analysis, probability, and topology. As already noted, the earliest recorded example of its usage had a bearing on transport geography. This is now known as the Königsberg Bridge Problem (Harary 1969). It deserves consideration here because of its seminal importance.

The Seven Bridges of Königsberg

In 1735 Leonhard Euler laid the foundations of graph theory and presaged the idea of topology when he settled a famous unsolved problem of his day, a problem that had baffled all interested parties before him. The city of Königsberg in East Prussia (now Kaliningrad, Russia) was set on both sides of the Pregel River, and included two large islands that were connected to each other and the mainland by seven bridges (Figure 3.1).

The dilemma was to find a path through the village that would cross each bridge once and only once. Apart from the bridges, the islands could not be reached any other way, and every bridge must have been crossed in its entirety (one could not walk half way onto the bridge and then turn around and later cross the other half from the other side) (Harary 1969).

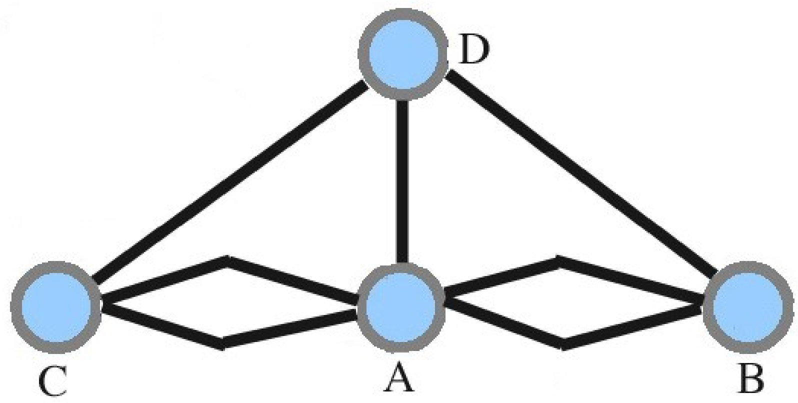
Figure 3.1: The Bridges of Königsberg, Prussia



Source: adapted from Euler's original work (in Latin), "Solutio problematis ad geometriam situs pertinentis." ***Comment. Acad. Sci. U. Petrop.*** 8**, 128-140, 1736. This work is considered to be in the public domain as per Canadian copyright law as it was created over 75 years ago.**

Using his wisdom, Euler proved that this problem has no solution. He reformulated this predicament into theoretical terms (laying the foundations of graph theory), eliminating all features except the list of land masses and the bridges connecting them. Using modern terminology, one replaces each land mass with an theoretical "vertex" or "node", and each bridge with an theoretical connection, an "edge", which only serves to confirm which pair of vertices (land masses) is connected by that bridge. The resulting structure is the graph (Figure 3.2).

Figure 3.2: The graph of the Königsberg Bridge Problem



Source: Created 11/15/10 by McCombe, C.G.L.

Rather than treating this specific situation, Euler generalized the problem and developed a criterion for a given graph to be so traversable; namely that it is connected and every point is an incident with an even number of lines. While the graph in Figure 3.2 is connected, not every point is incident with an even number of lines (Harary 1969, Euler 1736).

Graph-Theory Principles

It is evident from the Euler precedent that a graph is a symbolic representation of a network and of its connectivity. Due to the fact that the real world is so complicated, graphs adopt an abstraction of reality so that it can be simplified as a set of linked nodes. In other words, graph theory is a branch of mathematics concerned with how networks can be encoded and their properties easily measured. In transport geography, most networks have an obvious spatial foundation, namely road and rail configurations, which tend to be defined more by their links than by their nodes. However, this is not necessarily the case for all transportation networks. For example, air networks tend to be defined more by their nodes than by their links, since their links ("airways") are often not clearly defined or are always changing (Rodrigue 2006).

The following elements are fundamental to understanding graph theory:

Node: A node is, "a terminal point or an intersection point of a graph. It is the abstraction of a location such as a city, an administrative division, a road intersection or a transport terminal (stations, harbours and airports)" (Rodrigue 2006).

Link: A link is, "a connection between two nodes. A link is the abstraction of transport infrastructure supporting movements between nodes. It can have a direction that is commonly represented as an arrow. When an arrow is not used, it is assumed the link is bi-directional" (Rodrigue 2006).

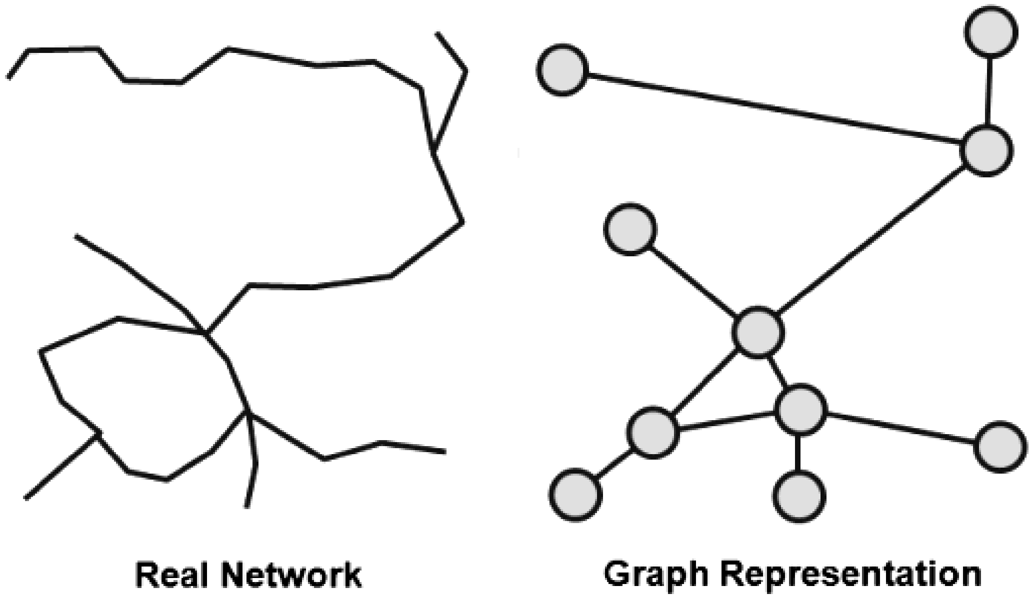
Graph Representation of a Real Network

The goal of a graph is to represent the *structure*, rather than the appearance of a network. The conversion of a real network into a planar graph is a straightforward process which follows some basic rules: first, and most importantly, every terminal and intersection point becomes a node; and secondly, each connected node is then linked by a straight segment.

The outcome of this abstraction, as portrayed in Figure 3.3, is the actual structure of the network. The real network, depending on its complexity, may be baffling in terms of revealing its connectivity (what is linked with what?). A graph representation reveals the connectivity of a network in the best possible way (Rodrigue 2006).

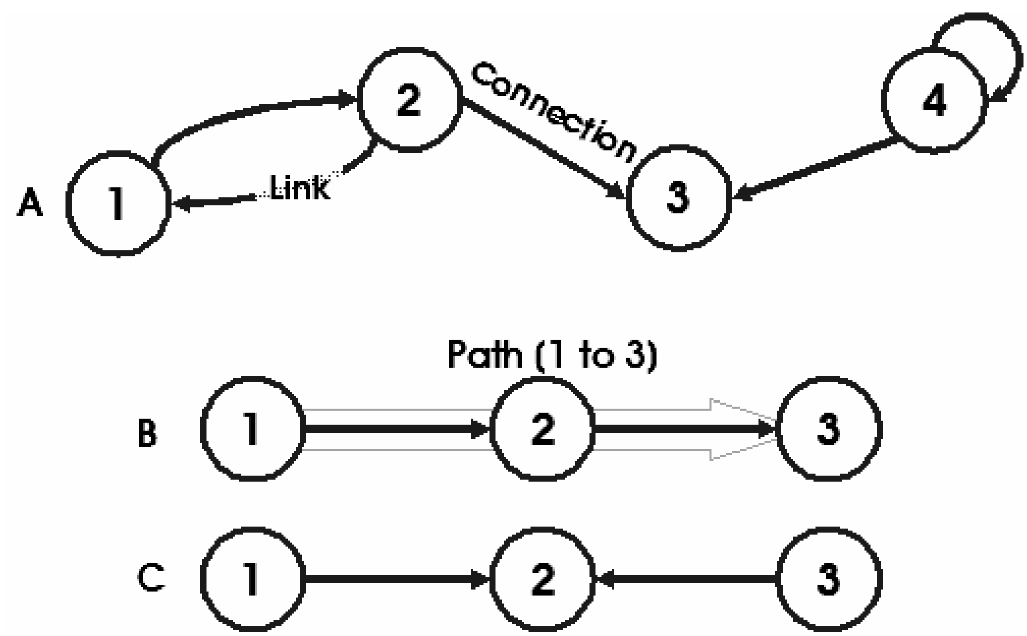
Graph theory offers the possibility of representing movements as linkages, which can be considered over several aspects. These are defined below (see Figure 3.4).

Figure 3.3: The Graph Representation of a Real Network



Source: Rodrigue 2006, pg. 60. Used with permission (granted 04/05/2011), © John-Paul Rodrigue.

Figure 3.4: Connections and Paths



Source: Rodrigue 2006, pg. 62. Used with permission (granted 04/05/2011), © John-Paul Rodrigue.

Connection (refer to 3.4A): is a, "set of two nodes, as every node is linked to the other; considers if a movement between two nodes is possible, whatever its direction. Knowing connections makes it possible to find if it is feasible to reach a node from another node within a graph" (Rodrigue 2006).

Path (refer to 3.4B): is a, "sequence of links that travel in the same direction. For a path to exist between two nodes, it must be possible to travel an uninterrupted sequence of links. Finding all the possible paths in a graph is a fundamental attribute in measuring accessibility and traffic flows" (Rodrigue 2006).

Chain (refer to 3.4C): is a, "sequence of links having a connection in common with the other. Direction does not matter" (Rodrigue 2006).

Cycle: Refers to a, "chain where the initial and terminal node is the same and does not use the same link more than once" (Rodrigue 2006).

Circuit: is a, "path where the initial and terminal node corresponds. It is a cycle where all the links are travelled in the same direction. Circuits are very important in transportation because several distribution systems are using circuits to cover as much territory as possible in one direction" (delivery route) (Rodrigue 2006).

The organization of nodes and links in a graph convey a structure that can be labelled. The basic structural properties of a graph are described in detail thus:

Symmetry and Asymmetry: A graph is symmetrical if, "each pair of nodes linked in one direction is also linked in the other. Typically, a line without an arrow represents a link where it is possible to move in both directions. However, both directions have to be defined in the graph. Most transport systems are symmetrical, but asymmetry can occur. For example, rail system asymmetries can occur in the form of one-way tunnels, narrow-bridge routings and incline systems. Asymmetry is rare on road transportation networks, unless one-way streets are considered" (Rodrigue 2006).

Completeness: A graph is complete if, "two nodes are linked in at least one direction" (Rodrigue 2006).

Connectivity: A complete graph is described as, "connected if for all its distinct pairs of nodes there is a linking chain. Direction does not have importance for a graph to be connected, but may be a factor for the level of connectivity. There are various levels of connectivity, depending on the degree at which each pair of nodes is connected" (Rodrigue 2006).

Complementary: Two sub graphs are complementary if, "their union results in a complete graph. Multimodal transportation networks are complementary as each sub-graph benefits from the connectivity of other sub-graphs" (Rodrigue 2006).

Root: A root is, "the starting point of a distribution system, such as a factory or a warehouse. Direction is of importance" (Rodrigue 2006).

Measures

Several measures can be used to analyze network efficiency and can be used for such key considerations as "expressing the relationship between values in the network structures they represent, comparing transportation networks at a specific point in time and comparing the evolution of a transport network at different points in time" (Rodrigue 2006).

Diameter: (d). "The length of the shortest path between the furthest nodes of a graph is the diameter. The d measures the extent of a graph and the topological length between two nodes" (Rodrigue 2006).

The diameter enables us to measure the development of a network in time. The higher the diameter, the less linked a network tends to be. In the case of a complex graph, the diameter can be found with a topological distance matrix (Shimbel distance), which computes for each node pair its minimal topological distance. Graphs whose extent remains constant, but with a higher connectivity, have lower diameter values (Rodrigue 2006).

Number of cycles (u). “The maximum number of independent cycles in a graph. This number (u) is estimated through the number of nodes (v), links (e) and of sub-graphs (p); u = e-v+p” (Rodrigue 2006).

Indices

Indices can be more complex as they involve the comparison of one measure over another. In rail transport analysis one of the most fitting is the Detour Index.

Detour Index is “the measure of the efficiency of a transport network in terms of how well it overcomes the distance or the friction of space. The closer the Detour Index is to 1, the more efficient is the network” (Rodrigue 2006). The DI is expressed as:

$$DI = \frac{DD}{TD}$$

TD represents the trip distance and DD the straight-line distance. For example, the straight distance (DD) between two nodes may be 80km while the transport distance (TD) is 100km. In this case the Detour Index is equal to 0.8 (80/100) (Rodrigue 2006). Inefficiency may creep into the transport system when it must be routed around physical, social or political boundaries, causing the DI to drop considerably.

The network density tells us how much a rail network has been developed. Network Density measures “the territorial occupation of a transport network in terms of km of links (L) per km^2 of surface (S). The higher it is, the more a network is developed. Commonly, smaller, higher-populated regions will have a higher network density than vast lower-populated regions” (Rodrigue 2006).

$$ND = \frac{L}{S}$$

Pi Index is "the relationship between the total length of the graph L(G) and the distance along its diameter D(d). It is labelled as Pi because of its similarity with the real Pi (3.14), which is expressing the ratio between the circumference and the diameter of a circle. A high index shows a developed network. It is a measure of distance per units of diameter and an indicator of the shape of a network" (Rodrigue 2006).

$$\Pi = \frac{L(G)}{D(d)}$$

Eta Index is "the average length per link. Adding new nodes will cause a decrease of Eta as the average length per link declines" (Rodrigue 2006).

$$\eta = \frac{L(G)}{e}$$

Theta index measures "the function of a node, which is the average amount of traffic per intersection. The higher the theta magnitude, the greater the load of the network" (Rodrigue 2006).

$$\theta = \frac{Q(G)}{v}$$

Beta Index measures "the level of connectivity in a graph and is expressed by the relationship between the number of links (e) over the number of nodes (v). Trees and simple networks have Beta value of less than one. A connected network with one cycle has a value of 1. More complex networks have a value greater than 1. In a network with a fixed number of nodes, the higher the number of links, the higher the number of paths possible in the network. Complex networks have a high value of Beta" (Rodrigue 2006).

$$\beta = \frac{e}{v}$$

Alpha Index is “a measure of connectivity that evaluates the number of cycles in a graph in comparison with the maximum number of cycles. The higher the alpha index, the more a network is connected. Trees and simple networks will have a value of 0. A value of 1 indicates a completely connected network. In short, the alpha index measures the level of connectivity independently of the number of nodes. It is very rare that a network will have an alpha value of 1, because this would imply very serious redundancies (and huge costs in the provision of a real network)” (Rodrigue 2006).

$$\alpha = \frac{u}{2v - 5}$$

Gamma Index (g) is “a measure of connectivity that considers the relationship between the number of observed links and the number of possible links. The value of gamma is between 0 and 1 where a value of 1 indicates a completely connected network and would be extremely unlikely in reality. Gamma is an efficient value to measure the progression of a network in time” (Rodrigue 2006).

$$\gamma = \frac{e}{3(v-2)}$$

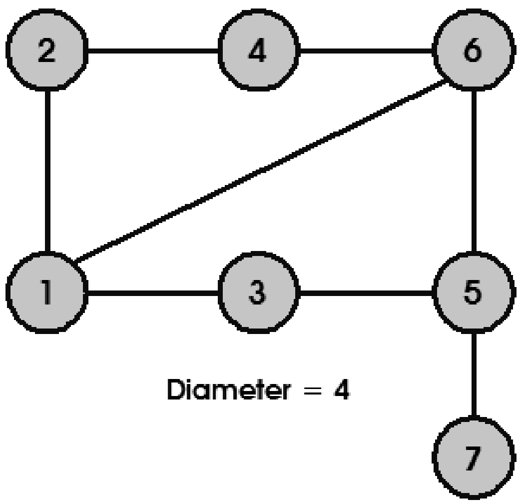
(Rodrigue 2006).

Thus it is obvious that graph theory has definite strengths in the field of transport network analysis. Using set formulas, one can harness the power required to properly calculate many aspects of past, current or future transport systems. It also provides an abstraction of reality that cuts away excessive and unnecessary details to make the systems easier to understand and subject to analysis.

Maps as Graphs

Although maps can summarize much, there are aspects of networks and flows that they cannot effectively deal with. The major limitation is in their computational abilities. A map is far too concrete and detailed to allow much in the way of analysis. For this reason we transform maps into graphs to perform various analyses using measures and indices. The shape of a network is a more difficult concept to grasp. It involves the concept of diameter in the context of the Pi index (π). The diameter is calculated in figure 3.5.

Figure 3.5: Derivation of a measure of network diameter.

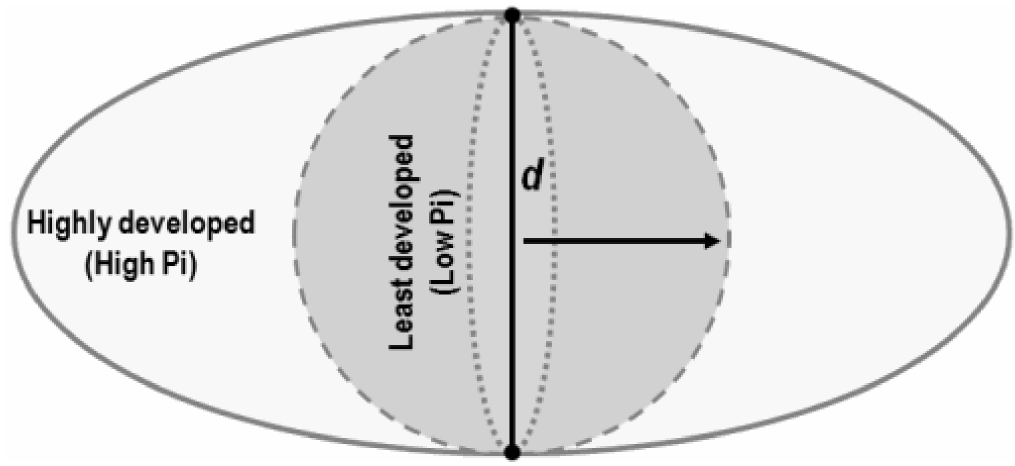


Shimbel Distance							
v	1	2	3	4	5	6	7
1	0	1	1	2	2	1	3
2	1	0	2	1	3	2	4
3	1	2	0	3	1	2	2
4	2	1	3	0	2	1	3
5	2	3	1	2	0	1	1
6	1	2	2	1	1	0	2
7	3	4	2	3	1	2	0

Source: Rodrigue 2009 pg. 64. Used with permission (granted 04/05/2011), © John-Paul Rodrigue.

Accordingly, the number of links (edges) between the furthest nodes (2 and 7) of this graph is 4. Consequently, the diameter of this graph is 4. The highest value of the topological distance of this matrix is the diameter of the graph (d=4). A high index shows a developed network. It is a measure of distance per units of diameter and an indicator of the shape of a network. Kansky developed an image in his 1963 work, which displays this concept graphically (Figure 3.6).

Figure 3.6: Kansky's abstraction between the diameter (d; vertical axis) and length of the network (horizontal axis). A low Pi index is linked with a low level of network development (such as simple corridors) and a high value of Pi is linked with a more extensively developed network (a system of linked cities).



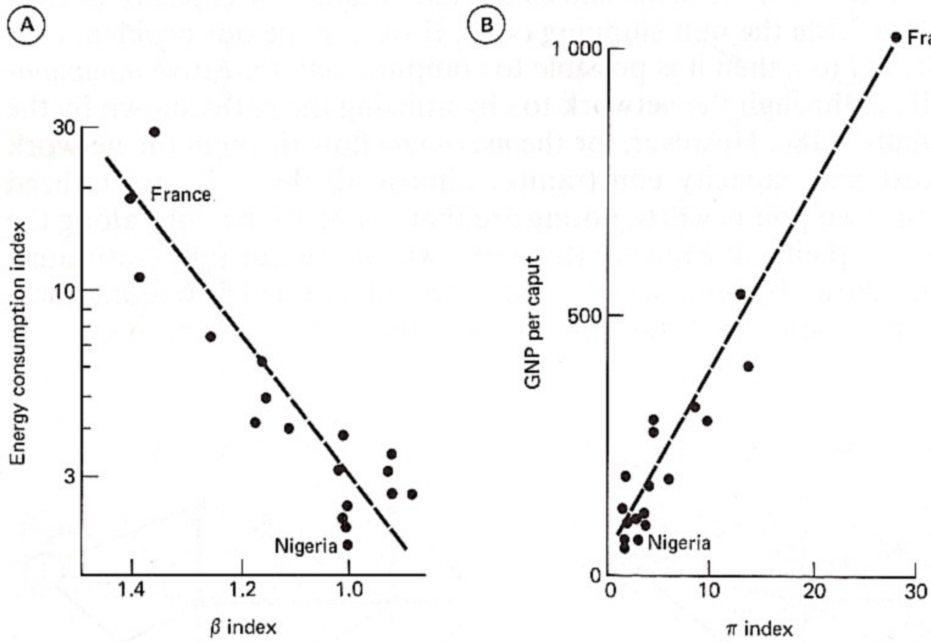
Source: Kansky 1963, pg. 23. Used with permission (04/15/2011), © University of Chicago Press.

Empirical Studies of Regional Networks Involving Graph Theory

Graph theory has long helped geographers study the particular structure of regional networks. Some of the main examples come from Kansky's 1963 work.[34] In the first example, Kansky discusses the railway networks of selected countries and their relationship to the general level of economic development applying there. To do this, Kansky plots the energy consumption index against the Beta (β) index (connectivity), as depicted in Figure 3.7A. Alternatively in Figure 3.8B, another measure of development, gross national product *per capita*, is plotted against the π index (network shape).

[34] Kansky, K.J., Structure of transportation networks: relationships between network geometry and regional characteristics. *Department of Geography Research Paper No. 84*. Chicago University Press, Chicago: 1963.

Figure 3.7: Relation of topological measures of the connectivity (A) and shape (B) of railway networks to indices of economic development.



Source: Kansky 1963, p. 42. Used with permission (04/15/2011), © University of Chicago Press.

As a result, it is easy to see in graph A how highly developed countries such as France have large connectivity indices for their railway system, while underdeveloped countries such as Nigeria have low connectivity indices. Again in graph B, France with its high shape values (more like a circle shape), stands in contrast to the elongated Nigerian system. In both graphs there seems to be a consistent relationship which is statistically significant and strongly suggests that the geometry of some route networks may be very closely related to the general development of regional resources (Haggett et al. 1977).

Network analysis using graph theory has also been shown to be useful for determining the position of particular places on a route system. In Garrison's 1960 work[35], he uses one measure of accessibility to analyse the relative accessibility of 45 places in the southeastern United States that were linked together by the Interstate Highway System (see figure 3.8).

Figure 3.8: The Interstate Highway System in the southeastern United States.

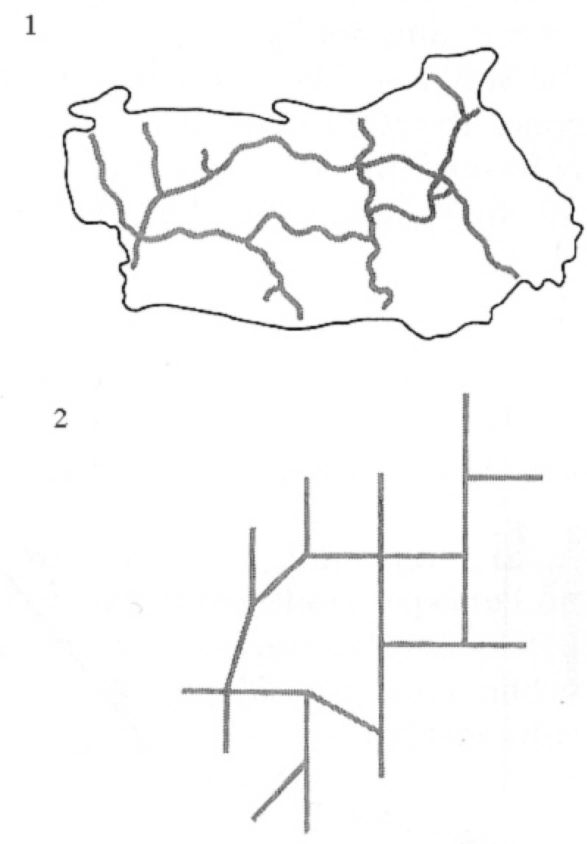
Source: Garrison 1960, p 132. Used with permission (03/29/2011), © John Wiley and Sons.

The nodes were defined partly on population size and partly on topological position (e.g. at the end of a route). Atlanta (a) proved to be the most accessible point on the network, and can be compared with St. Petersburg (b), which is among the least accessible places. Part of the reason for this contrast lies in the fact that graph theory

[35] Garrison, W.L., Connectivity of the interstate highway system. *Regional Science Association, Papers and Proceedings*, 6, 121-137. 1960.

concentrates on the topological property of the network, its connectivity, rather than on its dimensions. Kansky (1963) reminds us of this in his graphic representation of the Sardinia railway network (figure 3.9).

Figure 3.9: A graphic simplification of the railway network of Sardinia.



Source: Kansky 1963, p. 8. Used with permission (04/15/2011), © University of Chicago Press.

While in the real world the railways of Sardinia are laid out as shown in Figure 3.9 (1), in graph theory they appear as shown in Figure 3.9 (2). The advantages that this more abstract model presents from the perspective of analysis must, of course, be weighed against the loss of other significant detail (Haggett et al. 1977).

Becky Loo used graph theory to analyse the rapid transformation of a chinese rail transport network over time, a network currently experiencing physical expansion. Figure

3.10 shows the railways of the Zhujiang Delta in Guangdong from 1980 to 1995. Simplified graphs were generated by joining the cities/counties accessible by railways irrespective of the exact alignment or length of the lines. The relative geographical positions of the cities and counties are maintained by linking the networks with the locations of the seats of government which the transport lines passed (Loo 1999). The nature of the evolving railway network, including its complexity and connectivity, can then be examined by summary indices drawn from graph theory (Kansky 1963; Leung 1980).

Figure 3.10 shows us that the number of nodes has increased from 13 in 1980 to 21 in 1995. Similarly, the number of links has grown from 12 in the 1980s to 20 in 1995. The diameter or 'extent' of the network remained at 10 until 1995, when it increased slightly to 11. As the railway network of the region was still a tree-like graph by the end of the study period, its cyclomatic number (μ) and alpha indices (α), which measure network connectivity by using the number of circuits in a connected graph, are equal to zero (see first two values of Figure 3.10 for each year). Furthermore, the gamma index (γ), which is a measure of the actual-to-maximum number of edges, also shows a slight decline from 0.364 in the 1980s to 0.351 in 1995 (Loo 1999). This has arisen from the fact that this topological measure is independent of the number of vertices in a given network and the railway network of the Zhujiang Delta has basically undergone a period of spatial extension without the formation of any circuits. Accordingly, overall connectivity has been degraded slightly.

Figure 3.10: Graph Theoretic Evolution of the Guangdong Railway Network.

Image removed due to copyright, please see source below:

Source: (Loo 1999, p. 53).

In contrast, the beta index (β), which relates the number of edges to the number of vertices (β= *e/v*), has shown a gradual increase from 0.923 in 1980 to 0.952 in 1995. Rising β values denote an extension of the railway network structure without any circuits, which is why β remains less than 1 (Loo 1999). As a network develops, the eta index (η) is likely to decrease as the average distances between the vertices are reduced. In the Zhujiang Delta, η has declined from 35.10 in 1980 to 33.04 in 1995. Lastly, the pi index (π) is calculated by expressing the circumference of the network (*C*) as a share of its diameter (*d*) ($\pi = C/d$). Both the circumference and diameter are expressed in metric scale. Again, increasing π values indicate that the network has become more complex in the Zhujiang Delta. In fact the complexity of the railway network has grown, with π increasing from 1.487 in the 1980s to 1.880 in 1995 (Loo 1999). An interesting observation of this rail network is the absence of alternative routes (circuits), implying that it can be a very long way round by rail between places which are quite close to each other geographically.

However, nothing is perfect and graph theory is no exception. Looking at measures and indices for too long will incline the researcher to ignore the extremely important factors that are hidden behind the development of something so complex as a rail transport system. While graph theory succeeds in finding the quickest, most efficient, economical route and proving a mathematical answer to transport problems, it must never be forgotten that many transport operations take place on a non-economical basis. Graph theory's main weakness is that it does not take into account the fact that transport systems are influenced by many diverse economic, political and social factors. In addition, although graph theory could be modified using the complementary element to take into account multiple transport modes, it primarily deals with one mode at a time. This becomes a particular problem when scrutiny is directed to historical or contemporary examples of rail systems that combine multimodal systems integrating rail, road, sea and air carriage. Graph theory fails also to take into account the technical limits of rail transport. Railways must be used at maximum capacity to be fully economic. Capacity depends on a combination of trainload, average speed, condition of the rail line and the frequency of service. Physical limitations such as gradients are a huge limiting factor, since they quickly reduce trainload size and speed. Another critical influence is track gauge. The narrower the gauge bestows the advantage of the less earth that needs to be moved when laying track in very difficult terrain. In short, line creation becomes easier and generally cheaper; however, narrower gauge also means slower speeds and lower capacity. Now it is time to inject reality into the discussion by examining the formations and development of real railway networks.

Empirical Evolution of Rail Transport Systems

A cursory look at the development of real rail systems reveals that they have evolved far differently from what graph theory would predict. In many cases, rail transport systems have been created more for political than efficiency reasons. The history of railways in Manitoba, the substance of which was dealt with in the previous chapter, offers ample testimony of that fact. Arguably, Canada's premier line, the CPR, is a child of political - not economic - interests (Innes 1972). Similarly, in Asia, the Trans-Siberian Railway was built to extend Russian rule over the giant landmass of Siberia (Tupper 1965), and had little in the way of economic rationale to justify its massive costs.

Historically, governments, rather than private enterprise, have played a leading role in the development of rail links in many countries, especially when there are initially very low economic returns expected. Just a few instances testify to the point. For example, to tap into the rich mineral resources of the Altiplano in Peru, the government gave large concessions to private businesses. In the western USA, private investment in railways only became available when the government offered a guarantee of some immediate return. North America's first trans-continental rail link, the Union Pacific Railroad which opened in 1869 and, via Chicago and other rail companies, linked the

Atlantic ports with San Francisco, would not have been built without government assistance. In fact, it was built under direct government subsidy for every mile of track that was laid. Under the system of land apportionment in the USA, the land was divided into sections, each of one square mile. Under terms of the 1864 Homestead Act, settlers were given the title to a quarter section to develop as they pleased. In addition, railway companies were granted up to 10-mile sections on either side of their track, which they could divide or sell as they pleased. Accordingly, railway and economic development occurred in tandem, just as the government desired. In Argentina, the realization dawned in the early twentieth century that cart-hauls of more than 16 km to a railway station made wheat production unprofitable. Only with government connivance were the then British-owned railways granted enough incentives (through land settlement schemes) to respond with rail infrastructure (Crossley 1971).

It is a cardinal rule of railways that infrastructure provision is costly. Thus, it is seldom economic to duplicate railway lines and systems. One interesting deviation from this took place in the Pacific Northwest region of the United States. Here, a considerable amount of competitive service amongst private enterprise led to the creation of duplicate intercity and port linkages provided by trunk, main, and branch lines in the wheat-producing communities of the Columbia Basin. A similar scenario took place, albeit on a much greater scale in a territory of comparable size, and that was in Britain. One of the main reasons for this somewhat irrational development of the Pacific Northwest rail net – as indeed of Britain's railways - stems from the timing of its creation. Because the ultimate patterns of economic geography could not be fully foreseen at the time of investment decisions, an overall construction strategy to give the most efficient pattern of service to the region could not be undertaken, leading to the duplication of railway lines (Meinig 1962).

However, some very positive aspects came from the duplication of rail service in general. For example, in Britain the speed of trains increased as companies tried to provide the quickest possible service and fares were lowered on the competitive routes. Standards of service began to improve as well, thanks to the competition that ensured that many places were connected to the network that may well otherwise have been ignored (Wolmar 2007).

In the nineteenth century there was no alternative to the railway for efficient inland transport. Therefore, legislation aimed at controlling monopoly took hold. Mergers of railway companies in the United Kingdom required enabling Acts, which were commonly thrown out to prevent the emergence of a regional monopoly. In addition, there were extensive controls over rates and fares to prevent user exploitation. Measures included the 1854 Railway and Canal Traffic Act, which was notable for introducing the preference concept, a concept which was abandoned only in 1953. This Act stated that if a special rate were granted to a shipper, it had to be published and available to anyone else (Savage 1959).

Political interference in railways – either to invoke them into existence or to regulate their operations – is a topic with very wide implications for profitability, indeed viability of networks and competition. These implications will inform much of the next chapter, which focuses on the rationale for rail systems in general, and Manitoba’s system in particular.

Before leaving government influence, it is useful to note that some of it has been inspired by social concerns, notably those dealing with safety. Quite simply, if a proposal for a new rail system is made but the line is seen to be unsafe, the line will not be created. The 1889 Regulations of the (United Kingdom) Railways Act made the *block* signalling system and continuous automatic brakes on passenger trains compulsory. However, more progress was made in rail safety as a result of the 1840 Act setting up the Railway Inspectorate, which since its inception has held an enquiry into every rail accident and issued a report making recommendations for avoiding such accidents in the future (White 1983).

Despite political and social considerations such as those mentioned above, economics plays a large role in rail systems, as costs in general are very high in this sector. These costs are made up of *fixed costs,* which are inescapable and include providing the infrastructure, equipping and staffing the rail terminals, providing managerial, administrative and maintenance staff and their offices and workshops. These costs do not vary with the level of traffic, but remain independent of it. The second type, known as *variable costs,* is incurred by the actual movement of traffic and therefore varies with the amount of traffic. Variable costs include things like the cost of fuel, crew wages and maintenance of equipment and tracks. The railways usually have high fixed costs. It has been calculated that 44 per cent of rail costs are fixed, while 56 per cent are variable (Munby 1968). Due to the fact that fixed costs are so high in the rail industry, it is very important that the system be planned correctly from its inception and that operations ensure that no errors or oversights have taken place. It is also significant that *unit costs* fall off more rapidly than in road transport; that is to say, they benefit far more from economies of scale than does the road mode. If traffic is light, unit cost of rail is very high, but as traffic increases rail becomes very economical (White 1983).

Historically, the economic impact of rail systems has been huge. Many sources cite the completion of the railway as being the pioneering force for development in Western Canada and the USA in the late nineteenth and early twentieth centuries.[36] These pioneering railroads increased passenger and freight transport, as well as production and public consumption, while new markets and resources became more easily accessible.

More recently, intermodal transport co-ordination has become increasingly important. This means the integration of services between modes and the correct allocation of capital resources between the various modes making up a national transport system. That allocation is intended to maximize total output, and minimize overall costs in terms of initial investment and operating expenses. For example, in London, bus routes have been coordinated to synchronise with interchanges of underground light rail transit service. Even more recently and importantly, increasing competition, not only between road and rail, but also between ‘public’ and ‘private’ sectors, represented by conventional rail, high-speed rail, light rail transport, bus and road haulage has complicated intermodal systems. Having touched on the pressing issues governing real railway systems, it is opportune to revert to graph theory and demonstrate its continuing relevance.

[36] Robert Fogel claims that these railroads were “indispensable” to early economic growth and development in his book, *Railroads and American Economic Growth: Essays in Econometric History*, 1964.

A Graph-Theory Working Example – A Winnipeg LRT network

Graph theory can help us to envisage new rail systems, especially when invoking map software at the heart of Geographic Information Systems (GIS). GIS allows for a digital representation of the network to be created, stored, retrieved, modified, analyzed and displayed quickly and easily.

In Winnipeg, there has long been talk among city officials of the need for a Light Rail Transport System (LRT) similar to those present in many other cities across the world.[37] There has also been talk of creating a higher speed 'inner beltway' for road traffic that would see connections being made from Chief Peguis Trail all the way to the Charleswood Parkway, then eventually connecting with Bishop Grandin Boulevard (refer to Figure 3.11). Here, my proposal is to combine these two ideas and create a complete LRT system following the general route of this inner beltway. This would allow travel through the heart of the emerging Waverley West subdivision (as of 2010), which will eventually become one of Winnipeg's largest subdivisions, and, in so doing, provide a perfect opportunity for this new transport system to demonstrate its worth. As the urban landscape is a crowded one where all transport systems compete for scarce land, this LRT would run downtown as well on a parallel track to the existing CPR line that runs north to the city centre (Figure 3.11).

[37] Other 'small cities' such as Edmonton and Calgary, Alberta, have successfully implemented LRT systems (since 1978 and 1981 respectively). According to the 2006 Statistics of Canada census, Edmonton has a population of 730,372, making it very comparable to Winnipeg's 694,668. However, at the time of implementation, Calgary and Edmonton both had much lower population values than Winnipeg enjoys today.

As different LRT systems exist[38], the one relevant to Winnipeg would feature the trains running along their own tracks and would be completely separated from road traffic. The trains would often be boarded from a platform; there would be either level crossings with gate arms, or in high road traffic areas, complete separation with non-level crossings. This would provide Winnipeg with its own 'intermodal' transit system to ease the disutility of everyday traffic and cut down on greenhouse gas emissions, since it would be powered completely by clean hydro-electric power. Ideally, LRTs work best carrying high passenger volumes. However, this condition requires a moderately large population base to make the system possible. This barrier to entry can be avoided, if the Edmonton example has general applicability. Edmonton was the first North American city with a population under one million people to build an LRT system. It opened in 1978, prior to the Commonwealth Games, and consisted of 1.6 km of track in the downtown area. It expanded four times in network lenght over the next twenty years, consistent with the rise in the city's population, and now operates thirty-seven light rail vehicles over a 12.3 km route. Evidently, slow gradual network increase can overcome initial entry barriers.

If operating between street corridors, LRTs are limited by city block lengths to about four 180-passenger vehicles (720 passengers). Operating on two-minute headways using traffic signal progression, a well-designed system can handle more than 30 trains

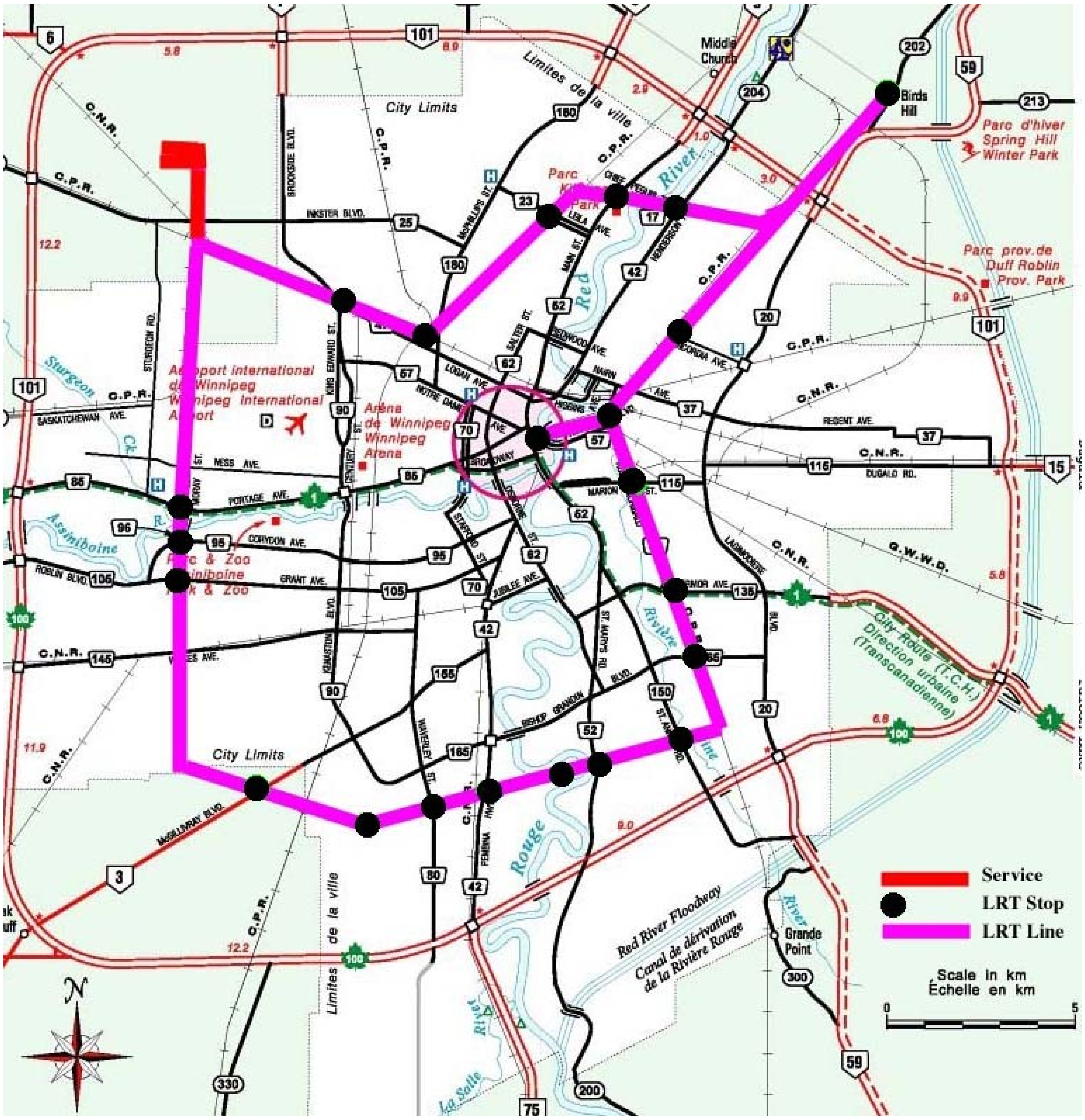
[38] The term light rail was devised in 1972 by the U.S. Urban Mass Transportation Administration (UMTA) to describe new streetcar transformations which were taking place in Europe and the United States. The American Public Transportation Association (APTA) in its Glossary of Transit Terminology defines light rail as: "An electric railway with a 'light volume' traffic capacity compared to heavy rail. Light rail may use shared or exclusive rights-of-way, high or low platform loading and multi-car trains or single cars." However, some diesel-powered transit services call themselves light rail, such as the O-Train in Ottawa and River Line in New Jersey, which use diesel multiple unit cars (Thompson 2003).

per hour, achieving peak rates of over 20,000 passengers per hour per track. At a maximum speed of 106 km per hour (the maximum speed of many LRT systems in use today), the LRT would cover distance within Winnipeg's urban landscape very quickly (TCRP Report 100).

The line would consist of twenty-two nodes or stations (shown in black in Figure 3.11) to collect people. Twenty-two links (shown in magenta) would intersect with all the main arteries in Winnipeg (Henderson, Lagimodiere, Main, Chief Peguis, McPhillips, Ness, Portage, Grant, McGillvary, Waverley, Pembina, St. Anne's, Marion, and Provencher), allowing people to easily walk, ride their bike, take a transit bus or even drive their car to the nearest station. The service centre would be located in the northwest corner of the city, thus avoiding the busy city centre (shown in red). A major attraction of this system would be the connection to the University of Manitoba's Fort Garry and Bannatyne Campuses. With over 25,000 students and staff moving to and from these campuses daily, the frequency of travel could be high.

To expand this LRT proposal to meet future demands we must look at the current trend of urban sprawl outside the city limits. Stage 1 of the LRT project would include the LRT line being extended to the area of Birds Hill/ East St. Paul, home to many new residential developments. A University of Manitoba student interested in a high-speed commute is currently able to travel by road transport at a maximum 100 km/h for 26 km via the east Perimeter Highway (shown in red on Figure 3.12). Using the new LRT system, the student can travel at a maximum of 106km/h for only 18km (shown in magenta on Figure 3.12).

Figure 3.11: One Proposed Winnipeg LRT Network



Source: Created April 2008 by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute.

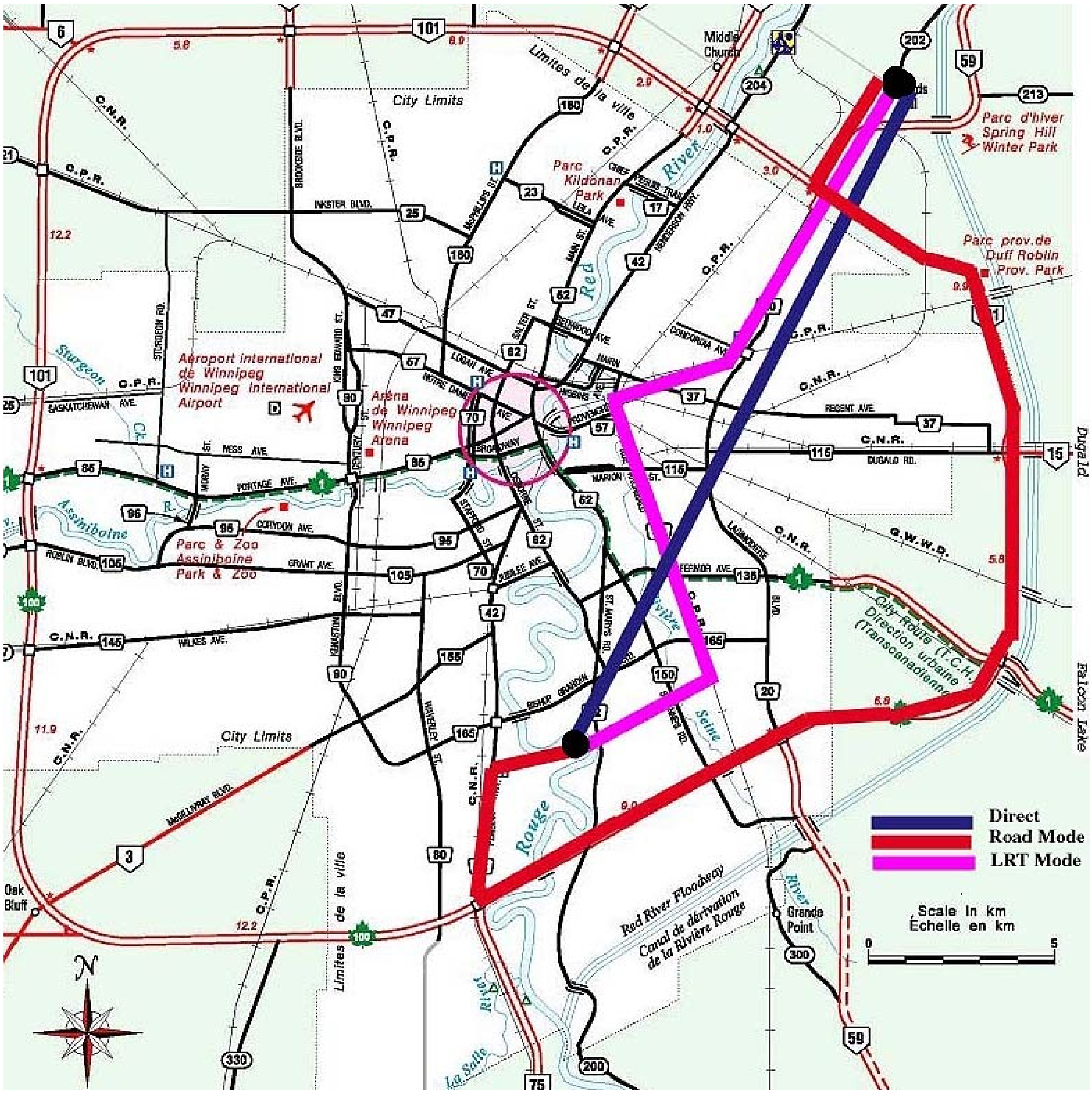
Using the detour index (DT/DD=DI), we see that the LRT is much more efficient, with a 0.78 index (14km/18km), than the perimeter highway which comes in at a meagre 0.54 index (14km/26km), not to mention a slower maximum speed. The direct distance

(DD) is shown in blue. Not only would this trip be faster for the student, but no fossil fuels would be burned, only clean Manitoba Hydro electric power. The network density tells us the territorial extent of the network. It measures the network in terms of kilometres of links per square kilometres of surface. This LRT network will consist of 65 kilometres of links covering 200 square kilometres, leading to a density of 0.325 (65km/200km). The eta index gives us the average distance per link. Adding more nodes to an existing network will cause the eta to decline as the average distance between links declines. This LRT network has 23 links with a maximum distance of 10.1 km and a minimum distance of 0.9 km. The average is equal to 2.4 km. The theta index measures the function of each node; the higher the theta, the higher the traffic load. Edmonton's LRT has a daily 'rider-ship' of 42,000 over fourteen nodes.[39] This gives the Edmonton system a theta index of 3000 (42,000/14). Winnipeg with a very similar population could most likely achieve a daily rider-ship of 37,000[40] across 23 nodes, resulting in a 1608.7 theta index (37,000/23).

[39] *Edmonton SLRT*, Santec Consulting Limited, viewed on April 6, 2008 <http://www.edmontonslrt.com/lrt_in_ed.htm>

[40] This estimate was generated by comparing the population (according to the 2006 census) of Edmonton and Winnipeg, and the rider-ship of Edmonton's LRT system and extrapolating for Winnipeg accordingly.

Figure 3.12: The commute comparison for a University of Manitoba student living near Birds Hill Park. The LRT line shown is in magenta and the road mode is shown in red.



Source: Created April 2008 by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute.

Conclusion

On the face of it, graph theory presents itself as a relevant tool for investigating the evolution and use of rail transport systems. However, it must be used with caution, for a multitude of factors influencing the evolution of these systems must be taken into account before a comprehensive appraisal is possible. Technological, physical, economic, political and social factors are fundamentally important, and to neglect the influence of any one of them would be a considerable error and lead to inappropriate conclusions. Graph theory, especially when used in conjunction with GIS databases, remains a useful methodology provided these limitations are borne in mind. A rationale for its application ultimately rests on the soundness of the reasoning put forward to account for how the rail network was conceived and how it subsequently evolved in the light of historical, geographical, economic and technical circumstances. The framework for such a rationale – and the hypotheses formulation embodied within it – is considered in the next chapter.

CHAPTER FOUR

Hypothesis Justification

Introduction

After gaining an appreciation of the actual circumstances justifying railway development in Manitoba (Chapter 2) and a familiarity with the toolkit tailored to unraveling its complexity (Chapter 3), the necessity has arisen to postulate the first principles upon which the entire system rests. In short, the object of this chapter is to construct testable hypotheses that shed light on the network effectiveness of Manitoba's railway system.

To begin with a cardinal principle, the ability of trains to haul large quantities of goods and significant numbers of people over long distances at moderate cost is the mode's primary asset. Once the cars have been assembled or the passengers have boarded, trains can offer a high capacity service at reasonable speed, adding a time-distance bonus. It was this feature that led to the train's pre-eminence in opening the area west of Winnipeg in the late nineteenth /early twentieth centuries, and it remains of fundamental importance to this day.

As previously noted, the initial fixed costs of railways are high because the construction of the line and the provision of rolling stock are expensive. In Canada, historically the investments have been made by the same source (either governments or the private sector) rather than by consortia. These expenditures have to be made before any revenues are realized and thus represent important entry barriers that tend to limit the number of operators. In the Manitoba case the early railway networks were built by the private sector with the help of heavy government subsidy (CPR, CNoR and GTP).

H_1

This leads to the formulation of my first hypothesis (H_1), which in its null form is inspired by the work of prominent transport geographer James Vance and celebrated economic historian Harold Innis. It can be expressed in conventional fashion as follows:

> H_{1o}: Manitoba's railway lines were all 'developmental penetration lines' that were cheaply built, and were implemented to encourage latent demand rather than meet existing demand.

Statistical analysis tells us that for every null hypothesis there must be an alternative hypothesis. In the present context that can be expressed as:

> $H_{1a:}$ Some lines were 'latecomers'; designed to tap an already 'opened' area.

By definition, 'developmental penetration lines' are 'premature enterprises'; that is to say, enterprises that would be avoided by private investors in the absence of government support.[41] Vance argues that railways in Canada were all of the developmental penetration kind.[42] Moreover, he asserts that they were built in British fashion, albeit modified to cater for developing rather than established economic

[41]The main purpose of developmental penetration lines is to link a port city (in this case Winnipeg is defined as the 'port city' or 'gateway' city, ultimately linking traffic to tidewater) with its hinterland, particularly in order to access natural resources such as minerals, agricultural products and wood products. The mesh of developmental penetration lines also represented one of the initial stages of rail development notably in the United States, which later became regional networks linked by transcontinental lines. This type of system is today mainly found in developing countries (Africa and Latin America) and was partially the result of the colonial era. Transporting freight is the dominant function of this type of network, although passenger traffic can be a factor (Rodrigue 2009).

[42] R. W. Fogel applied the 'premature enterprise' concept to US railroads (Fogel 1960).

conditions. We should recall that the British rail system came into existence within – and was intended to serve as an improvement to transportation of – an existing market. In fact, Britain's rail system was not a developmental device but rather a remedial device where previous forms of transportation had proved inadequate. Under these conditions heavy investment of capital could both be secured from investors and be justified by logical expectations of profit (Vance 1995). In contrast, in Manitoba the market was certainly undeveloped and in some cases non-existent, so it was the anticipation of need, rather than actual need, which often ruled the undertaking. Even where the current modes of transportation were taxed by existing conditions, it was usually because the quality of their infrastructure was inadequate (e.g. the Dawson route, see Chapter 2).

Vance points out how these lines in Canada (Manitoba included) needed to follow staged construction due to the costs and benefits of the system. The initial line had to be built as cheaply as possible in order to test the potential market and determine the ultimate level of construction as the economic geography was still a comparatively unknown quantity (Vance 1995). In short, the markets that in the long run proved to be critical to the chronic survival of the lines in Manitoba were only vaguely sketched out when these developmental lines were created. This contrasted starkly with the situation in Britain where for the most part the markets were already well established. Vance argues that it is precisely this lack of knowledge of the economic geography of the region that made the construction of railways in Canada and the United States so much more difficult than was the case in Britain.

The absence of any considerable population in the area west of Winnipeg meant that the CPR was the prime example of a developmental penetration line. In 1886 it earned a very modest $2,357 per mile of track, while in the same year the NP earned $4,316 per mile, which was very much a developmental line in its own right (Vance 1995).

Innis is another proponent of the null hypothesis, since he described the CPR as a "premature enterprise" (Innis 1971, p. xi). It warrants the title because building a line through uninhabited country meant that earnings on this developmental railway were likely to be small for several years after the line was completed due to a lack of traffic sufficient to yield profits. Vance backs this up, noting that, "For [the first] twenty years the Canadian Pacific was short on earnings, and thus short on money for capital improvements or massive extensions of its lines" (Vance, 1995 p. 277).

This "developmental" characteristic accounts for the railways becoming the focus of the provincial and federal government attention, a topic which is detailed in Chapter 2. By Innis's reckoning, if investors had believed that the railways would be profitable right from the start, then they could have built them without government subsidy (Innis 1971). In the case of the CPR there are several distinct phases in the evolution of the network and the early phase was totally indebted to government action. Vance corroborates this thinking, saying that, "The CPR was just as premature and equally political as the Union Pacific and Central Pacific had been" (see Chapter Four – End-Note 1), (Vance 1995, p. 278).

Further evidence adduced by Vance is drawn from Pierre Berton's history of the CPR[43]. As was noted in Chapter 2, rather than build the new line through the fertile belt of Manitoba up towards Dauphin that had been surveyed by Sandford Fleming, the CPR

[43] Berton, P., *The National Dream*, (1970).

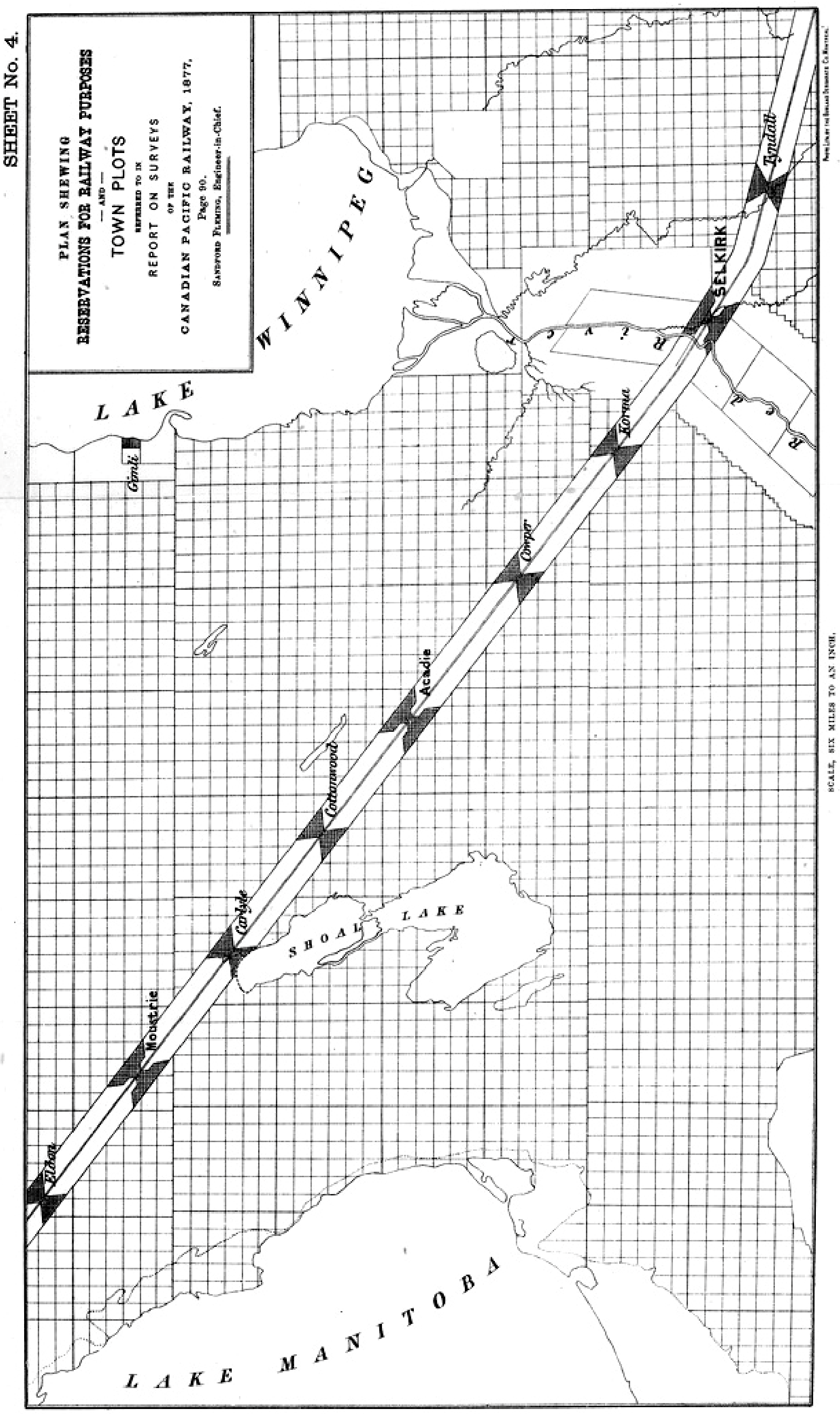
decided to move the line southwards in the Prairies. Berton argued that the decision was motivated by the company's desire to build through completely unsettled territory in order to control all the potential town sites (see Figure 4.1). In a region where no competing transportation was in existence or could be introduced (under the charter) for a period of twenty years, the effective monopoly granted to the company allowed them to implement what might appear to be economically irrational decisions.

Vance also notes that J. J. Hill, who pushed through this decision, was very successful in directing the operations of the GNR. In principle, Hill strived to avoid competition, to build the line economically, to lay it out ahead of the market, and then totally control both the line and the market (see Figure 4.2) for a long period of time (Vance 1995).

However, there is a case to be made for $H_{1a,}$ an alternative hypothesis to the null that amounts almost to received wisdom. It is my view that not all Manitoba's rail lines were developmental railways. To take one obvious instance, the GTP can be regarded as a non-premature enterprise. As Chapter 2 made clear, the GTP's main line in Manitoba was essentially routed in parallel to the older CNoR line, which dominated the modest market in this section of Manitoba. Besides, it is a documented fact that the GTP was not at all a cheaply built railway, but built to a very high "British standard".[44]

[44] Currie, A.W., *The Grand Trunk Railway of Canada* (1957);
Leonard, F., *A Thousand Blunders: The Grand Trunk Pacific Railway and Northern British Columbia* (1996);
Stevens, G.R., *Canadian National Railways* (1960-62).

Figure 4.1: Plan showing reservations for Manitoba CPR construction and town plots in Manitoba in 1877.

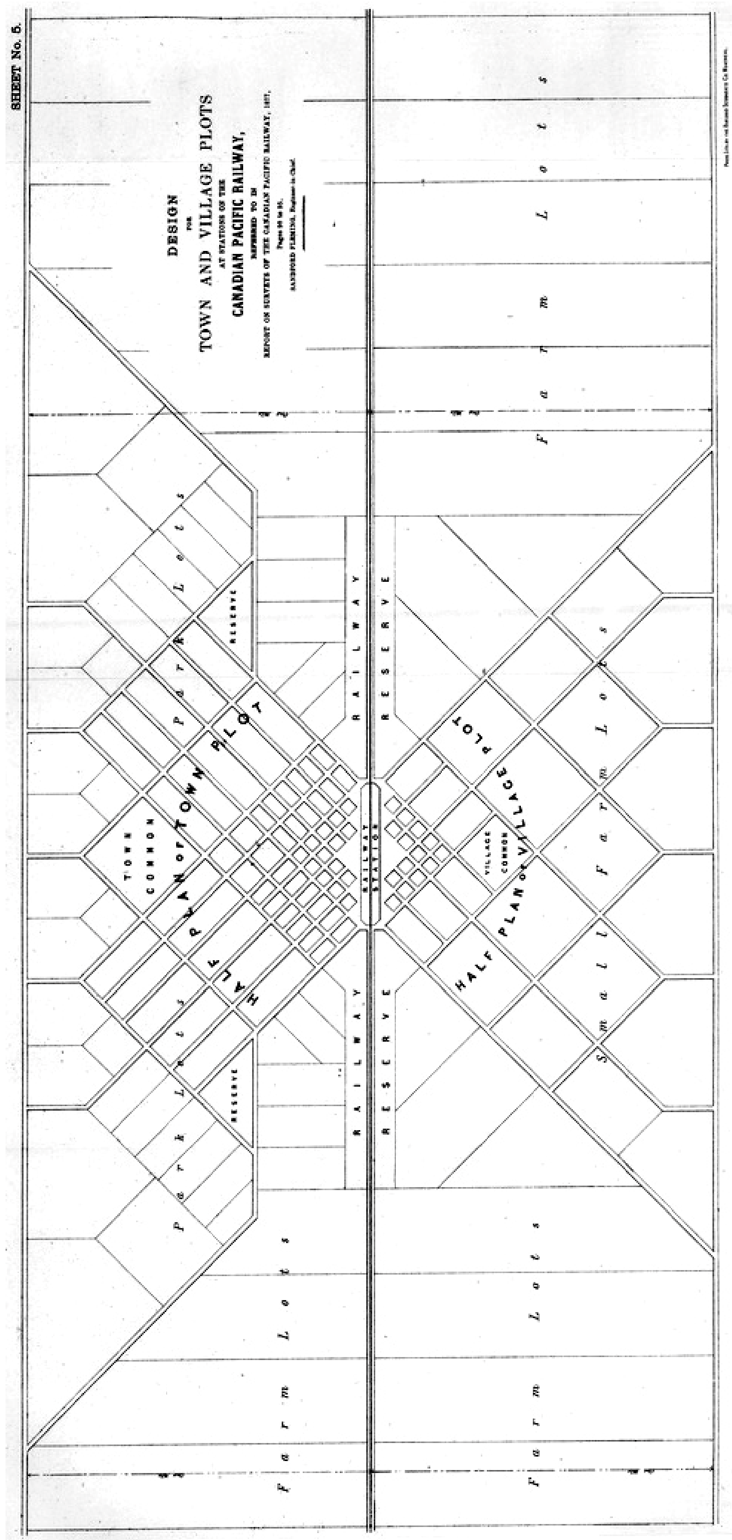


The spacing of the towns along the railway line is significant, showing that Fleming anticipated some aspects of what is discussed in central place theory.[45] For example, he suggests in his accompanying report that in agricultural areas the stations should not be so far apart as to leave an opening for intermediate stations at a future time. Even though Fleming's plans did not come to fruition, they at least show that some attempt was made at strategic town planning in Manitoba, beyond the idea of simply slamming down rail across the land. Source: Warkentin and Ruggles. *Historical Atlas of Manitoba*. Map 181, pg. 368. Used with permission (04/07/2011), © Manitoba Historical Society.

Indeed, the GTP was so well built that most of the GTP line is still in use today as CN's main line from Winnipeg to Jasper. It is specifically because of the GTP's high construction standards and its adherence to the Yellowhead Pass that it has the lowest elevation of any railway crossing of the Continental Divide in North America. Consequently, today the CN has a significant competitive advantage in terms of fuel efficiency and the ability to haul heavy unit trains. Clearly, on the face of it, the proposition that the GTP line is bound to be a "developmental" railway has not very much to recommend it. Casting doubt on the inevitability of the H_{10} in this case raises the possibility that the null hypothesis is invalid in other instances too. That possibility will be explored in detail in the next chapter, when H_1 will be reviewed in a comprehensive fashion that allows for testing based on network evolution.

45 German geographer Walter Christaller created the central place theory in 1933. Central place theory is a spatial theory in geography that attempts to explain the reasons behind the distribution patterns, size, and number of cities and towns around the world. It also attempts to provide a framework by which those areas can be studied both for historic reasons and for the locational patterns of areas today (Wheeler 1986).

Figure 4.2: Design for town plots along the CPR referred to in report on surveys of the CPR in 1877.



By laying out the line in virgin territory, the CPR could attempt to control every aspect of the market right down to its design. In this plan, the pattern would be a gridiron, but oriented so that the corner of the grid pointed to the railroad, with a small plaza left right next to the track. Provision was made for a village and town common, and for farm lots behind the built-up area. The surprising thing about these town plans is that even though a railway engineer proposed them, they do not provide for a solid façade of businesses facing the line, in a fashion considered desirable by many railway companies. Source: Warkentin and Ruggles. *Historical Atlas of Manitoba*. Map 180, pg. 367. Used with permission (04/07/11), © Manitoba Historical Society.

H_2

For the most part, testing of network hypotheses is rendered feasible through the application of graph-theory methods. This is made abundantly clear when the spatial domain is brought into direct focus. What cannot be gainsaid is that all Manitoba's railways, whether "developmental" lines or not, have an intimate relationship with space, since the rail mode, by its very nature, is severely constrained by physiography. These constraints are both fundamental to the operational costs of a railway and are mainly technical. They involve issues such as:

- **Space consumption**. "Rail transportation has a low level of space consumption along lines, but its terminals are important consumers of space, especially in urban areas. This increases operational costs substantially" (Rodrigue 2009). In Winnipeg, the rail terminals were some of the first major developments shaping the urban geography of the city.
- **Gradient and turns**. "Rail transportation can support a gradient of up to 4% (e.g. 40 metres per kilometre), but freight trains rarely tolerate more than 1% grades. This implies that an operational freight rail line requires 50 kilometres to climb 500 metres. For turns, the minimal curvature radius is 100 metres" (Rodrigue 2009).

- **Gauge**. “The standard gauge of 1435 mm (4’ 8 1/2”) has been adopted in many parts of the world, across North America and most of Western Europe. It accounts for about 60% of the world’s railways.[46] The narrower the gauge gives the advantage of less ground that needs to be moved when laying track in difficult terrain and the turning radius can be less. Line creation is cheaper the narrower the gauge but it also means slower speed and lower capacity” (Rodrigue 2009). All the Manitoba lines in question were built to standard gauge.

Thus, the physical attributes of space, embodied in the topography, obviously influence the route selection process. Although the work in building the Manitoba lines was lighter in comparison with what occurred in Alberta and British Columbia, CPR head William C. Van Horne questioned the categorizing of western Manitoba as “prairie”: “The so-called Prairie section is not prairie at all, it is broken, rolling country, with a great deal of heavy work, and the line we are building is a very different thing from [the] standard fixed [by the government survey] and costing double the price of a poor prairie road.” (Vance 1995, p. 271). Considerations of this kind lead me to the next hypothesis (H_2):

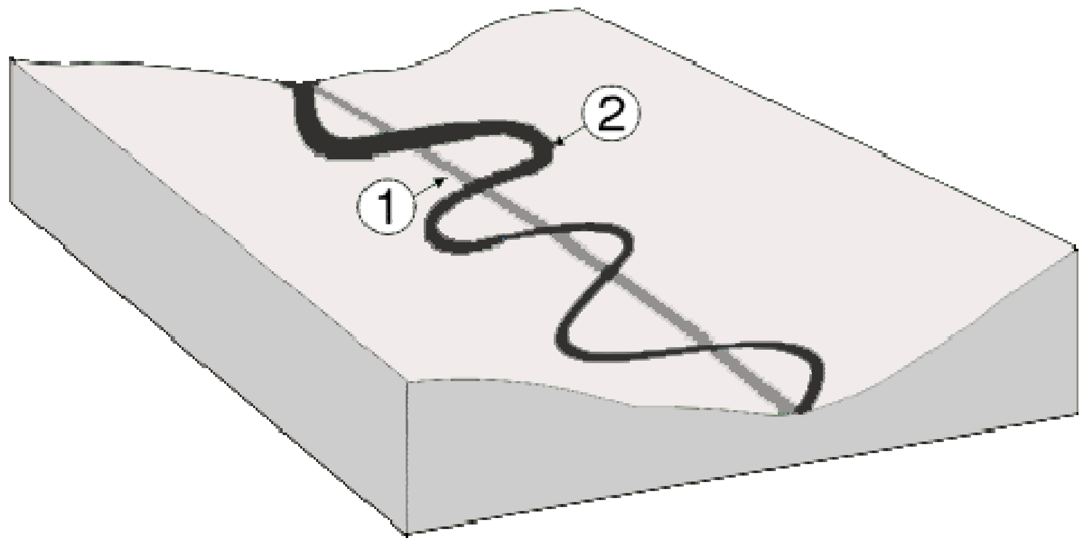
H_{2o}: Other things being equal, railways would follow ‘easy-gradient’ straight-line routes rather than ‘difficult-gradient’ straight-line routes.

H_{2a}: Where H_{2o} is impractical, railways prefer easy-grade meandering (Fig 4.3, 2) to difficult grade straight-line routes (Fig 4.3, 1).

---

[46] Other gauges have been adopted in other areas, such as the broad gauge 1524 mm (5’0”) in Russia and Eastern Europe accounting for about 17% of the world’s railways. This makes integration of rail services very difficult, since both freight and passengers are required to change from one railway system to the other. As attempts are being made to extend rail services across continents and regions, this is an important obstacle, as for example between France and Spain, Eastern and Western Europe, and between Russia and China. The potential of the Eurasian land bridge is limited in part by these gauge differences (Rodrigue et al. 2009).

Figure 4.3: Straight verses Meandering Lines.



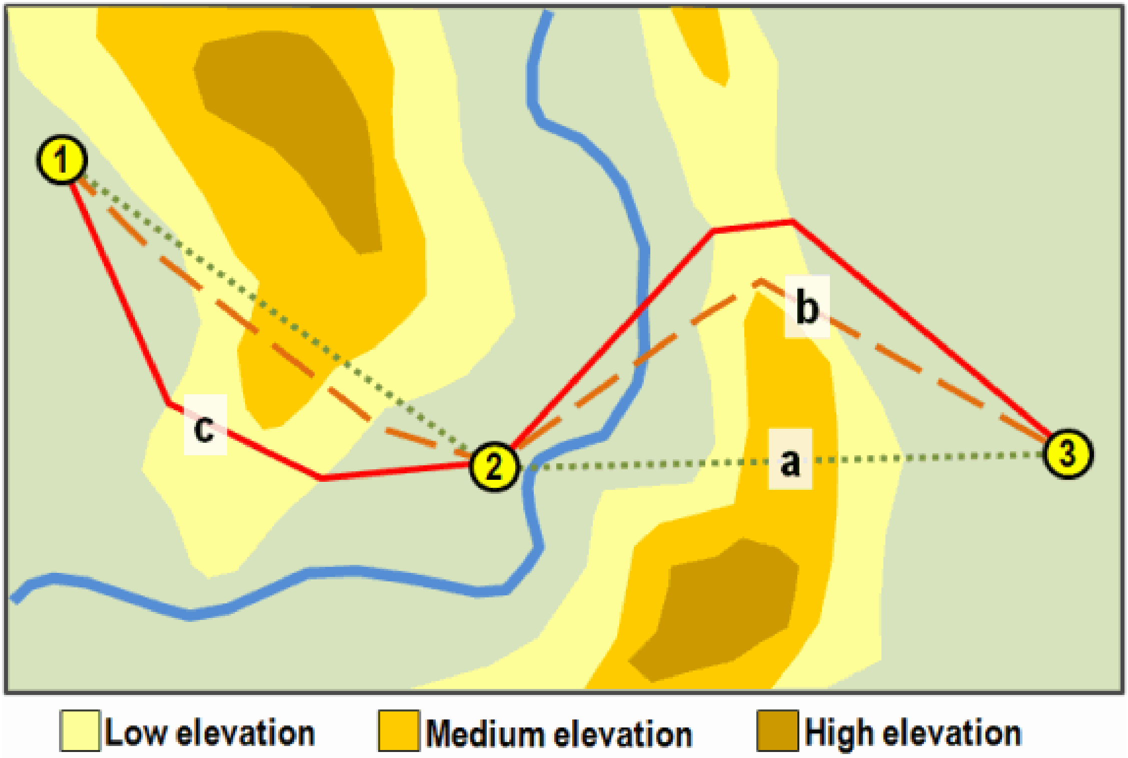
Source: Rodrigue 2006. Used with permission (04/05/11), © Jean-Paul Rodrigue.

In order to measure this, the effects of topography on route selection, I will resort to graph theory's **Detour Index**. The Detour Index (direct distance divided by the transport distance) is designed to illustrate the importance of physical constraints on route selection. It is used in conjunction with the complexity of the topography, which is often a good indicator of the level of detour (Figure 4.4).

Railway networks having a Detour Index of 1 are rarely, if ever, seen. To be sure, some networks fit an asymptotic curve and approach 1, but never actually reach it. Straight stretches of line do exist: the longest stretch of dead-straight railway track in the world is across the Nullabor plain in Australia, 478 kilometres (O'Dell 1956), with the second longest in Saskatchewan on the CPR line[47] from Stoughton to Regina (Adamson 1995).

[47] Adamson, J. "Canadian Maps: January 1925 Waghorn's Guide. Post Offices in Man. Sask. Alta. and West Ontario". *Online Canadian maps digitization Project.*

Figure 4.4: The Detour Index



Route (a) is shortest in terms of distance, but not necessarily the least expensive in terms of construction costs. Route (b) represents a tentative attempt to reduce costs and this at the expense of a direct path. From a logical viewpoint, route (c) will be the one used to link locations 1 and 3. It offers the best compromise between the lost distance (a higher detour) and the additional construction costs imposed by construction over rough terrain. Source: Rodrigue 2009. Used with permission (04/05/11), © Jean-Paul Rodrigue.

Route	Direct Distance (1-2-3)	Transport Distance	Detour Index
a	20 km	20 km	1.0
b	20 km	25 km	0.8
c	20 km	30 km	0.666

The table above shows how the direct distance stays the same while transport distance increases and the Detour Index decreases, as the route has to adjust for the topography of the region.

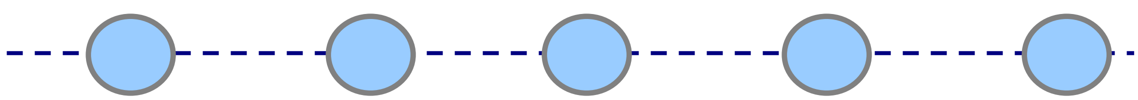
H_3

While it is now evident to us that the array of physiographic features of a region was always a factor in route selection, distinguished geographer Donald Meinig notes that such decisions were never completely dictated by the obvious lineaments of the land. Furthermore, he claims that with the exception of some extreme landforms there were always feasible alternatives for the specific route of any railway extension (Meinig 1962). In Meinig's seminal work, "A Comparative Historical Geography of Two Railnets: Columbia Basin and South Australia", he explains how insidiously easy it is to infer that a particular railway route was chosen simply based upon the terrain variations of the region. He argues rather that to help fully explain a rail network of a region, "detailed archival research must be completed to discover the actual bases of decision for each section of the railway" (Meinig 1962, p. 413), a recommendation which was followed to the letter in Chapter 2 of this thesis.

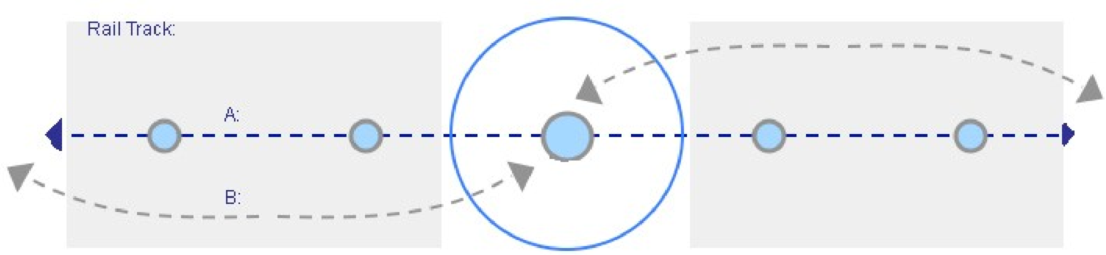
Meinig explains that once this archival research has been completed, certain network patterns may be identified in order to establish some regularity in the layout of the system. As mentioned at the outset of this thesis, Meinig's work compares the American Pacific Northwest to a portion of Australia, namely the state of South Australia. These systems were exactly contemporaneous with Manitoba's railway system, which renders credible any lessons drawn from them when applied to our region. Additionally, they were created with a prime function of linking farming districts with tidewater to serve the export grain traffic; again having an obvious bearing on Manitoba. The major difference between the rail nets was control, as the Pacific Northwest system was a completely private enterprise while South Australia's was a completely government-directed enterprise. Interestingly, the Manitoba network provided a blend of both public and private interests during this era, so aspects of both of Meinig's subject regions are relevant to understanding it.

The implication of these different kinds of control over railways leads to the formulation of a series of hypotheses that are entirely based upon Meinig's work. Again as was noted in Chapter 1, Meinig identifies four geographic forms that rail networks can assume:

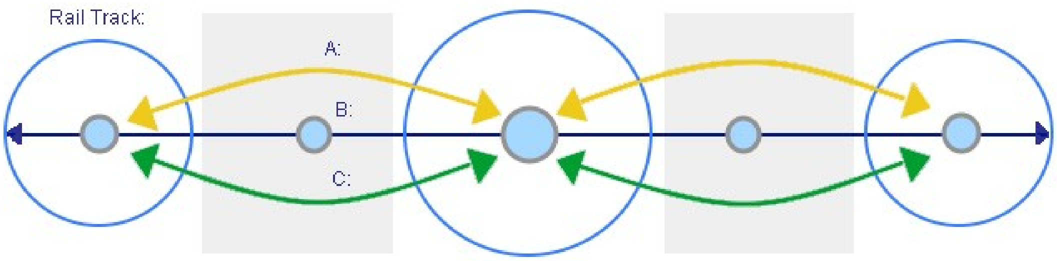
1. **Linear Segmentation**: a series of linear segments, each served by one railway line.



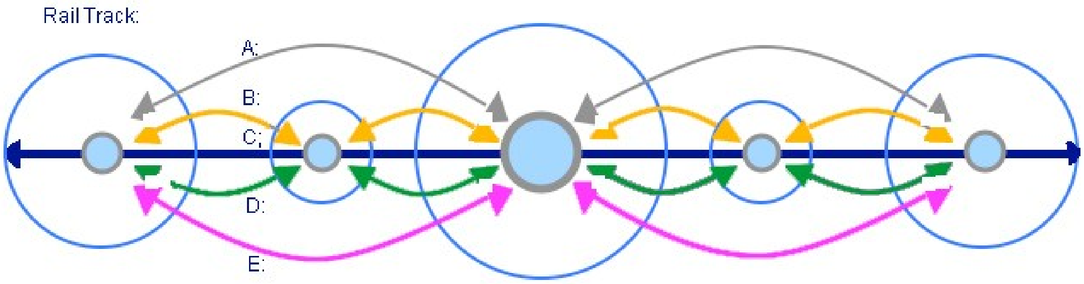
2. **Linear Duplication**: almost complete duplication of service in a narrow section of land.



3. **Multiple Point Duplication**: largely linear segments with duplicate service to most larger towns.



4. **Complex Web**: a true web composed of overlapping branches of three or more railway systems. Nearly all towns enjoy duplicate railway service, and many are endowed in triplicate or more.



Furthermore, Meinig argues that it is the control of the railways (public vs. private) that determines the overall shape of the network. In his work he identifies the South Australian rail network as assuming a largely **Linear** pattern with each line monopolizing a belt or area of the region (Meinig 1962). From this inspiration I present my third hypothesis:

H_{3o}: Government lines tend to adopt **Linear** networks – each line monopolizing a belt of tributary country.

H_{3a}: Some government lines are forced to react to rival systems – and therefore become less linear in pattern.

In the Manitoba case, the HBR stand out instantly as a prime example to define the H_{3o}. To this day, the HBR potentially monopolizes the entire market of the northern half of Manitoba from Hudson Bay Junction to Churchill. However, with regard to the H_{3a}, in many instances in southern Manitoba the provincial government built lines in close proximity to existing lines in order to compete with them (note, for example, the RRV lines fashioned to battle the CPR).

H_4

This notion of railway competition leads me to the next hypothesis, which is based on Meinig's suggestion that "laissez-faire conditions allow competition between railways to flourish, resulting in duplicate lines to the same places". This can be expressed formally in two phases (phase 1 corresponding to early development, phase 2 equating with later development):

H_{4o}: With competition, expect **Linear Duplication** of rail lines initially (phase 1).

H_{4a}: Some rivals avoid existing lines to carve out their own tributary territory.

In the Manitoba network the first lines of the CPR, CNoR and GTP from Winnipeg to Portage la Prairie essentially ran parallel to each other, since the companies were fighting for the same market area. However, with respect to the H_{4a}, the CNoR decided to construct their line far to the south of the CPR line east of Winnipeg to Port Arthur, essentially carving out their own territory. Similarly, the NT line was built far to the north of the CPR line with a branch line down to Port Arthur/Fort William.

H_5

Phase 2 succeeds phase 1 in the development of the railways once competition adopts a more intensive character. Meinig argues that this stage warrants the spatial arrangement known as the **Multiple Point Duplication**. Expressed formally this means:

> H_{5o}: Where competition is fierce, railways will adopt **Multiple Point Duplication** (phase 2, after phase 1 is complete)
>
> H_{5a}: Fierce competition does not result in network changes; i.e. the Linear Duplication pattern is not amended.

In southern Manitoba one section that stands out in this regard is the area from Portage la Prairie west to Brandon. However, in respect of the H_{5a}, there is reason to doubt whether networks of the companies involved were really changed from the Linear Duplication pattern in most of the railway sections in Manitoba, since the system amendments appeared minimal.

H_6

From here I move to the final stage of network development (phase 3). Meinig argues that in the final stage the network takes the form of a **Complex Web,** the upshot of the actions of three or more railway systems. Now all towns have duplicate railway service, many with triplicate or more. By definition, the ‘gateway’ city should be the busiest point on the web. Addressed formally this is:

> H_{6o}: All railway companies involved judge the ‘gateway’ access and control as vital. The result is – by phase 3 – a **Complex Web** of lines

(including metro area and suburban rail service) centred on the 'gateway city'.

H_{6a}: 'Gateway' rail traffic in Winnipeg never grows to justify a **Complex Web**.

With reference to the sixth hypothesis, I am arguing that Winnipeg never grew large enough to sustain an intricate pattern of railways corresponding to a Complex Web.

Conclusion

Now that the hypotheses have been justified, naturally the next step is to take a closer look at the Manitoba railway network in order to determine whether it conforms to the aforementioned hypotheses. Thus, the next chapter of this thesis consists of empirical verification of these hypotheses, resorting in most instances to use of graph theory. In short, it will produce a spatial analysis of the entire Manitoba railway network. It also contains an overview of the effectiveness of the entire rail systems of the different companies, the ultimate gauge of the mode's usage in the province.

Chapter Four - End-Note 1

The Central Pacific Railroad (CPRR) is the former name of the railroad network built between California and Utah that formed part of the first Transcontinental Railroad in North America. It is now part of the Union Pacific Railroad (UP). The 2,858 – km-long first transcontinental railroad included 1,110 km built by the CPRR and 1,747 kilometres built by the UP. Construction started in 1863 and was completed with the blending of the rails at Promontory Summit, Utah, on May 10, 1869. The line went from Omaha, Nebraska (UP) to Sacramento, California (CPRR), thereby connecting with other railroads from the east (for example, from Boston and New York via Chicago, or St. Louis) to cover the continent by rail from the east coast to the west coast for the first time. On April 1, 1885 the CPRR was leased to Southern Pacific Railroad. The headquarters of UP has been in Omaha, Nebraska, since its inception. Currently they are housed in the Union Pacific Center, completed in 2003 (UP: Chronological History: http://www.uprr.com/aboutup/history/uprr-chr.shtml). Today UPRR's chief railroad competitor is the BNSF Railway which covers much of the same territory.

Figure 4.5: 1881 CPRR–UPRR Timetable Map, showing railroad land grants.

Image removed due to copyright, please follow link below:

Source: Bruce C. Cooper Collection, http://cprr.org/Museum/Ephemera/CPUP_Timetable_1881/1881_Overland_Map_Detail.html

CHAPTER FIVE

Spatial Analysis and

Hypothesis Testing

Introduction

In the previous chapter, a series of hypotheses were presented as an integral part of a formal spatial analysis of the Manitoba railway network. Thus, the twin objectives of this section are to, first, determine the validity of the six stipulated hypotheses and, secondly, to review the overall effectiveness of the individual rail networks of the different companies involved in establishing the Manitoba rail system. The first objective necessitates addressing each hypothesis in turn.

H_1

To begin with, the Innis/Vance categorization must not be allowed to prevail without qualification. To recapitulate, it constitutes the first null hypothesis, namely:

> H_{1o}: Manitoba's railway lines were all 'developmental penetration lines' that were cheaply built, and they were laid down to encourage latent demand rather than to meet existing demand.

The absence of any considerable population in the area west of Winnipeg during this time means that the CPR main line from Winnipeg to Brandon is the prime example (Example H_{1o} -1) of a developmental penetration line (Figure 5.1). The entire population of the South Western section of Manitoba amounted to just 1505, according to the 1881 census (Statistics Canada. 1881 Census. Schedule 1, Families, Population, Sexes). The first Brandon census was conducted in 1891.

Subsequent censuses reveal that significant population increase did not occur until the first decade of the twentieth century.

Table 5.4: Census returns, Brandon.

	1891	1901	1911
Brandon, town	3,778	5,620	13,839

Source: (Statistics Canada. 1891, 1901, 1911 Census. Manitoba, Brandon, town. Schedule 1, Families, Population, Sexes).

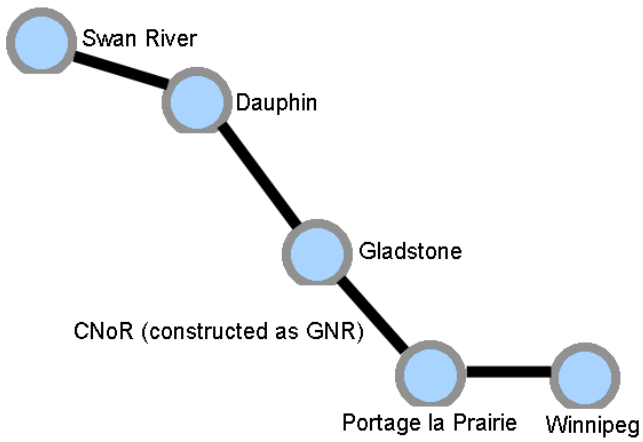
Figure 5.1: A graph representation of the CPR Mainline, 1885.

Source: Created 11/01/10 by McCombe, C.G.L.

This penetration factor can be corroborated from an actual instance drawn from the historical record. That event centred on a dispute over the land prices in the established community of Grand Valley on the north bank of the Assiniboine River. This dispute caused the CPR to locate its station approximately 3 km west of Grand Valley, which quickly resulted in that settlement's demise and the rapid expansion of the new settlement, Brandon (Welsted et al. 1996). Clearly, the presence of the railway stimulated development, rather than the railway reacting to development already in situ.

A second case (Example H_{1o}-2) focuses on the railway west of Lake Manitoba (Figure 5.2).

Figure 5.2: The Yellowhead Penetration line (via Dauphin) circa 1899.



Source: Created 11/01/10 by McCombe, C.G.L.

As discussed at length in Chapter 2, the Canadian GNR (not to be confused with its much larger American namesake) built a true penetration line through uninhabited Manitoba wilderness. Circumstantial evidence in favour of rail penetration occasioning development can be inferred from a comparison of populations before and after the line was completed (Table 5.2).

Table 5.5: Population changes, Portage - to - Swan River.

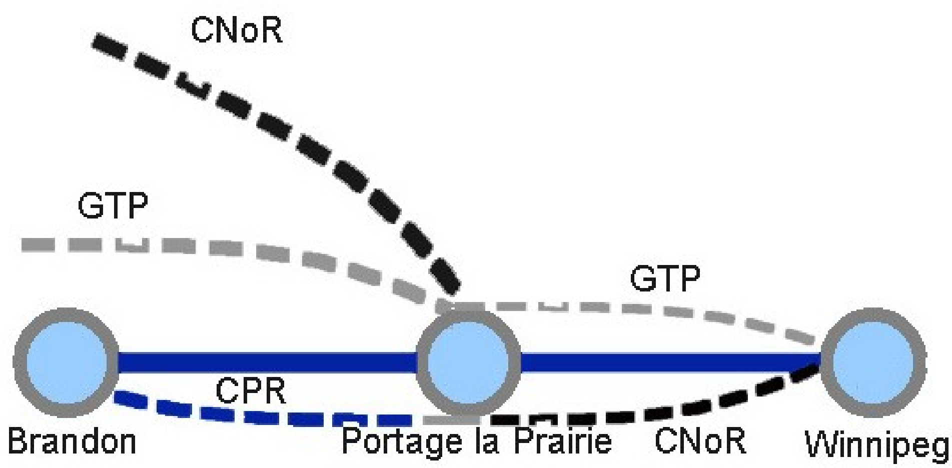
	1891	1901	1911
Portage la Prairie	3,363	3,901	5,892
Gladstone, town	378	781	782
Dauphin, town	No data	1,166	2,815
Swan River, RM	No data	1,407	2,150

Source: Statistics Canada. 1881, 1901, 1911 Census. Manitoba (various), Schedule 1, Families, Population, Sexes.

Evidently, population in the territory traversed by the line was modest in the extreme in 1891, but had grown three-fold or so within a decade of its completion.

Alternatively, and offsetting the above examples, many railways in Manitoba can be seen to conform to the $H_{1a:}$ in other words, some lines were ‘latecomers’; designed to tap an already ‘opened’ area. A ready example (Example H_{1a} -1) is furnished by the two ‘majors’ (GTP and CNoR) encroaching on the territory already opened up by the CPR in the critical Winnipeg to Brandon corridor (Figure 5.3).

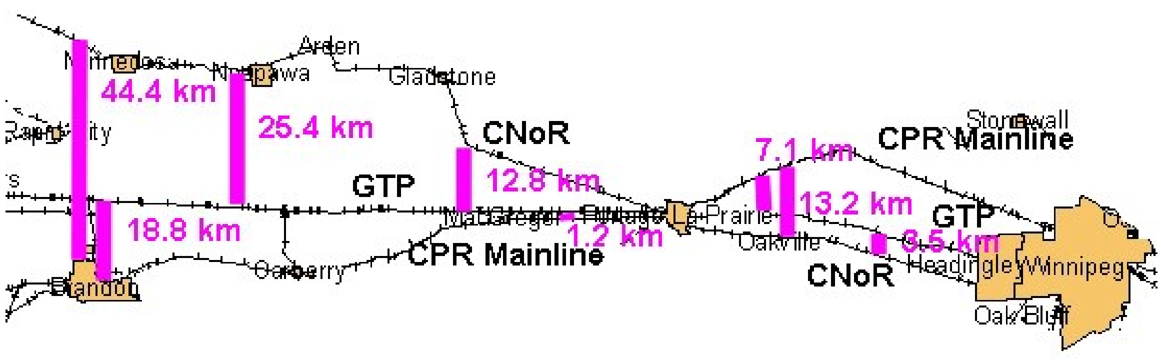
Figure 5.3: Latecomers (GTP, CNoR) tap an already opened area.



Source: Created 11/01/10 by McCombe, C.G.L.

The question that immediately comes to the forefront of this section of the study is did the later parties locate increasingly farther from the route of the first-on-the-scene or did they try to crowd-out the pioneer by locating in close proximity? The series of distance separating calculations, as illustrated in Figure 5.4, will expose the truth (see Table 5.3).

Figure 5.4: Distance separation calculations shown in magenta.



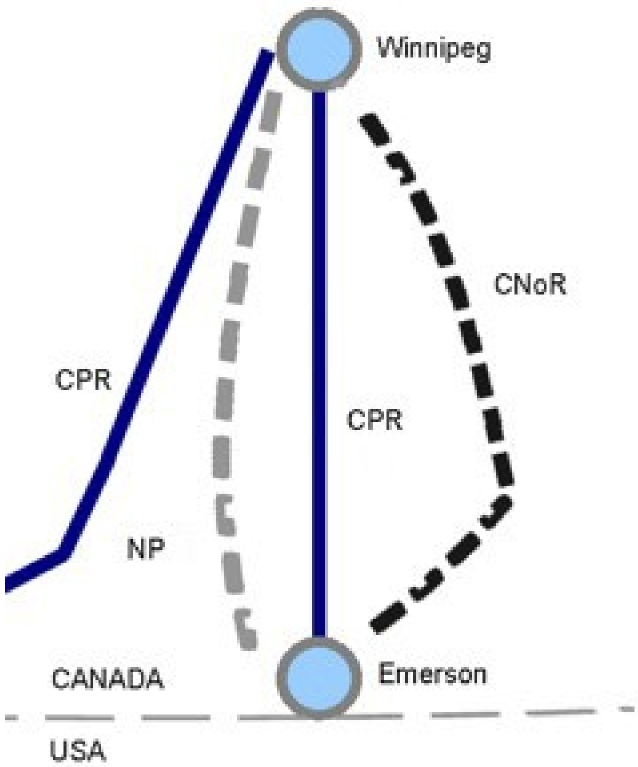
Source: Created by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute. Created 11/15/10.

Table 5.6: Distance Separations:

Distance Separations	CPR Mainline to GTP	CNoR to GTP	CPR mainline to CNoR
Distance 1	18.8 km	3.5 km	13.2 km
Distance 2	1.2 km	12.8 km	14.1 km
Distance 3	7.1 km	25.4 km	44.4 km
Average	**9.0 km**	**13.9 km**	**23.9 km**

In this section of the province, the CPR mainline was the first to be constructed and was completed in 1885. This was followed by the CNoR line, which was completed in 1891 (and originally constructed by the Canadian GNR). It was followed more than a decade later by the GTP. The evidence suggests that the GTP was attempting to crowd-out the CPR pioneer in the area by locating a close average of just 9.0 km apart from the CPR's mainline. This decision served equally to place their track within close proximity to CNoR's mainline, which was an average of 13.9 km to the north. The CNoR, as previously indicated, had attempted to carve out their own spatial monopoly by locating a good 23.9 km from the CPR's mainline. Further support for the alternative variant of the first hypothesis can be garnered from railway developments south of Winnipeg (Example H_{1a} -2; Figure 5.5). The first section of rail in this region was laid by the CPR. In November 1878 Manitoba's first operating railway opened for business, connecting with J. J. Hill's and D. A. Smith's, St. Paul, Minneapolis and Manitoba Railroad (Jackson, MHS Transactions Series 3, Number 30, 1973-74 season).

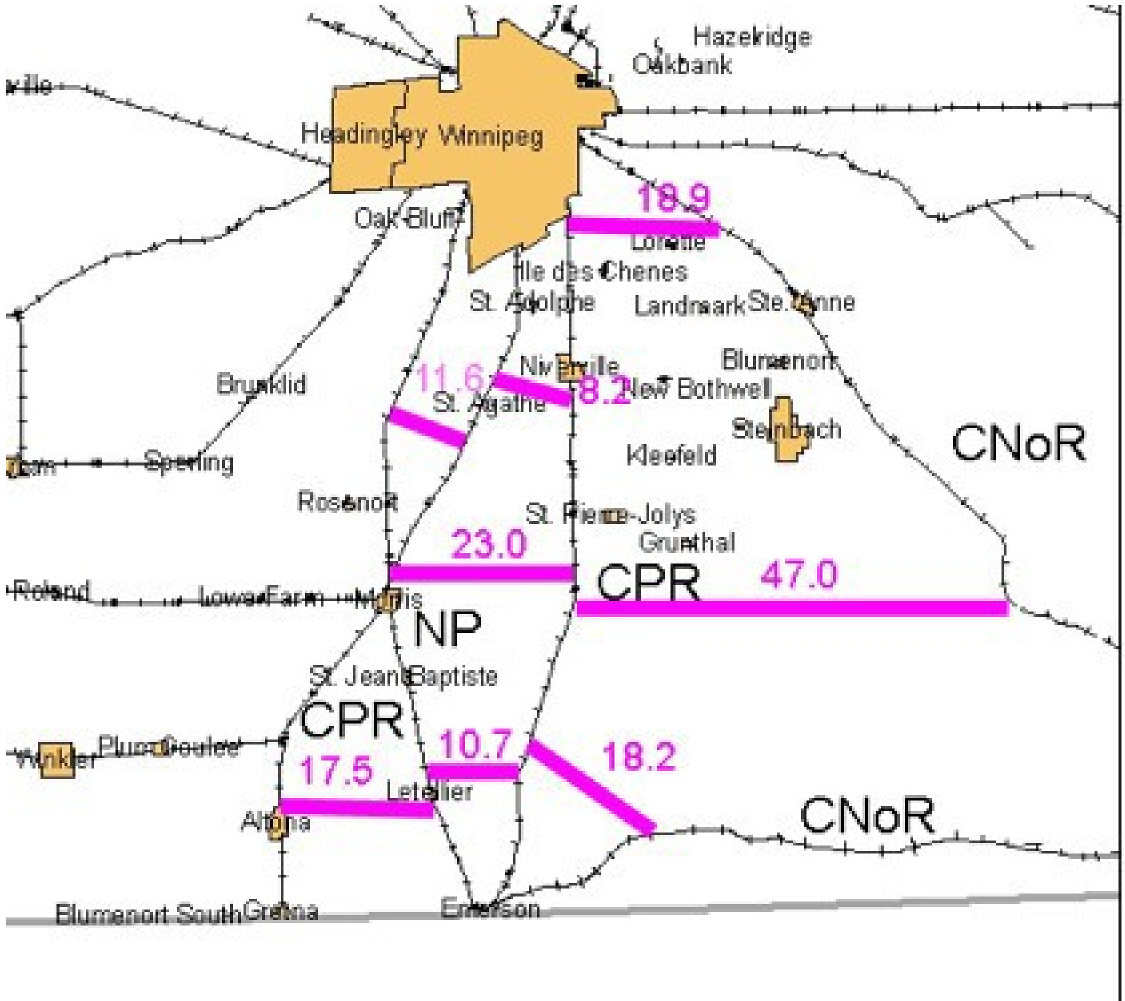
Figure 5.5: The Red River Valley region from the international boundary to Winnipeg.



Source: Created 11/15/10 by McCombe, C.G.L.

Subsequently, and in short order, it was followed in 1881- 82 by the CPR's Southwestern and Pembina Mountain Branch to the west of the original CPR line (designated the 'CPR West' for my purposes). The third line traversing the section in question was constructed in 1889 thanks to the end of clause 15. It became the NP line, and ran directly between the two CPR lines. The fourth and final line belonged to the CNoR, and it adopted a direction to the east of all the other lines. Below is a table (Table 5.4) showing the average distance between these railway companies (as configured in Figure 5.6).

Figure 5.6: Distance separation calculations shown in magenta.



Source: Created by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute. Created 11/15/10.

Table 5.4: Distance Separations:

Distance Separations	CPR West to NP	NP to CPR	CPR to CNoR
Distance 1	11.6 km	8.2 km	18.9 km
Distance 2	0.5 km	23.0 km	47.0 km
Distance 3	17.5 km	10.7 km	18.2 km
Average	**9.9 km**	**13.9 km**	**28.0 km**

Taking the average-distance-separating calculations into account, it is clear that initially the CPR spaced their lines perfectly apart to run an effective monopoly (approximately 20 km between the two lines), and this outcome was consistent with plans framed under clause 15. Their plans, however, were ruined by the incursion of other companies. First, the NP line to Emerson opened to traffic on September 1, 1889 (Moore 1975). Rates on this line were to be fixed favourably for the farmers of the province and by implication pared the profits realized from railway freight rates. In this case, the NP was clearly attempting to crowd-out the CPR pioneer in the area by locating a 'cheek-by-jowl' average of 9.9 km and 13.9 km apart from the CPR's two lines. Subsequently, when the CNoR arrived in the area in 1898, they chose to locate increasingly farther from the first three lines, in what amounted to an average of 28 km from the nearest CPR line. The circumstances attending these decisions are discussed in detail in Chapter 2.

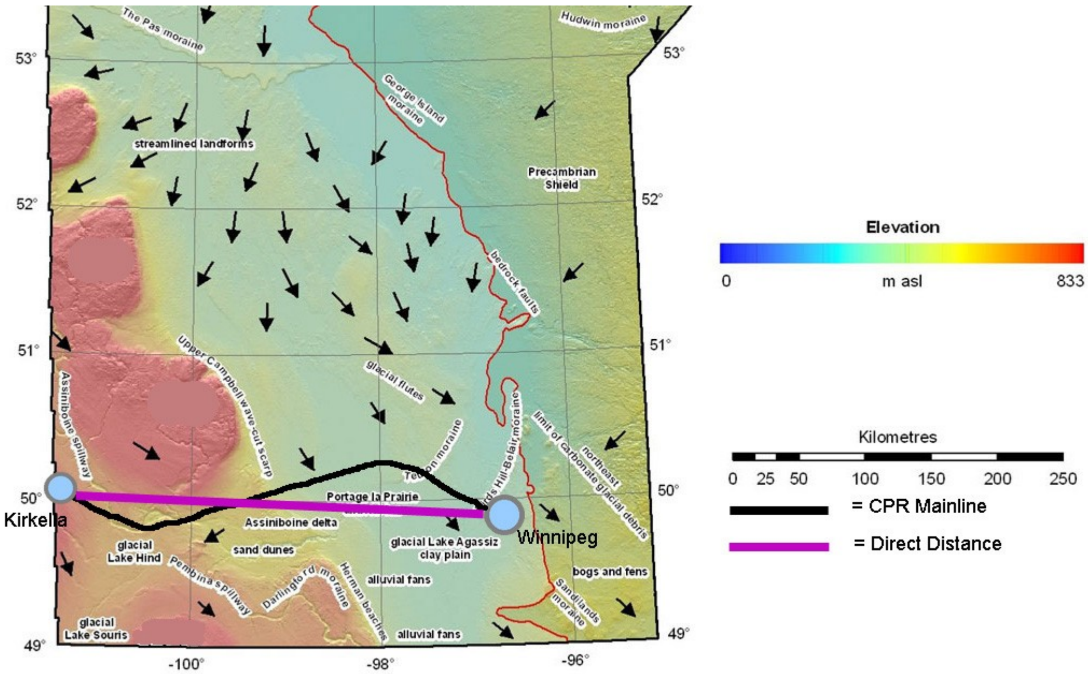
H_2

Railway companies, as remarked, confronted competitive conditions in different ways, resulting in distinct route configurations. They all, however, were faced with comparable terrain obstacles when penetrating the same region. How that influenced their routing decisions is addressed in the next hypothesis. So, to repeat the truism, the physical attributes of space, embodied in the topography of Manitoba, inevitably influence the route selection process. This leads to the null hypothesis:

> **H_{2o}**: Other things being equal, railways would follow 'easy-gradient' straight-line routes rather than those conforming to 'difficult-gradient' straight-lines.

The CPR's mainline provides the perfect example to prove this null hypothesis. Configured on a large-scale map of Canada, the CPR mainline looks like it goes straight across the province from east to west (Figure 5.7). When examined at a smaller scale it becomes apparent that the CPR mainline in fact follows what can be called an 'easy-gradient' straight-line route from Winnipeg to Kirkella.

Figure 5.7: A Digital elevation map (shown in metres above sea level) with the CPR Mainline shown in black and the Direct Distance shown in magenta.



Source: Created by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute. Created 11/15/10.

To measure of the efficiency of this section of the rail network, use will be made of the Detour Index (DI). It will be recalled from Chapter 3 that the DI takes the form of a ratio:

$$DI = \frac{DD}{TD}$$

in which TD represents the transport distance and DD the straight-line distance. In this case the Index is calibrated as follows (*distance is apporoximate):

Table 5.5: Detour Index – CPR Mainline:

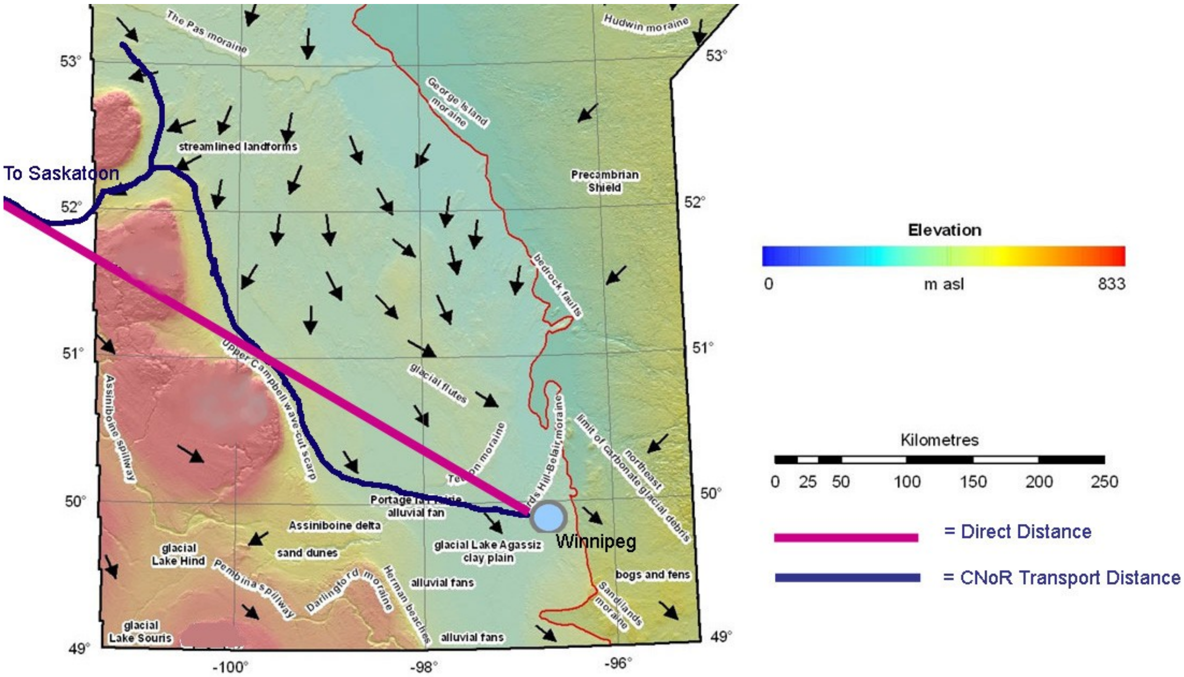
Route	Direct Distance (DD)	Transport Distance (TD)	Detour Index
CPR Mainline	303 km*	340 km	0.89

This confirms that the Detour Index of the CPR mainline is high, since it is close to 1. In other words, this route makes only slight changes to accommodate the topography of the region, for the terrain is not imposing any meaningful barriers to movement. Now it is appropriate to turn to the alternative hypothesis, $H_{2a.}$ This maintains that

> $\mathbf{H_{2a}}$: where H_{2o} is impractical, railways prefer easy-grade meandering routes (Figure 4.3, 2) to difficult-grade straight-line links (Figure 4.3, 1).

Study of a physical map of Manitoba shows the patterns of some railways vary in accordance with the topography of the country in which they traverse. Take for instance the CNoR mainline from Winnipeg to the western edge of the province (Figure 5.8).

Figure 5.8: A Digital elevation map (shown in metres above sea level) with the CNoR Mainline shown in blue and the Direct Distance shown in magenta.



Source: Created by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute. Created 11/15/10.

Again use is made of the Detour Index to put this route into context (*distance is approximate):

Table 5.6: Detour Index – CNoR Mainline:

Route	Direct Distance (DD)	Transport Distance (TD)	Detour Index
CNoR to Sask. Border	500 km*	625 km	0.8

In registering a DI of 0.8 the CNoR mainline is evidently less efficient than its CPR counterpart, for it has to go farther in transport distance to avoid the rugged topography of western Manitoba.

At this juncture the focus moves to matters of inter-company competition, the substance of the next several hypotheses.

H_3

Inspired by the work of Meinig, the third hypothesis assumes the following null form:

H_{3o}: Government lines tend to adopt **Linear** networks, with each line monopolizing a belt of tributary country.

It bears repeating that the HBR stands out instantly as the prime example substantiating the H_{3o}. To this day, the HBR actually and potentially monopolizes the entire market of the northern half of Manitoba from Hudson Bay Junction to Churchill (see Figure 2.13). The HBR in its current guise operates lines totalling 1303 km of trackage in northern Manitoba between The Pas and Churchill. The direct line from The Pas to Churchill is 824 km. In order to prove the linear aspect of this network it is sufficient to resort to the Pi Index.

$$\Pi = \frac{L(G)}{D(d)}$$

It will be recalled that the Pi Index is the relationship between the total length of the graph L(G) and the distance along its diameter D(d). In this case:

Table 5.7: Pi Index – HBRY

Route	Length of Graph L(G)	D(d)	Pi Index
HBRY, The Pas to Churchill	1303 km	824 km	1.58

The Hudson Bay Railway from the Pas to Churchill (see Figure 2.13) defines Meinig's interpretation of the 'linear' network. With a Pi index of 1.58 the HBRY falls into the low Pi category, which is tantamount to saying that it is linked with a low level of network development (a simple corridor/linear network). A high Pi value would correspond to a more extensively developed network (such as a system of linked cities) that is clearly not found in northern Manitoba.

Contrasting sharply with the situation applying in northern Manitoba are many instances in southern Manitoba where the provincial government built lines in close proximity to existing privately owned lines in order to compete with them. This notion of competition informs the third alternative hypothesis; namely,

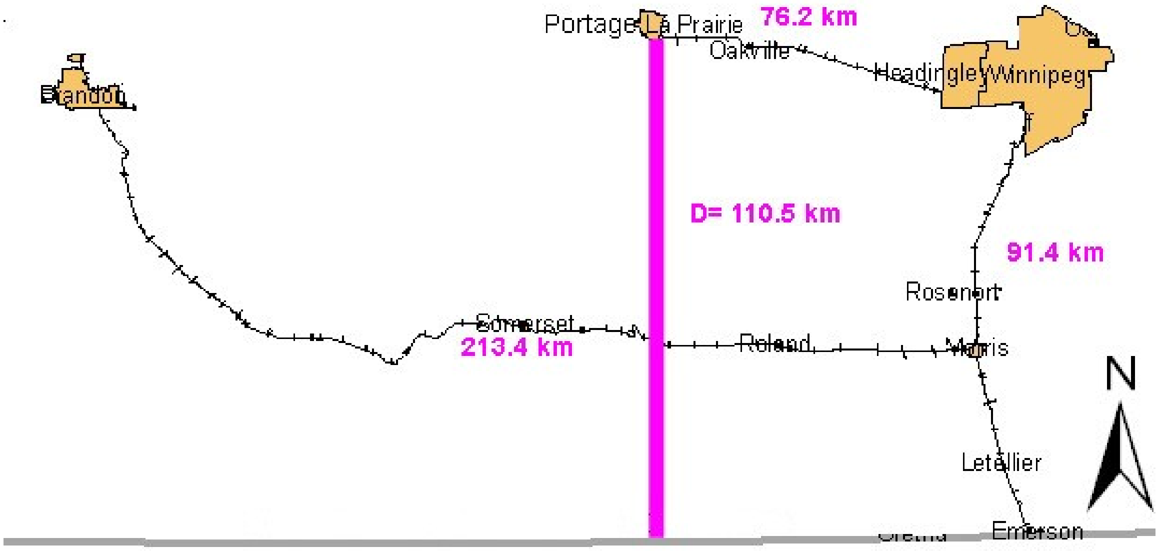
H_{3a}: Some government lines are forced to react to rival systems – and therefore become less linear in pattern.

As discussed in Chapter 2, The Red River Valley Railway became the symbol of a united Manitoba's determination to be done with disallowance and the CPR monopoly. Famously, the Winnipeg Board of Trade went on record as favouring a withdrawal from Confederation if the disallowance policy did not come to an end. After much debate and lobbying, the Manitoba Government achieved the withdrawal of the monopoly clause. Compensation to the disaffected parties cost the Dominion Government the guarantee of $15,000,000 in CPR bonds for rolling stock and branch-line construction. The Legislature was reconvened, passed an amended Red River Valley Railway Act empowering the line to build not only to the U.S. border, but also to both Portage la Prairie and Brandon, and in fact to wherever it might have to build in order to provide direct competition for the CPR across the Manitoba prairie. The routes embodied in this initiative were proposed in a manner depicted in Figure 2.6.

In the end, the government struck a deal with the Northern Pacific Railway in which the RRV was leased to a new venture, the Northern Pacific and Manitoba Railway (NP&MR), on September 4, 1888. The NP&MR would not only complete the line to Emerson but would also build from Winnipeg to Portage la Prairie and from Morris to Brandon.

Recourse will again be had to graph theory's Pi index to see how it reflects the configuration of a less-linear system such as that of the RRV (Figure 5.9). The calibrated value, in turn, will give a summary measure of the effectiveness of this system.

Figure 5.9: The Pi Index applied to the proposed RRV lines. The diameter is denoted with the magenta line.



Source: Created by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute. Created 11/20/10.

The Pi index ((L(G)/D(d)) in this network works out to:

Table 5.8: Pi Index – Proposed RRV

Route	Length of Graph L(G)	D(d)	Pi Index
Proposed RRV (NP)	381 km	110.5 km	3.45

There is no doubt that, with a Pi index of 3.45, this rail network is more developed than the HBR example. As the Hudson Bay route follows a simple corridor, this network, in contrast, branches out to connect cities and towns together. Thus, because the RRV was designed to compete directly with the CPR, its lines are less linear; a fact proved empirically by the higher Pi value.

H_4

This clear demonstration of the existence of railway competition and its effect on route configuration leads naturally to the next hypothesis, which is based on Meinig's proposal that "laissez-faire conditions allow competition between railways to flourish, resulting in duplicate lines to the same places". This can be articulated formally in two phases (phase 1 corresponding to early development, phase 2 equating with later development): In the first instance,

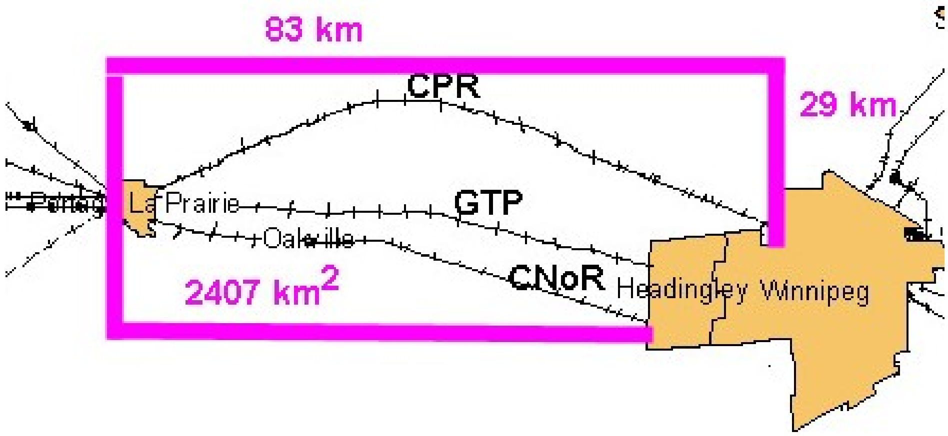
H_{4o}: With competition, expect **Linear Duplication** of rail lines initially (phase 1).

In the Manitoba system, the first lines of the CPR, CNoR and GTP from Winnipeg to Portage la Prairie basically ran parallel to each other, since the companies were openly competing for the same market area. To examine this market area empirically, the network density index will be utilized(recollect Chapter 3). The network density index tells us how much a rail network has been developed while measuring the territorial occupation of this rail network in terms of km of links (L) per km^2 of surface (S). The higher its magnitude, the more a network is developed.

$$ND = L/S \times 100$$

The geography underpinning the example is summarized in Figure 5.10.

Figure 5.10: The Network area of the three lines west of Winnipeg to Portage la Prairie illustrating Linear Duplication. The study area is highlighted in magenta.



Source: Created by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute. Created 11/20/10.

The Network Density calculation is forthcoming with the following:

Table 5.9: Network Density – Winnipeg to Portage

Route	Km of Links (L)	Km^2 of surface area (S)	Network Density
Winnipeg to Portage (3 Lines)	238.4 km	2407 km^2	9.90

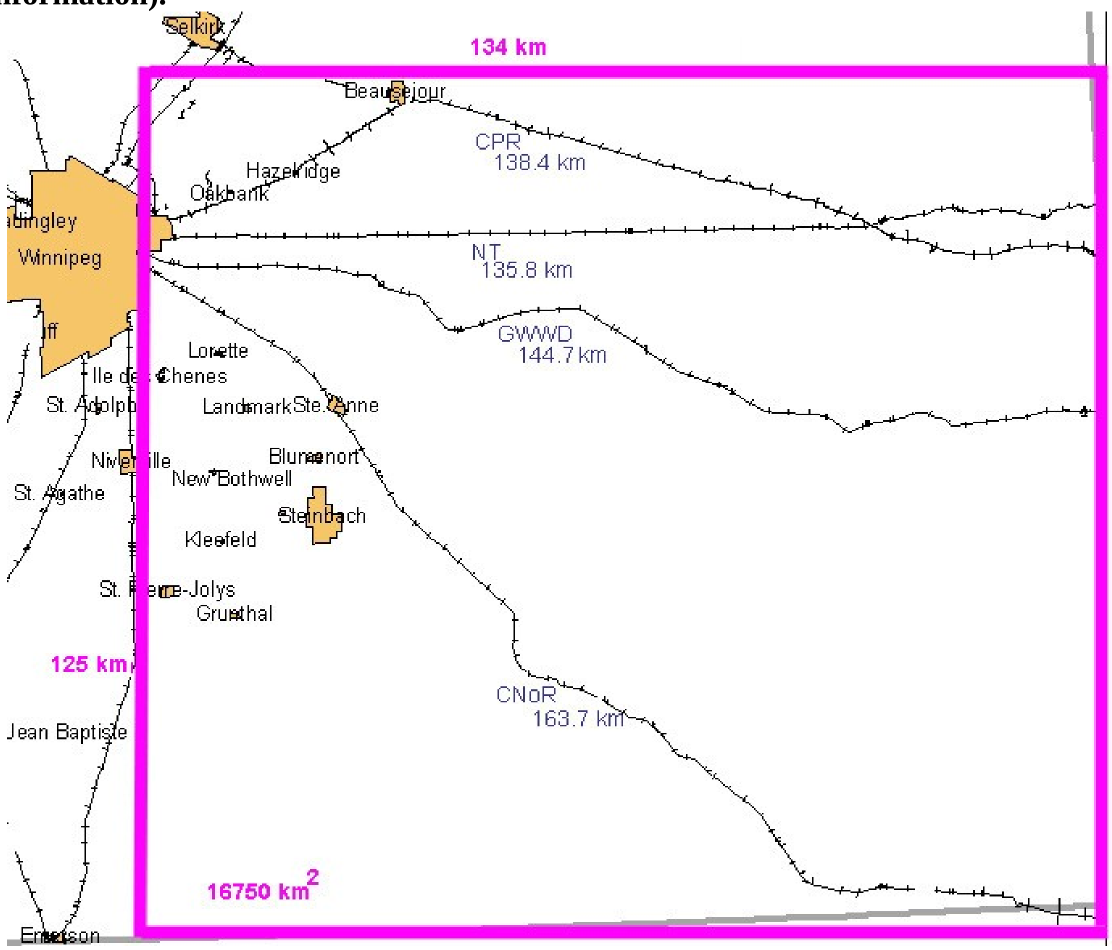
The Winnipeg to Portage la Prairie network has a density of 9.90 which is in all likelihood the best example of Linear Duplication in the Manitoba rail network.

However, on the east side of Winnipeg, the CNoR decided to construct their line far to the south of the CPR line from Winnipeg to Port Arthur, essentially carving out their own monopoly territory (Figure 5.11). Similarly, the government-funded NT line was built far to the north of the CPR line with a branch to the Lakehead (where it encroached on CPR territory once again). This leads to the alternative hypothesis:

H_{4a}: Some rivals avoid existing lines to carve out their own tributary territory.

The Network Density index will again be employed to distinguish the numerical characteristic associated with railways pursuing policies aimed at the avoidance of competition.

Figure 5.11: The Network area of the lines east of Winnipeg to Northwestern Ontario. The study area is highlighted in magenta. Note the GWWD railway (The Greater Winnipeg Water District Railway), see Chapter Two Appendix for more information).



Source: Created by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute. Created 12/02/10.

The appropriate Network Density calculation in this instance registers:

Table 5.10: Network Density – Winnipeg to Ontario

Route	Km of Links (L)	Km^2 of surface area (S)	Network Density
Winnipeg to Ontario	582.6 km	16750 km^2	3.48

Evidently, the network density is much lower on the east side of Winnipeg where the rail companies chose to avoid each other and carve out their own territory. All that has been discussed thus far has relevance for first-phase activities. Greater network maturity – phase 2 – leads to network adjustments, as recorded below.

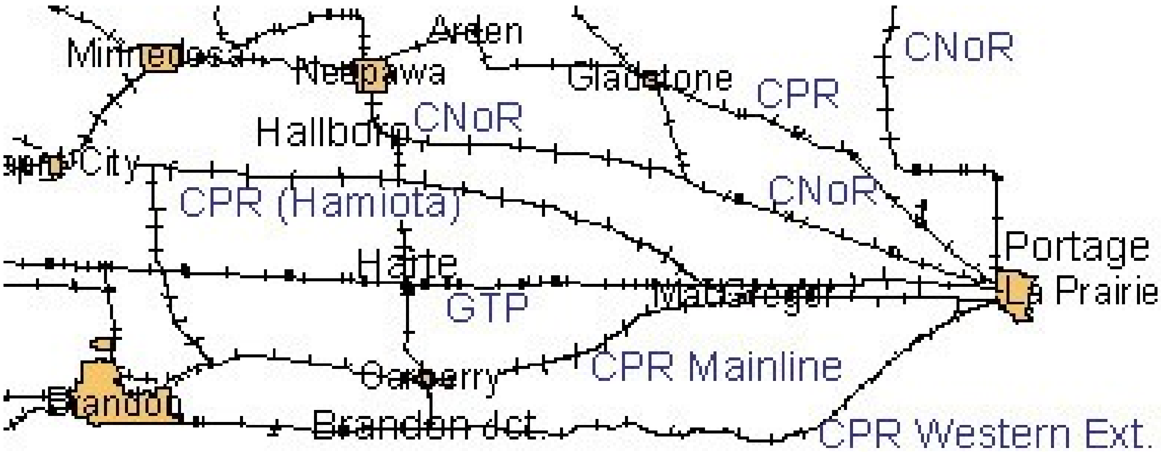
H_5

To be precise, phase 2 succeeds phase 1 in the expansion of the railways once competition adopts a more challenging character. Meinig argues that this phase warrants the spatial arrangement known as the **Multiple Point Duplication**. Articulated formally this means:

H_{5o}: Where competition is fierce, railways will adopt **Multiple Point Duplication** (phase 2, after phase 1 is complete)

In southern Manitoba, one section that stands out in this regard is the corridor extending from Portage la Prairie west to Brandon. This area benefits from largely linear segments of railway with duplicate service to the city of Brandon and to towns of the stature of Gladstone, Neepawa, Hallboro, Harte, Carberry, Varcoe, Minnedosa, Brandon Junction, and Portage la Prairie (Figure 5.12).

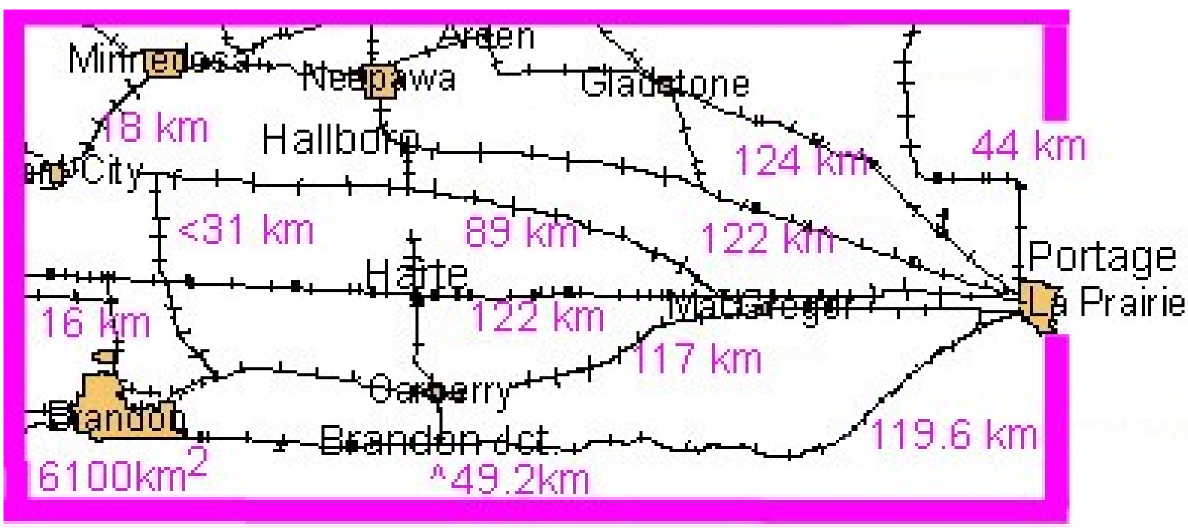
Figure 5.12: Multiple Point Duplication in Manitoba. This region between Portage la Prairie and Brandon represents the ultimate peak of railway competition in Manitoba. All three leading companies (CPR, CNoR and GTP) exist in this section and are in close proximity to each other.



Source: Created by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute. Created 12/02/10.

The area at issue is scored to allow a comparison of line proximities – a proxy for the intensity of competition – preparatory to network density calculation (Figure 5.13).

Figure 5.13: The network area of the all the competing lines west of Portage la Prairie to Brandon/Minnedosa illustrating Multiple Point Duplication. The surface study area is highlighted in magenta.



Source: Created by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute. Created 12/02/10.

The actual Network Density calculation pertaining to this area is:

Table 5.11: Network Density – Portage West to Brandon

Route	Km of Links (L)	Km^2 of surface area (S)	Network Density
Portage West to Brandon	851.8 km	6100 km^2	13.96

While this area has a much greater surface area than the area from Winnipeg to Portage, the total kilometres of links is more than proportionately larger, which has the effect of boosting the density of this area to 13.96. This result is consistent with Multiple Point Duplication.

Granted that competition was quite fierce in this section of the network, the same could not be said for most other sections of Manitoba's railway network. There the alternative hypothesis - H_{5a} – is likely to prevail. Formally, it is expressed as:

H_{5a}: Phase 2 competition does not result in network changes; i.e. the Linear Duplication pattern is not amended.

An outstanding example is the Winnipeg to Portage section that was discussed in H_4. It remained at the Linear Duplication stage, never moving up to Multiple Point Duplication. Thus, there is reason to believe that, for the most part, the networks of the railway companies never progressed beyond the Linear Duplication in Manitoba, since the system amendments appear minimal from the original railway-building era. Nevertheless, given the situation obtaining in the Portage-Brandon corridor and granted the dominant position of Winnipeg, it is necessary to proceed to the sixth and final hypothesis.

H_6

In the final stage of network development (phase 3), Meinig argues that the network takes the form of a **Complex Web,** the outcome of the actions of three or more railway systems. In this phase all towns enjoy at a minimum duplicate railway service, many with triplicate or more. By definition, the 'gateway' city should be the busiest point on the web. Addressed formally this is:

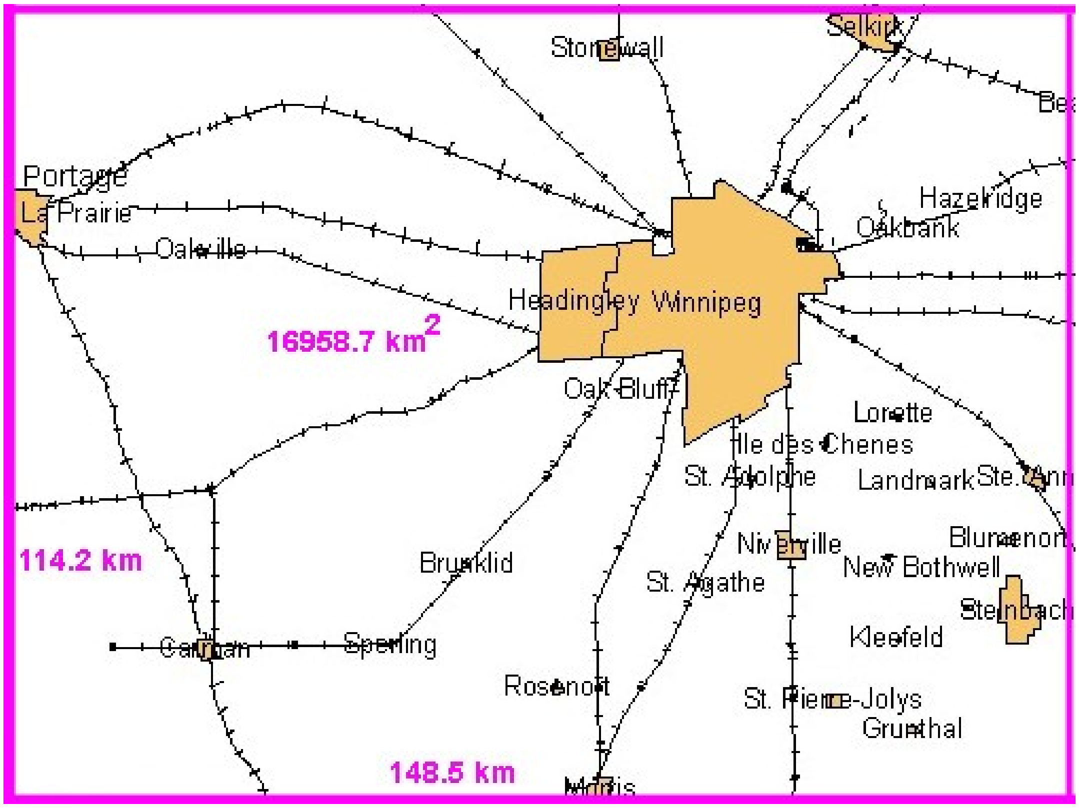
> H_{6o}: All railway companies involved judge the 'gateway' access and control as vital. The result is – by phase 3 – a **Complex Web** of lines (including metro area and suburban rail service) centred on the 'gateway city'.

Practically, this implies that Winnipeg should conform to the Complex Web pattern. Should it not do so – and there is much circumstantial evidence inclining one to this conclusion, then the alternative hypothesis prevails. Formally, it maintains that:

> H_{6a}: 'Gateway' rail traffic in and around Winnipeg never grows to justify a **Complex Web**.

Once again, resort is had to the Network Density calculation to determine finally if the Manitoba railway system has grown to include a Complex Web. If the Network Density around Winnipeg (the gateway city) is higher than that of the area discussed in H5, then it can be assumed that a Complex Web exists. If, however, the Network Density is lower, the H_{6a} will have been proven true. The study area is mapped formally in Figure 5.14:

Figure 5.14: The Greater Winnipeg area is taken as extending north to Selkirk, south-east to Ste. Anne, south to Morris, south-west to Carman, and west to Portage la Prairie. The study area is highlighted in magenta.



Source: Created by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute. Created 12/04/10.

The actual Network Density calculation pertaining to this area is:

Table 5.12: Network Density – Greater Winnipeg Area

	Km of Links (L)	Km^2 of surface area (S)	Network Density
Greater Winnipeg Area	920.1 km	16958.7 km^2	5.43

Thus, we see that the Manitoba railway system never grew to phase 3 - known as the Complex Web - even at its peak in 1915. With a proven Network Density of 5.43 the gateway city area of Winnipeg does not come close to the area west of Portage la Prairie with a Network Density of 13.96.

There are many reasons that the Complex Web stage was never reached in Manitoba around the gateway city. Winnipeg's period of growth and prosperity that had begun with the building of the CPR in the 1880s peaked by 1914, when the city entered a recession. Businesses closed and unemployment soared. This was followed by the Winnipeg General Strike in 1919, followed by the Great Depression of the 1930s that threw business, manufacturing, and wholesale trade into sharp decline. It was not until World War II that the economy turned around. Conditions improved in the postwar years, but growth was slow and steady compared to the fast pace earlier in that century as the development of oil, natural gas, coal and potash had shifted economic power westward to Alberta (Friesen 1987). Additionally, the advent of the internal combustion engine resulted in government construction of roads and highways; an event that undermined railway interest in suburban and ex-urban services.

Today Manitoba's railway system is much reduced from what it was at its peak, losing, along with the other Prairies Provinces, thousands of kilometres of track to abandonment in the last fifteen years alone.[48] By the 1960's the railways were operating many of their branch lines at a loss, as trucking firms had become much more prevalent and the railways had lost much of their traffic to them. More recently, with the advent of high through-put grain elevators, almost all the original wooden grain elevators have been abandoned (Figure 5.15), essentially leaving no traffic on the lines hosting them.

[48] According to the Canadian Transport Agency, during 1996-2008, a total of 2,997 kilometres of track have been abandoned across the three prairie provinces. (Canadian Transport Agency, http://www.otc-cta.gc.ca/index.php?lang=eng) Accessed in December 2010.

Figure 5.15: Changes in Prairie Primary Grain Elevator Network, 1994-2009

Image removed due to copyright, please see source below:

Source: "Grain Elevators in Canada", Canadian Grain Commission, www.grainscanada.gc.ca. Accessed in December 2010.

This abandonment destroyed economic growth in communities where the railway was the dominant or only transportation link. Because of this withdrawal of rail service in rural Manitoba, the rail network has become much more simplified, with few branch lines remaining. Emphasis has been switched to the trunk lines, but all the same, many of the stations on the main lines have been closed for passenger and freight pickup. Recently, there has been a trend towards ‘short-line’ railway companies that have been created to take over some of these abandoned lines. See the appendix for more information on this trend.

Clearly, any assumed tendency towards a Complex Web expired in the second decade of the twentieth century, for network contraction has increasingly taken hold ever since.

Overview of Effectiveness and Efficiency

Recent developments notwithstanding, the planning and placement of the railways in Manitoba played a fundamental role in determining the overall coverage and efficiency of the many companies that undertook to build them. The intent here is to gauge the degree of their effectiveness. To begin with, the CPR will be considered, befitting its status on the province's original railway.

As has been remarked, it was originally assumed that the CPR mainline would travel through the rich "Fertile Belt" near Dauphin up to the North Saskatchewan River valley and then cross the Rocky Mountains via the Yellowhead Pass, a route recommended by Sir Sandford Fleming based on his decade of survey work. However, the CPR promptly discarded this plan in favour of a more southerly route through Brandon, pushing to cross the arid Palliser's Triangle in Saskatchewan before tackling the Kicking Horse Pass and proceeding down the Field Hill to the Rocky Mountain Trench. This route was discovered by John Macoun who had a chance meeting with Fleming in 1872. Fleming recruited Macoun to participate in his expedition to the Pacific of 1872, and between 1872 and 1881 Macoun participated in five separate surveying expeditions in the prairies. Apart from determining the best route for the railway, a major purpose of these expeditions was to establish the agricultural potential of various regions of the prairies. Since Macoun's travels corresponded with a time of unusually high rainfall, he concluded that large regions of the Prairies were ideally suited to agriculture. Unfortunately, this blanket approval mistakenly included the normally arid plains of southern Manitoba, Saskatchewan, and Alberta in the region now known as Palliser's Triangle, which was to become a dustbowl during the Great Depression of the 1930's. Thus, the CPR, misled by optimistic claims, may have placed too much reliance on

Macoun's report. Equally telling, however, in influencing the routing decision were political considerations, for both the company and Ottawa were keen on forestalling American northwards expansion. There can be no doubt that the final southern routing made it easier for that company to keep American railways from encroaching on the Canadian market.

While the CPR was building their extensive branch-line network in and around this southern mainline, their interest did not extend to the parkland area near Dauphin. Meanwhile, advocates such as surveyor J. B. Tyrell had declared publicly that if he were choosing to build a farm he would go to the Dauphin area (Hanna 1919, p. 528-9) on account of quality growing conditions endemic to that part of the province. Thus, as described in detail in Chapter 2, William Mackenzie and Donald Mann, took control of the bankrupt Lake Manitoba Railway and Canal Company in January 1896 and the Canadian Northern Railway was instituted with the objective of filling this need. In early days the feature that separated the CNoR from the CPR was that the former's priority was to build the main trunk lines on the prairies first, then develop an extensive branch line network around these trunk lines, and finally to build the transcontinental connections (Regehr 1974). The CPR, in contrast, was initially obsessed with constructing a transcontinental line and only later became concerned with feeder lines. This inclines me strongly to the belief that this approach made the CNoR more sensitive to local needs in those early years of settlement when an extensive branch-line network was very important. Mackenzie and Mann recognized this critical fact of economic life more than other railway entrepreneurs and, after much political turmoil with both the Dominion and

Provincial Governments, were able to acquire the entire NP&MR system complete with all its branch lines; an event further consolidating their hold on local grain handling.

While the CNoR had gained the majority of customers in the northern half of the rail system and the CPR had gained the majority of customers in the southern half, the GTR was an interloper from the East eager to capture a share of the booming trade under way in the West. Initially a division of labour might have prevailed. Thus, Mackenzie and Mann suggested a plan between the two railways whereby the CNoR would control the Western portion while the GTR maintained its influence in the East. A traffic interchange between the CNoR and GTR would create a transcontinental system capable of meeting and beating CPR competition (PAC, Hays Papers, 15-16, 109-11, Hays to Wilson, March 1903). Had the GTR agreed to this plan, there are strong grounds for thinking that the most comprehensive and efficient railway system in Manitoba (and perhaps Canada at large) would have been created, for it would have given the GTR access to the branch-line traffic of the Prairies and the CNoR would have received the connections necessary to access the major urban centres of the East. Unfortunately, this arrangement never came to fruition, undermined by the intransigence of Hays of the GTR. Ironically, the Dominion Government forced a "marriage" between the two companies – by then both failed entities – in 1922, which tardily enforced such a division (through the resultant CN).

Hays, dismissive of any arrangement with the CNoR, pushed to get his new line built right through the middle of the CPR and CNoR territory in Manitoba. Hay's insistence on constructing a well-engineered (and thus costly) mainline from coast to coast in lieu of developing a network of branch lines for feeding local traffic proved to have detrimental consequences for the GTP and ultimately the entire GTR system. Although the GTP line was built to a very high standard, its mainline was probably redundant in Manitoba, since the CNoR and CPR mainlines already adequately served the province. In the event, forced merger of the two systems in 1922 had a lasting beneficial effect in terms of railway operating economies, for the best sections of the CNoR mainline were combined with the best sections of the GTP (which make up most of CN's Western mainline). In that sense, then, the GTP main line had long-term beneficial consequences.

Figure 5.16 below shows the entire provincial railway network at the end of my study period. This map has been converted into links and nodes to aid the various graph-theory calculations that follow. Thus, each black dot on the map represents a node on the graph. In this case, a node is defined by adhering to at least one of the following criteria:

1. A population (according to the 2006 census) of over 500 permanent residents.
2. Being an intersection town of two or more rail links.
3. Being the terminus (end point) of the rail link network.

Part of the reasoning behind these criteria is as follows;

1. If the population (in 2006)[49] is greater than 500 it means that settlement, thanks in part to the railway system, has been successful.
2. If the town is intersected by more than one rail line, it has some degree of importance.

[49] The justification for using the 2006 census rather than a more period appropriate one such as the 1921 is due to the fact that the census boundaries have not been consistent over time. A comparison would be fruitless owing to this change in political geography. Thus, only 2006 data have been used, since it is clear that these town sites have stood the test of time.

3. If the railway terminates (ends) in this town, there was obviously some good reason to extend the railway to this point.

Table 5.13 lists the details abstracted from Figure 5.16.

Table 5.13: Nodes and Links in the Manitoba Rail Systems

Railway System	Total Number of Nodes	Total Km of Links
CPR	55	2,850 km
CNoR[50]	44	2,888 km
GTP[51]	5	459 km

Using that information, the Network Density of the three railway systems can now be calculated (Table 5.14).

[50] Does not include the HBR or any lines built after 1922.
[51] Includes everything from the eastern Manitoba boundary to the western Manitoba boundary.

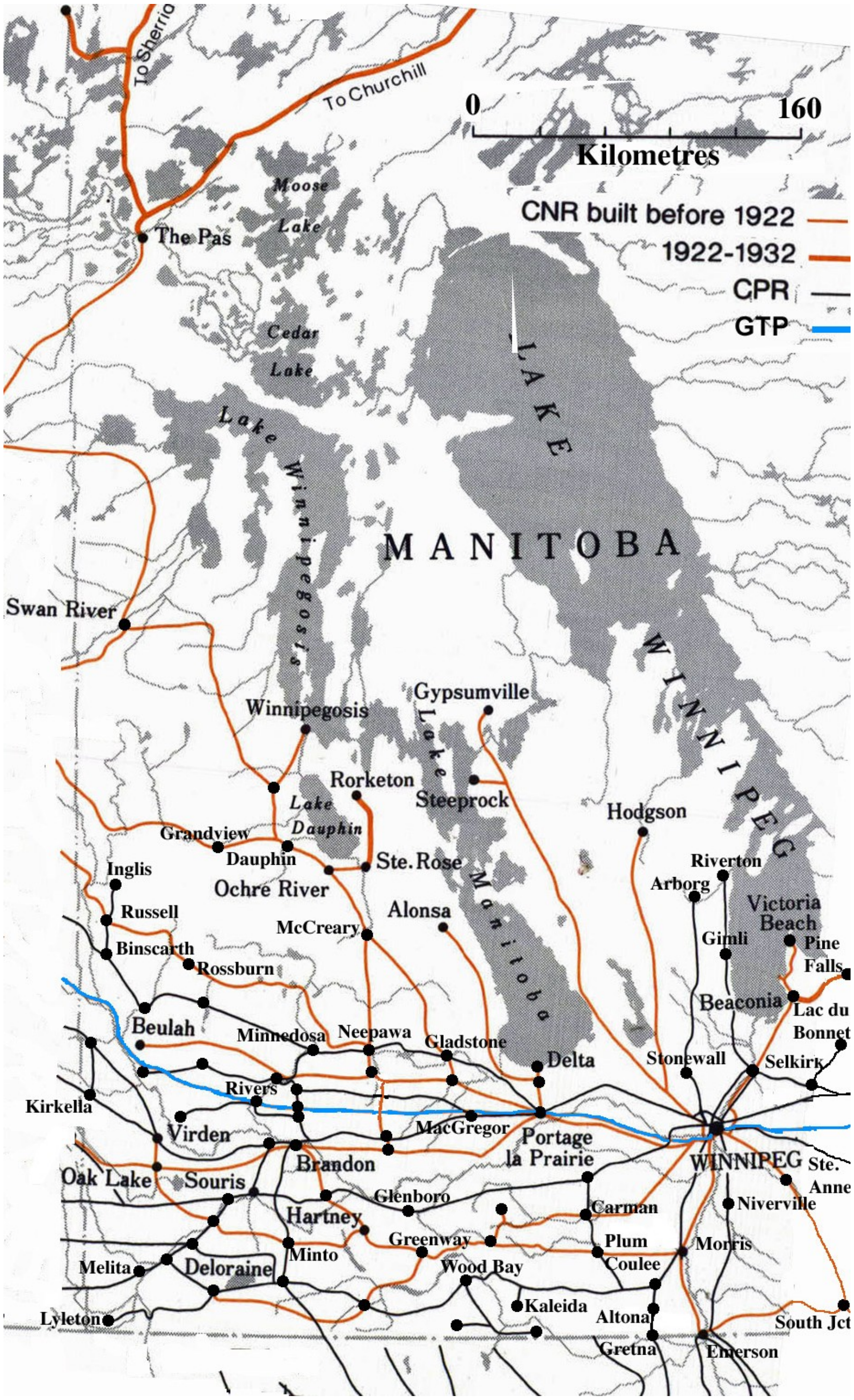
Table 5.14: Network Density Indicators, Manitoba's Railways

Railway System	Km of Links (L)	Km^2 of surface area[52] (S)	Network Density
CPR	2,850 km	163602 km^2	1.74
CNoR	2,888 km	163602 km^2	1.77
GTP	459 km	163602 km^2	0.28

Evidently, the CPR and CNoR were in a dead heat in terms of Network Density during this period, the upshot of the virtual equality in their total system lengths. The GTP fares much worse, the result of its lack of any branch-line infrastructure.

[52] The surface area in question is determined by looking at the competitive railway area of the province. This is considered from a point 20 km north of Swan River south to the international boundary (366 km), and from the eastern boundary (Ontario) to the western boundary (Saskatchewan) (447km).

Figure 5.16: A direct comparison between the three initial railway competitors in Manitoba. A series of graph theory indices follow to gauge the overall network efficiencies. See Table 5.14 above for details regarding this figure.



Source: Created by McCombe, C.G.L., using ArcGIS Desktop: Release 9.3. Redlands, CA: Environmental Systems Research Institute. Created 12/15/10.

In order to see how developed these networks are overall, it is necessary to resort to the Pi index (Table 5.15):

Table 5.15: Development Indicators, Manitoba's Railways

Railway System	Length of Graph L(G)	D(d)	Pi Index
CPR	2,850 km	366 km	7.79
CNoR	2,888 km	366 km	7.89
GTP	459 km	366 km	1.25

Once again, the CPR and CNoR are closely matched, with the CNoR maintaining the slightly more developed network. The GTP Pi index value of 1.25 is consistent with a network that exhibits a low level of development (a simple corridor).

In summary, it is safe to say that the CPR had the most effective hold on the southern half of the network while the CNoR had the more effective hold on the northern half (Figure 5.16). The CPR's main advantage comes in its occupation of territory more amenable both to cultivation and to laying track; for, as was discussed earlier in this chapter, their main line did not have to deviate as much as the CNoR. This railway had to contend with the rugged topography of the more north western section of Manitoba, a reality that both reduced the production capacity of the areas that it served and increased construction and operating costs.

Conclusion

To wrap up, the validity of the six stipulated hypotheses has been either proven or disproved. Additionally, the overall effectiveness of the individual rail networks of the different companies involved in establishing the collective Manitoba rail system has been concisely reviewed. In the next and final chapter, general conclusions will be drawn from the research and testing that has been performed on the entire Manitoba railway network. I will present this research in terms of its overall impact in the field of Geography and highlight problems, real and potential, that have been encountered while undertaking it. Finally, I will share my thoughts and recommendations as to how this thesis can serve as a starting point for future research.

Chapter Five Appendix

Since the early 1990's in Canada there has been a trend towards the creation of short-line railway companies. Many short lines were established when the CPR and CN sold off or abandoned low-profit portions of their trackage. Short-line operators typically have lower labour, overhead and regulatory costs than Class I railway companies[53] and therefore are often able to operate lines profitably that lost money for their original owners. (Atchison 1992) Short lines generally exist for one of three reasons: to link two industries requiring rail freight (e.g. a coal mine and a power plant); to interchange revenue traffic with other, usually larger, railroads; or to operate a tourist passenger train service. Often, short lines exist for all three of these reasons.

Hudson Bay Railway Short-line

The Hudson Bay Railway (HBRY) is a short-line that was formed in July 1997 to purchase the CN line running north from The Pas on two branches, one to Flin Flon and on to Lynn Lake, and the other to Thompson and on to the port of Churchill on the Hudson Bay. Operations began on August 20, 1997 and the company is owned by

[53] In Canada and the United States the definitions for the classification of railways are set out in each country's respective regulations. In Canada these are defined in the regulations made pursuant to the Canada Transportation Act while in the United States they are defined in the accounting regulations of the Surface Transportation Board. Both countries classify carriers into three categories or classes – Class I, II, or III – based on their gross revenues, although the revenue thresholds employed differ in each country. Canadian regulations define carrier classifications as follows:

Railway Classification	*Revenue Thresholds*
Class I	CDN $250 million or more
Class II	Less than CDN $250 million
Class III	Any railway company other than a Class I or II carrier engaged in the operation of bridges, tunnels or stations

Source: Carriers and Transportation and Grain Handling Undertakings Information Regulations (SOR/96-334)

American railroad holding company OmniTRAX[54]. At the same time, OmniTRAX also took over the operation and marketing of the Port of Churchill from the federal Department of Transport. CN, the original owner and operator, had limited tonnage on these lines as a result of the light rail and poor track base; however OmniTrax has been able to successfully operate heavier rail cars and longer trains in recent years without difficulty, resulting in increased business to the Port of Churchill and from various mines and pulp mills (Hudson Bay Railway Company – Broe OmniTRAX, http://www.omnitrax.com/railroads/hudson-bay-railway-company.aspx, Accessed in January 2011).

Keewatin Railway Company

The HBRY also originally ran the 298-kilometre line from Sherritt Junction to Lynn Lake. However when the mine closed near Leaf Rapids, the HBRY announced that they would be abandoning the line. The First Nations people in the area found this rail link to be crucial to their well-being, so they formed the Keewatin Railway Company (KRC) with the financial support of the federal government. The KRC began operations in April 2006, with First Nation members involved in all sections of the company, including management, administration and physical operations (Keewatin Railway Company, http://www.krcrail.ca/ Accessed in January 2011). On this line, they operate two round trips per week thanks to the services of Via Rail.

Via Rail Canada

Via Rail Canada is an independent crown corporation offering intercity passenger

[54] OmniTRAX, Inc. (owned by The Broe Group, headquartered in Denver, Colorado) is one of North America's largest private railroad and transportation management companies, providing management services to 16 regional and short-line railroads that serve 10 U.S. states and 2 Canadian provinces (OmniTRAX, Connecting you to Solutions, http://www.omnitrax.com/. Accessed in January 2011).

rail services across Canada. Beginning on April 1, 1978, CN's passenger subsidiary Via Rail became a separate Crown corporation, taking with it possession of former CN passenger cars and locomotives. Following several months of negotiation, on October 29, 1978, Via took over the operation of CPR's passenger train services as well, and took possession of its cars and locomotives. Headquartered in Montreal, Via currently operates 480 trains in eight Canadian provinces (exceptions are Newfoundland and Labrador and Prince Edward Island) over a network of 14,000 kilometres of track, almost all of which is owned and operated by CN. In 2009, Via carried approximately 4.3 million passengers (Via Rail, *Via Rail Annual Report*. 2009. Accessed in January 2011). In Manitoba, Via Rail currently runs the transcontinental *Canadian* with service between Toronto and Vancouver.[55] In Manitoba the *Canadian*'s only major stop is Winnipeg (Union Station), but the train can be requested to stop at Winnitoba, Ophir, Brereton Lake, Elma, Portage la Prairie, and Rivers. Via Rail also runs the *Winnipeg – Churchill* train (formerly known as the *Hudson Bay* and prior to that *Northern Spirits*). The train, which runs through Manitoba and Saskatchewan, travels on the CN line north to The Pas where it transfers to the HBRY and on to the Port of Churchill, taking approximately 36 hours. This train starts in Winnipeg and travels, with possible stops through Dauphin, Canora, The Pas, Atik, Cranberry Portage, Sherritt Junction, Channin, Flin Flon, Wabowden, Thicket Portage, Sipiwesk, Thompson, Pikwitonei, Ilford, Gillam, Weir River, Herchmer, and Belcher, to terminate in Churchill. Additionally, the KRC-owned section stops in Sherridon, Pukatawagan and Lynn Lake (Hanus and Shaske 2009).

[55] Before the current transcontinental service, the name "The Canadian" had been used on CPR's overnight Montreal / Chicago trains.

Central Manitoba Railway

The Central Manitoba Railway (CEMR) is a wholly owned subsidiary of Cando Contracting Limited that began operations in April of 1999. It was created for the operation of a total of 190 kilometres of the former CN Pine Falls and Carman subdivisions. The Pine Falls subdivision consists of approximately 108 kilometres of track running from Winnipeg to Pine Falls. The Carman subdivision runs from Winnipeg to Graysville and consists of approximately 81 kilometres of track. The CEMR is responsible for the movement of freight to and from the shippers located along these lines, to say nothing of their maintenance and rehabilitation. In 2003, a new transportation centre was built in the North Transcona area. The CEMR switches traffic loads with both the CPR and CN at the Transcona transport centre on a daily basis. (CEMR – Rail Operations, http://www.cemrr.com/index.php?option=com_content&task=view&id=13&Itemid=36. Accessed in December 2010).

Manitoba's Class I Railways in Contemporary Times

CP

By the First World War, the CPR had completed construction of the network that it would continue to use for almost another 100 years. Although the company remained heavily focused on its railway operations, it also diversified its business through investments in the hotel, shipping, real estate, energy and airline sectors. The growth in these operations resulted in the company being reorganized in 1971, with the railway recast as a subsidiary of a new parent company, Canadian Pacific Ltd. In 1995 CP relocated its headquarters from Montreal to Calgary, AB. In October 2001 the railway once again became an independent company when it and four other subsidiary companies were spun off under CP Limited's so‐called "Starburst" strategy[56].

Today the CPR is the smaller of Canada's two Class I railways. With a network spanning 25,000 km of track in both Canada and the United States, it is about 75% the size of CN. CP's network (Figure 5.17) extends from Vancouver to Montreal and reaches as far south as Kansas City, Chicago, Philadelphia and New York (QGI Consulting 2009).

CN

The operations of the Canadian Northern Railway, the Canadian Government Railways, the Grand Trunk Pacific Railway and the Grand Trunk Railway were formally merged into the Canadian National Railways Company in January 1923. In the fifty years that followed its formation, the company was enlarged to include the operations of several other smaller Canadian railways. The addition of these operations effectively served to increase the company's network to about 40,500 km by the early 1970s. Much as CP had done, the company ventured into several non‐rail related businesses. In addition to its hotels, which evolved from the passenger train operations of its predecessors, the company operated coastal marine services, trucking operations and was involved in the telecommunications, broadcasting and airline industries. Beginning in the mid 1970s, as part of the federal government's recapitalization strategy, the company began to divest

[56] The other four Canadian Pacific subsidiary companies spun off at this time included CP Ships, PanCanadian Energy, Fairmont Hotels and Resorts, and Fording Coal (QGI Consulting 2009).

Figure 5.17: 2009 CP Rail System Map.

Source: Central Data Bank, 2009. Used with permission © from Creative Commons Attribution 3.0 License, http://creativecommons.org/licenses/by/3.0/ Accessed May 2011.

itself of its non-freight railway operations. In the early 1990s, the Government of Canada privatized the company. In 2011, CN is the larger of Canada's two Class I railways, operating a network (Figure 5.18) of approximately 34,000 km that spans from coast to coast in Canada and extends southward through the mid□western United States to the port city of New Orleans (QGI Consulting 2009).

Figure 5.18: 2009 CN Network System Map.

Source: Central Data Bank, 2009. Used with permission © from Creative Commons Attribution 3.0 License, http://creativecommons.org/licenses/by/3.0/ Accessed May 2011.

CHAPTER SIX

CONCLUSION

Summary

It is almost impossible to exaggerate the profound impact of the railways in Manitoba. The opening of the first railway in November 1878 that ran from Fort Garry to Emerson/Pembina at the Canadian – North Dakota border marked the beginning of a transportation revolution in Manitoba. It has been the intent of this thesis to investigate this profound impact from the first railway to the completion of the HBR. This period was a time where railway networks expanded remarkably quickly and became the dominant land transport mode for both passengers and freight. This thesis focuses on the railways as they were at their zenith in the province; that is to say, in 1915.

First, a historical review pulls information from a variety of resources such as the Manitoba Provincial Archives in Winnipeg, the digital version of the Public Archives of Canada, old theses from those researchers who have come before myself, and path-breaking works from various historians, geographers and economists. Some emphasis in this chapter is given to the role the provincial and federal governments played in the construction of the lines in addition to international influences such as competition from American railroads. Finally, the vision and determination of the ambitious railway pioneers, be it from a business or government perspective, who developed this system is celebrated throughout the chapter.

Next, the network analysis tool known as graph theory is thoroughly discussed. This chapter is primarily inspired by the works of W. Garrison, D. Marble, and K. Kansky. These authors effectively made use of the theoretical work on graphs from the point of view of transportation and orientated it towards spatial development, the original function of Manitoba's railways. It is from this context that a number of indicators are identified. These are heavily relied upon later in this thesis during the hypothesis-testing stage. The hypotheses, for their part, were informed by theoretical precedents on how railways impacted spatial development. Six were put forward for testing.

First, it was hypothesized that Manitoba's railway lines were all 'developmental penetration lines' that were cheaply built, and they were laid down to encourage latent demand rather than to meet existing demand. This penetration role was proved from the historical record when the CPR chose to set up a station in Brandon rather than the established settlement of Grand Valley, which was 3 km away. The settlement of Grand Valley quickly dissolved in inverse proportion to Brandon's expansion. Alternatively, many railways in Manitoba were seen to conform to the alternative hypothesis that maintained that some lines were 'latecomers', designed to tap an already 'opened' area. The evidence in the area west of Winnipeg suggests that the GTP was attempting to crowd-out the CPR pioneer by locating a close average of just 9.0 km apart from the CPR's mainline. This decision served equally to place their track within close proximity to the CNoR's mainline, which was an average of 13.9 km to the north. The CNoR had attempted to carve out their own spatial monopoly by locating a good 23.9 km from the CPR's mainline. Similarly, in the area south of Winnipeg to the U.S. border, when taking the average-distance-separating calculations into account, it is clear that initially the CPR spaced their lines perfectly apart to run an effective monopoly. Their plans, however, were ruined by the incursion of other companies, when the NP attempted to crowd-out the CPR pioneer by locating a close average of 9.9 km and 13.9 km apart from the CPR's two lines. Subsequently, when the CNoR arrived in the area, they chose to locate increasingly farther from the first three lines, in what amounted to an average of 28 km from the nearest CPR line.

The second hypothesis deals directly with an aspect of physical geography and railway development. In this case, with other things being equal, railways would follow 'easy-gradient' straight-line routes rather than those conforming to 'difficult-gradient' straight-lines. Here it was learned that the mainline of the CPR system only had to make slight changes to its route selection as it had a Detour Index of 0.89. Meanwhile, the CNoR line had a less efficient mainline as its track only maintained a Detour Index of 0.8.

At this juncture the focus moves to matters of inter-company competition, the substance of the next several hypotheses. The third hypothesis, inspired by the work of Meinig, maintains that government lines tend to adopt **Linear** networks, with each line monopolizing a belt of tributary country. The definitive example of a linear network in Manitoba is the HBRY. To test this hypothesis, the Pi Index revealed a 1.58 level of development that falls into the low Pi category. This is the same as saying that it is linked with a low level of network development (a simple corridor/linear network). A high Pi value would correspond to a more extensively developed network (such as a system of linked cities) that is clearly not found in northern Manitoba. In contrast, the alternative hypothesis exposes the possibility that some government lines are forced to react to rival systems – and therefore become less linear in pattern.

To substantiate this case, the proposed RRV system is tested with the Pi Index. Registering a Pi Index of 3.45, this rail network is more developed than the HBRY example. While the Hudson Bay route follows a simple corridor, the proposed RRV, in contrast, branches out to connect a range of cities and towns. Thus, because the RRV was designed to compete directly with the CPR, its lines are less linear; a fact proved empirically by the higher Pi value.

The fourth hypothesis persists in the same theme, but is articulated in two phases: phase 1 corresponding to early development, phase 2 equating with later development. In the first instance, where competition occurs, expect **Linear Duplication** of rail lines initially (phase 1). To test that assertion, use is made of the Network Density Index. This device shows how much a rail network has been developed through measuring the territorial occupation of the rail network in terms of km of links (L) per km^2 of surface (S). The higher its magnitude, the more a network is developed. The Winnipeg to Portage la Prairie network was singled out for testing and shown to have a density of 9.90, which is in all likelihood the best example of Linear Duplication in the Manitoba rail network.

Alternatively, it was decided that some rivals avoid existing lines to carve out their own tributary territory. The Network Density Index was again engaged to distinguish the numerical characteristics associated with railways pursuing policies aimed at the avoidance of competition. Evidently, the network density is much lower on the east side of Winnipeg where the rail companies chose to avoid each other and carve out their own territory. Here the network density dropped to 3.48, a big change from those lines to the west of Winnipeg. All that has been discussed thus far has relevance for first-phase activities. Greater network maturity – phase 2 – is discussed in the fifth hypothesis.

In the fifth hypothesis, phase 2 succeeds phase 1 in the expansion of the railways once competition adopts a more challenging character. Meinig argues that this phase warrants the spatial arrangement known as the **Multiple Point Duplication**. The area that stands out in this regard is the corridor extending from Portage la Prairie west to Brandon. This area benefits from largely linear segments of railway with duplicate service to the city of Brandon and to towns of the stature of Gladstone, Neepawa, Hallboro, Harte, Carberry, Varcoe, Minnedosa, Brandon Junction, and Portage la Prairie. All three major companies (CPR, CNoR and GTP) exist in this section and are in close proximity to each other. While this area has a much greater surface area than the area from Winnipeg to Portage, the total kilometres of links is more than proportionately larger, which has the effect of boosting the areal density to 13.96. This result is consistent with Multiple Point Duplication.

Although competition was quite fierce in this section of the network, there were many sections where Phase 2 competition does not result in network changes; i.e. the Linear Duplication pattern is not amended. An excellent example is the Winnipeg to Portage section that was discussed in H4. It remained at the Linear Duplication stage, never moving up to Multiple Point Duplication. Thus, there is reason to believe that, for the most part, the networks of the railway companies never progressed beyond the Linear Duplication in Manitoba, since the system changes appear negligible from the original railway-building era.

The sixth and final hypothesis looks for the network configuration know as the **Complex Web**. In this phase, all railway companies involved judge the ‘gateway’ access and control as vital. The result is – by phase 3 – a Complex Web of lines (including metro area and suburban rail service) centred on the ‘gateway city’.

However, it was proven that ‘Gateway’ rail traffic in and around Winnipeg never grows to justify a Complex Web. This gateway area is taken as extending north to Selkirk, south-east to Ste. Anne, south to Morris, south-west to Carman, and west to Portage la Prairie. With a proven Network Density of 5.43 the gateway city area of Winnipeg does not come close to the area west of Portage la Prairie with a Network Density of 13.96. There are many reasons for the decline of rail service in Manitoba, such as the advent of the internal combustion engine which resulted in government construction of roads and highways; an event that undermined railway interest in suburban and ex-urban services. Today Manitoba’s railway system is much reduced from what it was at its peak, losing, along with the railway systems in the other Prairies Provinces, thousands of kilometres of track to abandonment in the last fifteen years alone.

Potential Problems

To my mind transport geography, like the field of transportation in general, does not receive a level of attention in academia proportional to its economic and social importance. Due to this lack of attention, one of the great challenges in my thesis research has been data availability. Personal circumstances prevented me from travelling to Ottawa to perform extensive research at the Library and Archives of Canada which is also the home of the CN rail archives. Similarly, the CPR Archives were denied to me, as they are an internal department of Canadian Pacific Railway, and only accessible at a cost and at the discretion of the company.

Additionally, while there are a great number of the histories written about the railways that are very thorough and complete, they are generally now dated and not abounding with data. That data limitation extends to official census and survey materials, which on account of boundary changes are often inadmissible.

Although graph theory provides users with an excellent tool kit tailored for a spatial analysis of railway systems, there are some areas where it falls short. One such area is the exclusion of the various economic factors, including forms of transport cost, which are extremely important in the study and understanding of any railway network. These costs include the capital costs, terminal costs, and line-haul costs. Railways are heavily capital-intensive enterprises, needing a relatively high proportion of their operating income to fund ongoing capital investment. Inclusion of these costs could lead to a completely new perspective on the effectiveness of Manitoba's railways as the accessibility and connectivity that was discussed in detail may prove to be completely un-sustainable owing to these economic factors.

Key Findings and Closing Remarks

Although a number of histories of railways exist for every railway company in Canada, this thesis has attempted to forge new ground in the area of transport geography. One of the principal conclusions that can be drawn from this study is the geographical truism: that spatial patterns such as railway networks are rarely as simple as they seem, and no railway network can be adequately understood without knowing the process of its formation. Thus, this thesis has attempted to *explain* the Manitoba railway system by first using historical and archival research to discover the actual bases of decisions for each section of the system. Next, the quantitative methods were explained in detail, which led straight into a geographical hypothesis-testing section, bringing this thesis together in a multidisciplinary fashion.

In this thesis, new approaches to cover basic network characteristics such as local network densities are applied with the use of modern GIS systems. This has allowed this thesis to assume the first ever GIS-based analysis of any railway network in Western Canada. As we know, the interest in the spatial structure of transport networks has been driven by the inherent impact of the network structure on its performance and its effects on land use. These studies began as early as 1960 but were limited by the data availability and the limited computational power of the time. The modern GIS system has permitted the reprisal of these classic transport geography hypotheses that had been neglected in recent years – not because they were erroneous – but because the methodologies (GIS systems matched to graph theory) had not yet been developed.

One of the most interesting findings I made during this thesis is that although the people mainly responsible for Manitoba's railway system were known as explorers, businessmen, and politicians, they were in fact "practising geographers" as they were constantly consciously thinking in spatial terms while wrestling with regional qualities, variations and potentialities.

Another finding is the complex public and private ownership relationship that existed during this time of railway development. I closely studied this symbiotic relationship, where a state-owned welfare-maximizing public firm operates in tandem with a profit-maximizing private firm to essentially build the best railway (e.g. the GTR/GTP and NT partnership). Moreover, while Canada's first transcontinental railway has always been entirely privately owned, this company would have never completed any of its western lines without the generous amounts of government financing, subsidies and land grants. Additionally, due to the fact that both government-owned lines and privately owned lines operated in a very competitive atmosphere, there is reason to believe that, in the instance of railways, public ownership was no less efficient than private ownership. Public ownership, in truth, can be more inefficient than the private alternative but that generally comes about from the absence of effective competition, which for the most part is not the case in Manitoba's railway system.

Today, Canada's two Class I transcontinental railways are "amongst the most profitable and by many measures the most efficient freight railways in North America. However, their current prosperity comes after a long period in the previous century that was characterized by a decline in their scale and competitiveness and by an equally long period of disinvestment" (QGI Consulting 2009). This decline was fuelled by the development of the U.S. and Canadian national highway systems in the 1950s and 1960s. Those programs laid the groundwork for the development of viable competitors to the railways in shorter-haul routes. Over many years the continued growth of the trucking industry eroded the railways' market share in short-haul and regional markets for many commodities. Railways in Canada rebuilt their profitability and efficiency through their dominance of the long-haul movement of commodity cargoes (QGI Consulting 2009). Furthermore, in the last decade, fuelled by growing trade in commodities and manufactured goods with Asia, intermodal traffic has become the fastest growing segment of the rail freight market in North America. Overall, the growth of intermodal traffic, "provides a welcome diversification of the railways' commercial base and, in partnership with ports, terminals, shipping lines and logistics companies, railway intermodal services have become a vital link in the international supply chains of many Canadian companies" (QGI Consulting 2009).

Future Research

Over the last several years, railways have achieved profitability that would seem to ensure their ongoing financial viability. This viability gains strength when you start to consider the economies of scale that railways provide and their moderate environmental footprint. Thus, one area of future research could be a comparative analysis of the road and rail modes in Manitoba. In that study one could focus on the environmental impact of the two modes, as issues related to the availability of energy, particularly fossil fuels, are likely to become more acute in the coming years. This will be reflected in higher energy prices and since each mode has a very different level of efficiency, the comparative advantages of modal options will change towards the most energy-efficient transport mode (where rail definitely emerges in a better light). Global climate change is also an issue that may add to the sustainability of the rail mode, particularly in terms of more rigorous regulatory frameworks.

Appendix I: Charters granted to the Canadian Pacific Railway in Manitoba

DESCRIPTION	FROM	TO	KILOMETRES	CONSTRUCTION DATE	NOTES	IN OPERATION
Main Line	Port Arthur	East Selkirk	659.83	1881-84	Built by Govt.	1882
Main Line	East Selkirk	St. Boniface	32.49	1878	Built by Govt.	1882
Main Line	Whittier	Stephen St.	1.93	1882	Built by Govt.	1882
Main Line	Stephen St.	Wpg. Station	0.32	1882	Built by C.P.R.	1882
Main Line	Wpg. Station	"Savonas Ferry"	2022.94	1882-85	Built by C.P.R.	1885
Stonewall Branch	Rugby Jct.	Stonewall	29.27	1880	Built by Govt.	Sept, 1881
" Teulon Ext.	Stonewall	Teulon	31.35	1898	Built by C.P.R.	Dec, 1898
" Komarno Ext.	Teulon	Komarno	13.02	1905-06	Built by C.P.R.	Aug, 1907
" Arborg Ext.	Komarno	Arborg	47.01	1906-10	Built by C.P.R.	Nov, 1910
Pembina Branch	St. Boniface	Emerson	102.21	1874-78	Built by Govt.	May. 1880
S.W. & Pembina						
Mountain Branch	Rugby Jct.	Manitou	161.50	1881-82	Built by C.P.R.	Dec, 1882
" "	Rosenfeld	Gretna	22.63	1882	Built by C.P.R.	Dec, 1882
Selkirk Branch	Rugby Jct.	Selkirk	35.41	1882-83	Built by C.P.R.	Dec, 1883
Souris Branch	Kemnay	Estevan	251.22	1889-92	Built by C.P.R.	Aug, 1892
" Glenboro Ext.	Souris	Glenboro	74.09	1890-92	Built by C.P.R.	Dec, 1892
" Deloraine Ext.	Napinka	Deloraine	29.59	1892	Built by C.P.R.	Aug, 1892
" Pipestone Ext.	Schwitzer Jct.	Reston	49.83	1892	Built by C.P.R.	Dec, 1892
Lac Du Bonnet Br.	Molson	Lac Du Bonnet	35.41	1899-01	Built by C.P.R.	June, 1901
Varcoe Branch	MacGregor	Varcoe	89.33	1899-06	Built by C.P.R.	June, 1905
Pheasant Hills Br.	Kirkella	Rosyth	896.24	1902-09	Built by C.P.R.	Unavail.
Molson Cut-Off	Molson	Whittier	57.93	1906-07	Built by C.P.R.	Oct, 1907
Virden Branch	Virden	McAuley	58.41	1908-13	Built by C.P.R.	Dec, 1913
Souris Branch	Reston	Antler	26.43	1898	Built by C.P.R.	June, 1900
" Pipestone Ext.	Antler	Arcola	77.43	1899-01	Built by C.P.R.	June, 1901
" Pipestone Ext.	Arcola	Regina	182.56	1903-04	Built by C.P.R.	Unavail.
Selkirk Branch						
" Lake Wpg. Ext.	Selkirk	Winnipeg Beach	56.38	1901-03	Built by C.P.R.	June, 1903
" Gimli Ext.	Winnipeg Beach	Gimli	15.46	1906	Built by C.P.R.	Nov, 1906
" Riverton Ext.	Gimli	Riverton	41.97	1913-14	Built by C.P.R.	Nov, 1914
Snowflake Branch	Wood Bay	Mowbray	42.01	1900-03	Built by C.P.R.	June, 1903
Snowflake Ext.	Mowbray	Windygates	10.54	1908-09	Built by C.P.R.	Nov, 1909
Souris Branch						
" Lauder-Westerly	Lauder	Alida	88.51	1902-12	Built by C.P.R.	Nov, 1912
Waskada Branch	Deloraine	Lyleton	60.29	1900-03	Built by C.P.R.	June, 1903
Darlingford Branch	Rudyard	Kaleida	10.06	1905-06	Built by C.P.R.	April, 1906
Boissevain Branch	Lauder	Boissevain	58.74	1911-13	Built by C.P.R.	Dec, 1913
Snowflake Branch	Snowflake	Fallison	16.09	1913	Built by C.P.R.	May, 1914

Notes: Arborg was originally known as "Icelandic River"

Appendix I: Charters Granted to other Railways, Later absorbed by the CPR

DESCRIPTION	FROM	TO	KILOMETRES	CONSTRUCTION DATE	NOTES	IN OPERATION
Manitoba S.W.					Leased in Perpe-	
Colonization Rly.*	Rugby Jct.	Glenboro	165.3	1882-86	tuity, June 1884.	Nov, 1886
"	Manitou	Deloraine	161.8	1884-85	"	Jan, 1886
"	Elm Creek	Carman	20.1	1889-90	"	Nov, 1889
Manitoba & N.W.					Leased for 999	
Rly Co. of Canada[a]	Portage La Prairie	Yorkton	358.8	1883-91	years, May 1, 1900	June, 1900
The Great N.W.					Leased in Perpe-	
Central Rly. Co.†	Chater	Gautier	44.7	1889-90	tiuity, Apr. 6, 1900	June, 1900
"	Gautier	Hamiota	37.7	1889-90	"	June, 1900
"	Hamiota	Miniota	32.2	1900	"	June, 1900
"	Forrest	Lenore	65.5	1901-02	"	June, 1903
Saskatchewan and					Leased to M&NWR	
Western Railway	Minnedosa	Gautier Jct.	28.9	1889	99 yrs May, 1887	June, 1900
Manitoba Great					Purchased on	
Northern Rly Co.¥	Carman	Plum Coulee	44.3	1907	01-Aug-26	May, 1907
Winnipeg River					Leased for five yrs	
Railway Co.	Lac Du Bonnet	Great Falls	22.5	1914	on June 1/53	
Manitoba & N.W.					Leased for 999	
Rly. Shell River Br.	Binscarth	Russell	18.6	1887	yrs from May 1, 00	June, 1900

Notes:

* Manitoba S.W. Colonization Railway Co. was absorbed by C.P.R. Sept. 26/57

[a] Previously named Westbourne & Northwestern Rly. Co. and Portage, Westbourne and Northwestern Rly. (till May 17, 1882)

† Previously named Souris & Rocky Mountian Rly Co. (till 1880), absorbed by C.P.R. in 1957

Source: Moore, G. A., Manitoba's Railways, *Canadian Rail*, No. 282, 285, I – II, 1975. © Used with permission, issued by Exporail, 07/06/2011.

Appendix II: Charters granted to the Canadian Northern Railway in Manitoba

DESCRIPTION	FROM	TO	KILOMETRES	CONSTRUCTION DATE	NOTES	IN OPERATION
Lake Manitoba Railway and Canal Company	Gladstone	Dauphin	136.5	1897		1897
Lake Manitoba Railway and Canal Company	Dauphin	North Jct.	4.6	1897		1897
Lake Manitoba Railway and Canal Company	North Jct.	Sifton	21.7	1897		1897
Lake Manitoba Railway and Canal Company	Sifton	Winnipegosis	34.9	1897		1897
Manitoba and South Eastern Railway	Marchand	Paddington Yard	68.1	1898		1898
Manitoba and South Eastern Railway	Paddington Yard	St. Boniface	8.0	1898		1898
Winnipeg and Hudson Bay Railway	Sifton	Cowan	86.0	1898		1898
Winnipeg and Hudson Bay Railway	Cowan	Swan River	51.5	1899		1899
Manitoba and South Eastern Railway	Sprague	South Boundary	20.9	1900		1900
Manitoba and South Eastern Railway	Sprague	Marchand	80.0	1900		1900
CNoR	Swan River	Bowsman	16.1	1900		1900
CNoR	Westgate	Erwood	38.0	1900		1900
CNoR	Beaver	Gladstone	29.5	1901		1901
Morden and N.W.	Carman Jct	Sperling	49.8	1901		1901
CNoR	Sperling	Carman Jct.	22.6	1901		1901
CNoR	Muir	Hallboro	44.7	1902		1902
Morden and N.W.	Hallboro	Neepawa	11.3	1902		1902
CNoR	North Jct.	Grandview	44.3	1902		1902
CNoR	Great Northern Jct	Emerson Jct	2.3	1903		1903
CNoR	Ridgeville	Great Northern Jct	16.4	1903		1903
CNoR	Carman	Learys	32.5	1903		1903
Morden and N.W.	Neepawa	Birnie	25.1	1903		1903
CNoR	Birnie	McCreary Jct	36.0	1903		1903
Morden and N.W.	Rossburn	Clanwilliam	33.5	1903		1903

Appendix II: Charters granted to the Canadian Northern Railway in Manitoba

DESCRIPTION	FROM	TO	KILOMETRES	CONSTRUCTION DATE	NOTES	IN OPERATION
Winnipeg and Hudson Bay Railway	Mile 8.3	Mile 10.0 (Oak Pt.)	2.8	1904		1904
Winnipeg and Hudson Bay Railway	Mile 10.0	Mile 48.0	63.1	1904		1904
CNoR	Mile 48.0	Oak Point	4.3	1904		1904
CNoR	Grandview	Kamsack	118.5	1904		1904
CNoR	Learys	Somerset	25.9	1905		1905
Western Ext. Railway	Portage la Prairie	Brandon Jct	85.7	1905		1905
Western Ext. Railway	Brandon Jct	M&B Jct	42.2	1905		1905
CNoR	Clanwilliam	Rossburn	97.1	1905		1905
CNoR	Brandon Jct	Carberry Jct	37.8	1905		1905
Western Ext. Railway	Greenway	Adelpha	86.0	1905		1905
CNoR	Hartney	Virden	61.8	1905		1905
CNoR	Erwood	Hudson Bay Jct.	14.1	1905		1905
Western Ext. Railway	Thunderhill	Prov. Boundary	33.5	1906		1906
CNoR	St. Boniface	Clark St Jct	3.3	1907		1907
CNoR	St. James Jct	Mile 5.3	8.8	1907		1907
CNoR	South Jct.	Ridgeville	101.4	1907		1907
CNoR	Rossburn	Russell	42.3	1908		1908
CNoR	Brandon	Kipling	213.8	1908		1908
CNoR	Ochre River	St. Rose	24.9	1910		1910
CNoR	Bowsman	Westgate	99.9	1910		1910
CNoR	Hudson Bay Jct	The Pas	145.9	1910		1910
CNoR	Russell	Calder	67.9	1910		1910
CNoR	Oak Point	Gypsumville	159.5	1911		1911
Western Ext. Railway	Hallboro	Beulah	125.3	1911		1911
CNoR	Grosse Isle	Mile 31.0	51.5	1912		1912
Winnipeg and Northern Railway	Mile 6.4	Grand Beach	84.2	1914		1914
CNoR	Inwood	Mile 74.5	72.2	1914		1914
CNoR	Mile 74.5	Hodgson	10.6	1914		1914
CNoR	Steep Rock Jct	Steep Rock	20.1	1914		1914
CNoR	Adelphe	Deloraine	46.5	1914		1914
Winnipeg and Northern Railway	Grand Marais	Victoria Beach	23.4	1917		1917

Source: Moore, G. A., Manitoba's Railways, *Canadian Rail*, No. 282, 285, I – II, 1975.

Appendix III:

Distances (km) from Selected Western Canadian Points to Churchill and Montreal

From	To		
	Churchill	Montreal	Montreal
	(all rail km)	(all rail km)	(great lakes)
Regina	1399.38	2843.58	3303.4
Saskatoon	1351.24	3034.48	3494.3
Prince Albert	1261.6	3105.86	3565.68
Moose Jaw	1469.1	2914.96	3373.12
Winnipeg	1621.82	2252.62	2710.78
Brandon	1555.42	2476.72	2933.22
Calgary	2015.24	3685.2	4145.02
Edmonton	1887.42	3564.02	4023.84

Source: Moore, G. A., Manitoba's Railways, *Canadian Rail*, No. 282, 285, I – II, 1975.

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