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The Canada–U.S. Border:

An Automotive Case Study

January 2002

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Prepared for the Canadian Department of Foreign Affairs and International Trade

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I. INTRODUCTION

For the Canadian and U.S. automotive industries, the internal crossing points of the Ambassador Bridge and the Windsor Tunnel (Detroit-Windsor); the Blue Water Bridge (Port Huron-Sarnia), and the Peace Bridge (Buffalo-Fort Erie) are the critical connecting points within the logistics chain that support new light duty vehicle shipments of approximately US$480[1] billion (the value of the products shipped from assembly plants) between the two countries. Automotive trade flowing between the two countries in 2000 was US$43.6 billion of vehicles and US$34.6 billion of automotive parts. From 1991 through 2000, the compound annual growth rates (CAGR) for total vehicle and total parts trade were 5.3 percent and 5.8 percent, respectively. These trade growth rates compare to a 3.9 percent growth rate for the value of vehicle shipments and 3.2 percent for material shipment into assembly plant value (U.S. rates of growth).[2] From this perspective, vehicle trade growth rates are 36 percent greater than overall industry growth rates, and component trade growth rates are 81 percent higher than the overall industry original equipment component shipment growth rates. The greater growth rates for cross-border shipments of vehicles and parts indicate a growing interdependence between the Canadian and U.S. auto industries and place a greater level of importance on keeping the primary automotive commercial crossing points as efficient as possible.

For this report we interviewed/surveyed four vehicle manufacturer representatives at corporate and plant positions, four first-tier supplier representatives, and three service providers. It was generally noted that in, 1999 and 2000, when country GDP growth rates and automotive vehicle production schedules peaked, the primary Canadian-U.S. border crossings were reaching capacities and stressing industry performance. In this regard, capacity is measured not in the physical sense (from the perspective of the maximum number of vehicles that the tunnels or bridges can handle) but in the number of vehicles afforded a dependable time window to cross through customs. Of course, the tragic events of September 11 pushed the issues of border security, commerce flow, and passenger travel towards the top of the Canadian and U.S. government agendas. The two weeks post-September 11 saw significant disruption of automotive vehicle production from a number of causes: security concerns that shut offices and plants, production schedules that were second-guessed, North American Free Trade Agreement (NAFTA) border shipment windows that were closed or became completely unpredictable, and expedited freight options that were shut off with a grounded air system. Slowly the system has been restored, but it remains fragile. Vehicle manufacturers and suppliers all recognize the current situation as just that—fragile—as they await the roll out of future security policies and border resource allocations.

By December 2001 the Ontario-Michigan border crossing times and time predictability were back to within the requirements needed to manage the industry's Just-In-Time (JIT) logistic requirements. However, the current system is known to depend upon volunteer public servants who have a limited time horizon and U.S. National Guard troops who have a January 30, 2002 time horizon (when an additional funding extension will be required). In addition, suppliers do report ongoing uncertainty over day-to-day border operations. From this perspective—where the border is considered a logistics but not a constraint issue—operations are not "back to normal." Manufacturers and suppliers are waiting to

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[1] We have made an attempt to reference all historic table data and text references in constant U.S. 2000 dollars.

[2] Center for Automotive Research, "Estimating the New Automotive Value Chain," 2001.

see how efforts such as the Canadian-United States Smart Border Declaration: Building a Smart Border for the 21st Century and other initiatives will play out before redirecting investment or sourcing strategies. Some estimate that under the current security requirements the Michigan-Ontario crossings may need up to twice as many human resources deployed to move the current infrastructure towards full utilization. The industry will be closely evaluating any proposed policy changes, infrastructure investments, and financial and human resource deployments. Practically speaking, such a deployment of additional resources (a net increase for the full border protection system) could take a minimum of nine months to hire, train, and deploy this additional workforce.

Five-year production forecasts[3] do not indicate any substantial change in the proportion of NAFTA vehicle production between the United States, Canada, and Mexico. With the need for the supply base to locate sequenced parts close to assembly plants (and other parts within a distance that will guarantee dependable shipping times), geographic stability of vehicle production generally supports geographic stability in supplier investment flows. Certainly the mix of manufacturer capacity will change as offshore firms increase their production capacity in each NAFTA country. In fact, Canada's production volume stability is due to Toyota and Honda adding close to 700,000 units of production capacity—over the past 10 years and through 2006. This new production capacity creates a magnet for supplier investment and is critical for traditional North American-based suppliers to diversify their customer base. Suppliers typically become more profitable by spreading production volume risk over a larger customer base. This is critical to improving the overall financial performance of the North American automotive industry.

Honda's and Toyota's (as well as other vehicle manufacturers) Canadian assembly plants are tightly integrated into the in-house supply activity at their respective U.S. plants and their respective U.S. supply bases. This places significant importance on an efficient Canadian-U.S. border to keep the current manufacturing capacity in both countries productive as well provide for an efficient allocation of future investment streams to support Canadian and U.S. vehicle production. With this said, it appears that Canadian automotive investment–current and future–has the greatest risk exposure to any decay in a dependable commercial border crossing. However, any massive restructuring of investment streams to circumvent border-related transportation costs and time delays will compromise an efficient allocation of investment based on maximizing capacity utilization and minimizing production costs. (This scenario includes labor as well as materials when factors such as quality are integrated into increased inventory levels.)

For the auto industry, any consideration of commercial and immigration policies, border infrastructures, and staffing must take into account the performance metrics by which the auto industry is managed. This case study focuses on the inbound side of the industry (component suppliers into assembly plants) and presents an overview of Canadian-U.S. trade statistics to establish the level of interdependency between the two countries as well as the automotive industry requirements necessary to maintain that level of trade interdependency.

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[3] CSM Worldwide, Northville, Michigan.

II. TOTAL IMPORT AND EXPORT TRADE

Table 1 shows the exceptionally close trading relationship between Canada and the United States and the importance of the automotive industry within those trade flows. In 2000, Canadian exports to the United States accounted for 87 percent of all Canadian exports. Of all Canadian imports in 2000, 64 percent originated in the United States. Canadian exports to the United States basically doubled over the past 10 years with a 7.2 percent CAGR; imports grew at a 5 percent CAGR over the same period. These statistics show that the relatively efficient border has created an excellent environment to foster trade.

Automotive-related exports account for nearly 20 percent of all of Canada's exports to the United States, with automotive-related imports accounting for an equal 20 percent of all of Canada's imports from the United States. Auto's percentage share of overall Canadian-U.S. trade has remained in a relatively narrow range between 1991 and 2000. Canadian automotive-related exports to the United States grew at a 6.3 percent CAGR between 1991 and 2000–a significant, but slower, pace than overall Canada to U.S. exports growth. Canadian automotive-related imports from the United States grew at a 4.4 percent annual clip–slightly lower than overall import trade growth. If these growth rates persist, automotive will become a smaller share of overall Canadian-U.S. trade. However, the automotive growth rates signal the continued importance of the industry's issues and concerns as consideration is given to creating overall border policy. It is obvious that, from a base of 1999–2000 where border delays were becoming more frequent, border crossing times and predictability of those crossing times will be at greater risk without additional dedicated resources and targeted policies if even a portion of these growth rates continue over the next decade. Border crossing capacity (in terms of total processing time) must grow in parallel to the prevailing trade growth rates in order for the border to stay a neutral issue in corporate investment and sourcing decisions.

Finally, looking specifically at the U.S. portion of Canadian automotive trade, it is obvious how important the United States is to Canada's individual customers and industrial base. Over 97 percent of Canadian automotive exports are shipped to the United States and approximately 80 percent of all of Canada's automotive imports originate in the United States. This level of integration within the North American assembly and supply base has allowed the auto industry to balance capacities, not just within individual countries but across the entire NAFTA region. This has broken down the political pressures of local production for local consumption and other allocation mechanisms that compromised the rationalization of production capacities in the most market-efficient manner.

Table 1
Canadian Trade with World and U.S.
Import and Export
(in Billions, Constant 2000 U.S. Dollars)

Trade with World: All Goods	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
All Exports	$161.1	$165.4	$173.3	$192.0	$215.9	$222.0	$231.0	$226.8	$247.0	$278.0
All Imports	149.5	150.4	157.0	172.5	185.7	187.2	211.5	212.5	222.8	240.2
Trade Balance: World	11.6	15.0	16.2	19.5	30.2	34.8	19.5	14.3	24.2	37.8
Trade with U.S.: All Goods	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
All Exports	$121.0	$127.7	$139.2	$155.9	$171.0	$179.6	$189.0	$192.3	$214.3	$241.9
All Imports	95.4	98.0	105.2	116.8	124.0	126.3	142.9	145.0	149.9	154.6
Trade Balance: U.S.	25.7	29.7	34.0	39.1	47.0	53.3	46.1	47.3	64.4	87.3
Trade with World: Vehicles and Parts	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Total Exports to World	$26.5	$27.3	$32.5	$37.2	$38.6	$38.3	$39.6	$42.0	$49.4	$48.7
Total Imports from World	28.1	28.0	29.3	31.7	31.5	31.0	35.5	35.1	39.0	39.2
Trade Balance	-1.5	-0.7	3.1	5.5	7.1	7.3	4.1	6.9	10.4	9.5
Trade with U.S.: Vehicles and Parts	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Total Exports to U.S.	$25.6	$26.3	$31.1	$35.8	$36.6	$36.9	$38.0	$41.0	$48.3	$47.3
Total Imports from U.S.	20.0	20.7	22.9	25.6	25.7	25.7	29.2	29.1	31.8	30.9
Trade Balance	5.6	5.6	8.2	10.2	10.9	11.3	8.8	11.9	16.5	16.4
Canada-U.S. Automotive trade as a percent of all trade with World	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Percent of Vehicle Exports	15.9%	15.9%	18.0%	18.6%	16.9%	16.6%	16.5%	18.1%	19.6%	17.0%
Percent of Vehicle Imports	13.4%	13.8%	14.6%	14.8%	13.8%	13.7%	13.8%	13.7%	14.3%	12.9%
Canada-U.S. Automotive trade as a percent of all trade with U.S.	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Percent of Vehicle Exports	21.2%	20.6%	22.4%	22.9%	21.4%	20.6%	20.1%	21.3%	22.5%	19.6%
Percent of Vehicle Imports	21.0%	21.1%	21.8%	21.9%	20.7%	20.3%	20.4%	20.1%	21.2%	20.0%

Source: Industry Canada, Strategis.gc.ca

III. AUTOMOTIVE VEHICLE AND PARTS IMPORTS/EXPORTS

With Canadian vehicle exports to the United States growing from US$18.2 billion to US$34.6 billion between 1991 and 2000, and the United States accounting for 99 percent of all Canadian vehicle exports, ease and dependability for commercial crossings is a must for Canadian assembly plants. While less than exports, vehicle imports from the United

States account for approximately 61 percent of all vehicles imported into Canada manufactured in the United States (see Table 2).

Table 2 Passenger Car & Light Truck Units Import & Export (in Thousand Units)										
	1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Total Exports to U.S.	1,220	1,200	1,468	1,591	1,678	1,688	1,722	1,878	2,126	2,076
Total Imports from U.S.	495	460	481	560	492	503	627	566	584	599

Source: Ward's Motor Vehicles Facts and Figures 2001, pages 56 and 58

Vehicle imports from the United States account for US$9.1 billion of the total Canadian vehicle imports of US$14.8 billion. It is interesting to note that, although Canadian vehicle exports to the United States have grown by 90 percent in the past decade, imports from the United States to Canada have increased by just 15.8 percent. This is a slightly faster rate of growth as compared to Canada's imports from the rest of the world. An underlying factor in the discrepancy in the import and export rates is that U.S. vehicle sales reached significantly higher record levels in 1999 and 2000 while the Canadian market increased by a much smaller percentage. Additional Canadian production of vehicles such as the Honda Odyssey fueled the U.S. demand for new vehicle consumption.

Canadian-U.S. automotive trade at the macro level shows that there is a significant, even unprecedented, level of interdependence between the two countries. In 2000, the Canadian automotive industry exported US$47.3 billion worth of vehicles and parts to the United States. At the same time, the U.S. automotive industry sent US$30.9 billion in vehicles and parts to Canada. This level of Canadian automotive activity with the United States equates to 97 percent of all Canadian automotive exports and 79 percent of all Canadian automotive imports.

To further illustrate the relationship between the two countries and the rapid increase of trade, it is useful to differentiate the vehicle and parts shipment trade data. During this period, three of the four trade components showed a strong increase—vehicle imports into Canada saw slow growth (US$7.8 billion in 1991 to US$9.1 billion in 2000, or a 15.8 percent increase). Total automotive exports from Canada increased 84 percent over the decade (1991-2000) to US$47.3 billion. This increase was driven by a 90 percent growth in vehicle exports (from US$18.2 billion to US$34.6 billion) and 70.6 percent increase in parts imports (US$7.5 billion to US$12.7 billion). Table 2 further illustrates the growth of vehicle exports to the United States, and the much slower growth of vehicle imports from the United States. Exports grew from 1.2 million units in 1991 to nearly 2.1 million units by 2000; imports grew from 465,000 units to 599,000 units.

Examination of import data shows a critical tie that binds the two countries' automotive industries. While parts exports increased by 78.9 percent, vehicle imports remained fairly steady, posting only a 15.8 percent increase over the decade. During the past 10 years, Canada increasingly has become an assembler and exporter of vehicles, while the United States increasingly has exported parts to Canadian assembly facilities. The industry has developed a paradigm that relies on a seamless border to deliver U.S.-built parts to the Canadian-based assembly plants.

It is important to note that the Canadian automotive parts sector remains vital to the cross border industry—exporting $12.7 billion. One U.S.-based manufacturer estimates that 12 to 15 percent of its supply base is in Ontario. It is clear that the competitiveness of the North American automotive industry relies upon the ability to deliver components without delay. It is also important to note that much of this trade, especially parts and components, is sent through three locations—Sarnia, Ontario - Port Huron, Michigan; Windsor, Ontario - Detroit, Michigan; and Fort Erie, Ontario - Buffalo, New York.

Table 3
Canada-U.S. Automotive Parts
Import & Export
(in Billions, Constant 2000 U.S. Dollars)

Automotive Parts	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Total Exports	$7.5	$8.2	$8.9	$9.5	$9.1	$10.0	$10.5	$11.3	$12.9	$12.7
Total Imports	12.2	13.3	15.4	16.8	17.7	17.6	19.4	20.2	22.7	21.8
Trade Balance	-4.7	-5.1	-6.5	-7.3	-8.7	-7.6	-8.9	-8.9	-9.7	-9.1
Automotive Vehicles	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Total Exports	$18.2	$18.1	$22.2	$26.2	$27.5	$27.0	$27.5	$29.8	$35.4	$34.6
Total Imports	7.8	7.4	7.6	8.7	8.0	8.1	9.8	9.0	9.2	9.1
Trade Balance	10.3	10.7	14.7	17.5	19.5	18.9	17.7	20.9	26.2	25.4
Total Automotive	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Total Exports	$25.6	$26.3	$31.1	$35.8	$36.6	$36.9	$38.0	$41.0	$48.3	$47.3
Total Imports	20.0	20.7	23.0	25.6	25.7	25.7	29.2	29.1	31.8	30.9
Trade Balance	5.6	5.6	8.2	10.2	10.9	11.3	8.8	11.9	16.5	16.4

Source: Industry Canada, Strategis.gc.ca

To better understand the role the Canada-U.S. border plays in the logistical planning of the industry, it is valuable to investigate more closely trade data for three time-critical sensitive components: seats, engines and transmissions. Each of these components has seen an increase in trade over the last decade. The first component (seats) is possibly the most visible of all time sensitive components. Engines and transmissions are indicative of build-essential components; due to their high cost per component, manufacturers must strive to maintain minimal inventories. It is noteworthy that each of these components experience growth rates (in terms of trade in constant dollars) higher than the overall automotive parts or vehicles.

Current JIT inventory and line sequencing practices have led seat assembly facilities to be located near the assembly plant they serve. Yet even given the JIT line-sequenced requirements for seat sourcing, the past decade has seen a phenomenal increase in cross-border shipments of seats, especially imported into Canada. Automotive seat imports rose from US$44.2 million in 1991 to US$163.4 million in 2000, an increase of 278 percent. Exports of seats to the United States increased 94 percent during this same period. These rates of growth would not have been possible without a well-functioning border crossing.

In what may be an indication of the proximity required for seat assembly, imports to Canada from Michigan increased 460 percent and exports to Michigan increased 148 percent in the past decade. Proximity to assembly also appears to be a positive factor for Canadian seat assembly facilities. Seat shipments from Canada to Michigan increased by 149 percent—a far greater percentage than the overall trend. Obviously, an effective border crossing has allowed the JIT sequencing across the border. However, the events of September 11th increased the risk of potential border delays and decreased the likelihood that parts requiring tight, sequenced delivery schedules will continue to be sourced across international borders. One interview respondent indicated that the challenges of sourcing seats across the border might lead to sourcing changes. The respondent said "obviously the border takes away lean manufacturing opportunities like building assemblies in sequence. We are doing that today with seats. However, we shut down the plant periodically due to lack of supply."

One important caveat is that seats, maybe more than any other component, have seen a percentage increase in content and cost. In 1991, many vehicles had standard seating with manual controls. By 2000, innovative suppliers added power features to seats and leather specification surged. Even given this increased value added, the increased dollar value of seats trade is noteworthy, and much of this increase is attributed to increased unit volumes allowed by a working border.

Table 4
Import & Export of Seats
(in Millions, Constant 2000 U.S. Dollars)

Imports	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Imports from the U.S.	$43.2	$60.9	$60.4	$60.3	$57.7	$54.6	$65.1	$70.8	$119.5	$163.4
Imports from all Countries	45.9	163.1	248.0	152.0	67.0	64.0	71.9	86.3	123.4	169.3
Exports	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Exports to U.S.	$51.0	$81.0	$55.3	$360.2	$237.2	$222.8	$168.7	$245.7	$116.6	$99.1
Exports to all Countries	54.7	81.2	59.8	362.2	240.4	225.8	170.2	246.4	119.5	106.4
Imports	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Seats Imported from MI	$20.0	$35.3	$23.8	$13.4	$9.3	$6.2	$12.2	$12.1	$62.2	$112.0
Seats Exported to MI	31.3	43.9	43.8	355.3	233.3	213.2	160.3	235.1	107.5	78.2

Source: Industry Canada, Strategis.gc.ca

Engines have also seen increased trade across the border between 1991 and 2000 (see Table 5). Engine exports to the United States increased 150 percent from US$1.237 billion in 1991 to US$3.085 billion in 2000. An important change in geographical sourcing change has occurred over that time period; it can be attributed to a single investment decision. During the last decade or more, the data indicates increased outbound engine trade from Canada to Kentucky, Ohio, Missouri and Virginia. This is a direct result of Ford Motor Company's decision to invest in its Windsor Engine Plant (WEP), putting much of their light truck engine capacity into the plant. Such significant investment in a border facility exemplifies the importance of a seamless, efficient border crossing. On any given day, Ford may deliver over 2,500 engines from WEP to facilities in Michigan, Kentucky, Missouri, and Virginia, and only a few hundred to its only customer in Canada.

Table 6 shows that the rate of change for cross-border shipments of transmissions is similar to that of vehicles and other parts. Current engines and transmissions scale economies require facilities to produce hundreds of thousands of engines per year. Yet, even at the required high production volumes, these components have a very high unit cost; thus, it is critical to reduce inventory levels. Border crossing delays for engines and transmissions not only create an increased transportation cost, but carry the added burden of creating additional inventory holding costs associated with high value components.

Table 5
Import & Export of Engines
(in Thousands, U.S. Constant Dollars)

Exports	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
---- MICHIGAN	$1,164,381	$1,228,947	$1,475,005	$1,311,185	$1,182,580	$1,740,392	$1,578,137	$1,256,318	$1,677,193	$1,502,071
---- KENTUCKY	308	1,365	2,307	5,177	6,739	5,406	39,164	292,071	380,249	416,816
---- OHIO	17,017	25,665	16,616	100,633	33,773	50,184	189,956	452,017	415,557	377,038
---- MISSOURI	1,771	1,335	3,626	2,098	4,039	9,863	172,390	321,779	302,838	322,989
---- VIRGINIA	2,758	2,702	5,864	4,073	23,066	245,619	279,095	276,083	299,443	273,585
Exports	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Exports to U.S.	$1,237,936	$1,352,352	$1,562,557	$1,489,724	$1,352,804	$2,152,743	$2,412,236	$2,764,293	$3,248,942	$3,085,751
Exports to all Countries	1,253,980	1,363,039	1,579,457	1,505,907	1,385,705	2,182,857	2,445,012	2,793,253	3,288,397	3,143,716
Imports	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
---- MICHIGAN	$1,631,255	$1,662,647	$2,005,067	$2,039,731	$1,769,903	$1,925,180	$1,966,749	$2,510,514	$2,798	$2,574,461
---- OHIO	379,893	523,040	504,117	343,904	399,486	486,440	543,406	590,236	909,756	1,108,046
---- NEW YORK	5,569	6,658	5,682	114,148	510,888	418,519	550,500	552,011	481,665	427,763
---- WISCONSIN	110,937	53,488	15,956	19,620	15,614	14,557	54,729	184,558	358,082	419,575
---- KENTUCKY	1,367	1,049	1,693	3,680	3,664	3,784	4,162	5,343	53,529	135,166
Imports from the U.S.	$2,374,378	$2,511,707	$2,841,442	$2,917,405	$3,123,628	$3,257,749	$3,563,034	$4,312,697	$5,117,163	$5,181,697
Imports from all Countries	3,137,674	3,192,159	3,605,956	3,875,438	4,051,204	4,079,806	4,193,338	4,659,915	5,779,529	5,743,174

Source: Industry Canada, Strategis.gc.ca

Table 6
Import & Export of Gearboxes
(in Thousands, U.S. Dollars)

Transmission Box Exports	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Exports to U.S.	$460,215	$484,151	$307,733	$6,242	$61,219	$132,747	$330,683	$675,312	$979,887	$1,029,227
Total (All Countries)	514,004	545,757	341,773	9,036	147,733	185,703	479,941	718,962	1,088,295	1,182,704
	1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
---- MICHIGAN	$333,537	$7,931	$7,326	$3,118	$9,413	$54,060	$19,667	$272,358	$511,633	$423,934
Gearbox Imports	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Imports from U.S.	$1,317,361	$1,544,301	$1,857,319	$2,365,033	$2,402,214	$2,226,285	$2,272,108	$2,455,130	$2,481,721	$2,284,499
---- MICHIGAN	750,136	864,677	908,577	1,240,334	1,107,689	1,000,415	1,065,777	1,094,572	970,547	927,108
---- INDIANA	158,892	236,830	492,085	679,084	571,370	659,745	608,537	790,957	835,611	745,865
---- OHIO	268,493	293,784	266,353	202,906	472,456	380,978	380,755	329,147	453,225	437,997

Source: Industry Canada, Strategis.gc.ca

The following two maps geographically represent the concentration of the Canadian–U.S. automotive industry and the border crossing concentrations. The maps, showing Canadian automotive parts imports (Fig.1) and automotive parts exports (Fig. 2) to the United States describe the high concentration of automotive activity located between southeast Ontario in Canada, and Michigan and New York in the United States. They also show a trade corridor stretching from the Michigan-Ontario crossings down through Ohio, Indiana, Kentucky, Tennessee, and spanning out to the surrounding states.

The maps make it clear that the Great Lakes serve as a significant geographical barrier to border crossing within this region, allowing for only a few natural crossing points. Given that the majority of the Canadian automotive industry is located in the southeast section of Ontario (and to a lesser extent, the southwestern part of Quebec) it becomes further evident that the Canadian automotive industry is perched at the end of what can be described as a peninsula bordered by Lake Huron to the west, Erie to the southwest and Ontario to the southeast.

FIG. 1 – 2000 CANADIAN AUTOMOTIVE PARTS IMPORTS BY STATE (U.S. DOLLARS)

Less than 49,999,999	100,000,000 to 249,999,999	500,000,000 to 999,999,999
50,000,000 to 99,999,999	250,000,000 to 499,999,999	Greater than 1,000,000,000

Source: Strategis.gc.ca

FIG. 2 – 2000 CANADIAN AUTOMOTIVE PARTS EXPORTS BY STATE (U.S. DOLLARS)

Source: Strategis.gc.ca

IV. ECONOMIC SIGNIFICANCE OF CANADIAN-U.S. AUTOMOTIVE TRADE

Some US$242 billion of materials was consumed in 2000 in the production of 12.4 million units of vehicles in the United States.[4] Rolling this number up proportionately to the 2.9 million units of Canadian production and 1.9 million units of Mexican production in 2000 results in a total original equipment component flow of approximately US$335.5 billion. Underlying this flow of components into the light duty assembly plants is a dependence upon JIT logistics. This pull system – pulling components into an assembly plant as needed rather than from massive inventory stock – has assisted the industry in reallocating capital from being idled in inventory to more productive uses and improved quality by shortening the time required to move components through assembly, problem detection and correction.

With JIT logistics, inventory buffers (system slack) have been reduced throughout the entire value-added chain. Without these buffers, the system is dependent upon a reliable transportation system delivering components at the right place, at the right time, in the right quantity, at the right quality. Any deviation to plan can cause significant disruptions to the system in terms of production to schedule and quality targets (as has been tested by labor issues, weather conditions, and transportation disruptions). (We define the industry requirements for JIT in the next section.)

Assembly plant revenue generation is approximately US$1.5 million per hour (60 units per hour at US$25,000). With a typical return on sales in the 4 percent range for a vehicle manufacturer, a lost hour of assembly output due to a parts shortage costs approximately US$60,000 per hour in lost earnings. Of course, if the vehicle is in demand, a vehicle manufacturer will make up for this lost production by working overtime. However, this will pull down average profitability through overtime premiums and expedited freight charges.

As the range of component value-added is incredibly large throughout the industry, the economic impact of closing down a component plant is also widely varied. Table 7 shows CAR's estimates of revenue generation per hour of production at major first-tier component operations. This table indicates the pressure on plant managers to keep a steady flow of components and production. Component suppliers typically operate at a slightly higher return on sales (ROS) margin than the vehicle manufacturers. Using a 5 percent ROS margin shows a range of lost first-tier supplier profit from US$7,500 per hour at an engine or major stamping operation to US$2,000 per hour at a heating, ventilating, and air conditioning component plant.

[4] Center for Automotive Research, Estimating the New Automotive Value Chain, 2001, page 7.

Table 7 Estimated First Tier Revenue Generation Per Hour of Production (U.S. Dollars)			
	Lost Revenue per Hour		**Lost Revenue per Hour**
Engine	$150,000	Body Structure	$140,000
Transmission	$100,000	Chassis Electrical	$45,000
Steering/Suspension	$100,000	Heating, A/C	$40,000

Source: Industry sources and CAR estimates.

United States assembly plants produced 12.77 million light-, medium- and heavy-duty vehicles in 2000; Canadian plants produced 2.96 million light-, medium-, and heavy-duty vehicles. As a rough estimate (as these trade numbers also include aftermarket components), U.S. vehicles contain approximately US$1,000 of Canadian content (US$12.75 billion divided by 2000 production) and Canadian vehicles contain approximately US$7,373 of U.S. content (US$21.83 billion divided by 2000 production). It is obvious from this data that Canadian vehicle production has more risk exposure to the Canadian-U.S. border than U.S. plants: i.e., Canadian assembly plants are more dependent upon an integrated NAFTA supply chain. Without an efficient border, the vehicle manufacturers must decide to rationalize vehicle production within the U.S. supplier network or convince suppliers to build supplier parks around Canadian assembly plants. However, without the ability to export reliably out of Canada (if the border crossing is unreliable), suppliers must depend upon the Canadian vehicle assembly customer base, which is far more limited in terms of size (some 75 percent smaller than the U.S.) and scope (six major manufacturers versus nine major light-duty/medium duty manufacturers in the United States).

V. INDUSTRY DEFINITION OF JIT

Vehicle production schedules, inbound inventory cost management, and production risk management strategies of vehicle assembly plants drive the flow of logistics throughout the rest of the supply chain. At approximately $1.5 million per hour of revenue generation, the cardinal rule of the supply base (and assembly plant managers) has always been "do not shut down an assembly plant."

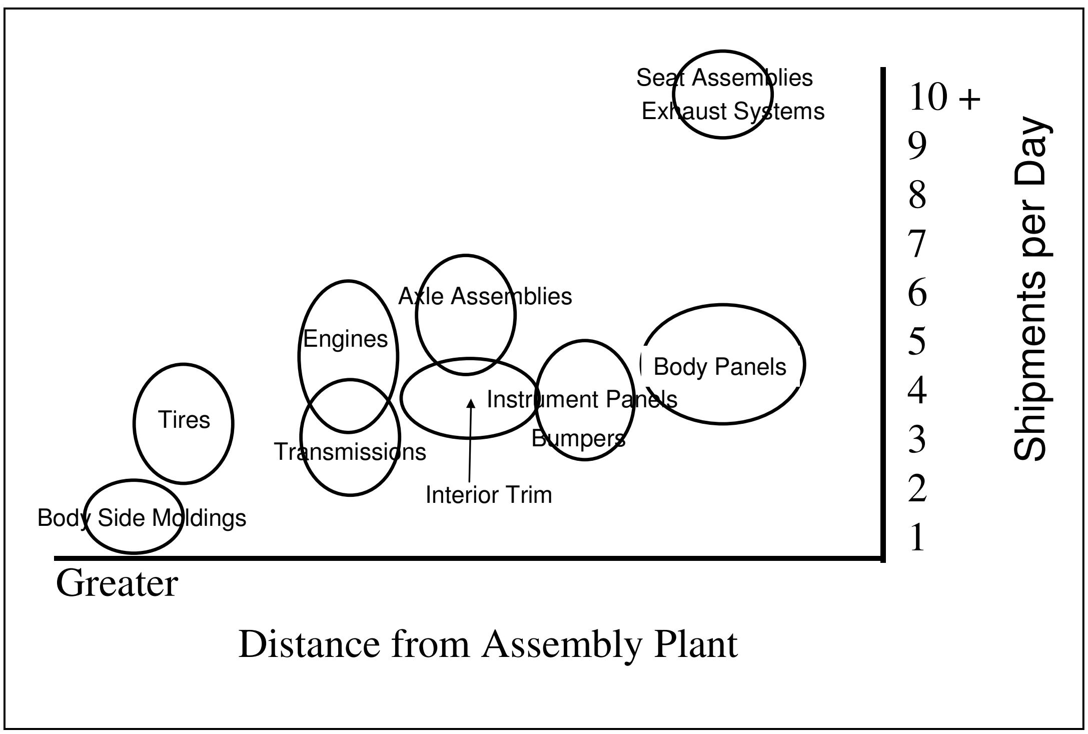
In general, automotive assembly and component plant managers are judged on the following production and cost metrics. (Other significant metrics are health and safety issues.) These issues are not ranked in importance.

- Build to schedule – performance to budget
- Total manufacturing costs – cost per unit
  - Direct labor/overtime costs
  - Direct materials/yields
- Mix optimization – minimizing time of production changeovers
- Quality – minimizing rework and warranty expense
- Inventory – minimizing carrying costs
- Logistics cost – minimizing total expense, especially expedited freight

The industry has been working to reduce inventories at every stage of production. At a cost of capital carrying charge of 10 to 15 percent, companies and individual plants can release a significant amount of value by freeing up inventories. In our interviews, several logistics managers spoke about a focus on creating a schedule to deliver out (and receive in) every part/every day. However, depending upon the critical nature (to final assembly) and the value of the component (to the total value of the assembly), deliveries once per week, once per day, and multiple shipments per day might be better characterized as 1/3, 1/3, 1/3, respectively, (of total part shipments) than logistics being dominated by a one-part-per-day strategy.

The graphic below depicts the general definition of JIT deliveries into assembly plants. Parts that are color sensitive and sequenced into the final assembly schedule (such as seats and instrument panels) are delivered most frequently into the assembly plants and are typically located closest to the assembly plant. Bulky parts which are difficult to ship and store (such as exhaust systems) are also shipped frequently into assembly plants. With shipments in the range of every two to three hours (four deliveries per shift), these types of components are rarely shipped across international borders due to their dependence upon transportation logistics. Stampings are not shown on this graphic as almost every assembly plant has a dedicated stamping facility or a supplier close enough (geographically) to be considered a contiguous plant.

FIG. 3 – GENERAL JIT REQUIREMENTS INTO ASSEMBLY PLANTS



Source: Industry and CAR estimates.

VI. THE BORDER AND LATE SHIPMENTS

Minimizing the risk of closing an assembly plant (meeting the production build schedule) is the major priority of vehicle manufacturer logistics executives and suppliers alike. These costs of a border disruption were outlined above. Even through the period of record production, suppliers noted that late shipments due to border-specific delays were usually at "less than 5 percent" or "at the bottom" of their tracking lists. It is generally noted that premium freight charges did increase through 2000 as the North American industry reached a record level of production at 17.2 million units (24.6 percent higher than 1985–the previous cyclical peak at 13.8 million units). Expedited freight is the immediate fallback to prevent closing an assembly plant. Assuming that suppliers are above a 95 percent on-time delivery schedule, 5 percent of late shipments are attributed to border crossings, which means that less than 1 percent of all shipments are late due to a border situation. A few suppliers did admit that during the peak 1999 and 2000 period, parts shortages due to border crossing delays did occur and closed component plants. However, material logistics managers were able, in most cases, to prevent production schedule slippage and, certainly, assembly plant closures.

It is a standard practice to manage a border crossing to a 20 to 30 minute window. Of the shipments that are late due to a border situation, 60 to 90 minute delays are common. Two trucking companies noted a time window of 20 minutes to approximately 2 hours to cross through customs at the Ambassador Bridge. While a minimum time delay will likely be covered by an inventory draw down, delays above 60 minutes will typically result in some type of an assembly plant disruption (beginning with schedule adjustments and moving to a full closure). In cases where assembly production is lost or overtime and expedited freight is required to make up for lost production the component supplier and/or inbound freight provider are financially exposed to these losses. In addition, the suppliers are exposed to being de-sourced on forward contracts as an on-time shipment is a critical performance metric used by the vehicle manufacturer purchasing groups to evaluate suppliers.

Congestion at the approach aprons is the most often mentioned cause of border-related delays. The root cause of the congestion is often traced, primarily on the U.S. side, to inadequate staffing at border crossings (a combination of Customs, Immigration, and other related law enforcement). Throughout the interviews there was a desire indicated that the U.S. and Canadian governments respond to the need to alleviate congestion at existing crossing points. Suggestions of crossings, such as an additional bridge crossing in Detroit (either dedicated to commercial traffic or shared with passenger traffic), as well as any ongoing changes to security policies, were generally welcomed by interviewees, but always with the caveat that these additional infrastructure investments or policy changes would be staffed with adequate resources. The greatest concern is that <u>additional</u> infrastructure capacity will be added with a <u>constant</u> level of staffing (or at least not incrementally matched with additional requirements), resulting in no net improvement across the entire system. While concern over staffing levels appears to be directed primarily at current and future U.S. resource levels, Canadian resource commitments must, of course, also match any changes in policy requirements or infrastructure capacities.

Other problems mentioned that cause delays at the border include paperwork difficulties (typically for smaller firms not using brokers), Customs slowdowns, and inconsistent handling of inspections/paperwork requirements at various border crossings. There were many anecdotes regarding inconsistent customs procedures, however, the largest suppliers and trucking operations did not see this as a problem. Most suppliers mentioned the fact that they keep a small number of drivers dedicated to border crossings so that relationships and familiarity are built with Customs agents. In addition, many noted that detailed inspections–and potential delays–were likely as a disciplinary action, placing additional emphasis on having all paperwork in order without any potential violations. Prototype parts shipments were noted as an issue, primarily because the paperwork and special treatment are disproportionate to the absolute value of the shipment. However, the ability to freely ship prototype parts is especially important to building research and development capabilities within Canadian firms.

Inventory levels have been managed down over the past 10 years and many companies report programs are in place to manage inventories to even tighter levels. While the events of September 11th will cause a reevaluation of these programs, the industry will continue to design its production and logistics systems around a lean operating mentality. Companies will manage down their inventories to a point that the expected loss of a plant closure (from all sources: including late shipments, quality problems, labor disruptions, and the like) equals the incremental savings in inventory carrying charges. Several suppliers mentioned the likelihood that inventories may creep up slightly. Changes will be strategic and targeted and will not measure a significant reversal of the downward inventory trend, but may mark a reversal of future planned reductions. While suppliers and assembly plants did report that inventories rose immediately after the September 11th events, the suppliers also noted that inventory levels were reduced to “normal” levels by December. No supplier or manufacturer reported a risk management strategy by carrying an increased level of inventory for a component that crossed the border versus a component that did not. Companies are looking to any resolution in commercial and immigration border policies and resource allocations to allow them to maintain minimum inventories of domestic production for domestic consumption and domestic production for international consumption.

At the industry level, inventory carrying charges on the flow of materials crossing the border are not insignificant but are generally not the largest areas of a potential pool of cost reduction items. This statement is not meant to mean that the industry is standing ready to take on additional inventory to cover unpredictable border crossing times. Every potential dollar of cost savings is critical to the industry. However, looking at the US$12.7 billion of components that comes into the United States from Canada, and dividing this number by 220 production days, means that approximately US$58 million of materials flows through the assembly plants per day (again, with the understanding that these figures include aftermarket components). Using a standard eight-hour, two-shift calculation–that is dividing US$58 million by 16 hours–equates to US$3.6 million of Canadian content that flows through U.S. assembly plants. Using a cost of capital of 12 percent equates to a carrying cost of US$432,000 to carry an additional hour of inventory to cover the risk of shipment disruptions. This cost, of course, will be proportioned to specific plants depending upon levels of Canadian sourcing. Additional costs of warehousing and potential quality problems would also need to be worked into a complete cost/benefit analysis. The specific point here is that Canadian suppliers need as efficient a border as possible, without any additional cost burdens, to expand their US$12.7 billion market of components into the United States. Otherwise, the Canadian component suppliers may be locked into participating only in the growth of Canada’s domestic production or within growth of commodities not requiring JIT logistics (typically lower value-added components).

Working the same mathematical logic for U.S. parts flowing into Canada, US$21.8 billion of parts per year breaks down to approximately US$100 million per day (across a 220 day production year). Assuming a 16-hour workday within an assembly plant means US$6.3 million per hour. At a 12 percent carrying cost, this equates to US$800,000 per hour of inventory carrying charges at the industry's assembly level. Again, any additional costs brought into the system (warehousing, quality, as well as inventory) hinder additional integration of the Canadian and U.S. auto industries and may lead to sub-optimized capacity rationalization decisions. While these estimates may appear low, it must be taken into account that the estimates are only on the amount of components flowing across the border; they do not include the built-up subsystems using those components that cross the border and the associated assembly plant safety stocks that might also increase.

With transportation costs averaging around 0.5 percent of sales (transportation costs can vary from 0.1 to 0.2 percent on very high value-added components, to 1 percent on lower value-added components requiring specialized containers or bulky shipping arrangements), the priority within the logistics staffs is keeping the assembly plants running. Certainly, most suppliers do have well-established programs of pulling down inventory costs and total logistics expenditures. However, the cost pressures (due to potential charge-backs to suppliers because of lost production or de-sourcing because of late shipments) are focused on delivering to the prescribed production schedule to pull components through the production system. Brokerage fees are seen as "insignificant" in relation to the value of their expertise in managing shipments, customs paperwork, and duty charges. An hour delay at the border will cost an additional US$30 for the truck and the driver, but could have repercussions throughout the supply chain, including the potential slowdown of an assembly plant. Any changes requiring additional truck runs to minimize border disruption risks will be calculated at the US$20 to US$25 per hour for the truck and driver plus approximately US$1 per mile (however, these charges may vary due to special equipment and handling).

VII. CONCLUSIONS

The greater growth rates for cross-border shipments of vehicles and parts indicate a growing interdependence between the Canadian and U.S. auto industries and place a greater level of importance on keeping the primary automotive commercial Canadian-U.S. crossing points as efficient as possible. Before the tragic events of September 11th, logistics managers developed the current system of JIT logistics around a 20 to 30 minute time window to clear materials through the Canadian-U.S. border. Vehicle production levels and macro-economic growth in 1999 and 2000 taxed the current border crossing infrastructure and personnel resources. To move outside this time window threatens vehicle assembly plant profits in the range of $60,000 per hour and US$7,500 to US$2,000 per hour at the major first tier component plants (on an individual plant basis). Keeping components flowing to the plants is the most critical issue facing plant and logistics managers and, in turn, is the major requirement throughout the entire system–including border operations. This system worked to the point that suppliers did not differentiate between domestic or internationally purchased components by keeping additional inventories to reduce risk or incur significant differentials in transportation costs.

Logistics managers look at minimizing the total cost and time in the delivery cycle of a component or vehicle. The current situation at the border is considered fragile as temporary resources are assigned to implement the more stringent security inspections. The industry is looking at the current situation to better understand ongoing customs policies and the resources needed to implement these policies and maintain a dependable time window to cross the border. The border crossing is an integral part of approximately US$1,000 of Canadian components in U.S.-built vehicles and approximately US$7,400 of U.S. content in Canadian-built vehicles. It appears that Canadian assembly and component plants are most exposed to any decay in the reliability and dependability of the border crossing, as they are most dependent upon U.S. flow of components and may not offer a large enough market to justify dedicated supplier parks. In particular, seating operations that require absolute adherence to a JIT production schedule discipline and engine and transmission plants that are very capital intensive and require full utilization for profitability are at the greatest risk to any decay in the border's ability to deliver dependable crossing times.