Using Data Visualizations to Improve Presentation and Marketing of the North American Transportation Statistics Online Database

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Any views expressed are those of the author(s) and not necessarily those of the U.S. Census Bureau.

1. Introduction and Background

Transportation plays a vital role in a changing economy. It links people and places, facilitates trade and tourism, and encourages economic competition. Within North America, initiatives such as the Canada-U.S. Free Trade Agreement (FTA)[1] and the North American Free Trade Agreement (NAFTA)[2] have reduced trade barriers. Taking all of this into consideration, along with an increasingly mobile population, the need for information on transportation infrastructure and services within and between the three countries has increased. Everyday governments, businesses, and people make decisions with regard to transportation: where to go, how to get there, what to ship, and where to locate facilities. Given transportation's overall importance in the economy, the transportation and statistical agencies of Canada, Mexico, and the United States established the North American Transportation Statistics (NATS) Interchange in 1992.

2. Mission and Vision[3]

The *mission* of the Interchange is to:

> *Raise the general awareness and improve the quality, relevance, and comparability of transportation data in North America.*

This mission is built around a shared recognition of the need for quality information in establishing sound public and private policies, and the advantages of partnering to improve our national data and develop a continental statistical view of transportation.

The Interchange provides a forum for the exchange of information, promotes increased data harmonization and the development of new statistical sources to fill data gaps, and facilitates international cooperation in data improvement efforts.

The *vision* of the Interchange is to:

> *Be the recognized leader in promoting and developing high quality, relevant, comparable data and analyses that provide information necessary for an efficient and fully integrated transportation data system for North America*.

To be successful, the Interchange depends upon the collective and individual actions of participating member agencies. These include:

- Sharing information on transportation and statistical programs and projects (to include, for example, exchange of information on transportation models and analyses, data definitions, and methodology)
- Identifying areas of common concern and opportunities for future cooperation

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[1] The FTA entered into force on January 1, 1989.
[2] NAFTA entered into force on January 1, 1994
[3] Mission and Vision text from North American Transportation Statistics Interchange, Strategic Plan 2010 - 2015

- Working cooperatively towards greater data harmonization Recognizing institutional imperatives; and the legal, technological, resource, and other barriers that may constrain each partner

3. Participants

Canada:
Statistics Canada (SC)
Transport Canada (TC)

Mexico:
Instituto Nacional de Estadistica y Geografia (INEGI)
Secretaria de Communicaciones y Transportes (SCT)
Instituto Mexicano del Transportes (IMT)

United States
US Census Bureau (BOC)
Bureau of Transportation Statistics (BTS)

In addition to the principal participants, the following U.S. agencies are permanent members of the Interchange: U.S. Army Corp of Engineers (ACE), Maritime Administration (MARAD), Federal Highway Administration (FHWA), and the Federal Railroad Administration (FRA).

Staff members from other Governmental agencies of the three countries also participate, depending upon the area of investigation. These agencies include, but are not limited to: the Customs agencies of the three countries, Canadian Tourism Commission, Canadian Transportation Agency, Natural Resources Canada, Instituto Nacional de Ecologia, Secretaria de Turismo, U.S. Bureau of Labor Statistics, Bureau of Economic Analysis, Environmental Protection Agency, Energy Information Administration, and modal administrations of the U.S. Department of Transportation (DOT) that are not permanent members.

4. Programs and Activities[4]

The interchange consists of various sub committees/working groups that are responsible for accomplishing specific tasks. They are:

- Maritime and Trade Working Group
- Surface Transportation Working Group
- Environment and Energy Working Group
- North American Transportation Statistics Online Working Group
- Aviation Statistics Working Group

The working groups focus on the exchange of best practices and new developments, as well as harmonization and data sharing. Each addresses ad hoc issues relevant to their subject matter. The working groups meet during the annual Interchange and more often as their work-schedule or need arises.

[4] Program and Activities text from North American Transportation Statistics Interchange, Strategic Plan 2010 - 2015

The North American Transportation Statistics group focus is on identifying critical information necessary to support comprehensive analyses of North American transportation. As such, it reviews data comparability across the three countries and identifies key data gaps. It also has been responsible for several outputs including the North American Transportation in Figures, a three-country tri-lingual report and the North American Transportation Statistics On-line Database. The working group is now focusing its effort on adding data tables and variables and improving the functionality of the on-line database.

In addition to working groups, the Interchange also has established a leadership committee, the Strategic Planning Committee or SPC. The SPC is responsible for providing overall guidance and planning. It also serves as the Interchange's "knowledge base" of best practices and approaches on key issues. It establishes the vision, mission and strategic goals of the Interchange, and approves the vision, mission and strategic goals of the working groups. From a functional perspective, the SPC approves the establishment or termination of working groups as well as the scope and mandate of both existing and new working groups. The SPC also works to ensure that the activities of working groups are complementary rather than overlapping.

5. Accomplishments

North American Transportation in Figures and now the North American transportation Statistics Database are the most visible accomplishments of the Interchange. The print report and the database characterized transportation activity and its impacts across and among Canada, Mexico, and the United States. The print report and the database are available in English, Spanish, and French and covered twelve thematic areas, including transportation and the economy, transportation safety, transportation's impact on energy and the environment, domestic freight activity, and transportation and trade.

The Interchange also has led to a number of other major statistical improvements for transportation and the sharing of information. These have included:

- Adoption of the International Classification of Ship Types by all three countries in their statistical reports;
- Reconciliation by all three countries of their waterborne port definitions and the use of these definitions and their geographic locations;
- Resolution of data inconsistencies in trans-border marine merchandise trade data;
- Exchange of information and assistance in the development of national reports on transportation statistics;
- Exchange of various maritime databases in order to reconcile port import and export data;
- Exchange of information on value-to-weight ratios used in foreign trade statistics and application to U.S. trade data;
- Development of foreign trade statistics by mode of transportation in Mexico;
- Joint trilateral development and release of the North American Transportation Atlas Database;
- Joint Canadian and U.S. development of the Standard Classification of Transported Goods (SCTG);
- Exchange of North American travel and transportation data to help fill critical gaps in U.S. international travel information;

- Canadian and U.S. agreement to cooperate in the design and implementation of dual carrier information in the air passenger origin-destination surveys;
- Exchange of information and technical assistance on the development of Transportation Satellite Accounts;
- The exchange of information on data used for disaster planning, recovery and assessment;
- NATS Interchange Internal Web Site making available to member agencies presentations, summary of discussion, etc., for previous and upcoming interchanges.

5.1 **North American Transportation in Figures**

As stated earlier, the two major products of the interchange have been the *North American Transportation in Figures* and the North American Transportation Statistics Online Database. The *North American Transportation in Figures* was a paper publication that presented transportation related data for 1990, 1995, and 1996 http://www.census.gov/econ/www/natf/english.pdf (Figures 5-1 and 5-2):

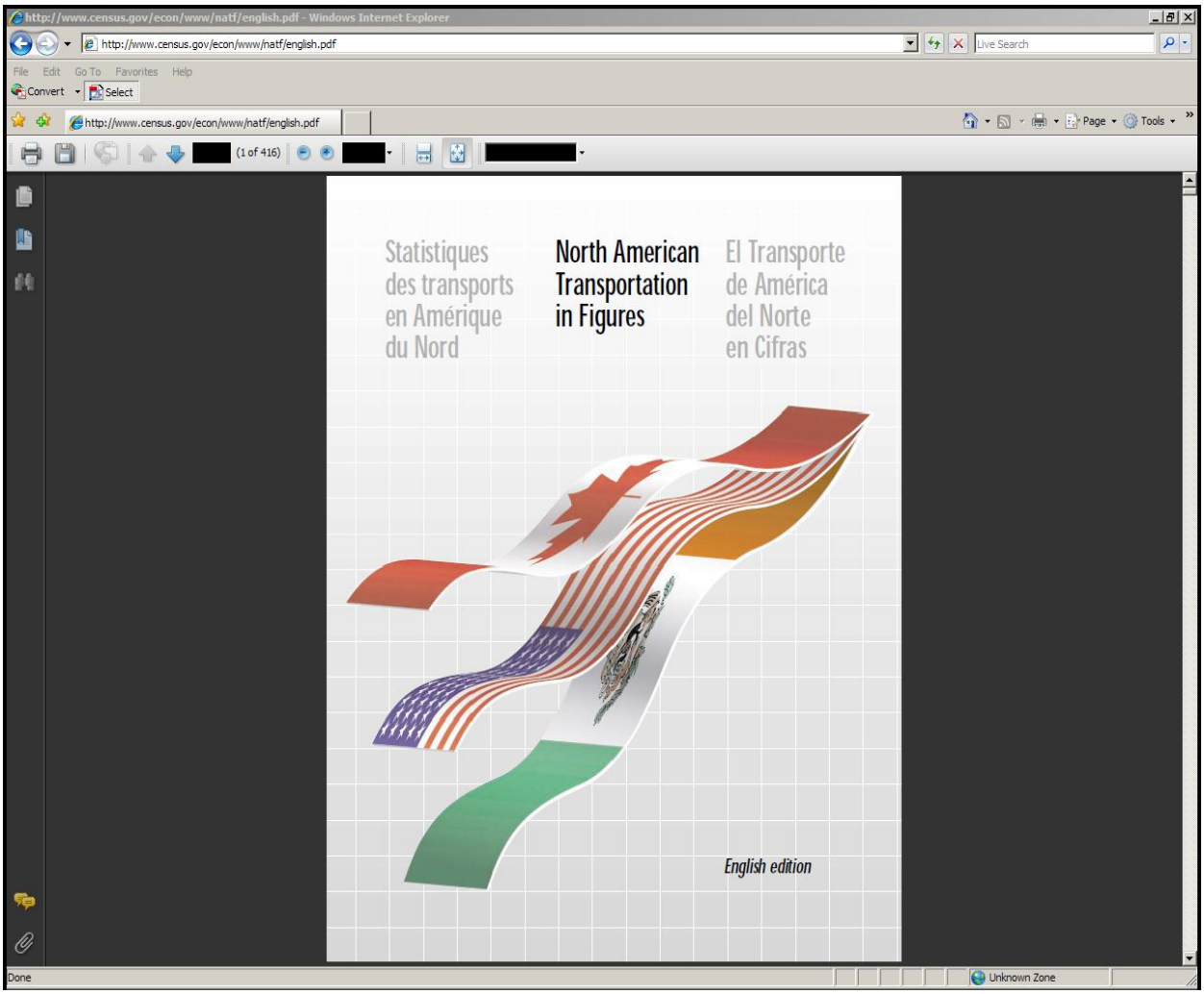


Figure 5-1

table 3-1

Transportation Fatalities by Mode

	Canada			Mexico			United States		
	1990	1995	1996	1990	1995	1996	1990	1995	1996
Fatalities, total	**4,184**	**3,794**	**3,502**	**10,234**	**9,121**	**9,472**	**47,248**	**44,426**	**44,697**
Air	**99**	**117**	**75**	**24**	**30**	**86**	**864**	**963**	**1,089**
Air carriers	30	59	28	0	0	0	97	229	457
General aviation	69	58	47	24	30	86	767	734	632
Road	**3,963**	**3,351**	**3,091**	**10,201**	**9,043**	**9,305**	**44,599**	**41,817**	**[a]42,065**
Passenger cars and light trucks	2,804	2,473	2,264	2,919	2,385	2,562	32,693	31,991	32,437
Passenger cars	U	U	U	U	U	U	24,092	22,423	22,505
Motorcycles	260	166	128	54	138	142	3,244	2,227	2,161
Buses	8	6	0	279	271	279	32	33	21
Large trucks	107	72	59	67	125	176	705	648	621
Pedestrians	584	416	460	1,388	1,038	1,111	6,482	5,584	5,449
Other	200	218	180	25	408	225	1,443	1,334	1,374
Pipeline	**0**	**0**	**0**	**U**	**U**	**U**	**9**	**21**	**53**
Rail	**103**	**120**	**119**	**9**	**48**	**81**	**1,297**	**1,146**	**1,039**
Grade crossing	48	53	47	U	U	U	698	579	488
Railroad	55	67	72	U	U	U	599	567	551
Transit, total	**N**	**N**	**N**	**U**	**U**	**U**	**339**	**274**	**264**
Transit rail	N	N	N	U	U	U	228	186	152
Water transport	**N**	**206**	**217**	**N**	**N**	**N**	**950**	**875**	**759**
Passenger vessels	N	195	210	N	N	N	U	U	U
Recreational boats	N	194	209	N	N	N	865	829	709
Commercial passenger vessels	6	1	1	N	N	N	U	U	U
Commercial freight vessels	13	11	7	N	N	N	U	U	U

[a]Includes two fatalities that have not been assigned by the National Highway Traffic Safety Administration to a subcategory.

KEY: N = Data are nonexistent. U = Data are unavailable.

NOTES

All Countries

Fatalities, total: For the United States, the number for total fatalities is less than the sum of the fatalities listed for individual modes because some fatalities are counted in more than one mode. That is, the United States has corrected for double counting in calculating total fatalities (see Appendix B). For Canada, the total shown is the sum of the modal totals and has not been corrected for double counting. (Note also, that Canadian fatality data for transit does not exist nor does Canadian fatality data for recreational boats for 1990. These data, if available, would increase the overall fatality totals for Canada.) For Mexico, the total is the sum of air, road and rail only, and therefore the total number of transportation fatalities is underrepresented.

Air: United States and Canada include fatalities from both passenger and all-cargo flights. Mexico includes fatalities from passenger flights only. For Canada and the United States, the air carrier data are for their own national flag carriers, operating both domestic and international flights.

Road: Data refer to occupants of the road motor vehicles listed. Other comprises pedalcyclists, other nonmotorists (except pedestrians, who are separately listed) and occupants of other or unknown motor vehicles.

Road: For road especially, it is important to note that the United States and Canada (except for the Province of Quebec) count all fatalities that occur within 30 days of the crash (and can be attributed to the crash), whereas Mexico counts those fatalities that occur at the site of the crash. See Appendix B, All Countries.

Water transport: United States and Canadian data are not comparable in several respects. See Appendix B, All Countries.

Mexico

Road: Includes 5,469, 4,678 and 4,810 fatalities that occurred on the federal highway network in 1990, 1995 and 1996, respectively. These fatalities cannot be allocated to a specific vehicle category but are included in the road total.

Figure 5-2

It examined transportation and transportation-related passenger, freight, economic, safety, energy, environment, and demographic statistics relating to Canada, Mexico, and the United States. It increased awareness of transportation-related statistics available in each of the three countries, assessed the comparability of the statistics, determined where information gaps exist, and revealed which additional data were needed for a more complete picture of transportation in North America.

Each language edition (English, French, and Spanish) of the *North American Transportation in Figures* contains twelve thematic sections that together contain more than 90 data tables. Section 1, Country Overview, sets the context of the report with an overview of each country: population, labor force, physical area and Gross Domestic Product (GDP). Section 2, Transportation and the Economy, draws a comprehensive picture of the impact that transportation has on the economic indicators of each country (including GDP), government expenditures for transportation, and transportation employment. Section 3, Transportation Safety, provides critical information on fatalities and injuries by mode. Fatality and injury rates for road and air also are included. Section 4, Transportation, Energy and the Environment, responds to current energy and environmental concerns, and includes tables on energy consumption, fuel costs and emission control requirements. Section 5, Domestic Freight Activity, summarizes freight activity by mode, by major commodity and by major origin/destination pair. Sections 6 and 7 provide data on North American merchandise trade and international merchandise trade between North America and the rest of the world. For Section 6, each country decided to use its own merchandise trade data. Thus, there will be statistical differences when comparing, for example, Canada's data for trade with the United States and the United State's data for trade with Canada. Section 7 represents international merchandise trade for each country, excluding trade with the other North American countries. Sections 8, 9 and 10 provide data on domestic, North American and international passenger travel. Section 9 presents a picture of North American travel with information about the type of travel

(overnight versus same-day), mode of transportation used and trip purpose. Section 10 provides data on international passenger travel between North America and the rest of the world. Section 11 concentrates on transportation infrastructure, and its use in each country. Section 12, Transportation Vehicles, provides a detailed inventory of transportation vehicles and equipment and summarizes domestic movements, in terms of vehicle-kilometers, by mode.

5.2 North American Transportation Statistics Online Database

As more and more statistical agencies started making their data available on the internet, members of the NATS Interchange wanted to make their data available on the internet as well. Because of this desire, the North American Transportation Statistics Online Database was born -- http://nats.sct.gob.mx/nats/. Selected tables (currently 40) were presented online for each of the twelve sections. Data users could choose what language they wanted to review their tables in (Figure 5-3), pick their tables to view (Figure 5-4 and Table 5-5), and export them to excel for further manipulation. In addition to the increased flexibility of the online database, yearly updates to the data were added. Data users now had a broader time series of data for selected tables.

Figure 5-3

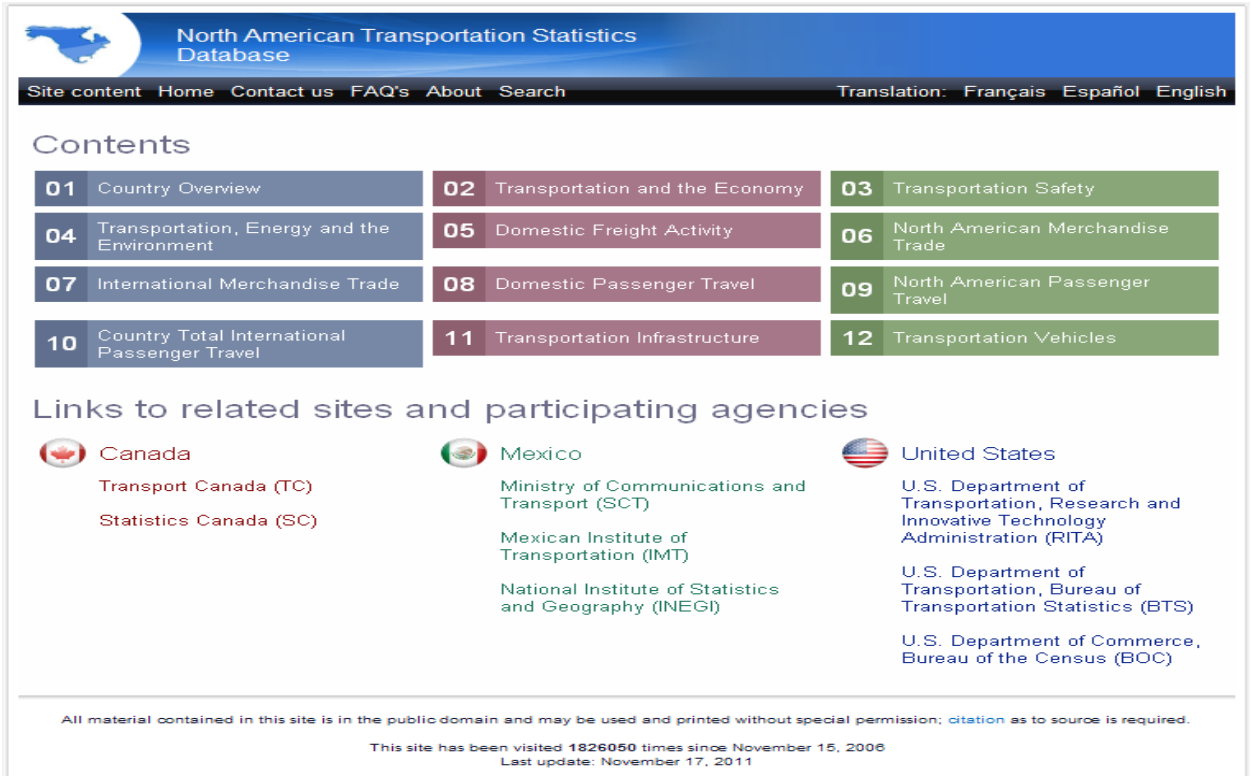


Figure 5-4

Technical documentation | Export to Excel | Print

03 Transportation Safety

Table 3 - 1
Transportation Fatalities by Mode
(Number of people)

Table positioning: horizontal vertical auto

Hierarchies	Canada																Mexico										
	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Fatalities, total	4,222	3,791	3,552	3,484	3,346	3,346	3,228	3,107[r]	3,252[r]	3,099[r]	3,054	3,229	3,187	U	U	U	U	8,822	8,053	8,401	U	10,192	10,721	10,637	10,198	10,048	10,188	9,852
Air	101	117	76	86	94	81	63	65	56	67	44	54	48	48	54[r]	64[r]	61	U	U	72	51	99	56	77	55	34	49	41
Air carriers	30	58	23	23	43	21	18	16	10	15	18	13	20	10	18[r]	33[r]	26	U	U	24	2	42	25	19	0	0	0	0
General aviation	71	59	53	63	51	60	45	49	46	52	26	41	28	38	36[r]	31	35	U	U	48	49	57	31	58	55	34	49	41
Road	3,963	3,313	3,129	3,076	2,919	2,980	2,903	2,756	2,921	2,779	2,731	2,898	2,884	2,761	2,419	2,217[p]	U	8,813	8,005	8,194	U	10,050	10,631	10,487	10,124	9,954	10,052	9,690
Passenger cars and light trucks	2,830	2,511	2,333	2,300	2,140	2,205	2,148	2,049	2,172	2,006	1,942	2,115	2,046	1,933	1,700	1,521[p]	U	1,597	1,641	1,721	U	3,392	3,633	3,332	3,259	3,457	3,706	3,239
Passenger cars	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	1,141	813	823	U	3,278	3,463	3,206	3,126	3,329	3,586	3,024
Motorcycles	260	166	130	122	166	158	170	155	172	176	198	233	212	225	216	195[p]	U	32	95	95	U	2	12	4	7	8	6	43
Buses	9	6	0	46	4	3	10	6	2	4	6	1	2	18	6	2[p]	U	163	186	188	U	75	72	49	51	47	43	101
Large trucks	108	64	61	69	70	68	81	69	83	92	100	78	90	82	79	70[p]	U	39	86	118	U	129	149	130	123	149	150	275
Pedestrians	584	415	475	408	406	414	372	333	364	382	364	342	376	376	299	311[p]	U	1,388	1,038	1,111	U	1,380	1,612	1,728	1,502	1,412	1,478	1,361
Other	172	151	130	131	133	132	122	144	128	119	121	129	158	127	119	118[p]	U	125	281	151	U	8	47	20	34	17	19	68
Pipeline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	U	U	U	U	U	U	U	U	U	U	U
Rail	103	120	117	109	101	106	88	98[r]	96	79	101	103	95	84	74	71	81	9	48	81	1	15	16	5	7	26	59	40
Grade crossing	48	53	46	32	39	37	34	40[r]	46	28	25[r]	37[r]	28	25[r]	26	19	24	9	48	81	1	15	16	5	7	26	59	40
Railroad	55	67	71	77	62	69	54	58	50	51	76[r]	66[r]	67	59[r]	48	52	57	U	U	U	U	U	U	U	U	U	U	U
Transit, total	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	U	U	U	U	U	U	U	U	U	U
Transit rail	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	U	U	U	U	U	U	U	U	U	U
Water transport	N	241	230	213	232	179	174	188[e]	179[e]	174[e]	178[e]	174[e]	160[p]	U	U	U	U	N	N	54	23	28	18	68	12	34	28	81
Passenger vessels	N	213	206	194	189	158	151	158[e]	162[e]	159[e]	158[e]	159[e]	145[p]	U	U	U	U	N	N	N	N	N	N	N	N	N	N	N
Recreational boats	N	212	205	192	186	157	147	158[e]	157[e]	157[e]	157[e]	157[e]	143[p]	U	U	U	U	N	N	N	N	N	N	N	N	N	N	N
Commercial passenger vessels	7	1	1	2	3	1	4	0	5	2	1	2	2	0	0	0	6	N	N	N	N	N	N	N	N	N	N	N

Figure 5-5

6. Data Visualizations

In addition to making yearly updates to the NATS online database, which is a very complex and time-consuming process. The members of the NATS Interchange have made the decision to try to expand the number of tables in the online database. The most recently added tables were the top gateways for North American trade by mode, greenhouse gas emissions by the transportation sector, and the fuel efficiency of new vehicles. The members of the NATS Interchange have also made the decision to try to add data visualizations to the NATS online database.

Data visualizations are much more than graphical representations of data. They allow the data user to see relationships across the data that are not readily apparent in data tables. In Figure 6-1, the data user can look at the data table and see that New York had 19.9 million people and Chicago had 8.6 million people. With the data visualization below (Figure 6-2) the data user not only sees the magnitude of population, but they also see where the top population centers are on the map. New York is on the east coast and Chicago is in the center of the United States. When the data for Canada and Mexico are graphed on the map below, the user quickly notices that the top population centers in Canada are mostly along the Unites States border and that the United States has more large population centers than the other two countries. These relationships are not as intuitive with only the data tables.

table 1-1c

Top 25 U.S. Population Centers: 1996

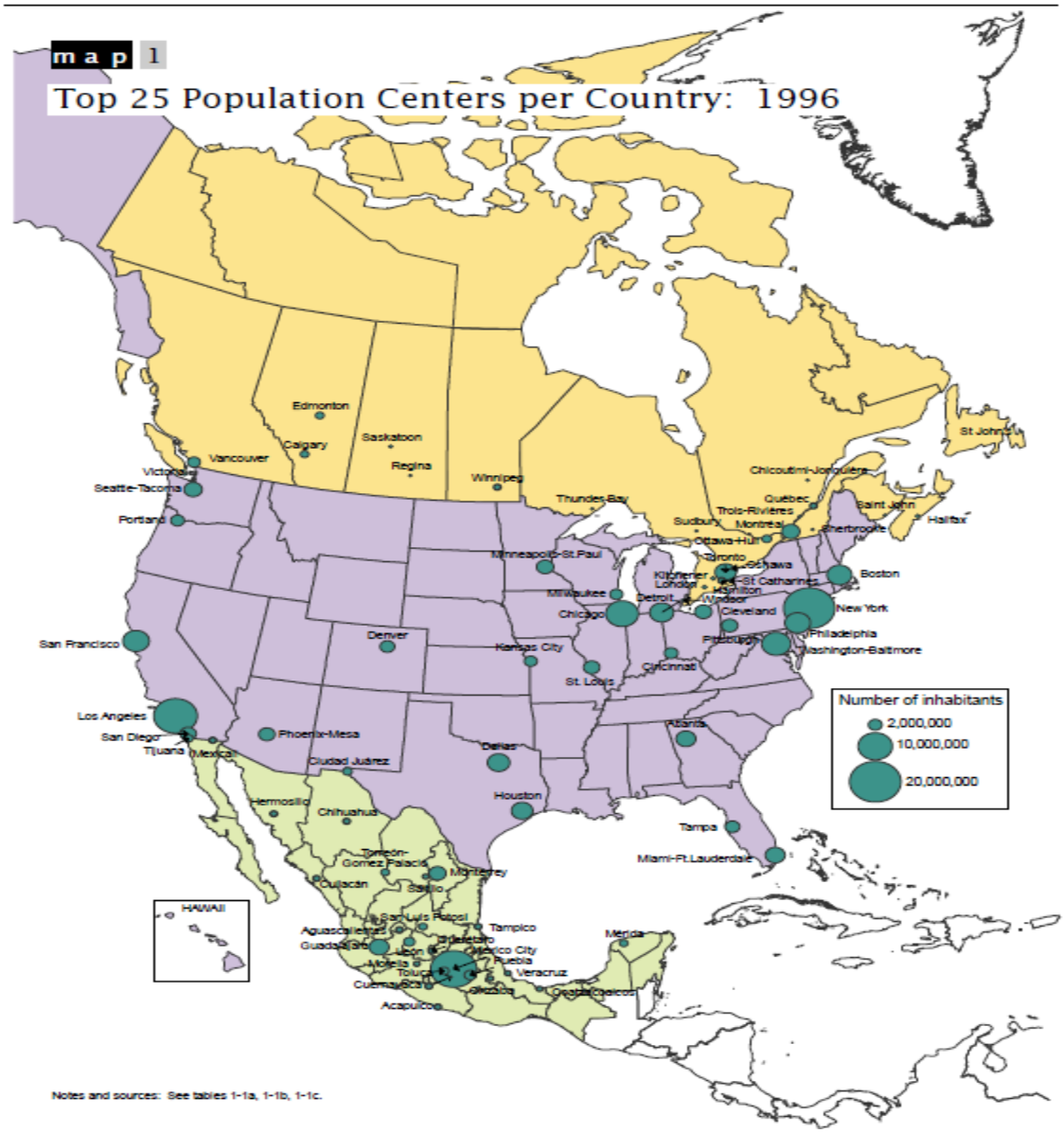
(Thousands)

Metropolitan area	1996	Metropolitan area	1996
New York, NY-NJ-CT-PA (CMSA)	19,938	Minneapolis-St. Paul, MN-WI (MSA)	2,765
Los Angeles, CA (CMSA)	15,495	Phoenix-Mesa, AZ (MSA)	2,747
Chicago, IL-IN-WI (CMSA)	8,600	San Diego, CA (MSA)	2,655
Washington-Baltimore, DC-MD-VA-WV (CMSA)	7,165	St. Louis, MO-IL (MSA)	2,548
San Francisco-Oakland, CA (CMSA)	6,605	Pittsburgh, PA (MSA)	2,747
Philadelphia, PA-NJ-DE-MD (CMSA)	5,973	Denver, CO (CMSA)	2,277
Boston, MA-NH-ME-CT (CMSA)	5,563	Tampa, FL (MSA)	2,199
Detroit, MI (CMSA)	5,284	Portland, OR-WA (CMSA)	2,078
Dallas-Ft. Worth, TX (CMSA)	4,575	Cincinnati, OH-KY-IN (CMSA)	1,921
Houston, TX (CMSA)	4,253	Kansas City, MO-KS (MSA)	1,690
Atlanta, GA (MSA)	3,541	Milwaukee, WI (CMSA)	1,643
Miami-Ft. Lauderdale, FL (CMSA)	3,514	**Total of top 25**	**122,010**
Seattle-Tacoma, WA (CMSA)	3,321		
Cleveland-Akron, OH (CMSA)	2,913	**Percent of total U.S. population**	**45.9**

NOTE: For definitions and explanations of MSA (metropolitan statistical area) and CMSA (consolidated metropolitan statistical area), see Appendix B.

SOURCE: U.S. Department of Commerce. U.S. Census Bureau. *Statistical Abstract of the United States: 1998.* (Washington, DC: 1998).

Figure 6-1



Sources: Statistics Canada. *Annual Demographics Statistics, Catalogue No. 91-213-XPB.* (Ottawa, Ont.: 1998), ; Instituto Nacional de Estadística, Geografía e Informatica. Dirección General de Contabilidad Nacional, Estudios Socioeconómicos y Precios. *Estadísticas del Medio Ambiente, 1997.* (Aguascalientes, Ags.: 1998). ; U.S. Department of Commerce. U.S. Census Bureau. *Statistical Abstract of the United States: 1998.* (Washington, DC: 1998).

Figure 6-2

In addition to these observations, data visualizations allow users to see complex data from multiple sources in one picture. They allow them to quickly see data relationships that would take a lot of time to see in data tables. An example of this is the U.S. Export/Import Flows By Truck To & From Canada: 2007 data map (Figure 6-3). By identifying tonnage of freight by origin, and destination, where origins and destinations are states and metropolitan areas in the United States, and mapping these data onto the nation's highways. The user quickly sees where the major points of entry are into Canada and

where those flows come from. The NATS committees are currently working on making this map connect trough the three countries, and adding commodity type and mode information

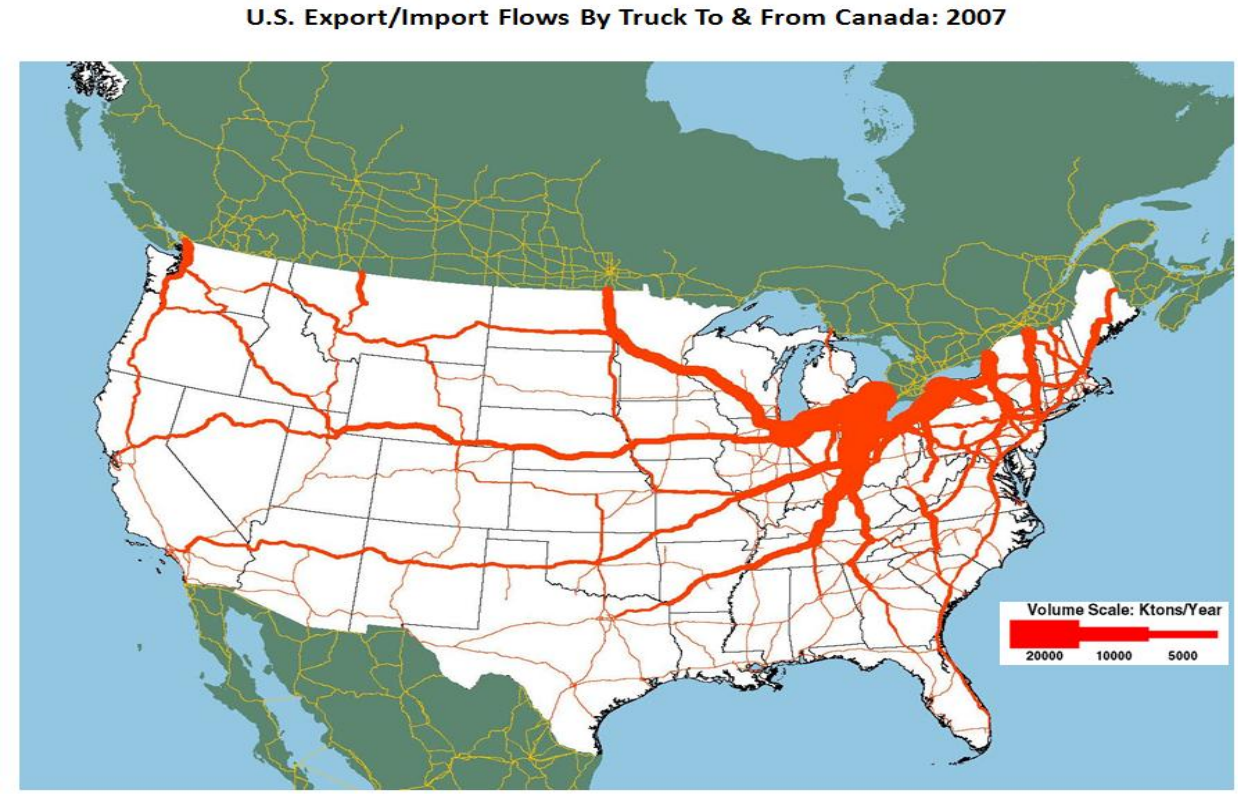


Figure 6-3

7. Conclusion

Given the dynamic needs of data users, the increasing complexity of data sets, and need for good transportation statistics for North America we hope that providing an excellent data tool that incorporates data tables complimented with relevant data visualizations will satisfy these needs. We are hoping the results will be useful data with intuitive data visualizations that assist data users in making good sound decisions.