CONTINENTAL GATEWAY AND TRADE CORRIDOR QUEBEC-ONTARIO: BETTER MULTIMODALITY

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Introduction

The project of the Continental Gateway and Trade Corridor Quebec-Ontario (CGTCQO) is an agreement between the governments of Quebec, Ontario and Canada as well as 46 institutions working in the maritime, air and land in order to develop in this commercial area a multimodal transportation network, secure, efficient and sustainable (Ontario-Quebec Continental Gateway, (2009)). The project was created to solve many problems plaguing the network, especially congestion problems, mainly existing in areas centers (Montreal and Toronto), in the borders (especially Detroit-Windsor) and the busiest roads. Through several years, this situation increased wear of the infrastructure and declined security level, especially at the borders and security, especially on roads; the environmental impacts are also considerable in terms of emissions GAS, and quality of life of the population.

To resolve this problematic, we identify some several solutions by applying a Benefit-Cost Analysis (BCA) on the transportation network of the OQCGTC, subsequently, we propose a National Planning (NP) methodology to expose how to determine an optimal solution for balancing the transportation networks of OQCGTC.

In BCA, we do not propose to construct a section of road due to costs associated to this solution, and especially for our interest in solutions that can be achieved in the short term and that can have a rapid return on investment, thus, solutions will be adopted quickly and the transportation system can be improved rapidly.

as a result of BCA, we have proposed a combination of options that seems the most likely to cover all issues affecting the OQCGTC: apply a tax on GHG emitted by trucks and private cars - with a lower rate for the latter -; install Advanced Fleet Management

Systems (AFMS) in all transport fleets (trucks, trains, boats) and in the consolidation and transfer terminal's facilities, with ensuring the integration of all these AFMS together; install a Scan -Truck (a Commercial vehicles operating - CVO) border, starting at the Detroit-Windsor border, the border is the busiest among the five boundaries of the network.

Subsequently, we expose what is a NP and we learn from the use of this methodology in Sweden because of its resemblance to the OQCGTC in some areas (weather, geographic position, existence of concentrated traffic flows in the same area, etc.); then we end by proposing a methodology to implement NP in OQCGTC while detailing the stages of its implementation and at the same time addressing the factors affecting the infrastructure, integrated technology and / or technology to integrate, the economic, political, regulatory and Social aspects.

1. Cost-Benefit Analysis of the CGTCQO

a. The problematic exposition

In CGTCQO commercial area, we find the greatest flow of trade in the country - 70% at least, which participates in more than 60% of GDP in Canada (Transport Canada (2008)); also, 80% of the Canada-US road and rail trade pass through the boarders of CGTCQO (IBI Group, (2008)); in addition, over 60% of Canada's population occupies this area.

On the other hand, the area of CGTCQO is strategically positioned relatively to the international maritime flows because of the existence of the Marine Highway – on Saint-Lawrence river - which link the entire commercial area from the Atlantic to the five lacks of Ontario and Michigan, knowing that shipping is by far the largest type of international freight transport in terms of quantity and it consolidates more and more deliveries in order to stop the least possible.

Therefore, in the area of CGTCQO, there are large international flows of goods circulating in a restricted area; with time, road transportation (of goods and people) has been developed to answer the demand. Due to the continuous growth of the international trade and its speed, some congestion problems were created, especially in central areas: the total annual cost of congestion for the nine major cities of Canada in regard to lost time and fuel consumption is between 2.3 and 3.7 billion USD (Transport Canada; (2008)) and it is expected that congestion continues to grow in the future (Transport Canada (2008)).

the biggest problems plaguing the OQCGTC are the imbalance of multimodality due to the dominance of the truck transportation; the wear of the infrastructure especially in the most used sections of the surface transportation network, hub-and-spokes areas and the terminals facilities; safety and security at borders (65% of Canada-United States trade pass through the boundaries of OQCGTC); increased wait times especially in borders and in the consolidation and transfer terminals; the high emissions of greenhouse gases (GHG) emissions and their impact on quality of life in the commercial area.

To decorticate this problematic, we separated the economical and social problems:

- Economical problems:
  - *Multimodality disequilibrium*: truck dominate the merchandise transport
  - *Wear of infrastructure*: especially on the strategic nodes, due to the high level of truck circulation on the roads – as well as the other transportation vehicles -;
  - *Lack of fluidity, security and boarders safety;*
  - *Expansion of Lead times*: especially at the area centers (Montreal and GTA), the boarders and, mostly, the consolidation and transfer terminals;

- Social problems:
  - *Lack of road safety*: due to the truck-car cohabitation - 71% of fatal accidents in Canada involving a car and / or a truck in 2004 (Statistics Canada 2008);

- *High level of GHG emissions*: 74% of the transportation GHG emissions are due to road transportation (Plan d'action 2008-2012); the effects of this emissions appears in terms of air pollution, respiratory disease among the population, damage to the landscape and global warming acceleration.

The problems plaguing the area of CGTCQO have a major negative impact on the companies supply chains efficiency on several levels (cost of transportation, of inventory, of treatment, etc.), and increases their Total SCM Cost as well. On the other hand, social problems fall directly on the quality of life of the population (high accident rate, air quality, etc.).

b. Aims of the BCA

The specific objectives that we derived from the problematic described above and following this overall objective are as follow:
1. The reduction of congestion in the most affected nodes
2. Enhance distribution of demand between all modes of transport
3. Reduce GHG emissions
4. Enhance security on the transport network
5. Enhance safety on the transport network

c. Baseline scenario

Like baseline scenario, we propose to redirect the trucks circulation from the road sections that are suffering from congestion problem to other road sections that will be affected only to trucks, with being focus, during the detection of the other road sections, on the optimization of the ride.

d. Determining options

The following table summarizes the 4 options that we consider most relevant to the actual situation that the transport network in the area of CGTCQO is facing:

Table 1: options determined for the CGTCQO area during the BCA

Option	Description	BCA aims
1-Tax policy on trucks and personal vehicles	Set up a law that dictates to the trucking companies to pay a rebate related to the number of Kg of GAS issued;	1; 2; 3; 4; 5.
	Apply at the same time the same law on personal vehicle, but with a lower rate;	
2-Accelerating the transfer of freight between boats/trains/trucks at the consolidation and transfer terminals	Implement an integrated Advanced Fleet Management System – AFMS in terminals, boats, trains et trucks;	1; 2; 3; 4; 5.
	Update the transfer facilities train/truck	
	Standardize loading units	
3-Install an STI at borders targeting non-stop trucks	Install an STI that scans moving trucks (Truck-Scan)	1; 4; 3; 5
4- Establish a Short Sea Shipping (SSS) in the CGTCQO area	Establish a fleet adaptable to SSS	1; 2; 3; 4; 5
	Arrange facilities of central and regional to SSS	
	Allow reliable access to the fleet during the winter.	
	Equip the fleet with an AFMS	
	Easing regulations on SSS	

The options are autonomous and the reference period of time to apply the options is at maximum 17 years[1].

e. Organizing options

Option 1: Tax policy on trucks and personal vehicles: the system of taxation of GHG issued by road transport is proposed by the European Commission to be implemented by 2012 (Commission of the European Communities (2007)) and is already implemented in London, Australia and Germany (Blauwens, and al. (2006)). Also, emissions of GHGs from private cars in Canada are more important than those from trucks (Baldwin JR, Gu W. (2008)), that is why we propose to include the individual costs of GHG emissions related to personal cars; this strategy - the taxation of private transport of people - is part of short-term plans of the European Union (European Commission (2001)).

Option 2: Accelerating the transfer of freight between boats/trains/trucks at the consolidation and transfer terminals: Among others, we propose to normalize the loading units (containers, pallets and trailers); this has already been proposed by the European Union. We also propose to install an AFMS, which is a control system that provides, among others, better automation of fleets and real-time coordination of vehicle loads (Architecture Development Team, (2007)).

Option 3: Install an ITS at borders targeting non-stop trucks: it's a Commercial Vehicle Operations (CVO). Briefly, two devices (for screening and for satellite transmission) will be installed at the motorway crossing of the truck at the border; also, trucks must be equipped with a communication device compatible with those present in the border (The ITS/CVO community (2008)). This ITS is already in use in Australia (Reid, Myers (1996)) and the United States, only stations check the weight. We propose to start by the

[1] Transport Canada should respect this duration (Gaudreault Valérie., Lemire Patrick, (2006)).

Detroit-Windsor border because it's the busiest among the five boundaries of the CGTCQO network.

Option 4: Establish a Short Sea Shipping (SSS) in the CGTCQO area: The SSS is already well established in Europe (Working Group "Accessibility" (2006)), in western Canada (British Columbia) and begins to emerge in the PCCCQO (Quebec Maritime Day (2009)).

Options 1 and 2 are combined in option A, to be known as "distribution of demand between boat / truck / train": the combination of these two options is encouraged in the literature, because with a fee between 10% and 20% on GHG emissions in road transport and, simultaneously, a decrease of half a day in lead times for rail, multimodality between the two modes is significantly promoted (Blauwens, and al. (2006)). Moreover, among the variables that determine the integration of seaport container terminals in supply chains are using the latest information and communication systems in the industry, the reliability of multimodal operations, adoption of services to the needs of consumers and identification of the least expensive option for transporting goods to hinterland destinations (Panayides, PM and DW Song (2008)); elements of this option meets these criteria by normalizing the loading units and by installing an AFMS in the consolidation terminals that helps in the distribution of demand between rail / truck.

Option 3 will be named option B
Option 4 will be named option C

f. Costs of options

Option A: distribution of demand between boat / truck / train:

- *Cost of establishment of a tax on GHG emissions:* in terms of meeting and discussions, visibility of the Act, monitoring of its implementation, staff training for measurement and inspection of gas emissions emitted by trucks, companions of awareness and accountability of the individual. (Costs supported by the governments of Canada, Quebec and Ontario).

- *Cost of standardization of loading units*: in terms of planning and implementation of the standards, modernizing obsolete or non-compliant items (Costs supported by the three governments and the owners of the lading units)
- *Cost of modernizing facilities of consolidation and transfer terminals:* cost of updating and acquiring facilities dealing with the movement of goods between the three modes (Costs are assumed by the three governments and by shipping lines, road and rail companies)
- *Costs of installing an AFMS in the terminals and the fleets of the three modes of transportation (*costs are supported by the three governments and the transportation companies concerned)

Option B: Install an STI at borders targeting non-stop trucks:

- *Costs of governmental implication in international negotiations:* in terms of negotiating, with the United States the possibility of installing the Truck-Scan in the five CGTCQO borders, starting by Detroit-Windsor (Costs supported by the three governments, Canada, Ontario and Quebec and by the USA government if the collaboration implicates a financial of southern neighbour)
- *Cost of installation of screening devices and satellite transmission border* (Costs assumed by the governments of Canada, Ontario and Quebec and neighbouring states where the device is installed)
- *Cost of installing the device in screening trucks* (Costs supported by the governments of Canada, Ontario and Quebec and by the trucking companies)

Option C: Establish a Short Sea Shipping (SSS) in the CGTCQO area:

- *Costs of government involvement*: in terms of financial support to major investments in the SSS, negotiation of reducing regulations that impede the development of maritime transport, adaptation of terminal facilities at central and regional SSS, addition of significant ice-breakers on the marine highway (Costs assumed by the three governments)
- *Costs related to the maritime fleet*: the costs of adapting existing vessels and acquisition of new ones which are fast and reliable

(Costs are supported by the shipping companies and the three governments)

- *Cost of establishment of the AFMS in the fleet* (Costs supported by the governments of Canada, Ontario and Quebec).

While calculating the costs of options, the discount rate should consider the variation of the Canadian dollar due to the 2007 recession.

g. Benefits of options

In the table 2, we present the benefits of each option proposed above:

Table 2: benefits of the options proposed for the BCA:

option	***Security & safety***	***Transportation efficiency & productivity gains***	***Environmental impact***
A	**Fewer road accidents** **Under-faulty goods**	**Multimodality enhancement (Train/ truck)** **Decrease wear of the infrastructure** **Increased flow rail** **Decrease in lead times at terminals** **Increased use of transit**	**Significant reduction of GHG emissions**
B	**Less risk of terrorism** **Over-delivery reliability**	**Reduced lead times at borders**	**relative reduction of GHG emissions**

C	**More safety (AFMS)**	**Multimodality enhancement (SSS/train/truck)** **Increased activities of regional ports**	**Significant reduction of GHG emissions**

h. Analyse and presentation of results

The baseline scenario requires change the paths of all journeys, what have a direct effect on Just-In-Time (timeliness of delivery); at short term, it's difficult to ensure a secure way to separate trucks and cars with forecasting all the impact of change of road transportation paths. Option B, while involving less investments comparatively to options A and C, it's has less advantages. Option C depends on the relaxation of the cabotage acts (for example, marine fee for international vessels) and the presence of consensus between industry and providers of SSS, while the vast majority of industries are not yet receptive to adopting this type of transport.
We choose option A - distribution of demand between boat / truck / train, because it's the option that respond the most effectively to the objectives of the study its actions are solving the maximum of the most urgent and important problems, while offering advantages early and involving limited investment.

2. Structure of National Planning (NP) methodology

During this step of the study, we try to describe how the transportation system of the CGTCQO could be well managed by installing a National Planning (NP) system that handle the transportation system by calculating continuously the optimum solutions to all the problems of the area; the options that we proposed during the BCA above have to be considered during the calculations.

NP develops a comprehensive, rigorous and thorough vision for the transportation problem of a region, a country or a group of countries; it is an analytical tool that address, at the same time, the factors affecting the infrastructure, technologies and the economical, political, regulatory and social aspects. Any NP follows 4 steps: demand modeling, supply modeling, mode choice and assignment. Several countries have set up a NP system for managing their transportation systems, for example Belgium, Norway, Italy, Brazil, Sweden, etc.(Crainic, Gendreau, Kuncyté (2006)).

Generally, the PN can be transferred from one study area to another with some reservations. For CGTCQO area, the region that most resembles to this area is Sweden. Indeed, both regions have a goods transportation system concentrated in the southern region, have focused international trade in these two areas have intensive trade corridors through which the greatest flow of goods in transit as well as two regions a similar climate. It is possible to learn from the Swedish model to implement a methodology for PN in the area of CGTCQO which will be discussed in the following:

Demand modeling: this step begins with the collection of input-output tables and simplification (generation) of data. Follows after the distribution of demand, where we determine the volume of goods passing through each sub-area for each product group (origins-destination. In the area of CGTCQO, we propose to divide the whole area by administrative geographical regions (17 in Quebec and 16 in Ontario) and the provinces of New England in the States United, the eastern provinces of Canada, the other States of the United States and the provinces of Mexico will be distributed by the states and provinces. Thereafter, the distribution of demand will be based on input-output tables available for different ministries (transport, industry, etc.). In Sweden, the model used at this level is the entropy. The latter is considered as a snapshot of data, however, this is the case for other most popular models (gravity and spatial equilibrium); so we propose to rely on the same model, entropy.

Supply modeling: this step provides matrix gathering information on different modes of transportation (all infrastructure and services relates to goods transportation from one point of origin to a destination point) that exist in the study area but without associating the flows with the product groups indentified earlier in the application. In the area of CGTCQO, we propose to gather all information about infrastructure of all transportation modes, carriers, shippers, intermodal transfer facilities, logistics services providers. To do so, we suggest first to apply to the associations of stakeholders mentioned above. This data set will develop an integrated matrix on the flows of goods.

Mode choice: this step involves gathering data (provided by the demand modeling, the supply demand, found in industrial and strategic studies - such as Cost Benefit Analysis (CBA) - etc.) to create a matrix that provided all information about the behaviour of the commodity in the network (the set of nodes, links, modes and transfers that represent every possible physical movement of goods over the available infrastructure in the area). The network of supply and all key measures to use during the assignment step must be clearly identified at this step (congested road sections, its intensity, its frequency, lead times in terminals, etc.). Also, the BCA is often devoting a high optimism when calculating costs and benefits. We therefore propose to integrate data of the BCA applied on CGTCQO area in this step to ensure the validity of the options and the choice of option A (distribution of demand between boat / truck / train). For the model to apply Sweden has used the “assignment on multimodal networks” which is a recognized modal for its capacity to expose the overall behaviour of the transport system (Crainic, Gendreau, Kuncyté (2006)), so we propose to use the same modal.

Assignment: Once the origin-destination matrices are created, they are affected to the network of supply by using a mechanism of trip choice. This step determines the routes for each product by mode of transport and by sub-area, focusing on the most optimal trips in terms of cost, travel time and all the economic, political, technological and social implications that we had consider in the study. At this step, Sweden has used an optimization model system that can explain the overall behaviour of the transport system in the area which is in study and simultaneously be flexible enough to provide different results depending on multiple scenarios to consider; this system is an optimization model nonlinear that considerate at the same calculation multiple modes of transportation and multiple products. We propose to use at the CGTCQO the optimization model system used by Sweden at this stage.

Feed-back: at this step, the government deliver the information about the optimal trips to the shippers, carriers and all the institutions that will be implicated in these trips choices; also, the operators evaluate continuously the reliability of these trips and of the new devices included in the transportation system. For the CGTCQO, after implementing the NP system and the recommended actions in option A, it will be possible to verify the reliability of the Truck-Scan and AFMS installations.

References

Adam J., Bergeron. M., 2008, Vocabulaire des Systèmes de Transport Intelligents. Gouvernement du Québec. ISBN 978-2-550-52829-6.

Architecture Development Team; 2007; Executive Summary-National ITS Architecture, Research and Innovation Technology Administration (RITA) ; US Department of Transportation ; Washington D.C.

Baldwin J. R., Gu W.; 2008; « Impartition et délocalisation au Canada ». Statistiques Canada. Division de l'analyse microéconomique. 18-F, Immeuble R.-H.-Coats, 100, promenade Tunney's Pasture No 11F0027M au catalogue — No 055 ISSN 1703-0412. ISBN 978-0-662-08980-3.

Blauwens, G., N. Vandaele, E. Van de Voorde, B. Vernimmen et F Witlox; 2006; «Towards a Modal Shift in Freight Transport? A Business Logistics Analysis of Some Policy Measures», Transport Reviews, vol. 26, no 2, p. 239-25.

Commission of the European Communities; 2007; Freight Transport Logistics Action Plan – Impact Assesssement; European Commission, Brusselss.

Coyle, J.J., E.W. Bardi et R.A. Novack ; 2006 ; Transportation, 6e éd., Thompson.

Crainic, T.G., Florian, M. ; 2008; ‘ National Planning Models and Instruments’, INFOR 46- CIRRELT-2008-20.

Crainic T. G., Gendreau M., Kuncyté R.; 2006; « Prototypage d’une enquête - chargeur sur les flux de déplacements de marchandises au Québec », Centre de Recherche en Transports. C7PQMRPO2006-05-X.

Ontario-Quebec Continental Gateway, 2009; on line: http://www.continentalgateway.ca/about.html

Commission européenne; 2001; Livre blanc : La Politique européenne des transports à l’horizon 2010 : l’heure des choix. Commission européenne. ISBN 92-894-0342-X.

Gaudreault Valérie., Lemire Patrick ; 2006 ; L’âge de l’infrastructure publique au Canada, Statistique Canada, No 11-621-MIF au, catalogue — No 035, ISSN: 1707-0511, ISBN: 0-662-71059-2.

Groupe De Travail « Accessibilité »; 2006; « L’intermodalité Dans Le Transport De Marchandises : Ports Et Hinterlands, Transport Maritime, Y Compris Celui A Courte Distance; Réseau Transnational Atlantique Des Partenaires Économiques Et Sociaux.

Groupe IBI; 2008; « Étude sur le Corridor de Commerce Saint-Laurent Grands Lacs »; Réalisée pour le conseil du Corridor de Commerce Saint-Laurent Grands Lacs.

Journée Maritime Québécoise; 2009; « Le Saint Laurent, le Corridor de l’Avenir »; le 27 octobre 2009.

Integrated Corridor Management - Concept Development and Foundational Research ; Phase 1 – Concept Development and Foundational Research ; Task 3.1 – Develop Alternative Definitions; April 11, 2006 ; Prepared for United States Department of Transportation ; ITS Joint Program Office ; FHWA ; FTA ; FHWA-JPO-06.

Panayides, P.M. et D-W Song; 2008; «Evaluating the integration of seaport container terminals in supply chains», International Journal of Physical Distribution and Logistics Management, vol. 38, no 7, p. 562-584.

Reid, Myers; 1996; WRP, cité dans Crainic T. G., Gendreau M., Potvin J-Y., Intelligent Freight Transportation Systems: Assessment and the Contribution of Operations Research, 2008. CIRRELT-2008-40.

The ITS/CVO community; 2008; Introductory Guide to CVISN; FMCSA; Washington. On ligne : http://www.fmcsa.dot.gov/documents/cvisn/deployment/IntroductoryGuide2008-12-30r1.pdf

Transport Canada ; 2008 ; Estimations de la totalité des coûts du transport au Canada; la Direction générale de l'analyse économique de Transports Canada; ISBN 978-0-662-04233-4.

Transport Canada, 1994 ; guide to Benefit-Cost Analysis in Transport Canada ; Transport Canada ; On ligne : http://www.tc.gc.ca/eng/corporate-services/finance-menu.htm