Transport Canada Transports Canada

Performance Measurement and Total Logistics Costs

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Canada

Agenda

- Measurement of transportation performance
- The Total Logistics Cost approach and model
- Demonstration – alternative routings
- Demonstration – Indexing TLC
- Practical issues and challenges
- Future research

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Rationale

- This transportation system is increasingly concentrated in a few geographic zones - "gateways" - connected to major markets by "corridors". Efficient intermodal transportation gateways and corridors are essential to Canada's continued success in international commerce and its future prosperity.
- Measurement is important for both looking back and looking ahead.

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Transportation Performance Measurement Today

- Price indices
- TFP
- Service performance surveys
- National logistics cost percentage
- World Bank Logistics Performance Index

- Total Logistics Cost Metric

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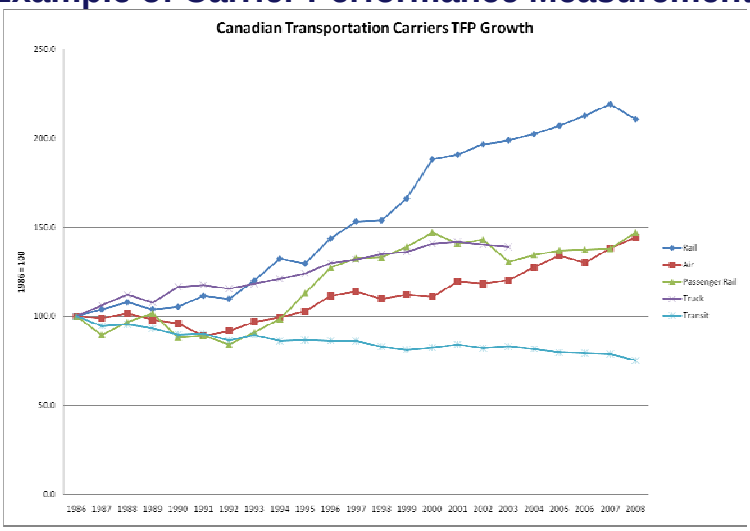
Example of Carrier Performance Measurement



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Why a Total Logistics Cost (TLC) Performance Metric?

- What's better?
  - Rail at $7 per ton, 14 days, 75% on time
  - Truck at $12 per ton, 6 days, 85% on time
- TLC weights multiple performance criteria
- TLC recognizes total cost tradeoffs

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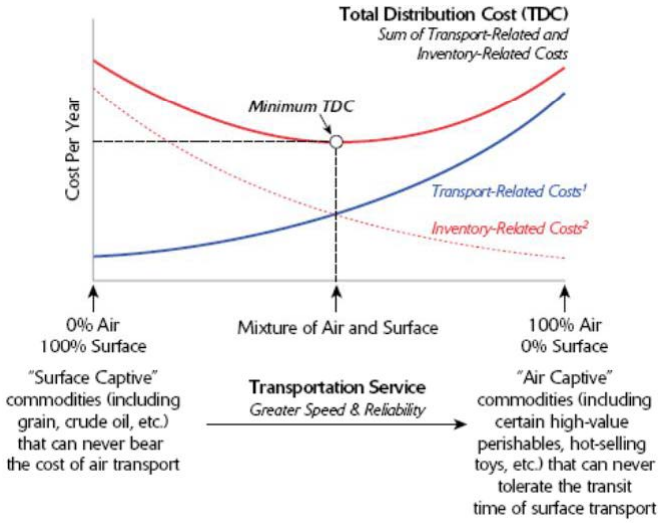
Total Logistics Cost Application Applied to Competitiveness of Alternative Transportation Services



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Principle

- Shippers ultimately choose a specific service – offered by a specific logistics service supplier which uses a specific combination of modes - offered over a specific route,
- which is defined by specific links and nodes where a link is a specific transportation corridor and a node can be a gateway or hub.

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Commodity and Shipment Characteristics Relevant to Total Logistics Cost

- origin and destination
- shipment size
- annual volume
- demand per period of time
- unit value
- required service level (product availability)
- density
- perishability (shelf life)
- fragility
- packaging and handling characteristics
- stock out cost
- obsolescence cost

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Transportation Alternative Characteristics Relevant to Total Logistics Cost

- rate per unit for transportation between a unique origin and destination
- transit time between a unique origin and destination
- variability of transit times
- minimum shipping quantity for rate and service levels defined
- damage rates
- other charges

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Transit Time Data Sources

- Shippers often do not have or are unable to share transit time data, though they have knowledge of commodity characteristics
- Transport Canada Fluidity/Reliability project provides carrier transit time data
- Transit times and transit time volatility can be estimated for multimodal shipments using a Monte Carlo simulation
- Nature of carrier data also results in a modular approach (many trade lanes can be simulated with each additional link)
- Third party sources will be used for end to end transit times of container shipments (or at least port to rail yard or DC), container numbers can be obtained from shippers (if willing)
- These two latter sources are now being explored as data sources in place of shipper data

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Example of Linking Carrier Data

Link 1		Link 2		Link 3	
Cumulative probability	days	Cumulative probability	days	Cumulative probability	days
0	9	0	0.5	0	2
0.1	10	0.1	0.6	0.1	2.2
0.2	10.5	0.2	0.7	0.2	2.5
0.3	11	0.3	0.8	0.3	2.7
0.4	11.5	0.4	0.9	0.4	3
0.5	12	0.5	1	0.5	3.3
0.6	12.5	0.6	1.2	0.6	3.8
0.7	13	0.7	1.4	0.7	4
0.8	14	0.8	1.8	0.8	5
0.9	16	0.9	2	0.9	7
Average	12.0	Average	1.1	Average	3.6
StDev	2.0	StDev	0.5	StDev	1.5

Linked Results

Average	Standard Deviation
16.57	2.48

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Total Logistics Cost Components in Model

Total Logistics Cost =
Direct Transportation Cost +
In Transit Carrying Cost +
Ordering Cost +
Cycle Stock Carrying Cost +
Safety Stock Carrying Cost +
Other costs

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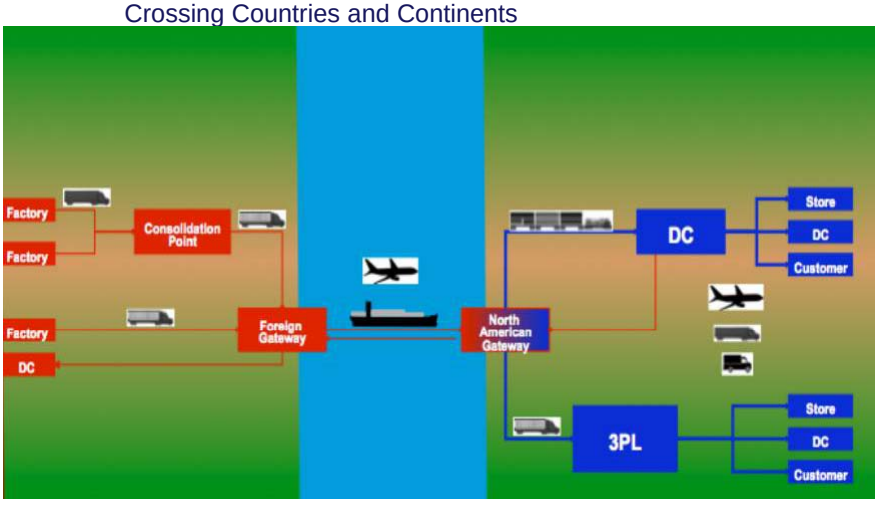
Global Supply Chain

Door to Door – Multimodal – Multiple Participants/Functions
Crossing Countries and Continents



Garland Chow, Sauder School of Business, May 2010

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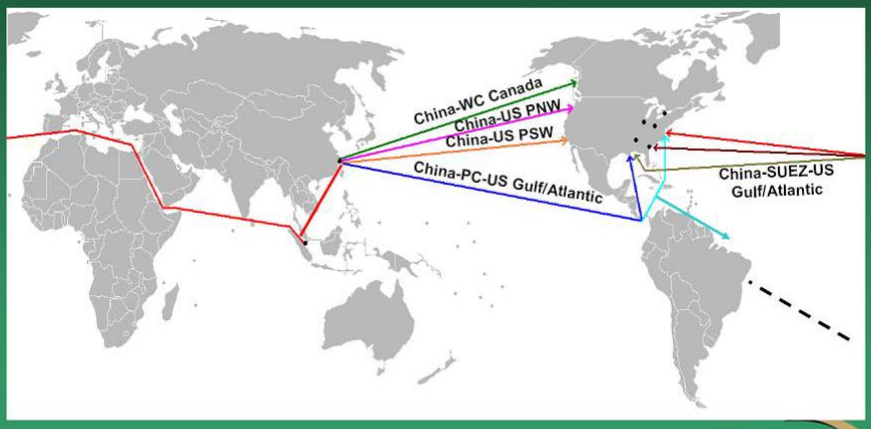
There are multiple options for Asia (China)-North American container trades

Asia-Americas Routing Options



Norbridge

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Your Off Shore Alternative is Shanghai
What's the Total Logistics Cost of Competing Gateways?

- Shanghai to Chicago trade lane
- Alternative gateway routings are:
  - Via Vancouver
  - Via Los Angeles/Long Beach
  - Via Lazaro Cardenas
  - Via Norfolk and Panama Canal
- Marine-rail

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Apparel

- Value – $17.50 per lbs.
- Annual demand – 540,000 lbs.
- Standard deviation of demand per day – 5 lbs
- Density of product – 300kg/M3
- Service requirement – max. 5% stock out during lead time goal (95% in stock rate)
- Inventory carrying cost – 25%
- Inventory carrying cost in transit – 15%
- Stock out cost – $.10 per lbs.

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Ocean Transportation Characteristics

From Shanghai to	Vancouver	LA/LB	Norfolk	Lazaro
Distance (Nautical Miles)	5,103	5,724	10,141	7,004
Rate / Lbs	$0.073	$0.073	$0.13	$0.073
Transit Time (days)	11	10	24	16
Reliability (days)	1.65	1.5	3.6	2.4

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Rail Transportation Characteristics

From Shanghai to	Vancouver	LA/LB	Norfolk	Lazaro
Distance (Estimated)	3,540 KM	3269.48 KM	1430.40 KM	3,181 KM
Rate / Lbs	$0.072	$0.069	$0.040	$0.077
Transit Time (days)	5.4	4.5	3.7	7
Reliability (days)	2.43	2.025	1.66	3.5

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Port Transportation Characteristics

	Vancouver	LA/LB	Norfolk	Lazaro
Rate / Lbs	$0.021	$0.026	$0.023	$0.016
Transit Time (days)	1.86	2.75	0.70	0.40
Reliability (days)	0.49	1.32	0.23	0.08
Container Dwell Time (Vessel Discharge to rail car loading in Days)	4	4	4	5

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Door to Door Transit Time Performance Rail + Port + Marine (Days)

	Vancouver	LA/LB	Norfolk	Lazaro
Ocean Shipping	11	10	24	16
Port Terminal	5.86	6.75	4.7	5.4
Rail Haul	5.4	4.5	3.7	7
Total	**22.26**	**21.25**	**32.4**	**28.4**

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Door to Door Transit Time Reliability Rail + Port + Marine (Days)

	Vancouver	LA/LB	Norfolk	Lazaro
Ocean Shipping	1.65	1.5	3.6	2.4
Port Terminal	0.49	1.32	0.23	0.08
Rail Haul	2.43	2.025	1.66	3.5
Total	**2.98**	**2.84**	**3.97**	**4.24**

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Door to Door Transportation Rate
Rail + Port + Marine ($/lb.)

	Vancouver	LA/LB	Norfolk	Lazaro
Ocean Shipping	$0.073	$0.073	$0.13	$0.073
Port Terminal	$0.021	$0.026	$0.023	$0.016
Rail Haul	$0.072	$0.069	$0.040	$0.077
Total	**$.1661**	**$.1677**	**$.1900**	**$.1662**

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Shanghai – Chicago Input Data
Marine - Rail

		Via Gateway			
Variables	Description	VC	LA / LB	Norfolk	Lazaro
C	Value of Commodity (Lbs)	$17.50	$17.50	$17.50	$17.50
U	In-transit Inventory cost	15%	15%	15%	15%
I	Standing Inventory cost	25%	25%	25%	25%
K	Stockout Cost (Lbs)	$.10	$.10	$.10	$.10
S	Order Processing Cost ($/order)	$50.00	$50.00	$50.00	$50.00
D	Annual Demand (Lbs)	540,000	540,000	540,000	540,000
L	Customer Service Level	95%	95%	95%	95%
R	Transportation Rate ($/Lbs)	$.1661	$.1677	$.1900	.$1662
T	Transit Time (Days)	22.26	21.25	32.4	28.40
V	Transit Variability (Days)	2.98	2.84	3.97	4.24
Q	Minimum Shipment size required to use rate	5000	5000	5000	5000

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Total Logistics Cost Comparisons

		Via Gateway			
Variables	Descriptions	VC	LA / LB	Norfolk	Lazaro
EOQ	Economic Order Quantity (Lbs)	3,496.69	3,496.53	3,494.32	3,496.68
Q(Lbs)	Minimum Shipment Size (Lbs)	5000	5000	5000	5000
Qa	Actual Order Quantity (Lbs)	3,496.69	3496.53	3,494.32	3,496.68
Ds	Standard Deviation of Demand Over Transit Time (Lbs)	4,408.83	4,201.71	5,873.49	6,272.93
Z	Z-Value For Service Level	1.64	1.64	1.64	1.640
N(Z)	Unit Loss (from Unit Loss Integrals Table)	0.0211	0.0211	0.0211	0.0211
Ta	Annual Transportation Cost	$89,694.00	$90,558.00	$102,600.00	$89,748.00
Ua	Annual Carrying Cost of In-transit Inventory	$86,448.08	$82,525.68	$125,827.40	$108,895.07
Sa	Annual Order Processing Cost	$7,721.60	$7.721.95	$7,726.82	$7,721.62
Ia	Annual Carrying Cost of Standing Inventory	$7,721.60	$7,721.95	$7,726.82	$7,721,62
SS	Annual Cost of Safety Stock	$32,028.11	$30,526.22	$42,725.94	$45,044.05
Ka	Annual Stockout Cost	$1,436.62	$1,369.19	$1,915.18	$2,044.05
TC	**Total Annual Relevant Cost**	**$225,050.01**	**$220,423.00**	**$288,522.16**	**$261,700.57**

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Shanghai – Chicago – Apparel
Total Logistics Cost via Marine

	Vancouver	LA/LB	Norfolk	Lazaro
Marine to Rail	$225,050.01	$220,423.00	$288,522.16	$261,700.57

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Total Logistics Cost Indices (as percent of sales) – Food Products/Single Trade Lane

Month	Sales	DTC	ITIC	OC	CSCC	SSCC	SOC	NTLC	TLC
Jan-09	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Feb-09	106.4	95.8	68.6	95.1	100.0	9.0	100.0	70.4	89.6
Mar-09	156.3	116.9	68.8	91.1	100.0	5.9	100.0	69.6	105.3
Apr-09	104.3	109.6	72.0	97.6	100.0	40.4	100.0	78.4	102.0
May-09	105.8	103.8	68.3	102.5	100.0	31.2	100.0	75.4	96.9
Jun-09	102.1	108.1	66.7	123.5	100.0	13.6	100.0	71.7	99.2

Sales – Inventory value in $, DTC – Direct Transportation Costs,
ITIC – In-Transit Inventory Cost, OC – Ordering Cost,
CSCC – Cycle Stock Carrying Cost,
SSCC – Safety Stock Carrying Cost, SOC – Stock Out Cost,
NTLC – Non Transportation Logistic Costs (total of all above except for DTC),
TLC – Total Logistics Cost

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Total Logistics Cost Indices (as percent contribution to total) – Food Products/Single Trade Lane

	Transit Time									
Month	Average	Deviation	DTC	ITIC	OC	CSCC	SSCC	SOC	NTLC	TLC
Jan-09	14.7	6.8	75.6	7.2	0.8	7.4	5.4	3.6	24.4	100
Feb-09	10.1	0.6	80.8	5.5	0.8	8.3	0.5	4.0	19.2	100
Mar-09	10.1	0.4	83.9	4.7	0.7	7.1	0.3	3.4	16.1	100
Apr-09	10.6	2.7	81.2	5.1	0.8	7.3	2.2	3.5	18.8	100
May-09	10.0	2.1	81.0	5.1	0.8	7.7	1.8	3.7	19.0	100
Jun-09	9.8	0.9	82.3	4.8	1.0	7.5	0.7	3.6	17.7	100

Sales – Inventory value in $, DTC – Direct Transportation Costs,
ITIC – In-Transit Inventory Cost, OC – Ordering Cost,
CSCC – Cycle Stock Carrying Cost,SSCC – Safety Stock Carrying Cost,
SOC – Stock Out Cost,
NTLC – Non Transportation Logistic Costs (total of all above except for DTC),
TLC – Total Logistics Cost

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Issues and Challenges
Relevant level of aggregation

- Commodity level aggregation
- Lane (O-D) level aggregation
- Shipment size

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Issues and Challenges
Data Availability

- Shipper
- Carriers
- TPLs
- Third Party information sources
- Transit times are the most critical!

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Conclusions

- TLC model and approach appropriate for measuring corridor performance
- Purpose is not to replicate total costs actually incurred
- Purpose is to see trends and make comparisons
- Can be used for monitoring and for strategic analysis

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Conclusions

- No one source can provide all the data for nationwide coverage, may have to use multiple sources
- Different commodity, industry, cargo and mode types may require different models
- Focus on important corridors
- Consider “representative” commodities, shipment sizes and standard services as indicative rather than try to measure everything

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What Next

- Case studies of TLC validity in different commodity environments
- Development of carrier – link/node specific performance data
- Modular approach to utilize independent data
- Evaluate feasibility of large scale implementation in major traffic lanes

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End

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