

A Total Logistics Cost Approach to Measuring Collateral Benefits of Security and Supply Chain Improvements at International Gateways

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Asia-Pacific Gateway and Corridor: International – Domestic and Cross Border Supply Chains



BITSAFS

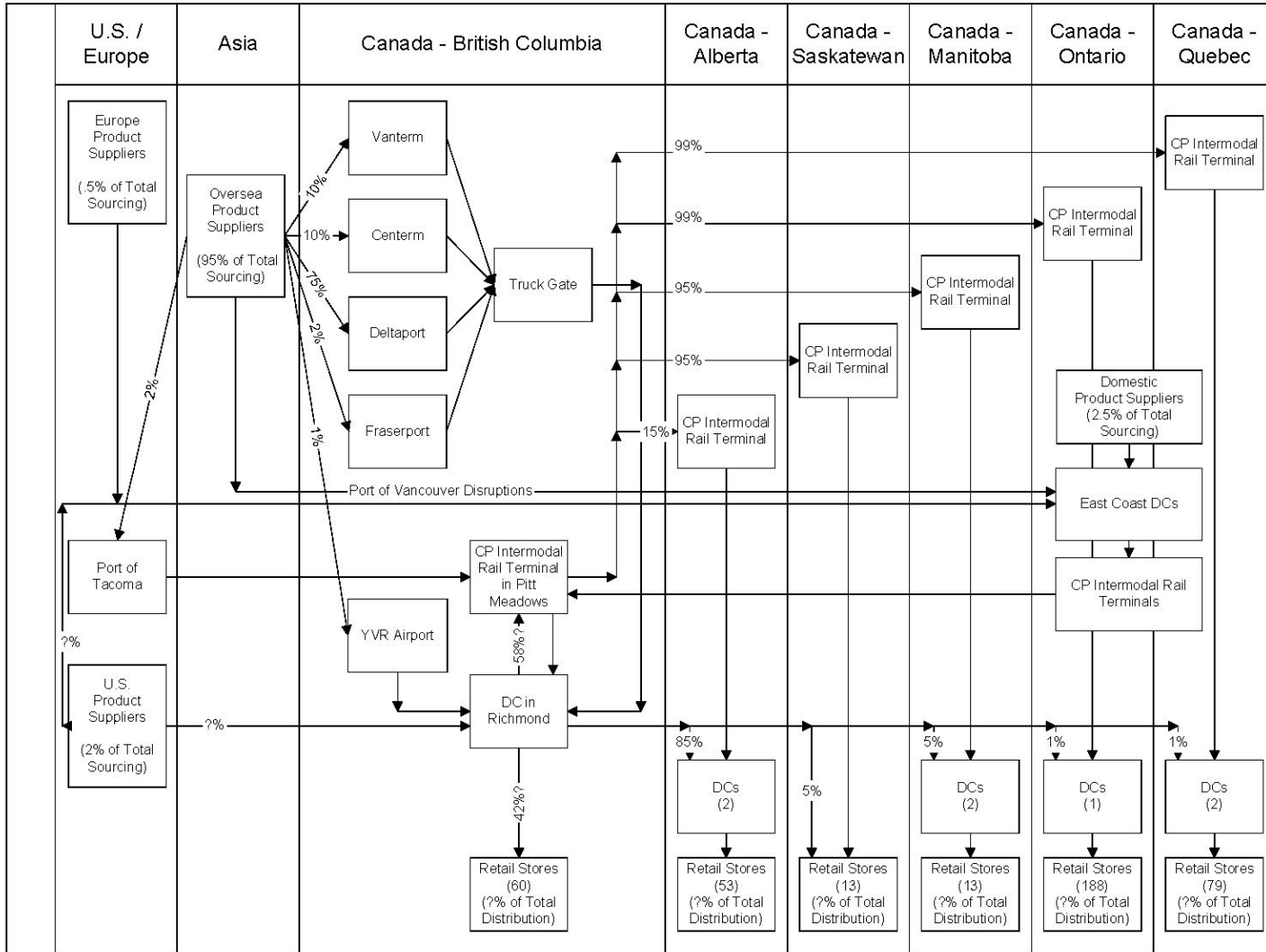
Source: BCMOT 2006



SAUDER
School of Business
University of British Columbia

Case 5: Department Stores #1

Department Stores #1 Supply Chain



Source: BITSAFS; Sauder School of Business, UBC 2006

The Impact of 9/11 on the Supply Chain

- 9/11 Heighten security concerns going across borders
- Probability of substantial disruptions increases
- Increased regulations
- Intensified inspections
- Higher transportation and shipping costs
- More shipping delays
- Supply chain costs and effectiveness
- Impact on trade

Higher Security Barrier into US versus into Canada Impacts Distribution of Trade

- Since 9/11
- No significant export (US to Canada) shortfall forBlaine
- Significant import (Canada to US) shortfall of around 13% for Blaine



Impact of Security on Supply Chain Competition

- Services
- Carriers
- Modes
- Transportation routing
- Gateways and corridors
- International sourcing

The Security Burden

- Mandated direct costs/investment to comply to regulatory programs and fees to government
- Delays, uncertainty, loss in productivity
- Discretionary costs/investment
- Justified by B/C or ROI
- Collateral benefits of security investment

Collateral Benefits of Security Initiatives

- Enhanced asset utilization through greater visibility
- Improved Lead times
- Reduction in safety stock inventory
- Increased efficiency and productivity
- Improved reliability and service
- Enhanced shipment integrity resulting in reduced inspection costs

A Secure Supply Chain Ensures The Integrity Of The Shipment Throughout The Supply Chain

- Not allowing any biological or chemical agent to be introduced to the product.
- Not allowing any illegal commodity to be intermingled with the shipment.
- Not allowing the replacement of the product with an illegal commodity or person.
- Not allowing the shipment to be used as a weapon.

Hasbro Toys

- \$200,000 on its up-front C-TPAT compliance
- additional \$112,500 a year maintaining compliance
- Since C-TPAT certification, inspections dropped from 7.6 percent of containers coming into the U.S. to 0.66 percent
- The company imported about 8,000 containers, and that port authorities charge around \$1,000 per inspection
- Savings of \$550,000 a year in inspection costs alone, approximately a 5- to-1 return rate (Worthen, 2006).

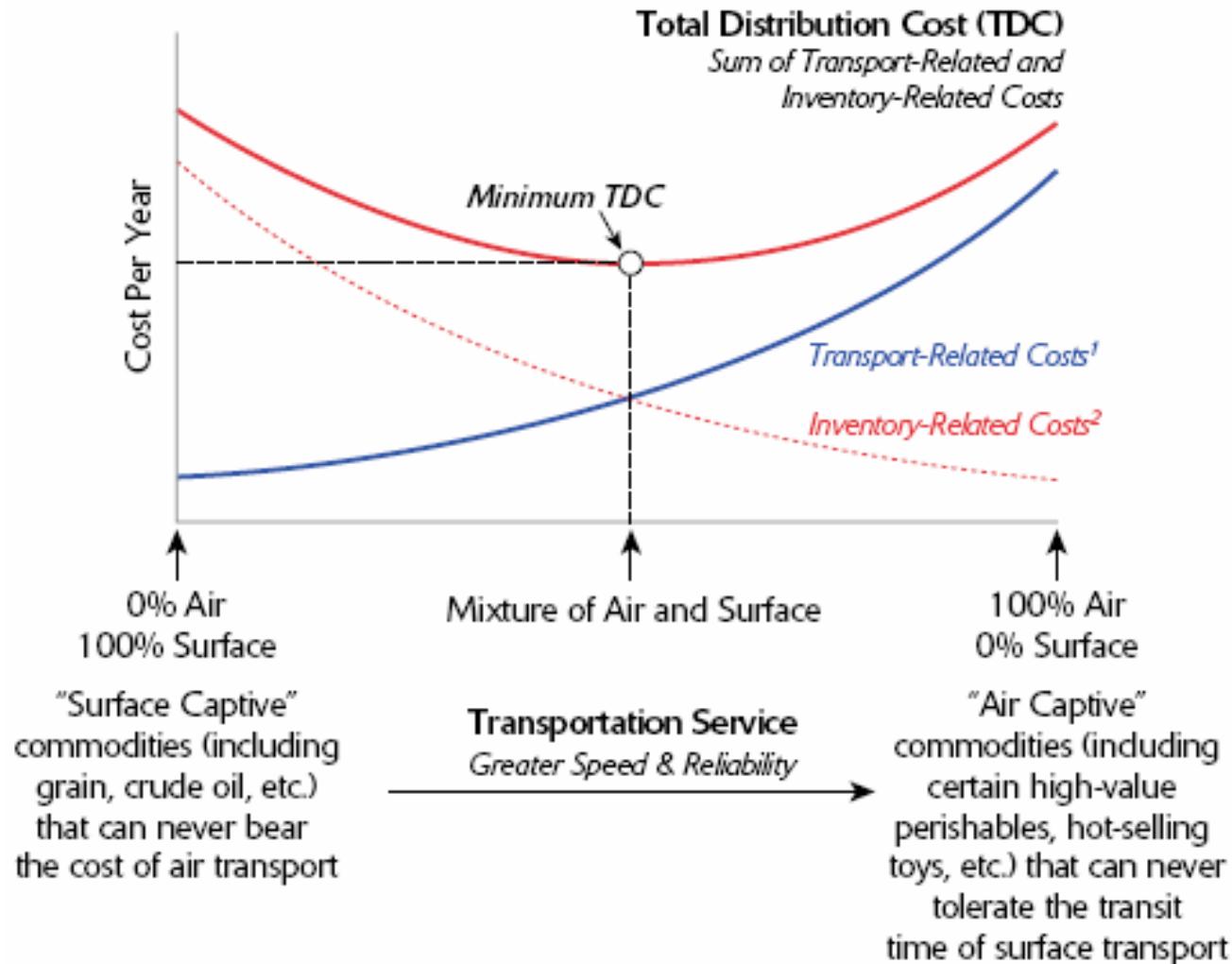
Standford Multiple Case Studies

- higher supply chain visibility by 50 %
- improved supply chain efficiency including increased automated handling of their imports by 43%
- better customer satisfaction through improved on time shipping to customers by 30%
- improved inventory management reducing excess inventory by 14%
- reduced cycle time and shipping time, they saw a 29% reduction in transit times
- cost reduction following above improvements such as:
 - reduced customs inspections by 48%
 - reduced time to identify problems by 21%
 - reduced theft in inventory management by 38%.

How Can We Measure Collateral Benefits?

- Inventory cost impacts are significant
- Total logistics cost approach in logistics decision making
- Inventory-theoretic model used in mode split and demand modeling

Total Logistics Cost Application Applied to Competitiveness of Alternative Transportation Services



Studies using a total logistics cost approach typically account for

- direct transportation costs
- in transit inventory costs
- cost of holding cycle stock inventories
- cost of holding safety stock inventories
- cost of ordering
- stock out costs (penalties for shortages)

Other costs accounted for in some of the studies include

- loading and unloading costs (usually embedded in direct transportation costs)
- shelf life loss (usually included in cost of holding cycle and safety stock costs)
- loss and damage claims and losses
- emergency shipping costs (usually included in stock out costs)

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

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

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

Total Logistics Cost Model

$$\begin{aligned} \text{TLC}(Q, r : T, ST) = & \\ & \text{RD} + \\ & (\text{UCTD}/365) + \\ & (\text{SD}/Q) + (\text{QCI}/2) + \\ & r\text{IC} + \\ & \text{K}(\text{D}/Q) \text{N}(\text{Z})\text{S}^1 \end{aligned}$$

Total Logistics Cost Example

- Shanghai to Toronto trade lane
- Alternative gateway routings are:
 - Via Long Beach
 - Via Vancouver
 - Via Halifax
- Back of the envelop input data

Shanghai – Toronto Input Data

Variables	Descriptions	Gateway		
		VC	LB	HF
C	Value of Commodity (\$/cwt)	400.00	400.00	400.00
U	Carrying Cost of In-transit Inventory (% of value)	15	15	15
I	Carrying Cost of Standing Inventory (% of value)	25	25	25
K	Stockout Cost (\$/cwt)	10.00	10.00	10.00
S	Order Processing Cost (\$/order)	50.00	50.00	50.00
D	Annual Demand (cwt)	5,400	5,400	5,400
L	Customer Service Level (max. % stockouts)	5	5	5
R	Transportation Rate (\$/cwt)	7.00	8.00	6.50
T	Transit Time (days)	23	26	25
V	Delivery Time Variability (days)	10	4	9
Q	Minimum Shipment Size required to use Rate R (lbs.)	45,000	45,000	45,000

Shanghai to Toronto

Total Logistics Cost Comparisons

Variables	Descriptions	Gateway		
		VC	LB	HF
EOQ	Economic Order Quantity (cwt)	72.85	72.76	72.89
Q(cwt)	Minimum Shipment Size (cwt)	450.00	450.00	450.00
Qa	Actual Order Quantity (cwt)	450.00	450.00	450.00
Ds	Standard Deviation of Demand Over Transit Time (cwt)	147.95	59.18	133.15
Z	Z-Value For Customer Service Level (# of Standard Deviations)	1.65	1.65	1.65
N(Z)	Unit Loss (from Unit Loss Integrals Table)	0.02	0.02	0.02
Ta	Annual Transportation Cost (\$)	37,800.00	43,200.00	35,100.00
Ua	Annual Carrying Cost of In-transit Inventory (\$)	20,416.44	23,079.45	22,191.78
Sa	Annual Order Processing Cost (\$)	600.00	600.00	600.00
Ia	Annual Carrying Cost of Standing Inventory (\$)	22,893.75	22,950.00	22,865.63
SS	Annual Cost of Holding Safety Stock (\$)	24,838.15	9,959.67	22,326.87
Ka	Annual Stockout Cost (\$)	366.43	146.57	329.79
TC	Total Annual Relevant Cost (\$)	106,914.77	99,935.70	103,414.07

Sensitivity Analysis – What if?

- A combination of public and private initiatives reduced
- Transit time to 22 days (-1) and transit time variability to 6 days (-4)
- Only variability reduced to 6 days (-4)
- Only transit time reduced to 19 days (-4)

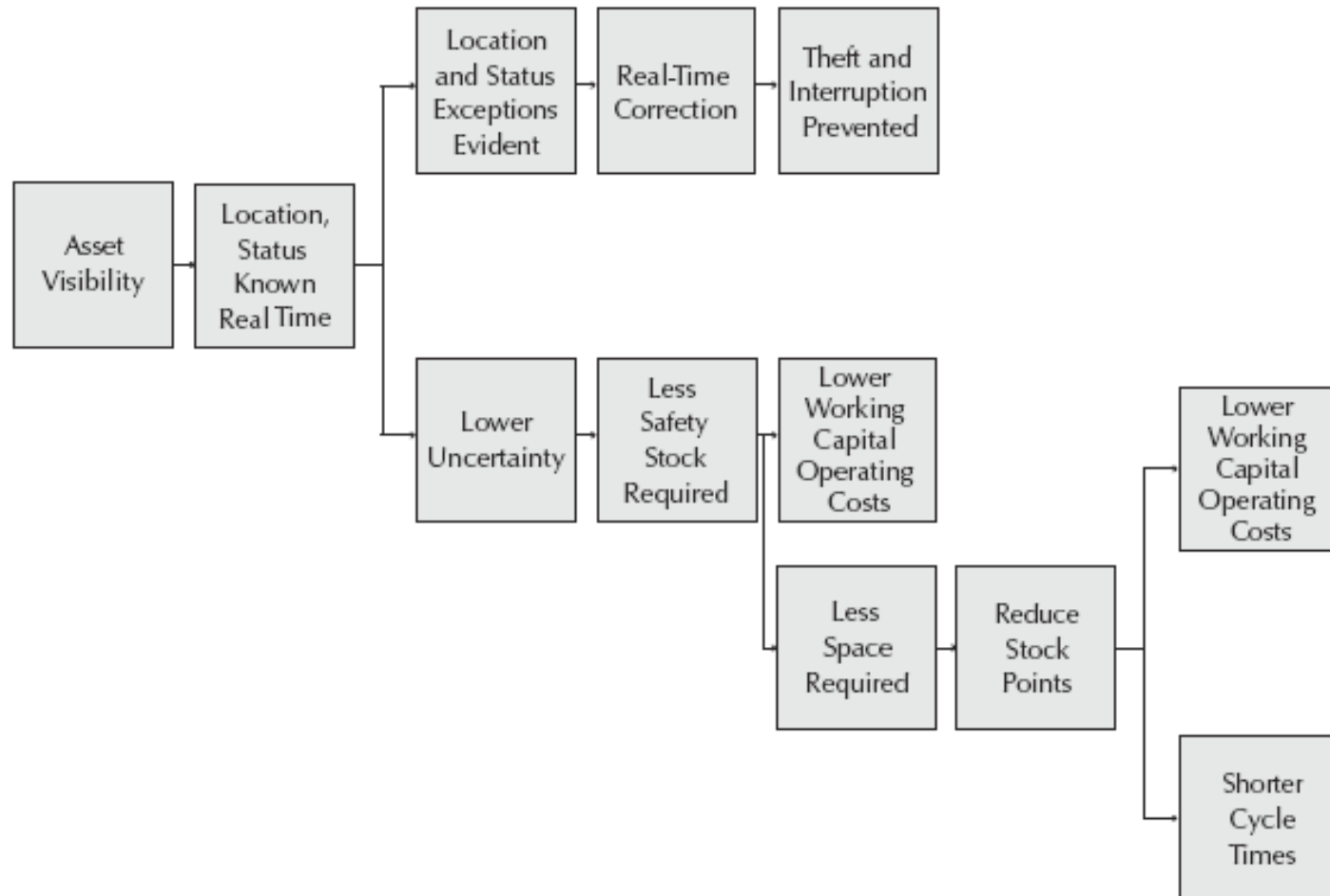
Results of Sensitivity Analysis

Scenario	Transit Time	Transit Time Variability	Total Logistics Costs
Base Case	23	10	\$106,915
Combination of improvements	22	6	\$95,945
Reduce variability only	23	6	\$96,833
Reduce transit time only	19	10	\$103,364

What Next?

- Focus on container movements
- Expand cost elements especially collateral impact on loss and damage cost reduction
- Modeling different types and categories of shippers or freight
- Better linkage between security initiatives and collateral benefits – Linkage maps

Collateral Benefits Linkage Map



What if?

- Public sector and private sector
- An intelligent gateway/corridor
- From BC to Ontario (and points on the way)
- That provides best in class security and
- Seamless, efficient, fast and reliable movement

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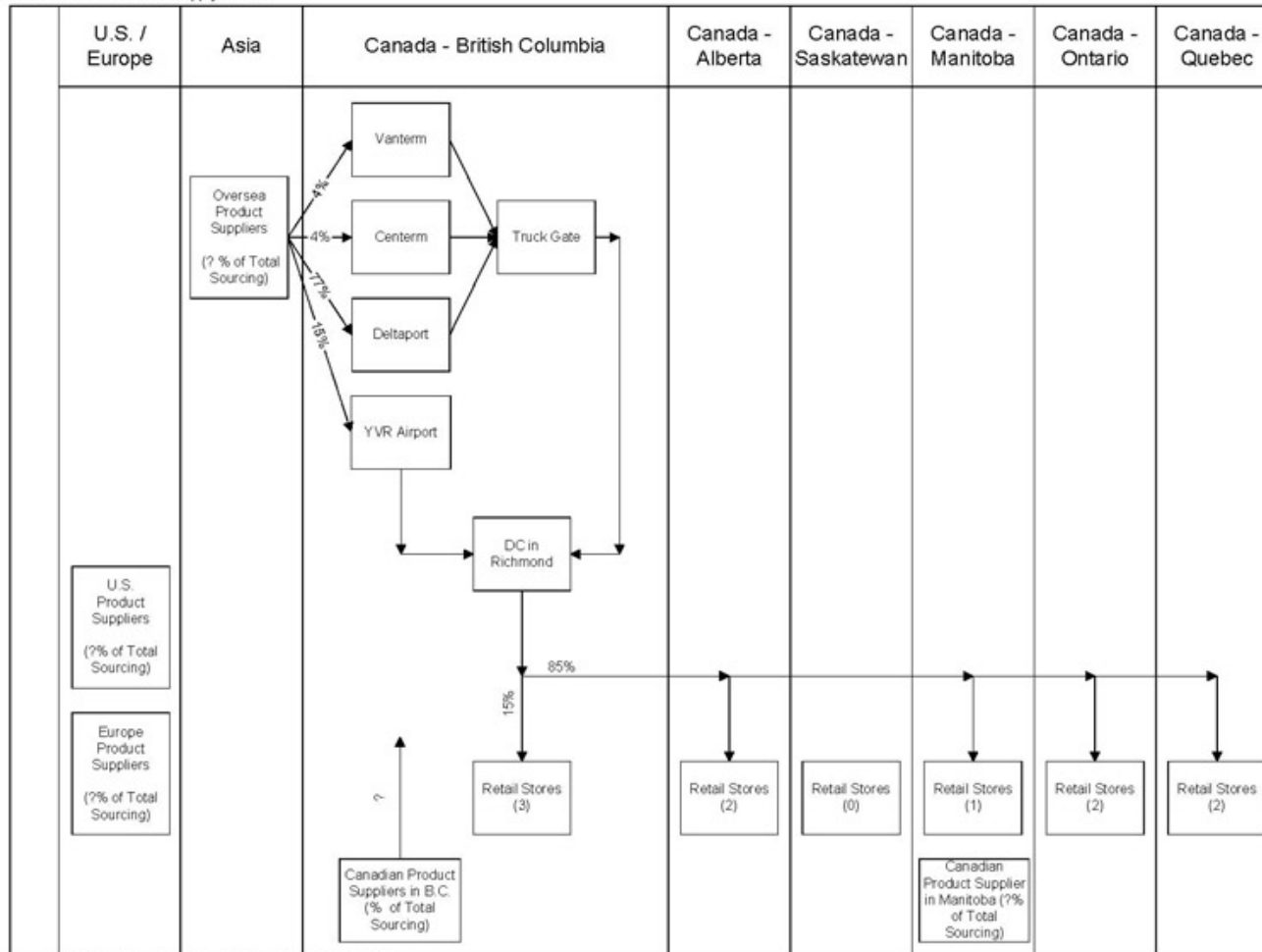
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Logistics Network Map: Case 1 – Small to Medium Multi-brand Specialty Chain Store

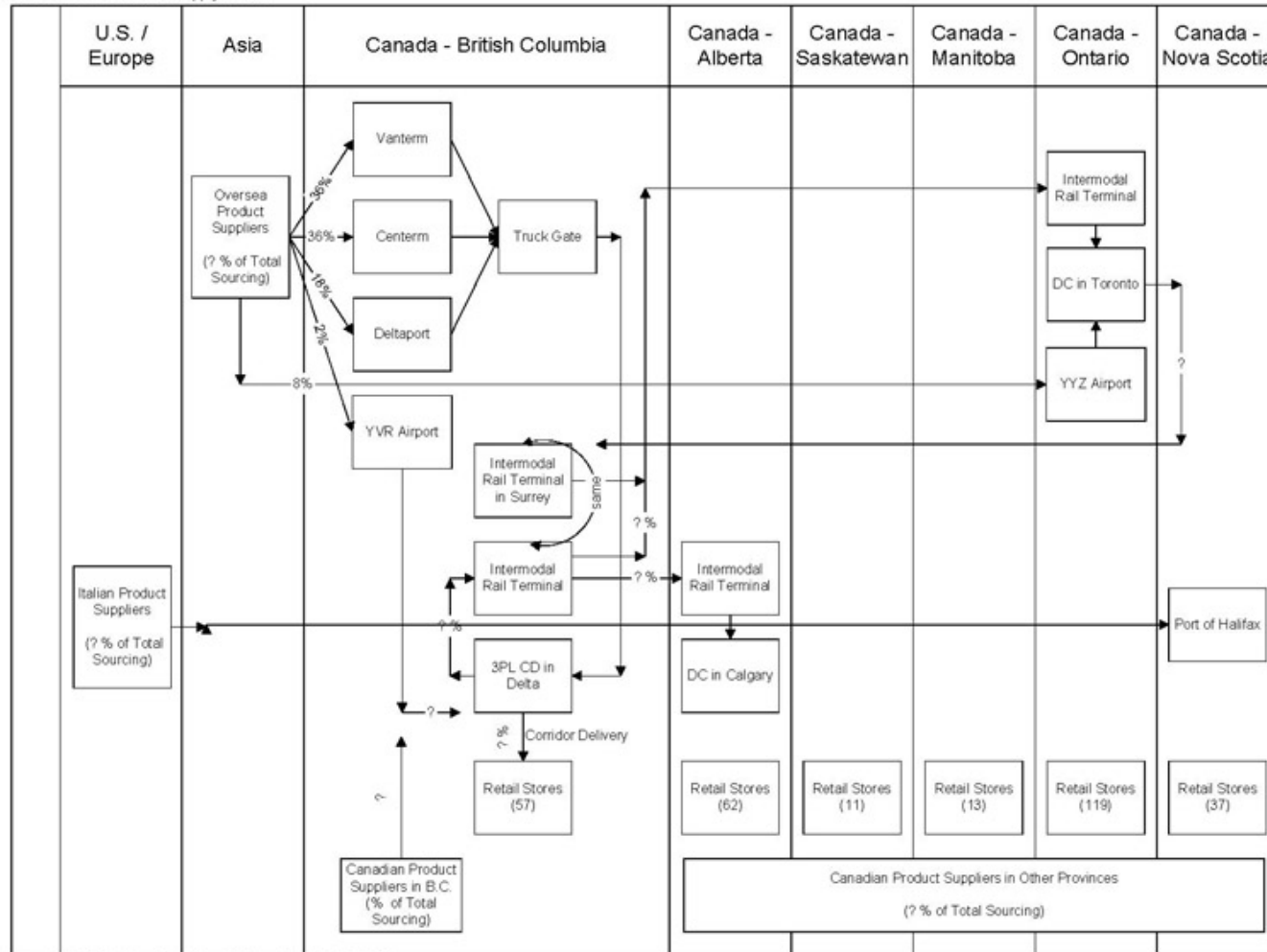
Multi-Brand Chain Stores Supply Chain



Source: BITSAFS; Sauder School of Business, UBC 2006

Logistics Network Map: Case 2 – Medium size Multi-brand Chain Store

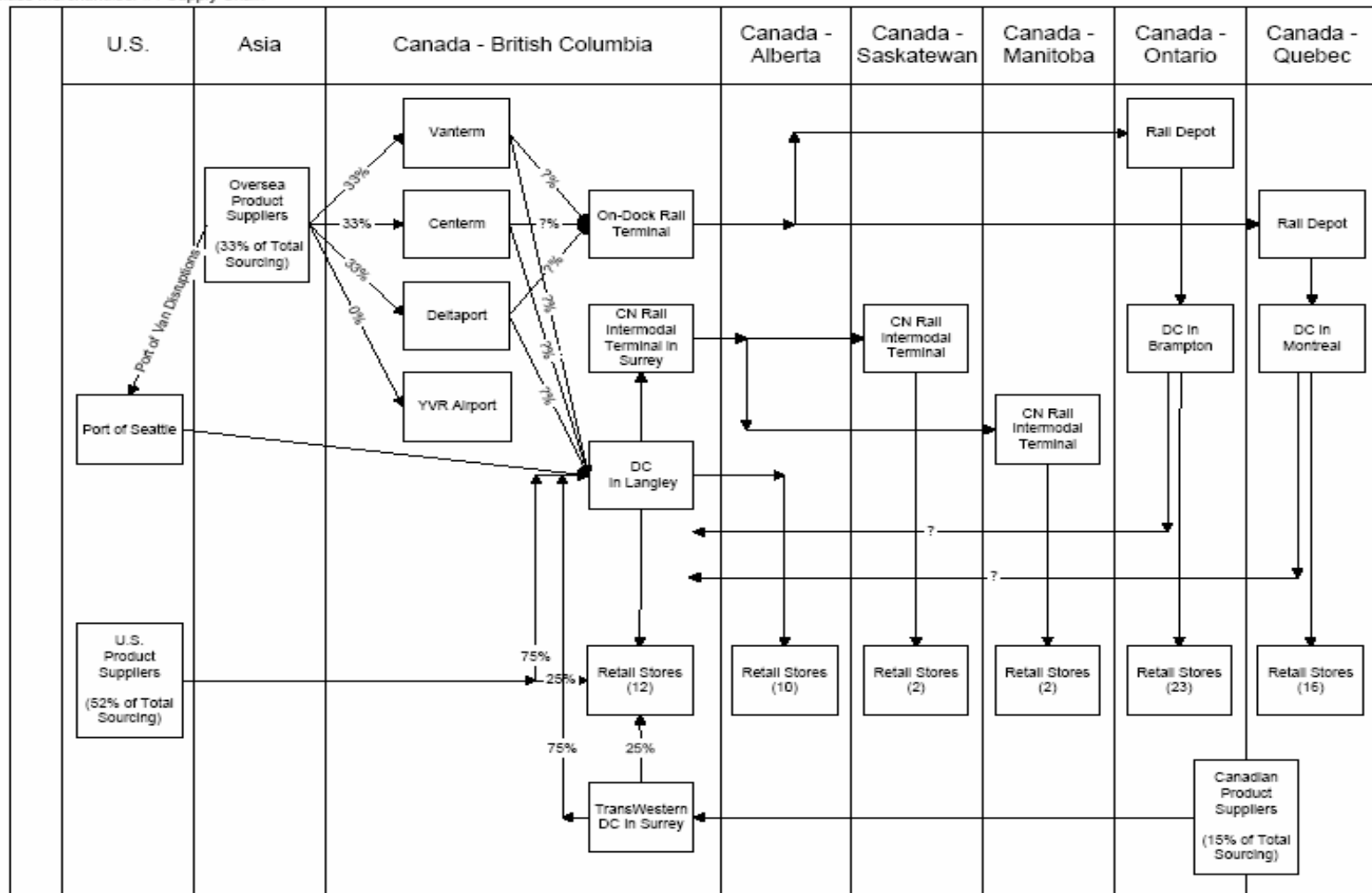
Multi-Brand Chain Stores Supply Chain



Source: BITSAFS; Sauder School of Business, UBC 2006

Case 3: Large Mass Merchandise Store #1

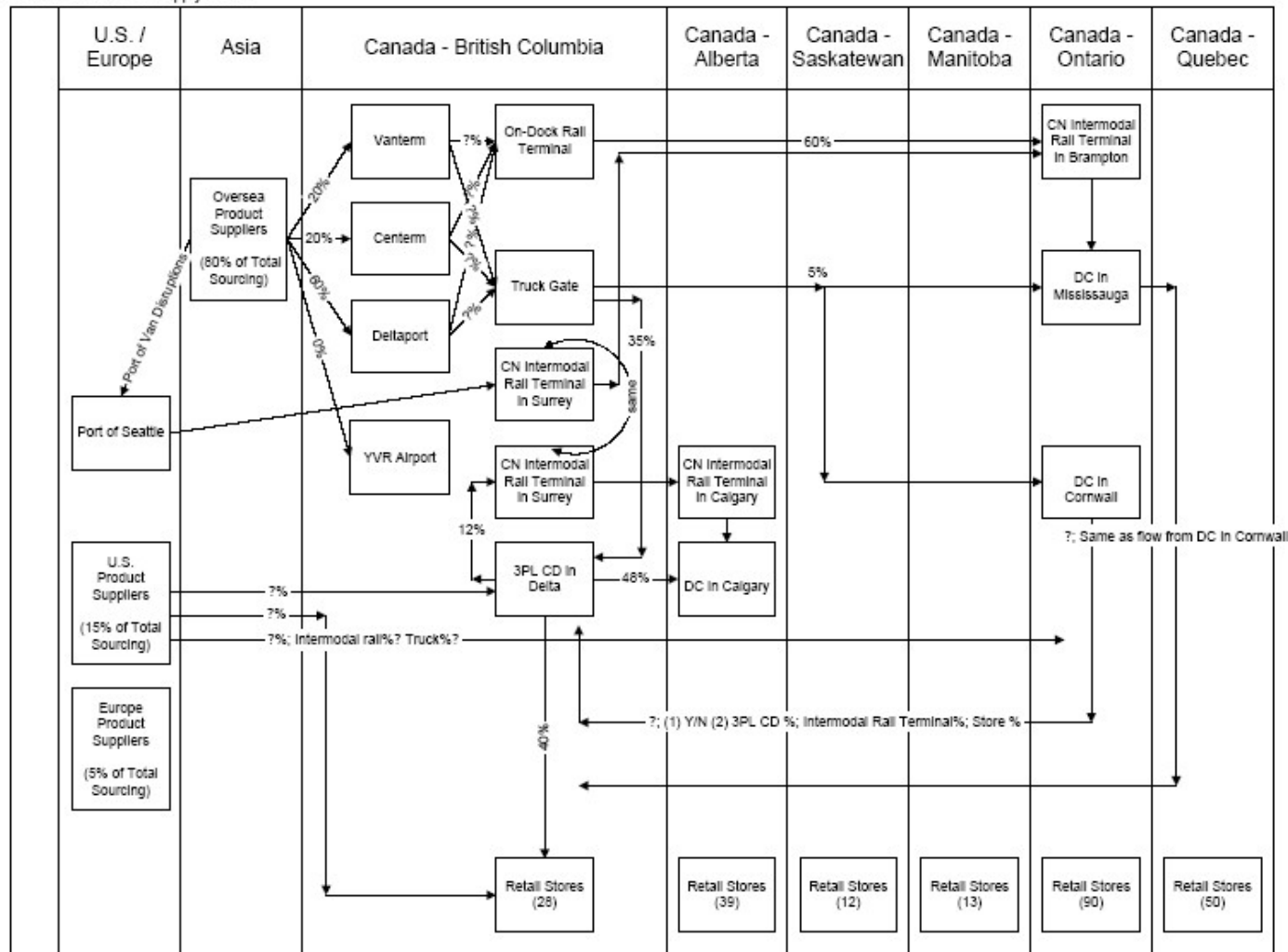
Mass Merchandiser #1 Supply Chain



Source: BITSAFS; Sauder School of Business, UBC 2006

Case 4: Large Mass Merchandise Store #2

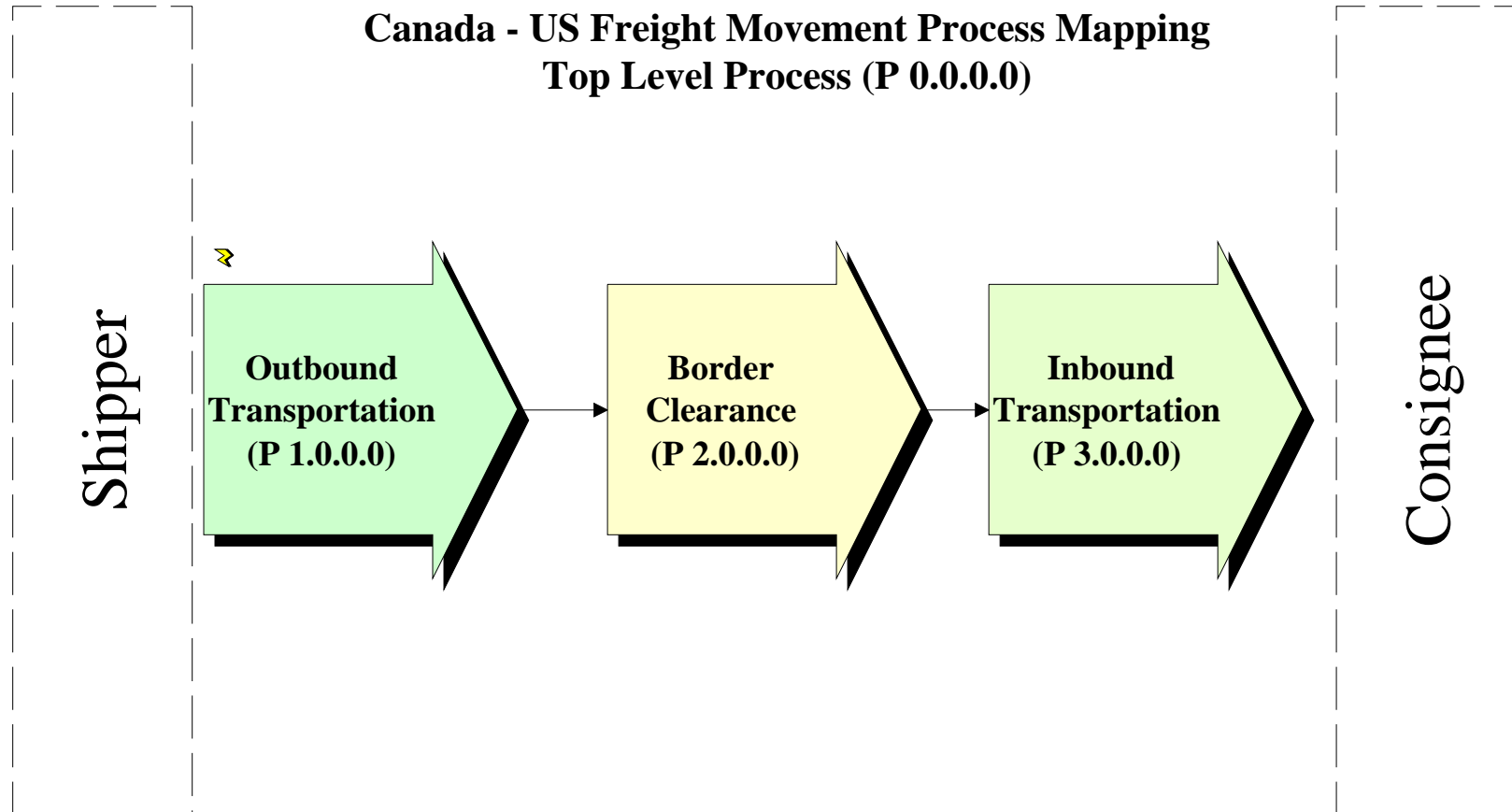
Mass Merchandiser #2 Supply Chain



Source: BITSAFS; Sauder School of Business, UBC 2006

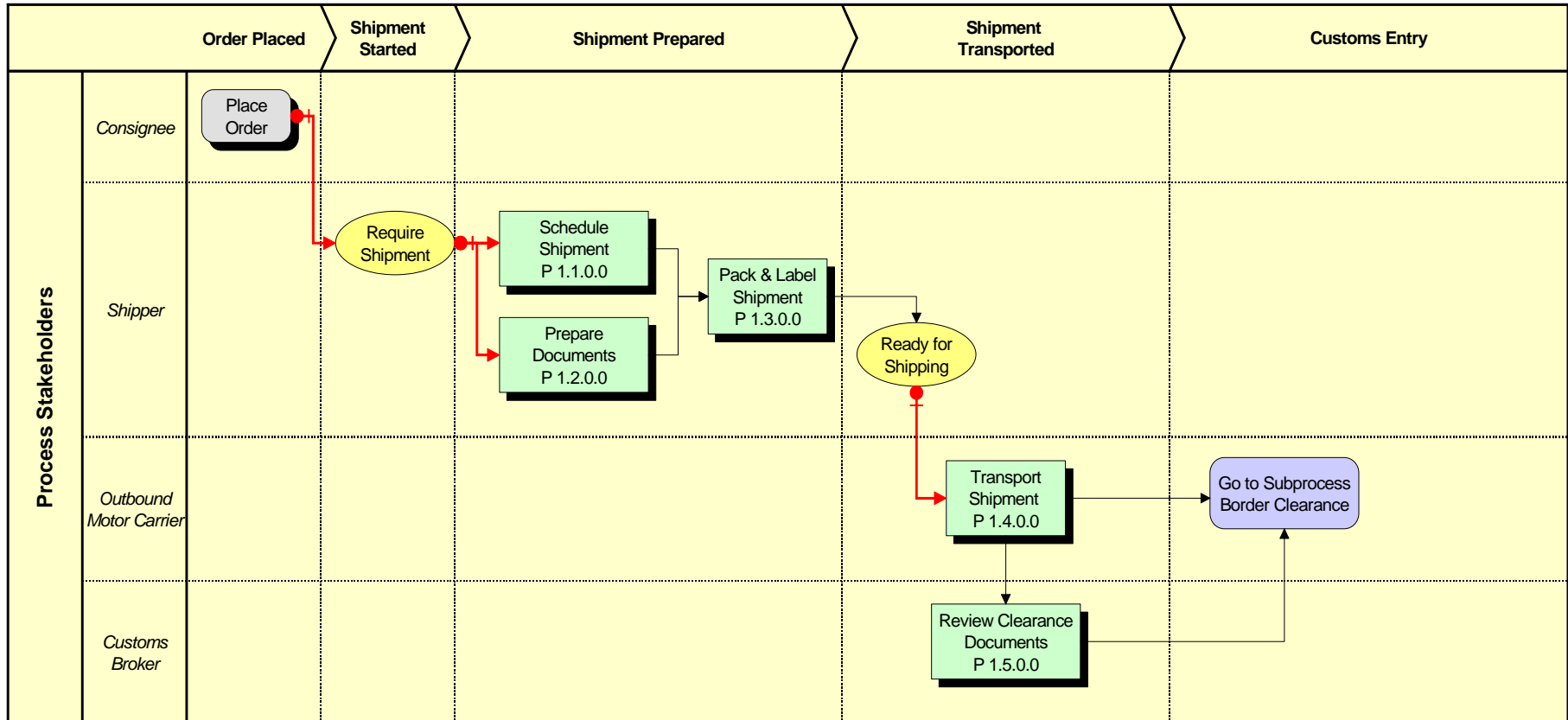
Freight Movement Canada-US

Top Level



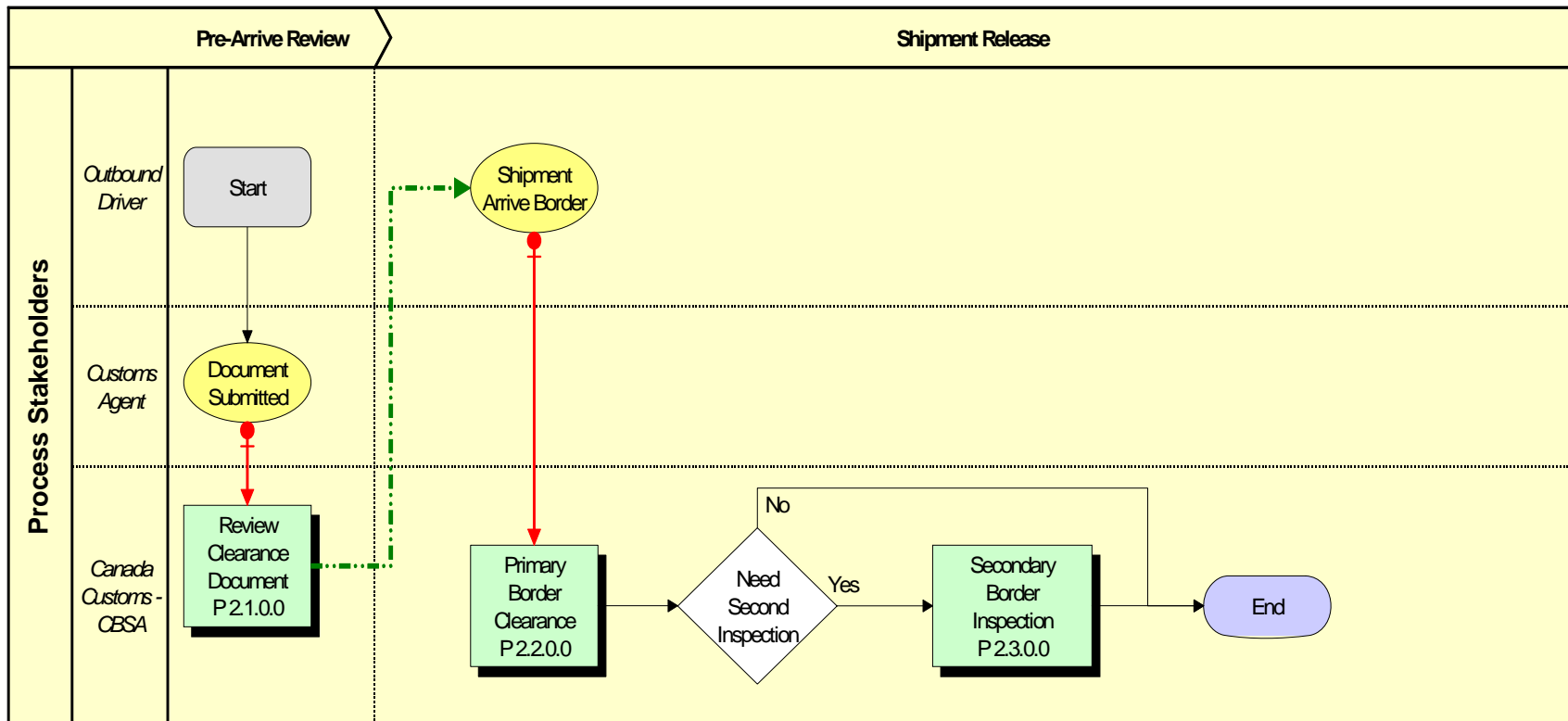
Outbound Transport Process

Canada - US Freight Movement Process Mapping Outbound Transportation Process (P 1.0.0.0)



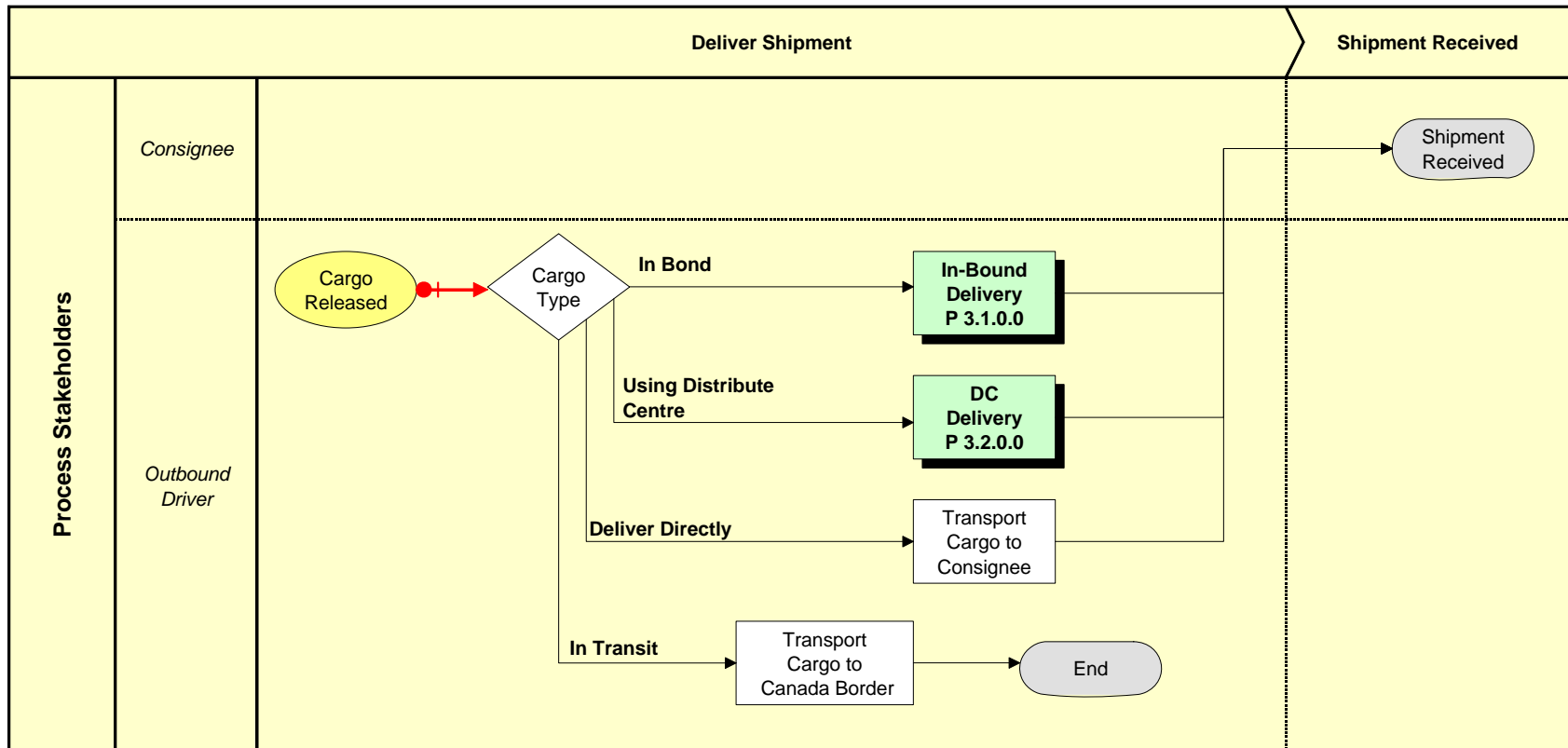
Border Clearance Process

US - Canada Freight Movement Process Mapping Border Clearance Process P 2.0.0.0



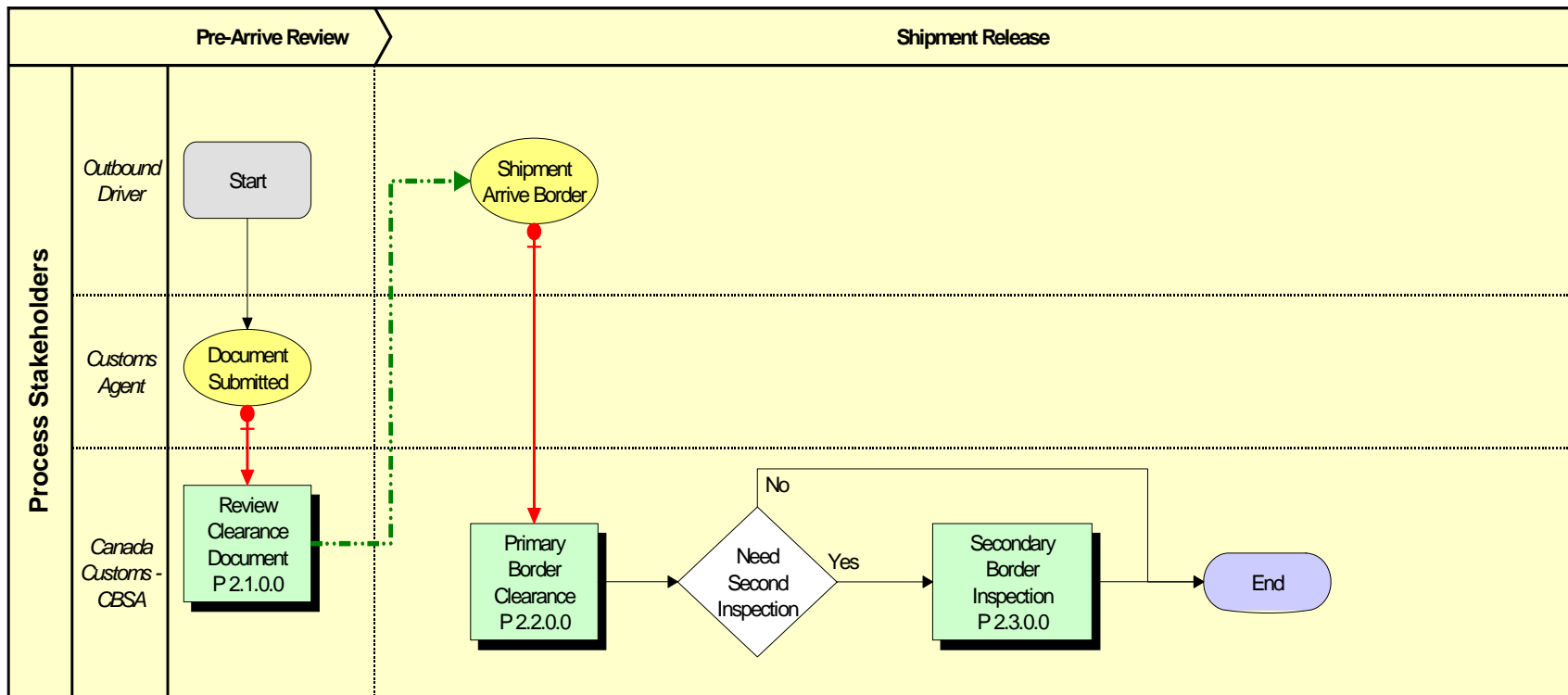
Inbound Transport Process

US - Canada Freight Movement Process Mapping Inbound Transportation Process (P 3.0.0.0)



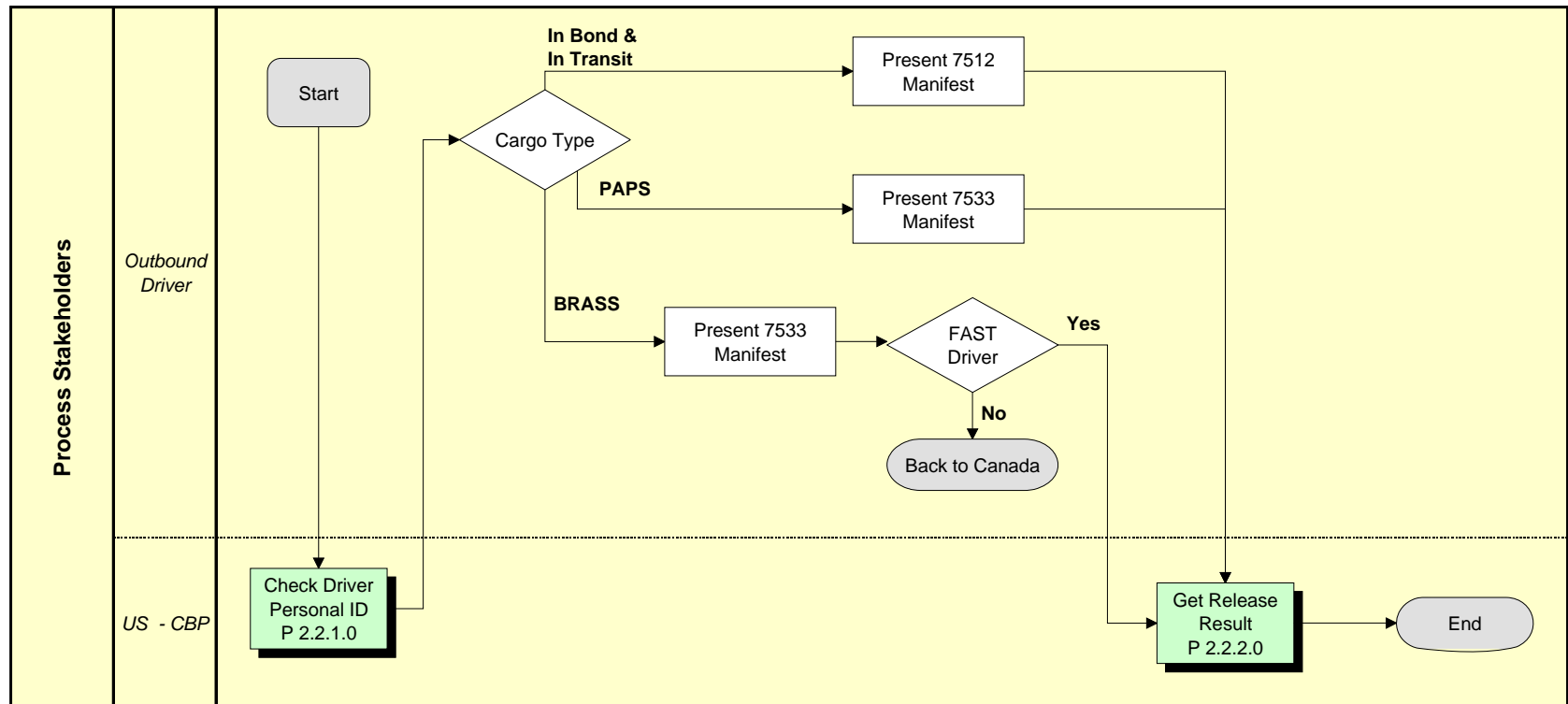
Border Clearance Process

US - Canada Freight Movement Process Mapping Border Clearance Process P 2.0.0.0



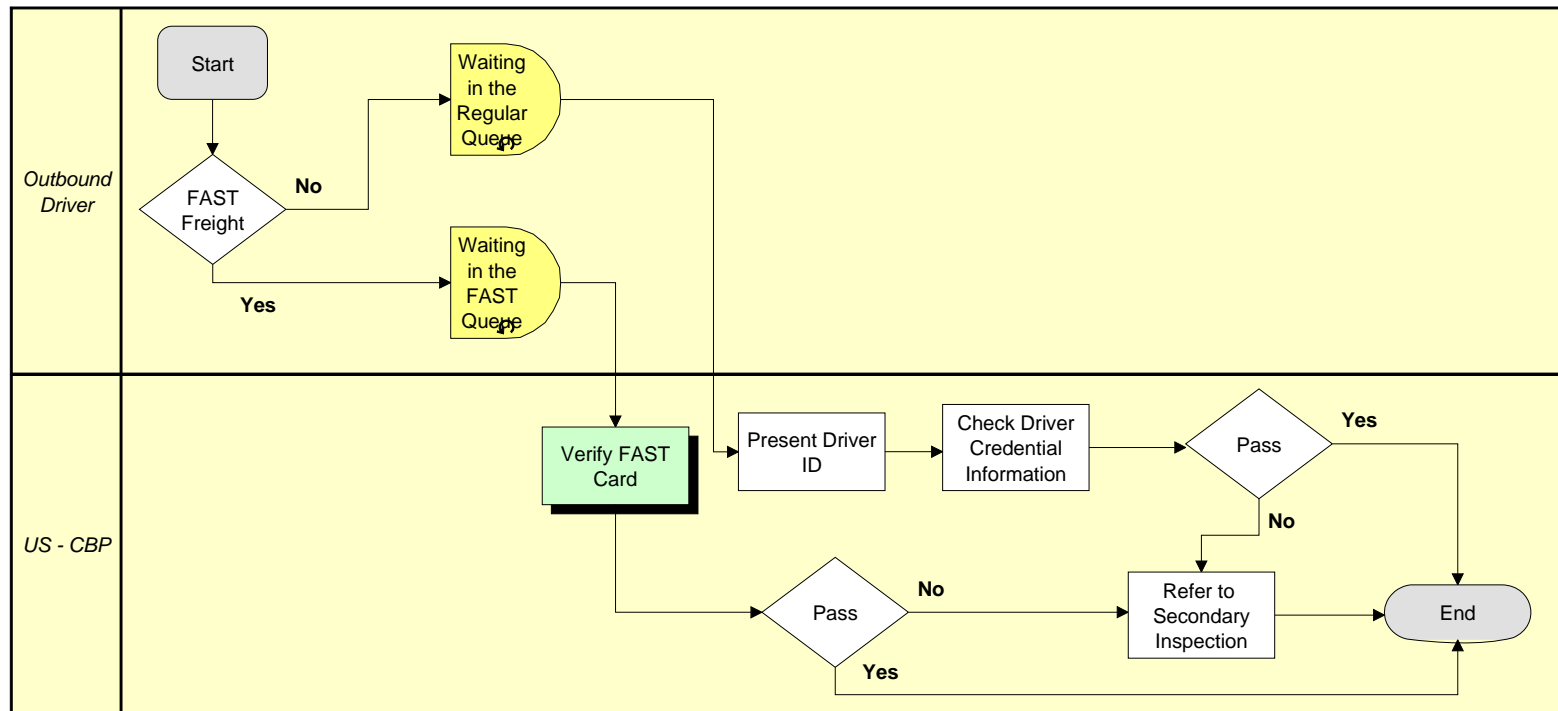
Primary Border Processing

Canada - US Freight Movement Process Mapping
Primary Border Processing (P 2.2.0.0)



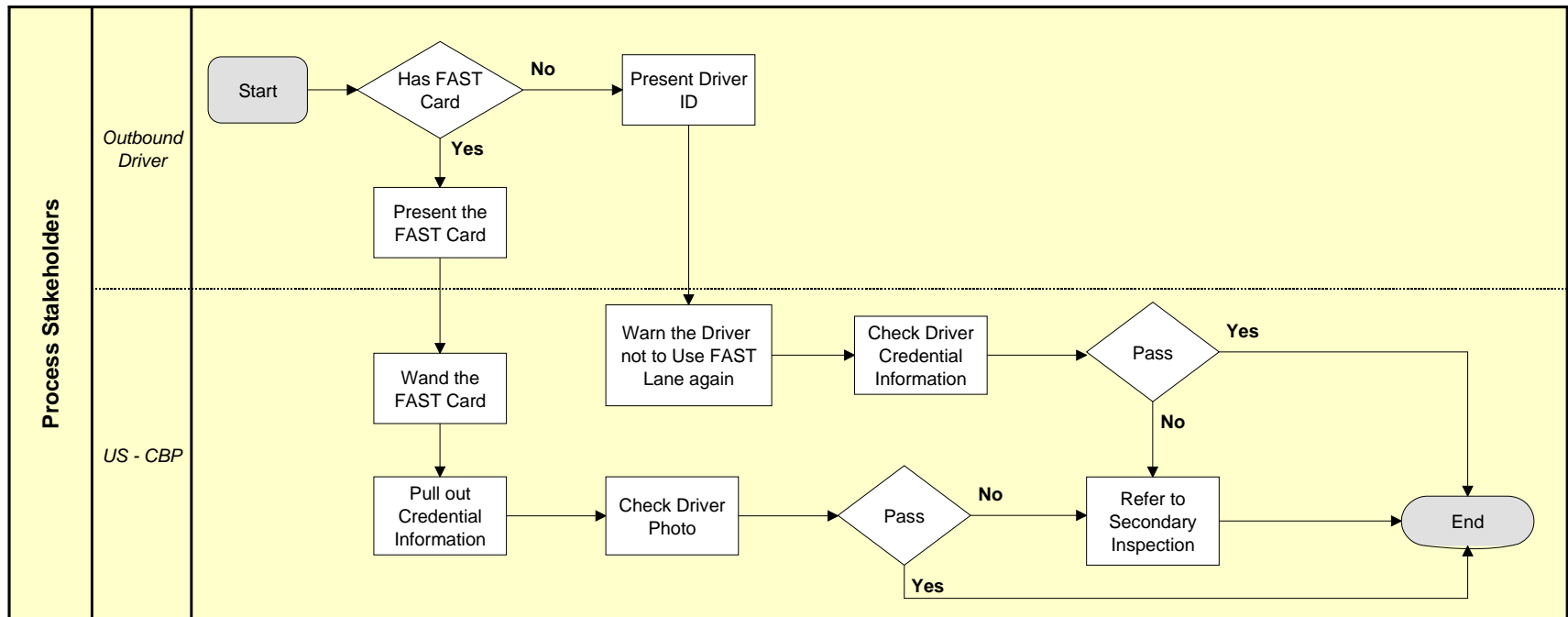
Process Map of FAST

Canada - US Freight Movement Process Mapping Check Driver ID (P 2.2.1.0)



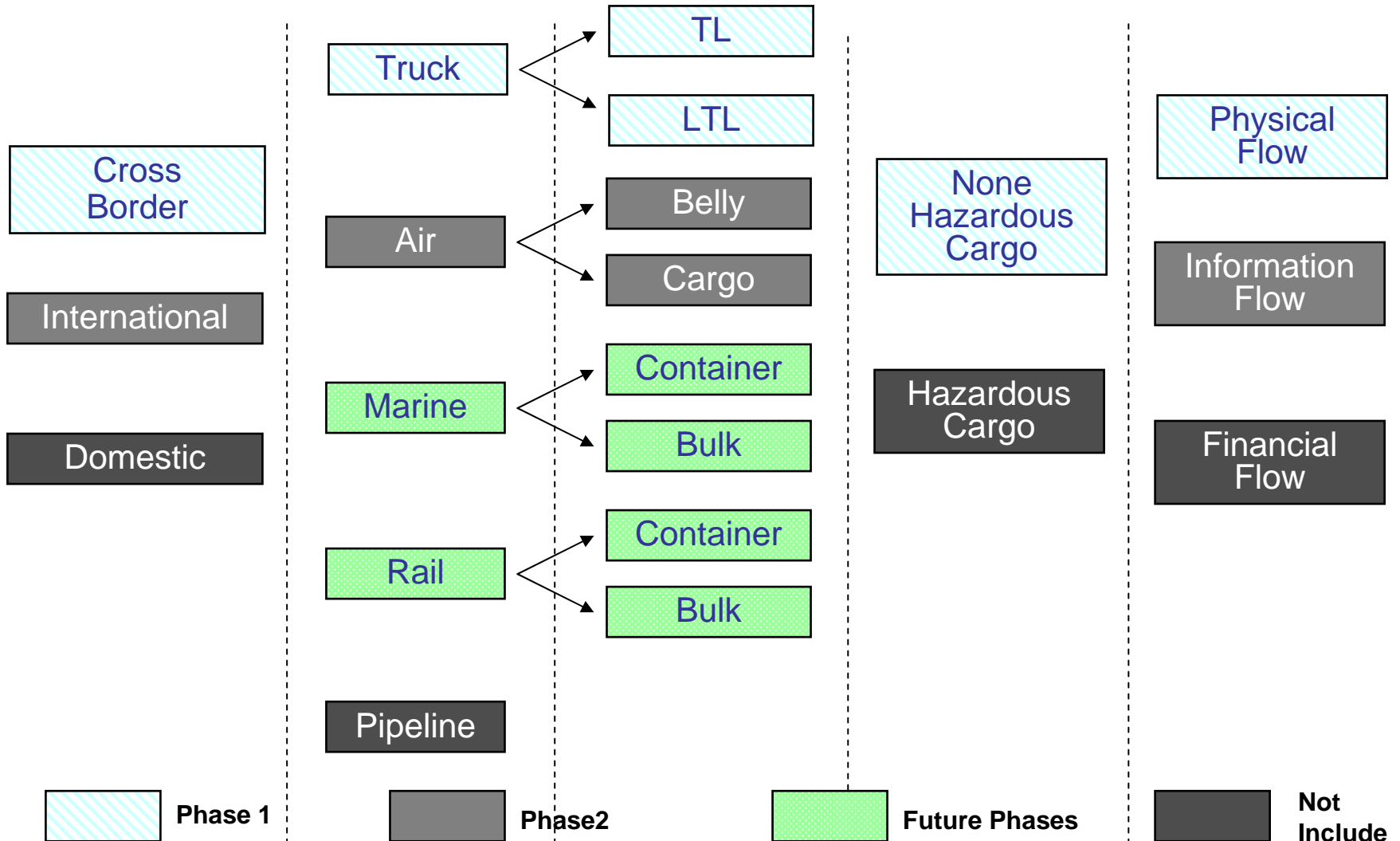
Sub-Process – Verifying FAST

Canada - US Freight Movement Process Mapping Verify FAST Card (P 2.2.1.1)



Inter-Modal Transport Chains (1)

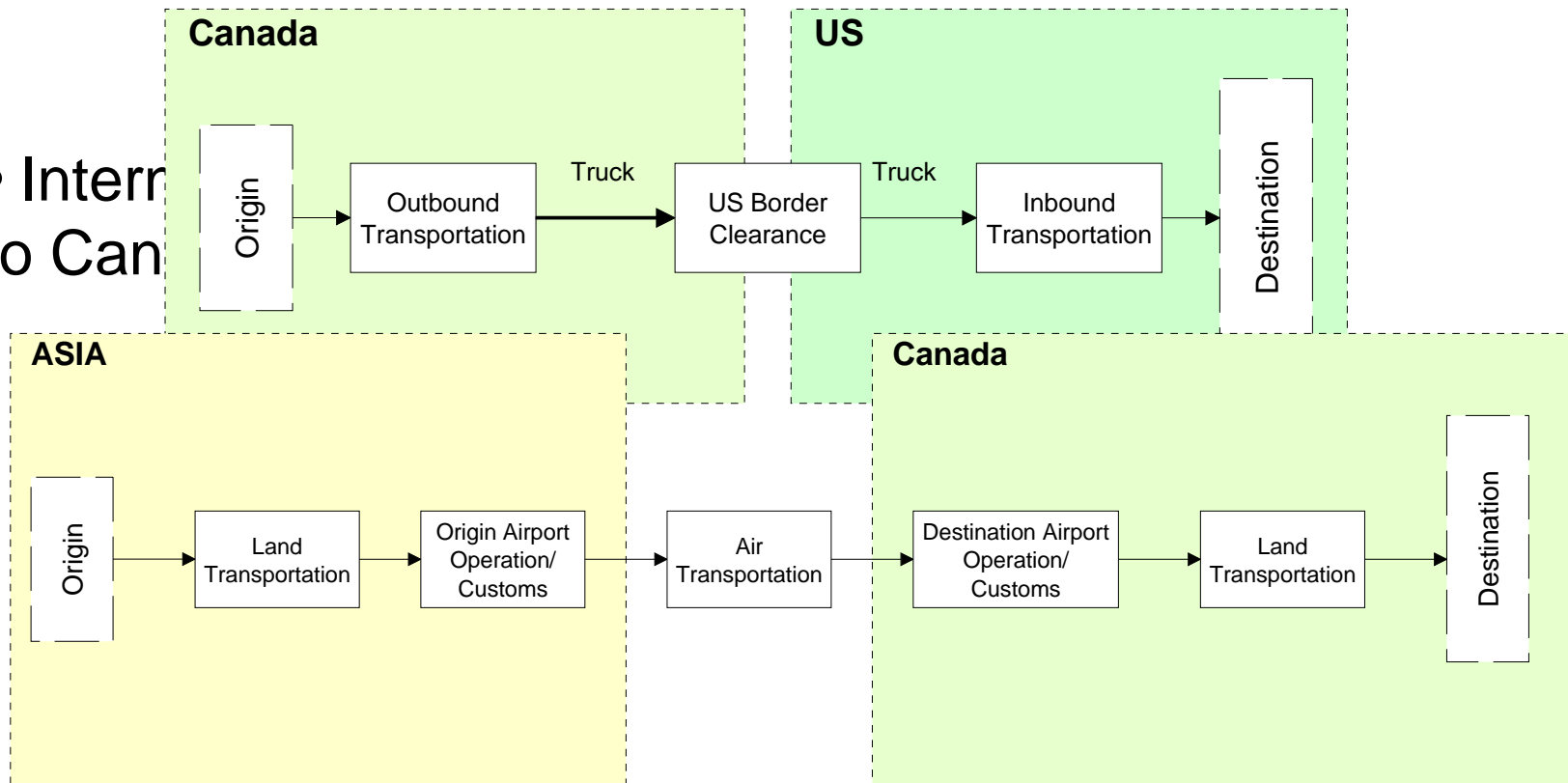
Process Mapping Scope



Inter-Modal Transportation Chains (2)

- Truck Freight Movement From Canada to US

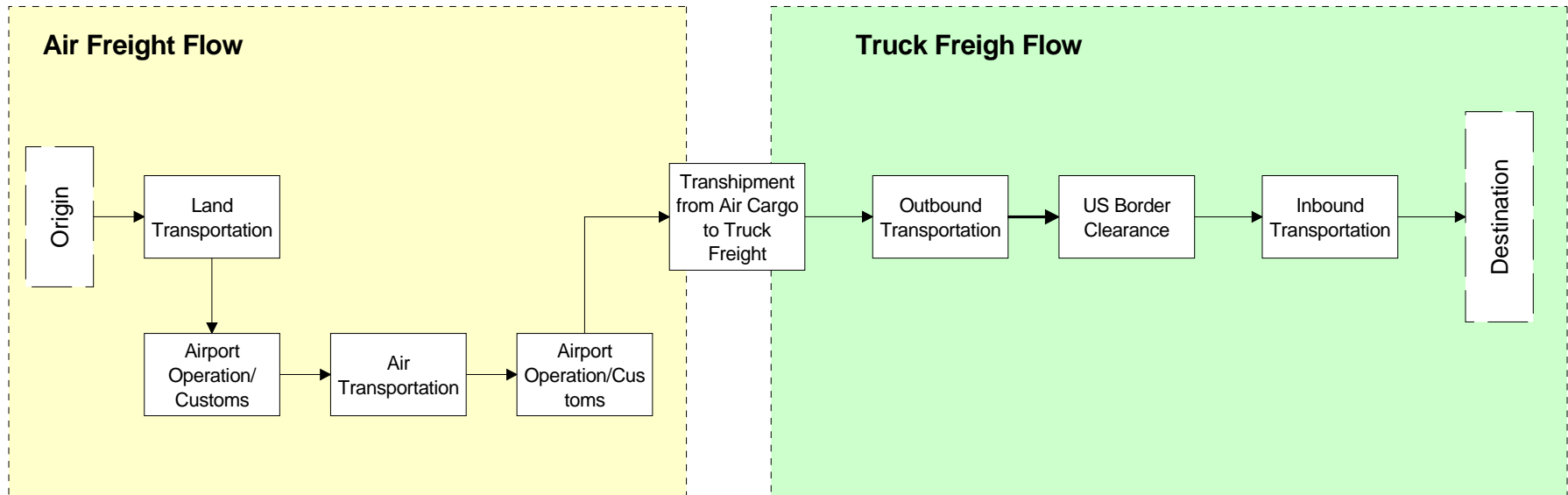
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Inter-Modal Transport Chains (3)

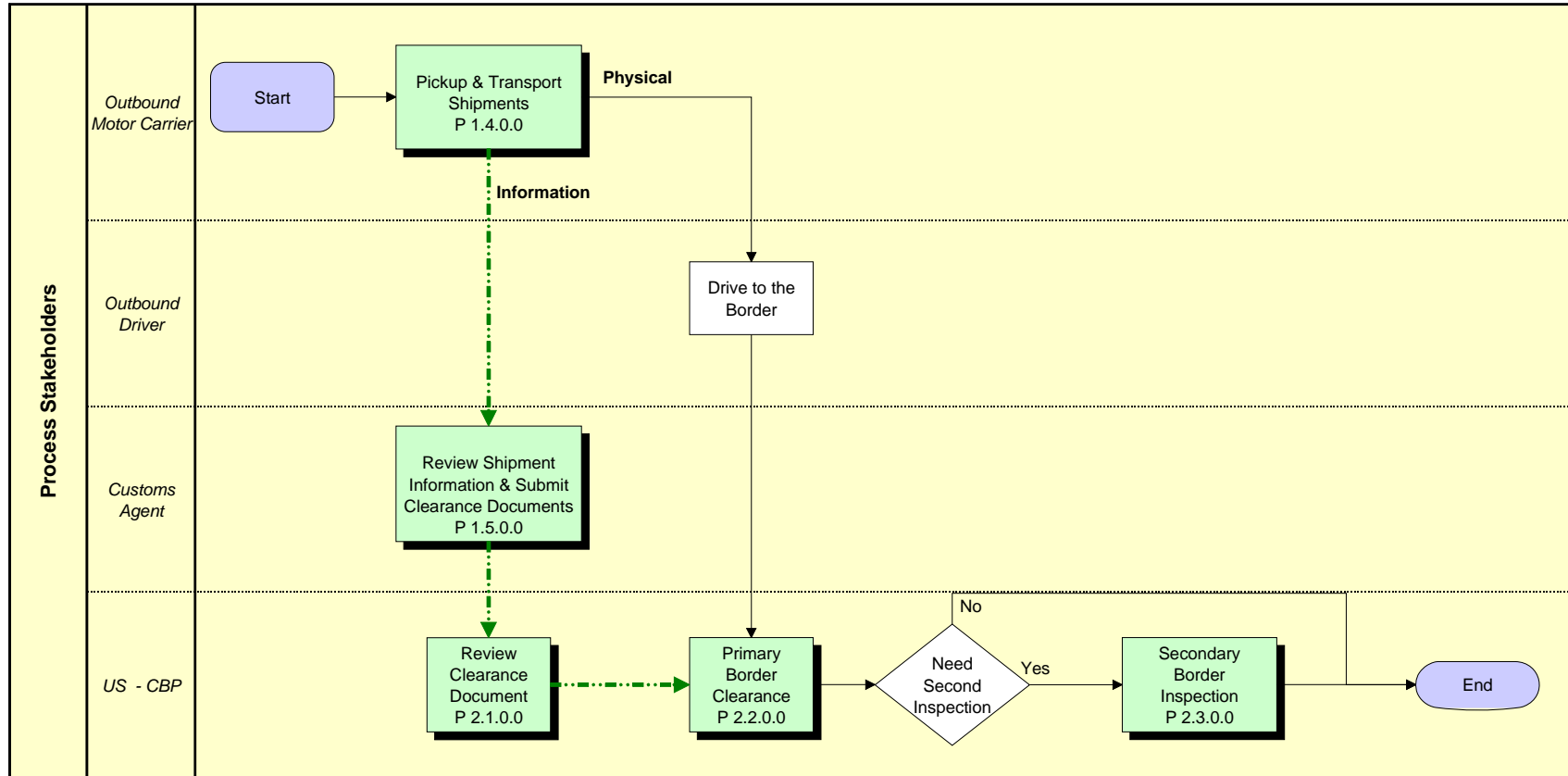
Process Mapping Extension

- Door To Door International Intermodal Freight Movement Flow



Impact of IT Systems (ACE, ACI), and Other Regulatory Initiatives

Canada - US Freight Movement Process Mapping ACE Simulation Model



Canada - US (Truck Load) Process Mapping Check Driver Credential Information (P 2.2.1.0)

