Analysis of Competitive Position of Ports Using Total Logistics Costs of Representative Supply Chains

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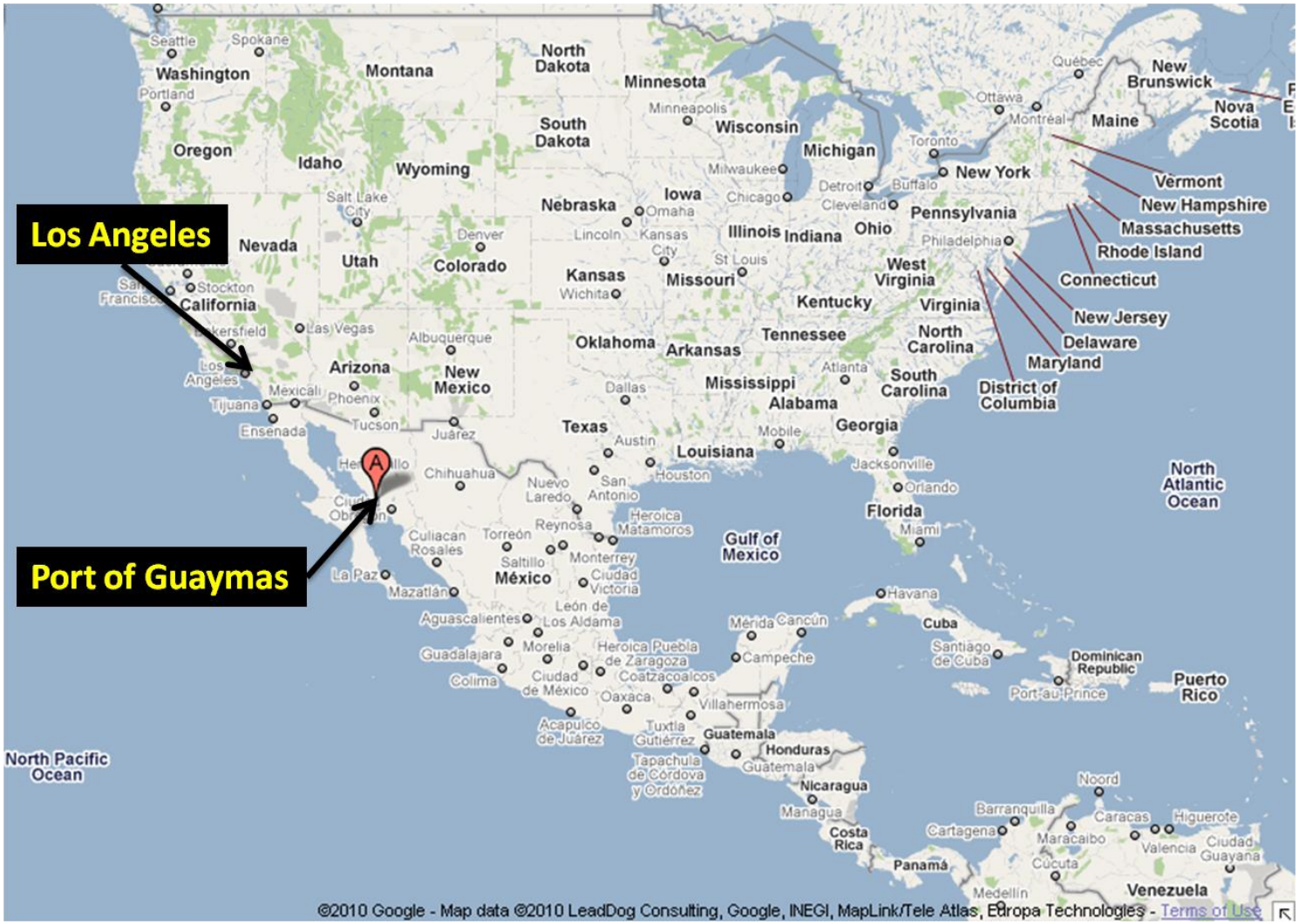
Agenda

- Introduction
- Definition of Total Logistics Costs
- Competitive Positioning of Ports
  - Development of a Methodology
  - The Port of Guaymas Case Study
- Overall Conclusions

Background

- The Port of Guaymas is the main port in the Sea of Cortez.
- Guaymas did not have a regular container service. Container service is usually provided through the Ports of Long Beach and LA and more infrequently through Ensenada.
- Industries within the port's influence zone may not be getting an efficient container service for their import/export operations with the Far East countries.
- The ports of Long Beach/LA and Ensenada are commonly used to send/receive containers.
- This may be an opportunity for the Port of Guaymas if the adequate service to industry is provided.

The Port of Guaymas: Case Study



Motivation

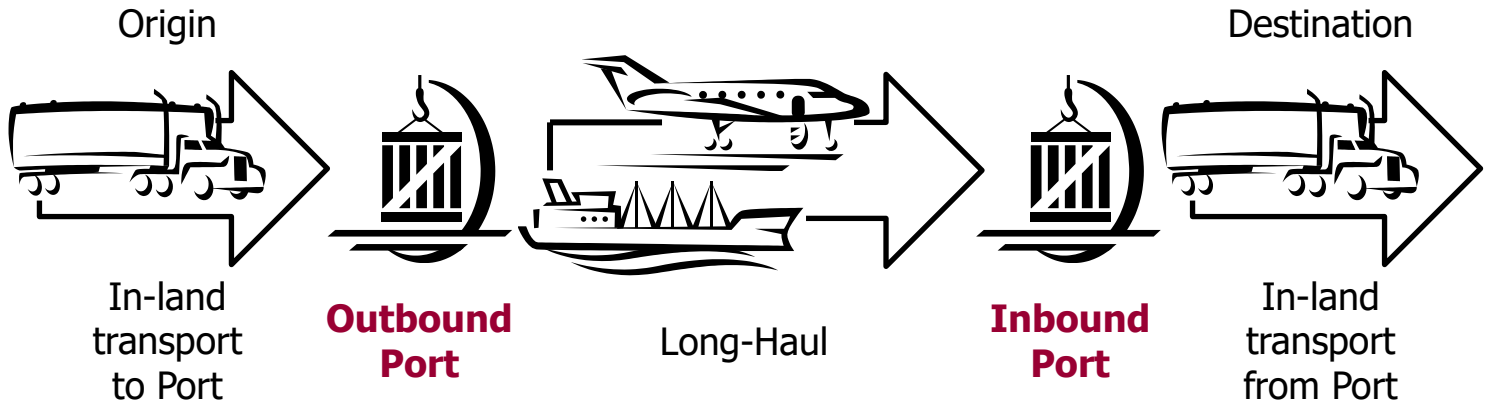
- Objective
  - Positioning of a commercial port with respect to its competition to best serve the companies located in its hinterland in terms of Total Landed Cost of supply chains.

- Research Motivation
  - The Relevance of Logistics in Modern Supply Chain
  - The Port of Guaymas Project: "Logistics Analysis of the Port of Guaymas in the Supply Chain of Regional Companies"

The Supply Chain

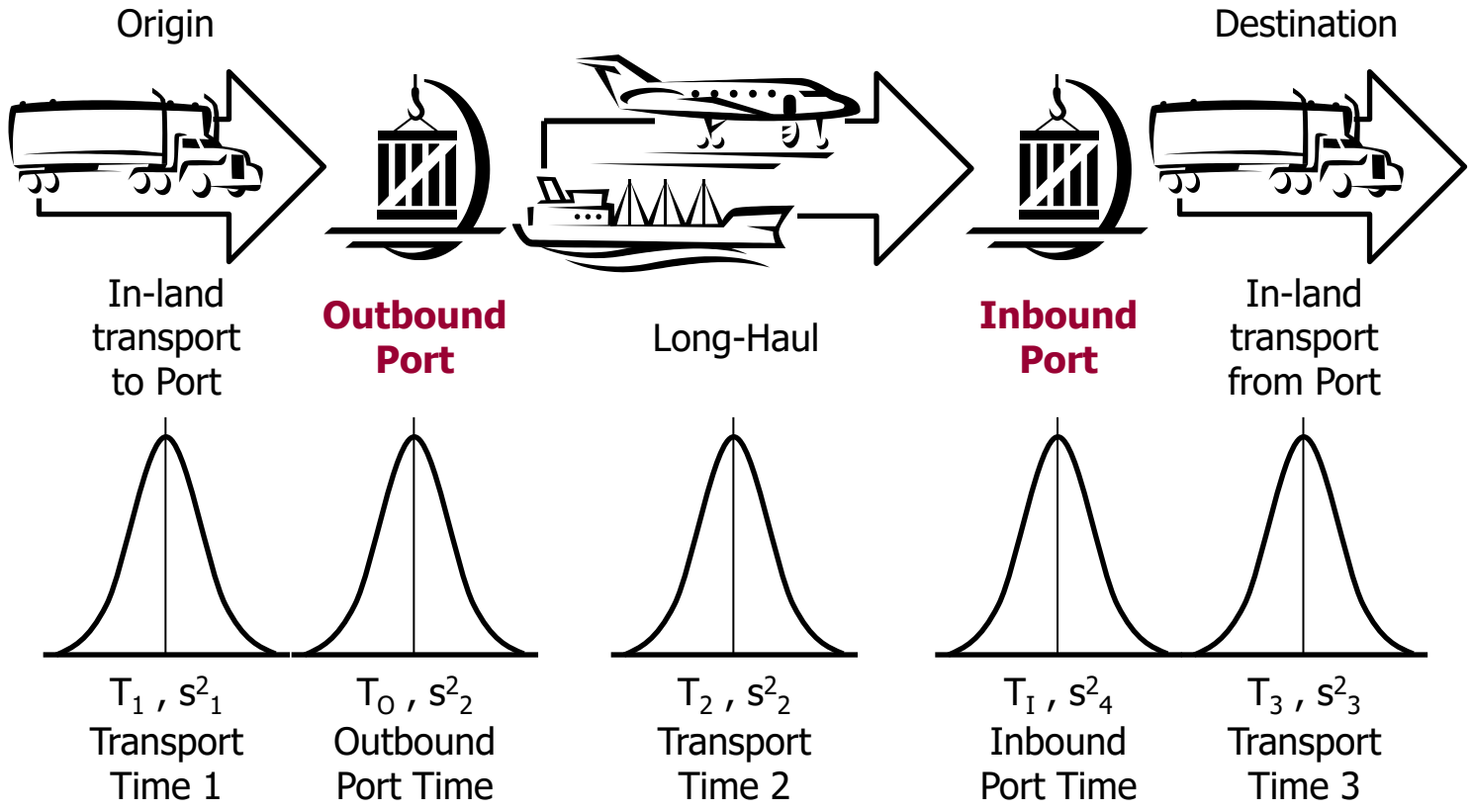
The Transportation Process of the Supply Chain

The Transportation Process of the Supply Chain



Motivation

- Importance of Variability in Logistics Decision



Objective

- Determine the impact of port operations' variability in the transportation lead time and in its clients' total logistic costs; and
- Define operational parameters within the port in such a way that this impact is reduced, so the port itself becomes more attractive to serve the supply chains of those companies operating in its hinterland.

Total Landed (Logistics) Costs

$$Order\ Cost: \left(\frac{D}{Q}\right) * S +$$

$$Transportation\ Cost: R(Q) * D +$$

$$In - transit\ Inventory\ Cost: \frac{ICDT}{365} +$$

$$Carrying\ Cost\ of\ Regular\ Stock: \frac{IC'Q^*}{2} +$$

$$Carrying\ Cost\ Safety\ Stock\ due\ Transportation: IC * s_t' +$$

$$Stock\ Out\ Cost: \frac{D}{Q^*} * ks_d' E(z)$$

- Where:
- D = Year Demand S = Order Setup Cost
- Q = Order Batch Size R(Q) = Transportation rates as function of Q
- I = Opportunity Interest C = Product Unit Cost
- T = Total Time of Transportation s'_t = Transportation Standard Error
- k = Stock out penalty factor

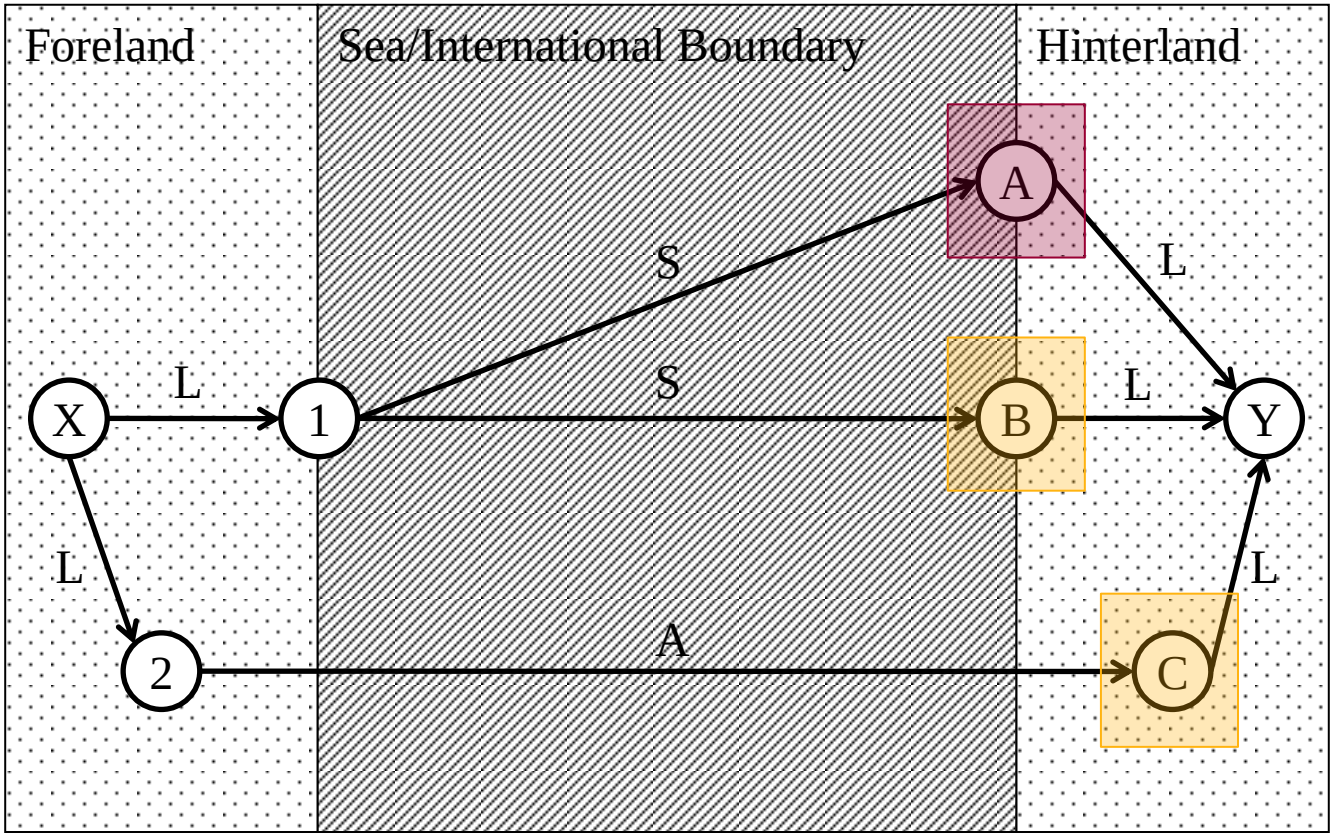
Development of the Methodology

- Develop a systematic approach to determine competitive port parameters based on the Total Logistics Costs.

- Identify when the competition service time variability presents an opportunity:
  1. The service levels **required** by the costumers.
  2. The service time variability **observed** by the costumers from the competing ports.

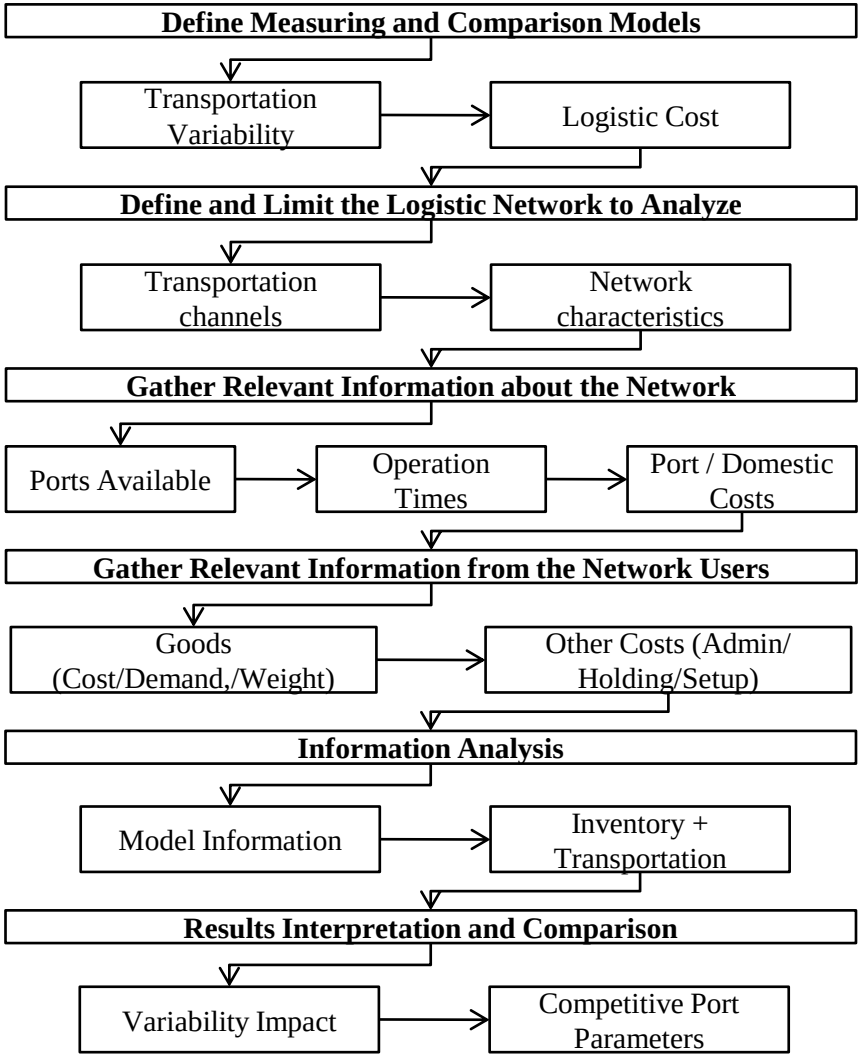
Development of the Methodology

- Description of General Problem

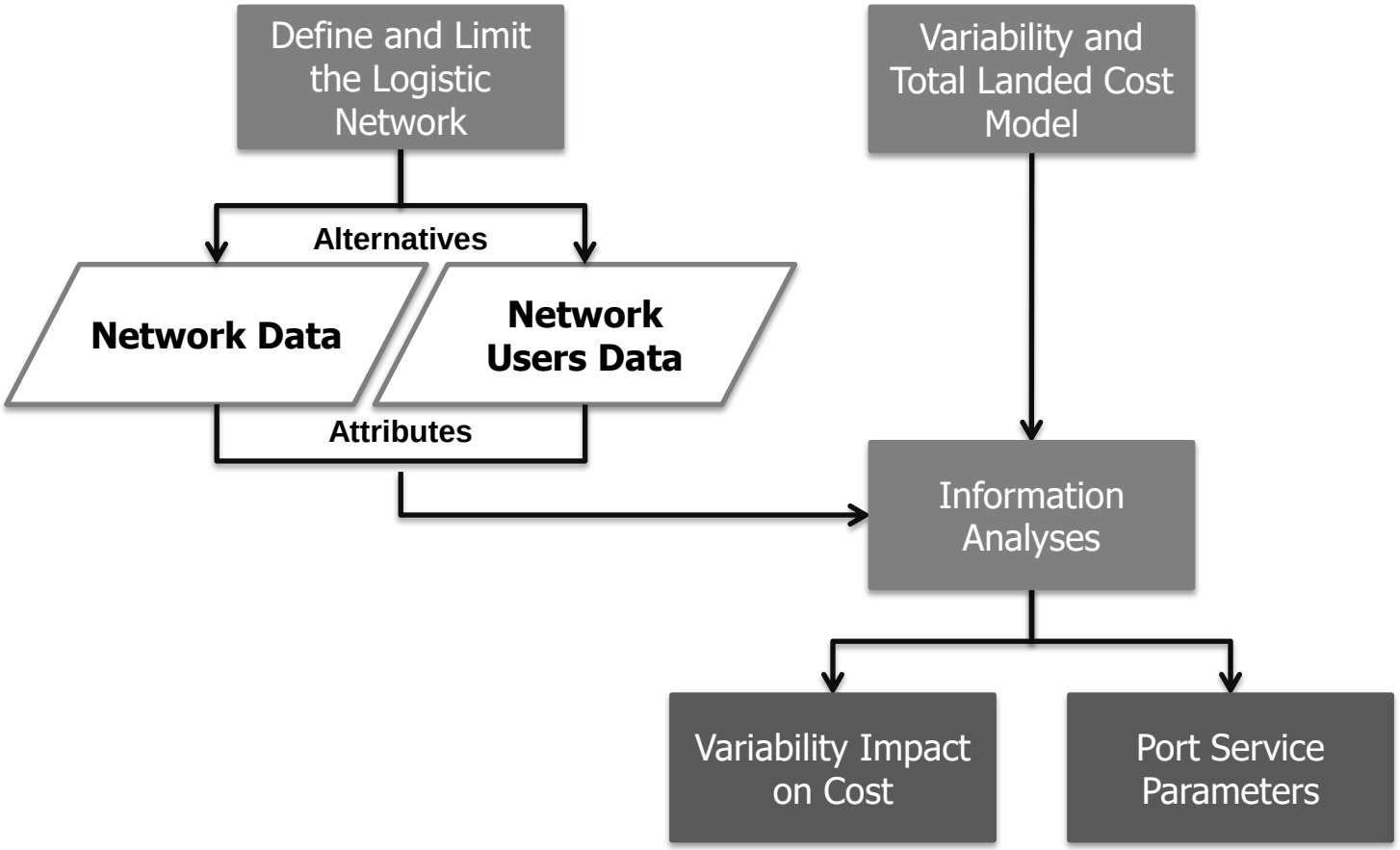


L = Land Transportation
S = Sea Transportation
A = Air Transportation

Development of the Methodology



Methodology Overview



Methodology Overview

Variability

Coefficient of Variation

Total Landed Cost

Order Cost +

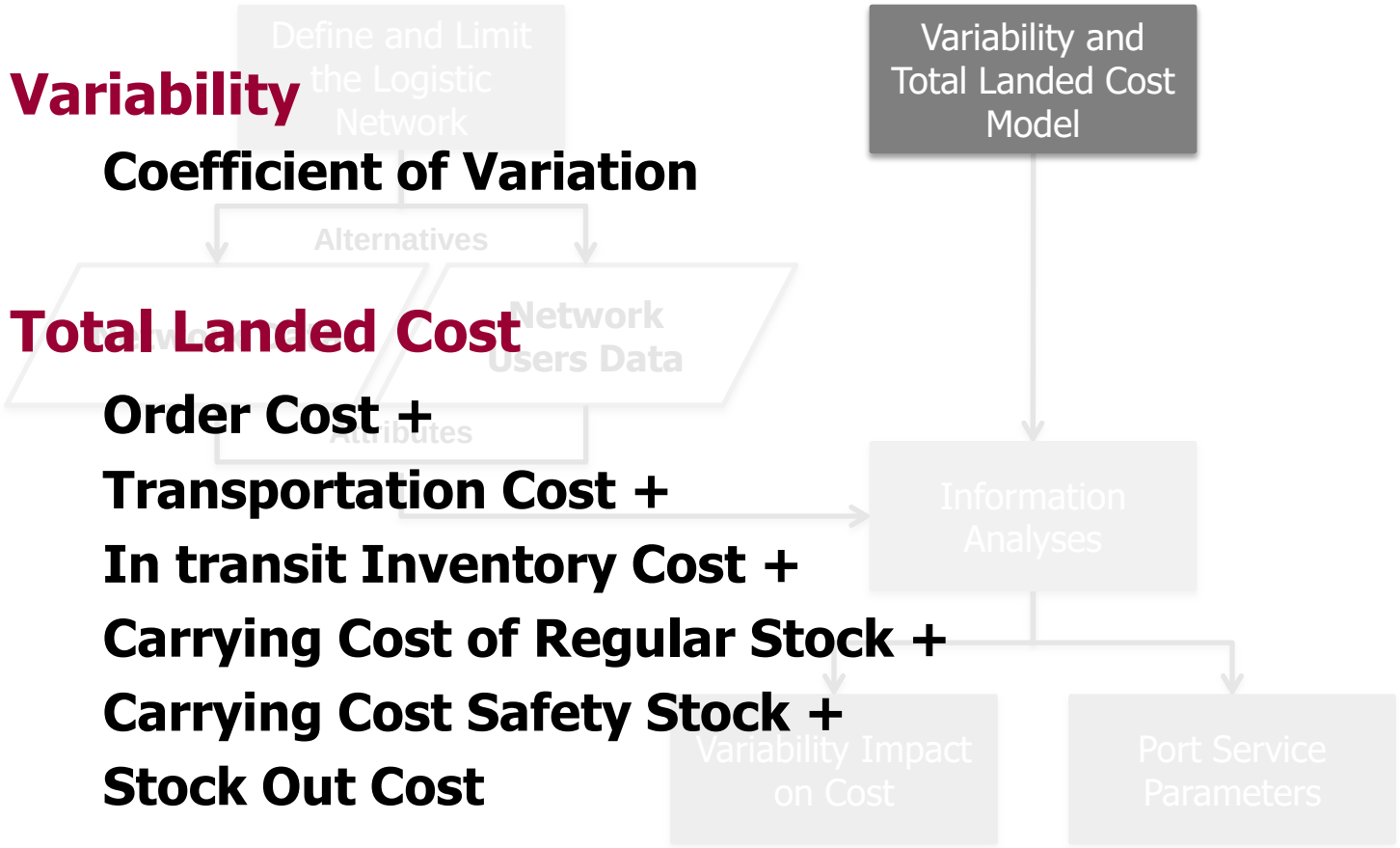
Transportation Cost +

In transit Inventory Cost +

Carrying Cost of Regular Stock +

Carrying Cost Safety Stock +

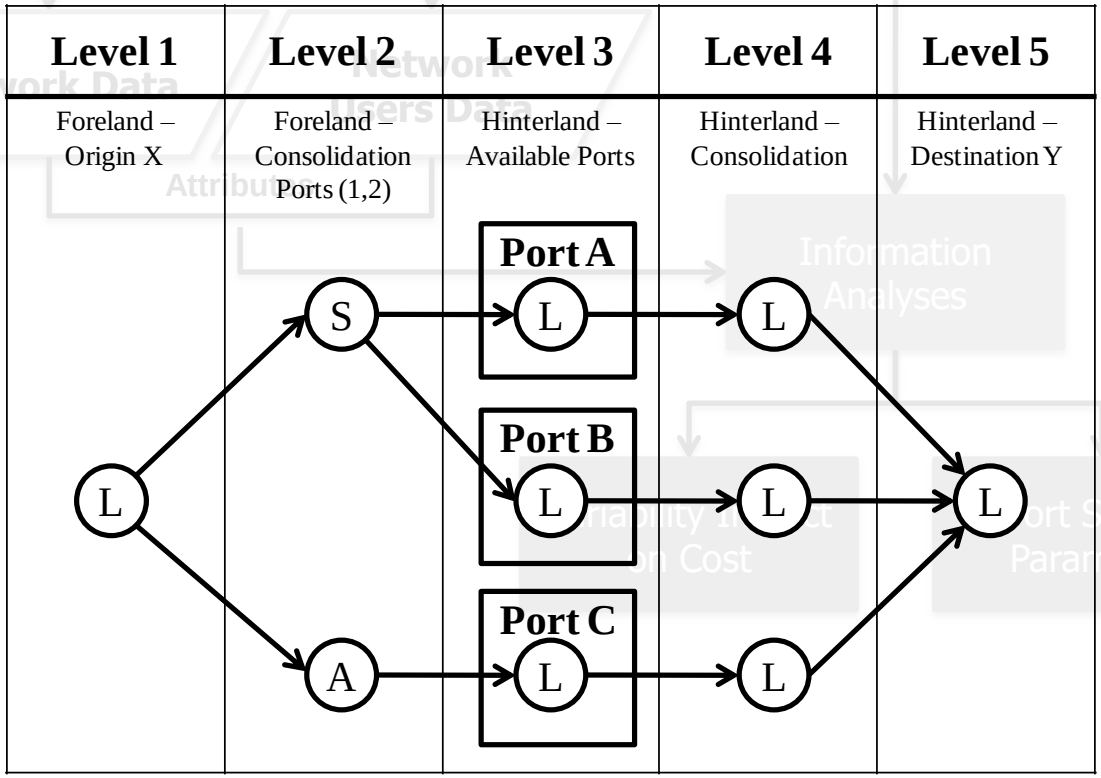
Stock Out Cost



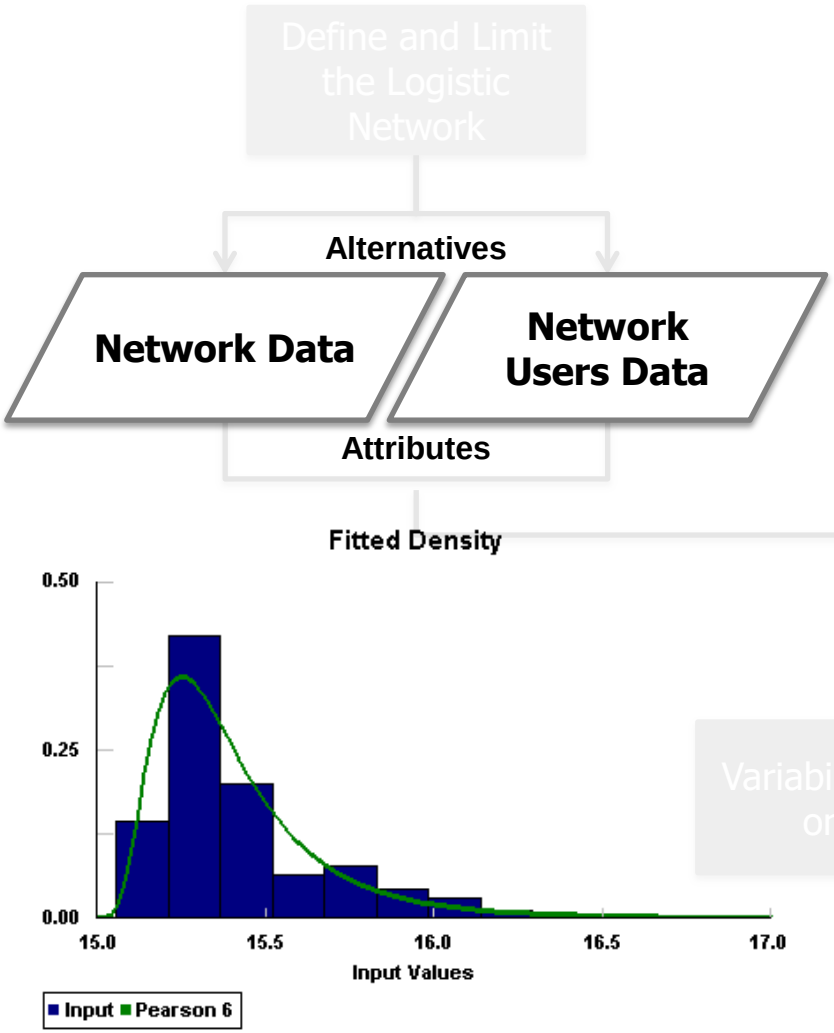
Methodology Overview

Define and Limit the Logistic Network

Network Segmentation



Methodology Overview



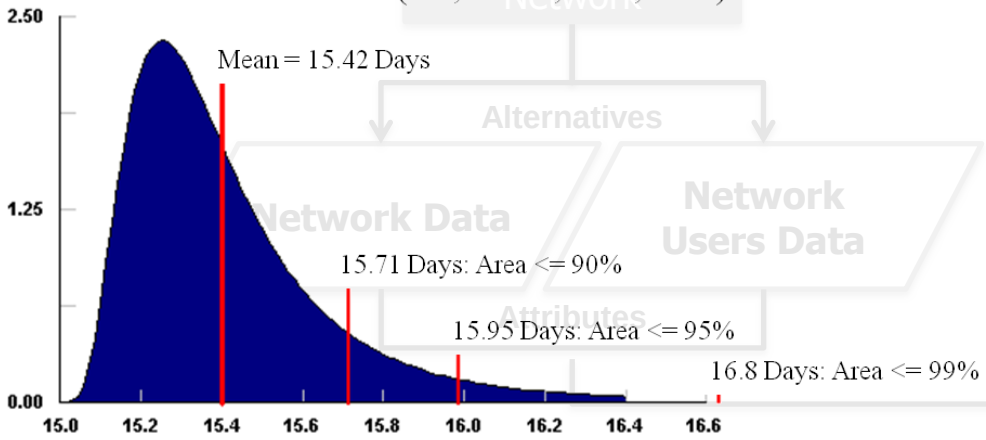
Network Data

- Regular transit times
- Port distances
- Transportation tariffs
- Port operation tariffs

Users Data

- Shipment Profiles
- Demands, Cost, Weight
- Admin, Setup, Holding
- Service levels

Methodology Overview



Define and Limit the Logistic Network

Variability and Total Landed Cost Model

Alternatives

Network Data

Network Users Data

Attributes

Information Analyses

Variability analysis on Cost

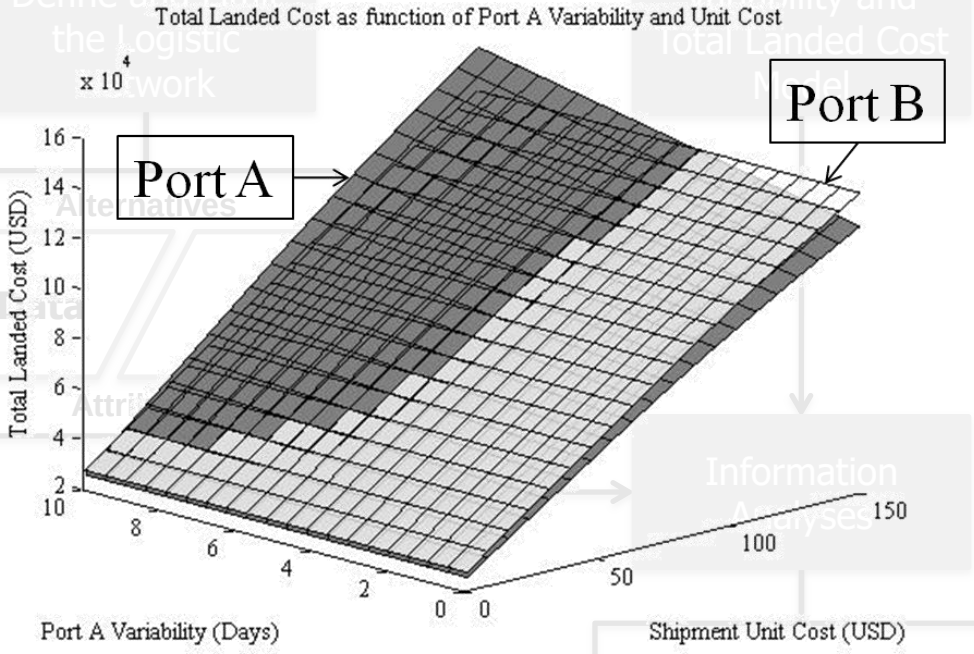
Sensitivity to Parameters

Setup and Computation

- **Integration of Users' Service Level Requirements with Observed Port's Variability**
- **Scenarios based on Users' Data and Analyses within Model**

Methodology Overview

Total Landed Cost Surface Comparison

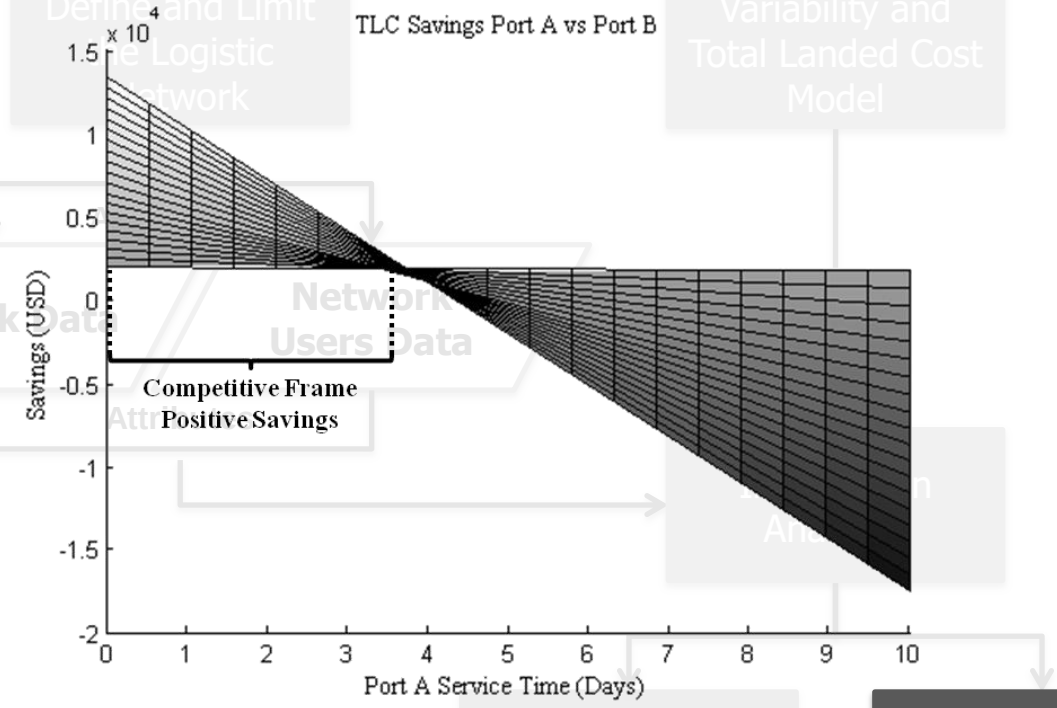


Variability Impact on Cost

Port Service Parameters

Methodology Overview

Total Landed Cost Savings

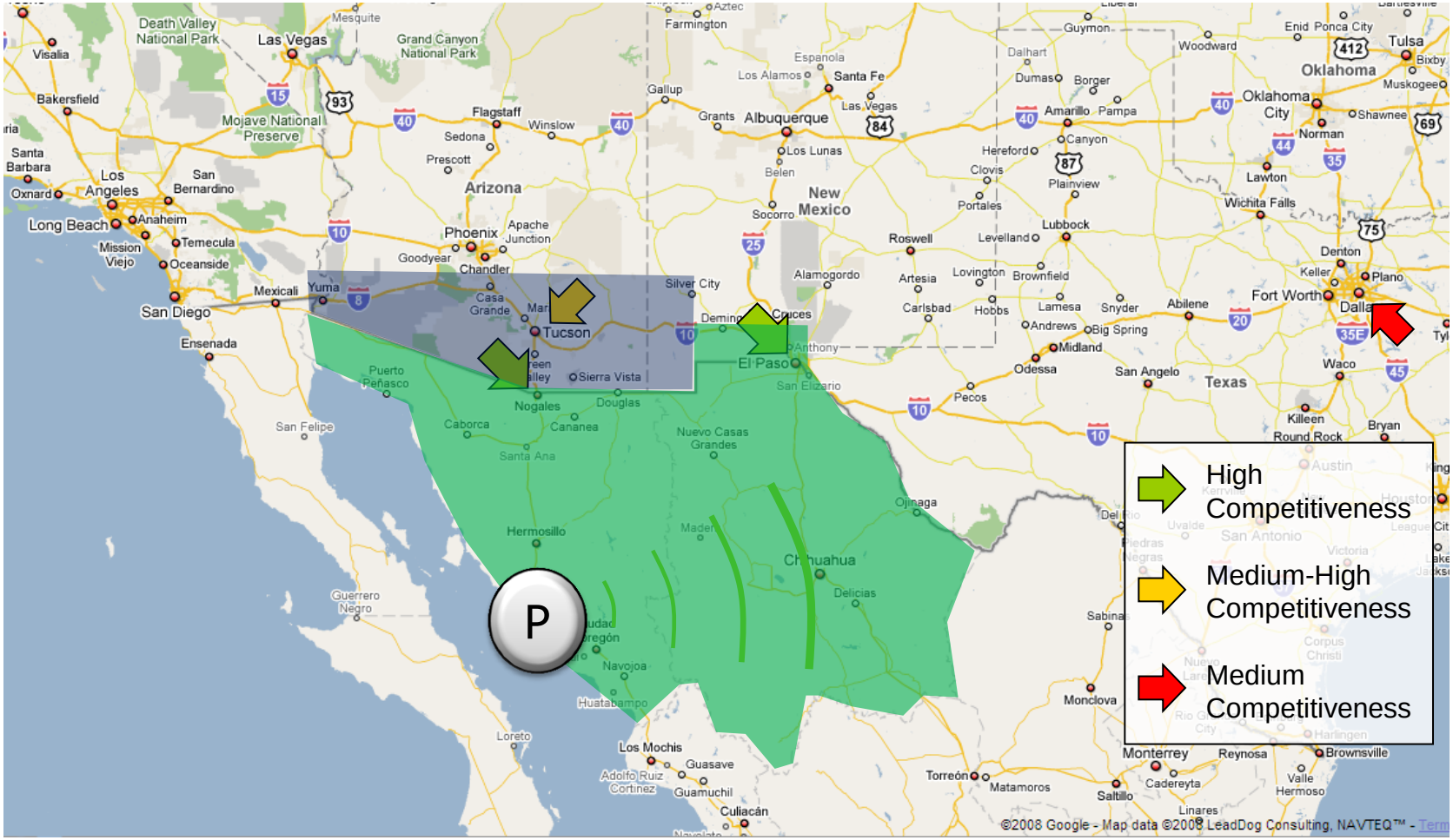


Port Service Parameters

The Port of Guaymas: Problem Definition

- The challenge is how to design and offer an efficient and competitive container service to the hinterland.
- Most companies in the hinterland may only compare factors like inventory transit times and shipping rates when selecting the port.
- It is necessary to explore possible trade-offs existing in the logistic costs between transportation and service time variability.

The Port of Guaymas: Influence Zone



* Key Factors and Players in the Design of the Multimodal Corridor, TEKNES, 2006

The Port of Guaymas: Methodology

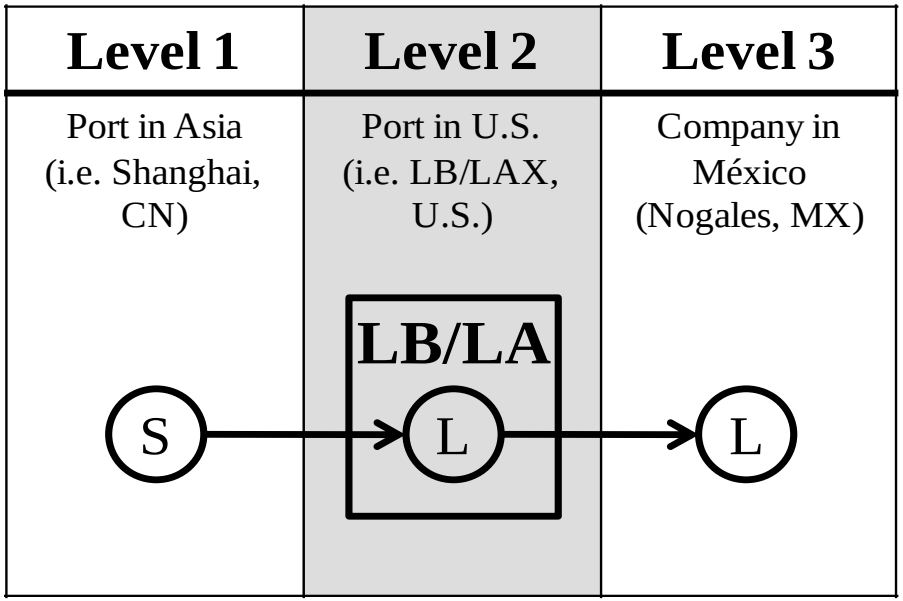
Network Segmentation

Level 1	Level 2	Level 3	Level 4	Level 5
Supplier in Asia (i.e. Hangzhou, CN)	Consolidation - Port in Asia (i.e. Shanghai, CN)	Port in U.S. (i.e. LA/LB, U.S.)	Consolidation Point –U.S. – México Border (Nogales, AZ)	Company in México (Nogales, MX)
L →	S →	L →	L →	L

L = Land Transportation
S = Sea Transportation

The Port of Guaymas: Methodology

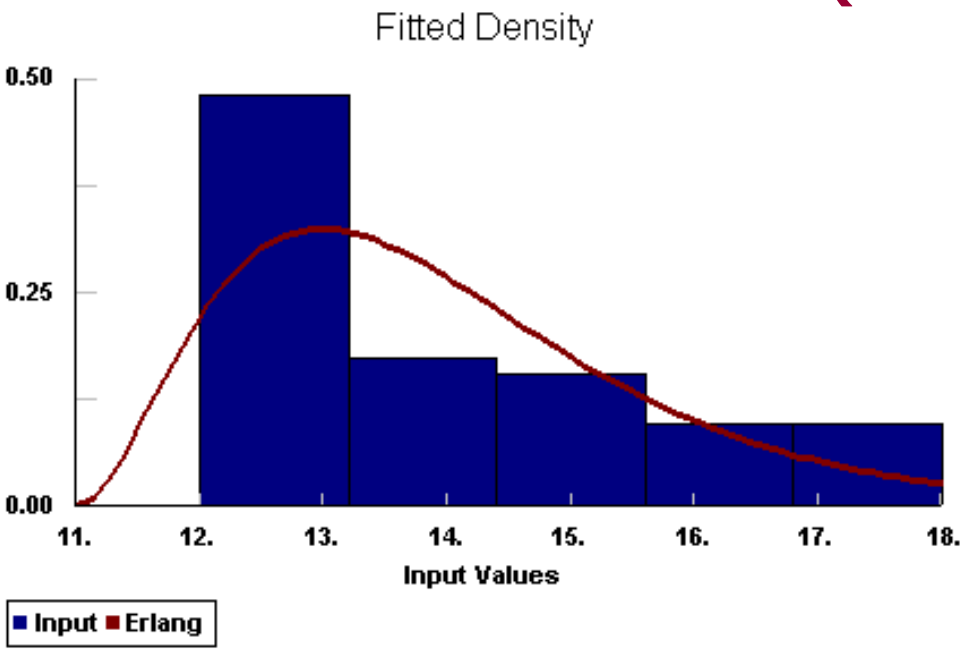
Simplified Network



L = Land Transportation
S = Sea Transportation

The Port of Guaymas: Methodology

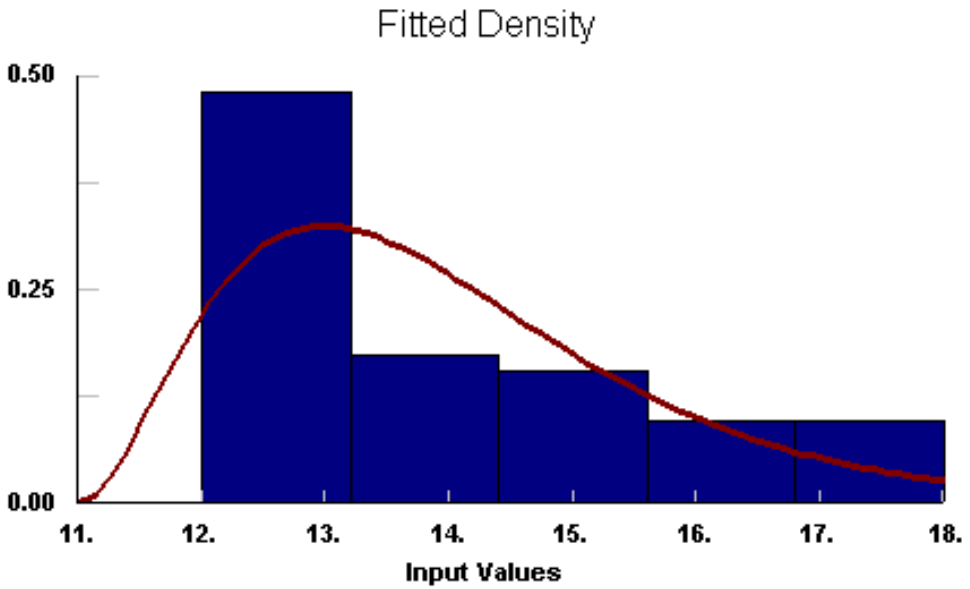
Observed Service Times in Network (Port LB/LA)



- Goodness of fit
  - Data points: 52
  - Estimates: MLE
  - Accuracy of fit: 0.0003
  - Level of sign.: 0.05
- Fitted Distribution
  - Erlang Distribution
  - Minimum: 11
  - M: 3
  - Beta: 0.999981
  - Mean: 14

The Port of Guaymas: Methodology

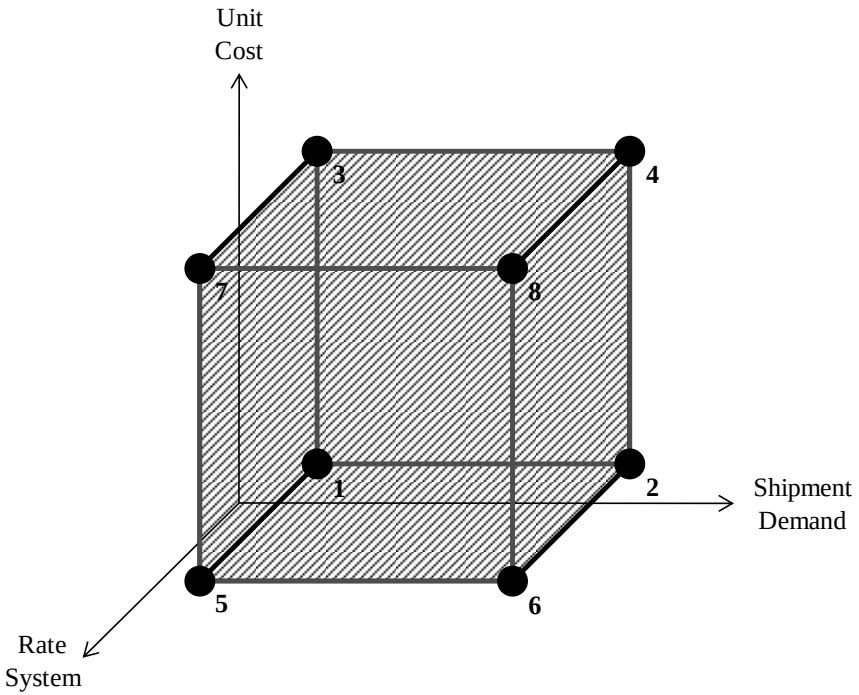
Observed Network Attributes



Origin	Port	Max Vessel Size (TEU)	Ave. Time at Sea	Time at Port	Distance to Nogales (High Influence)	Distance to Dallas (Medium Influence)
Shanghai	Los Angeles/ Long Beach	14,000	14	Variable (Erlang Dist.)	557 mi	1,430 mi
Shanghai	Guaymas	**N/A**	16	**Unknown**	258 mi	1,231 mi

The Port of Guaymas: Methodology

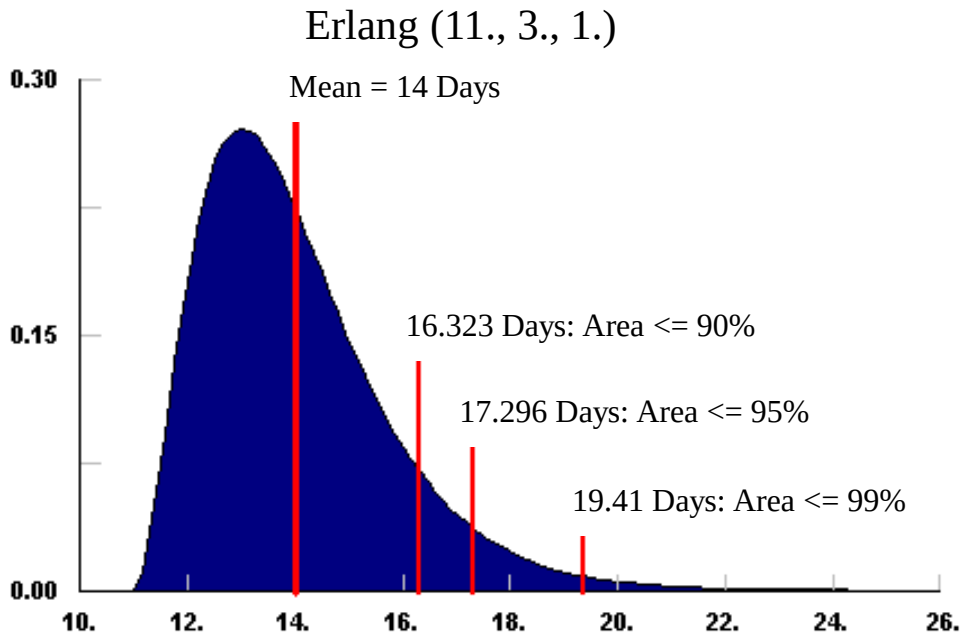
Network Users' Data



Industry	Shipment's Data	Values
Manufacturing Industry	Origins	East Asia
	Costs (USD)	From 5.00 to 150.00
	Demand (U/Yr)	From 10,000 to 500,000
	Shipment Type	Containerized
	Service Levels	90%, 95% and 99%

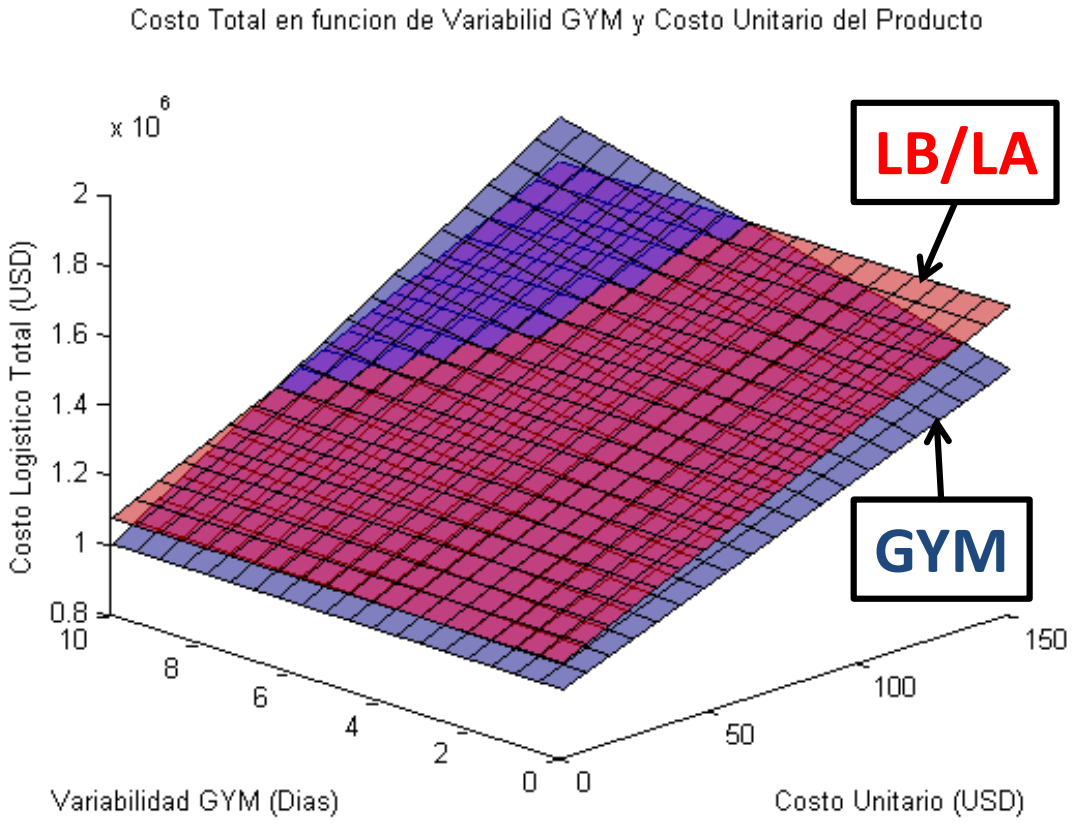
The Port of Guaymas

Observed Service Times in Network vs. Required S.L.



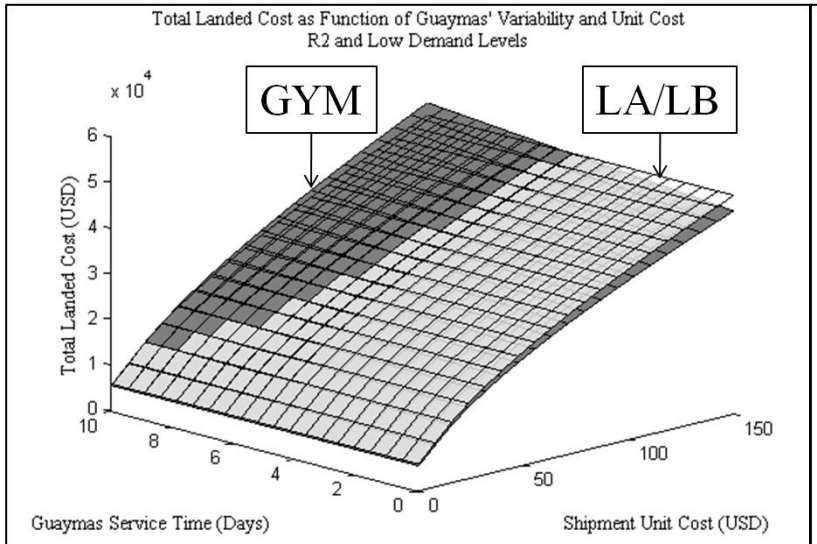
Origin	Port	Time at Port (w/Service Levels)			Distance to Nogales (High Influence)	Distance to Dallas (Medium Influence)
Shanghai	Los Angeles/ Long Beach	**90%** 2.32	**95%** 3.30	**99%** 5.41	557 mi	1,430 mi
Shanghai	Guaymas	**Unknown**			258 mi	1,231 mi

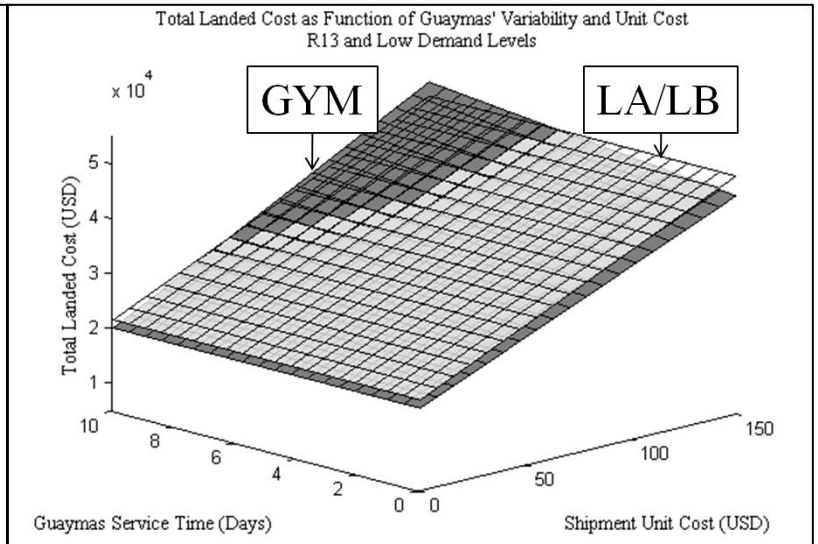
Impact of Container Terminal on TLC (GYM)

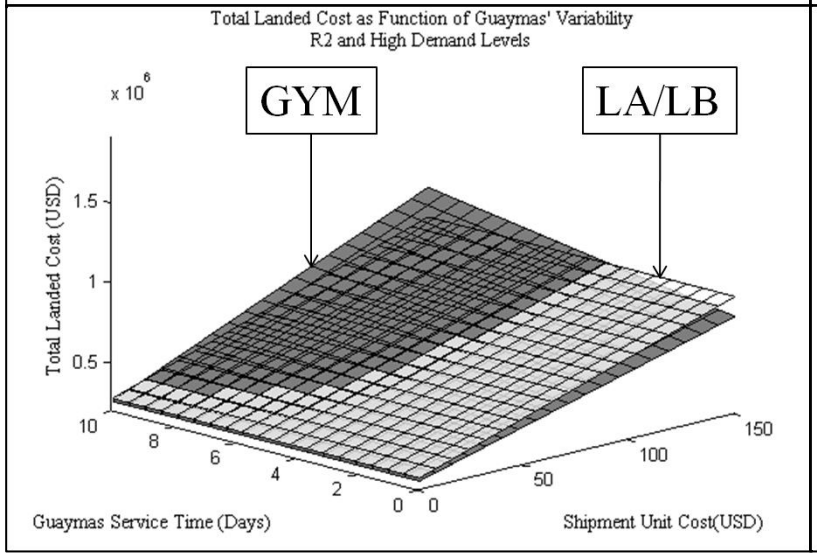


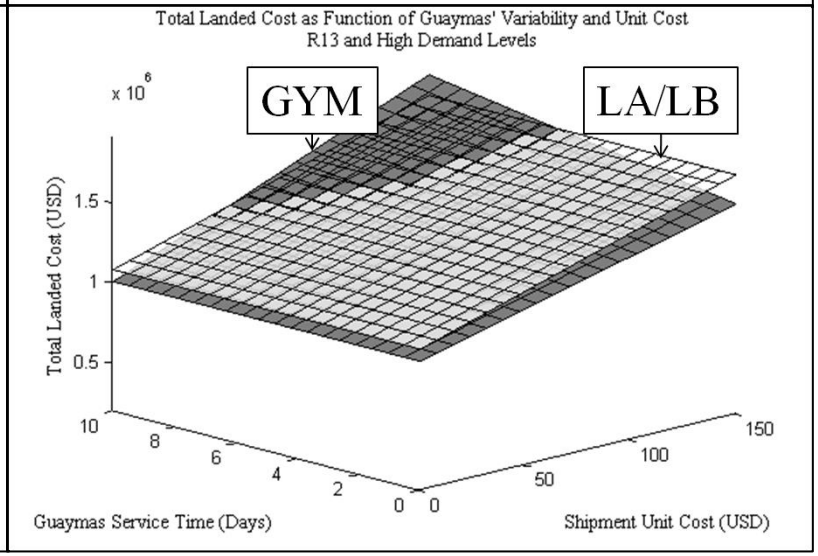
Ejem plo Comparativo (Costos - Escenario 8)

The Port of Guaymas: Variability Impact

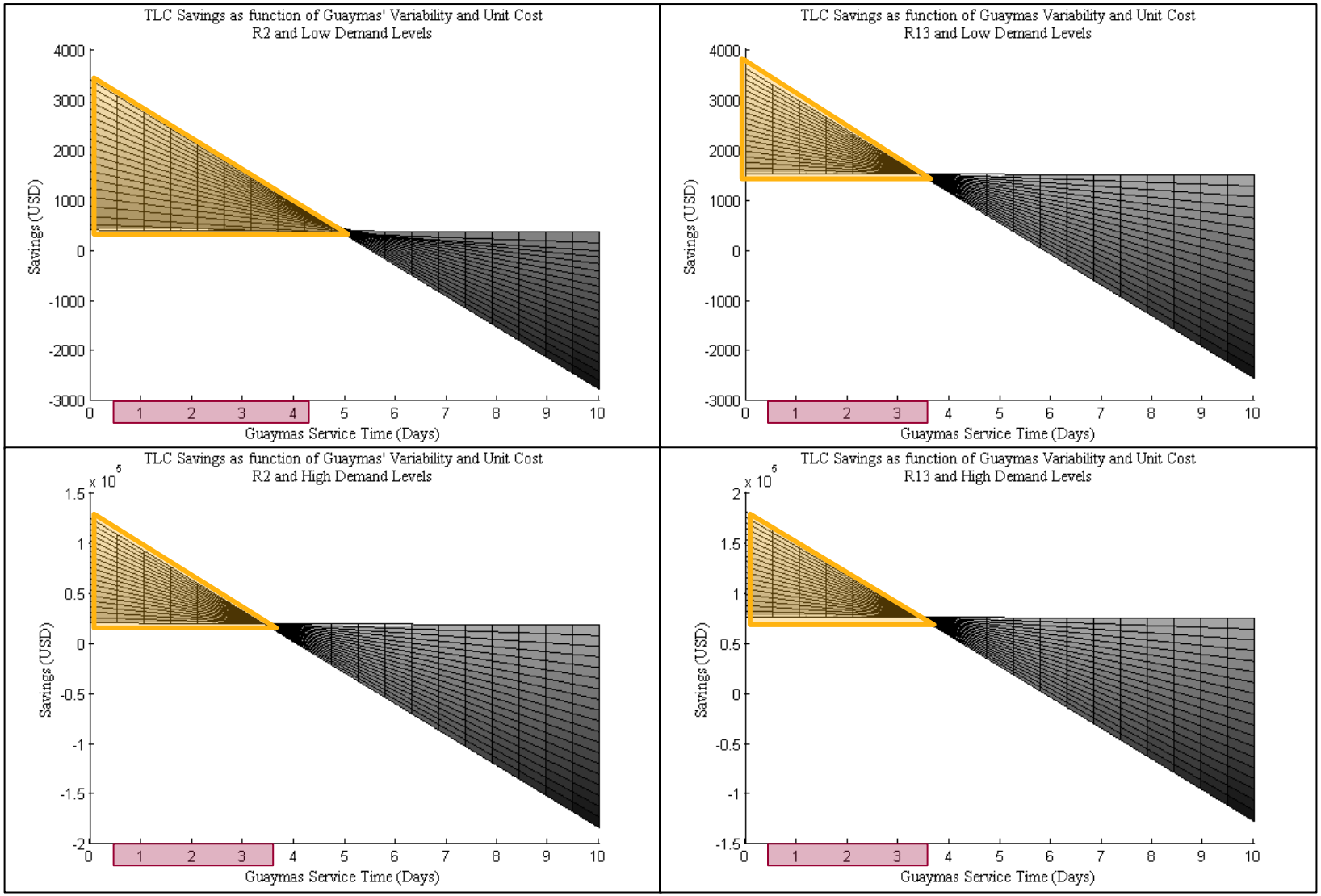








The Port of Guaymas: Parameters



The Port of Guaymas: Conclusions

- From the analysis framework, the Port Administration should offer variability no greater than **2.5 days**, this will provide the Service Level required to compete with other ports that currently cover the influence zone.

Findings of Port of Guaymas vs. Port of Long Beach

Scenario	Rate	Unit Cost	Demand	Conclusion vs. the Port of Los Angeles
1	R_2	$5.00	10,000	No Significant Savings
2	R_2	$5.00	500,000	Low Savings by using Guaymas
3	R_2	$150.00	10,000	No Significant Savings
4	R_2	$150.00	500,000	No Significant Savings
5	R_{13}	$5.00	10,000	Low Savings by using Guaymas
6	R_{13}	$5.00	500,000	High Savings by using Guaymas
7	R_{13}	$150.00	10,000	Low Savings by using Guaymas
8	R_{13}	$150.00	500,000	High Savings by using Guaymas

Conclusions

- The Proposed Methodology:
  - Establishes a relationship between port variability and total logistic costs.
  - Helps determine logistic conditions where a port can provide an efficient service.
  - Establish operation guidelines for a port that yield a competitive positioning within its hinterland supply chains.
- Identifying the proper competitive parameters for a port is economically beneficial for the port users.
  - If the logistic costs of the users are reduced, so their operational costs.
  - At the end could be beneficial for the economic development of the port's influence region.
- Powerful benchmark tool for port competitiveness.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