# Supply Chain Strategies for the International Interoceanic Mazatlan-Houston Logistic Corridor

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**ABSTRACT**
Describe the interoceanic Mazatlan-Houston Logistic Corridor (MHLC) as an alternative route to create sustainable competitive advantages for Mexican, USA, and international firms competing in an international marketplace. Taking into account the competitive advantages of utilizing this corridor for international trade, we analyze supply chain strategies for Mexican and international companies demanding economical logistic solutions in this region. It was found that the MHLC benefits efficient industry segments with demand well known in advance. It was also found that the potential of both inbound and outbound container traffic to the Asia-Pacific marketplace along this international commerce corridor fluctuates between 39,000 and 761,000 TEU´s.

Keywords: international trade; supply chain management; containerized freight; logistics; supply chains in Mexico; multinational corporations.

**RESUMEN**
El corredor logístico interoceánico Mazatlán-Houston (MHLC) se describe como una ruta alterna para crear ventajas competitivas sustentables para empresas mexicanas, estadounidenses, o internacionales que compitan en el mercado global. Considerando las ventajas competitivas al utilizar este corredor para comercio internacional, se analizan diversas estrategias de cadenas de distribución para empresas internacionales y mexicanas que demanden soluciones logísticas económicas en esta región. Se encontró que el MHLC beneficia segmentos industriales eficientes con demandas conocidas con anticipación. También, se encontró que el tráfico potencial de contenedores de importaciones y exportaciones para el mercado Asia-Pacífico en este corredor comercial internacional fluctúa ente 39,000 y 761,000 unidades equivalentes de veinte-pies.

## 1. Introduction

Mexico´s geographic location, 44 interconnected international free trade agreements [1], comparative low-cost location, and increasing investment in infrastructure create exceptional long-term business opportunities for international firms doing business in the region. The country´s continued investment in international logistic infrastructure as well as the willingness of private companies to utilize such requires an accurate measure of the freight transportation system performance. This

performance information is valuable information to many stakeholders of the supply chain, including retailers and multinational corporations (MNCs), logistic companies, corridor coalition authorities, industrial and chambers of commerce, research planning centers, and federal, state, and local governments.

Recently, a new highway, which includes a large collection of tunnels and bridges through the Sierra Madre Occidental Mountains, was constructed between the cities of Mazatlan and Durango. This highway only reduces the driving distance by a total of 75 km, yet it decreases the truck travel time from 10 - 12 hours to approximately 4 hours, and greatly reduces the rate of accidents [2]. Considering this new Mazatlan-Durango highway, an international interoceanic corridor between

Mazatlan, Mexico and Houston, Texas (the MHLC corridor) has been created, and it is described in this paper. More specifically, this paper attempts to answer the following two questions about the MHLC corridor: 1) which supply chain strategy will best be able to foster sustainable competitive advantages for retailer and manufacturing firms willing to establish operations in the MHLC? and 2) can we quantify both inbound and outbound containerized flow through the MHLC to the Asia-Pacific marketplace?

While the MHLC corridor will benefit any retailer or MNC, this paper focuses only on the analysis of retailers or MNCs having commercial operations with containers flowing from only the Asia-Pacific marketplace. We focus on retailers or MNCs that add value to the containerized products in the maquiladora segment. In this paper, we will describe the MHLC along with its hinterland, find the firms that would benefit from this corridor by applying supply chain strategies in order to create sustainable competitive advantages, and quantify the potential of both inbound and outbound container traffic to the Asia-Pacific marketplace.

The remainder of the paper is organized as follows: in Section II, we present the geographical description and the extended hinterland composition of the MHLC. In Section III, characteristics of the corridor and appropriate supply chain strategies to create sustainable competitive advantages in the MHLC are analyzed. In Section IV, the containerized freight flow is described. Lastly, conclusions, recommendations, and directions for future research are presented.

## 2. MHLC geographical description and its extended hinterland composition

The Port of Mazatlan is located on the Pacific Coast of Mexico just east of the southernmost tip of the Baja California peninsula. Figure 1 shows the geographical position of the port. This port has been in operation since the early 19th century. In 2012, the port of Mazatlan had the highest increase in rate of international containerized flight flow [3]. It increased from 22,746 TEU´s in 2011 to 39,263 TEU´s in 2012; corresponding to a 72.6% increase.

The new Mazatlan-Durango highway avoids driving along the famous “Devil´s Backbone,” a narrow road with steep climbs and deadly drops that follows the crest of the Sierra Madre Occidental Mountains [2]. From Durango to the Laguna region a four lane highway is in operation. The metropolitan area of the Laguna region includes the cities of Gomez Palacio in Durango and Torreon in Coahuila. The Laguna region is known for its agricultural and industrial activities as well as for its industrial parks with good infrastructure.

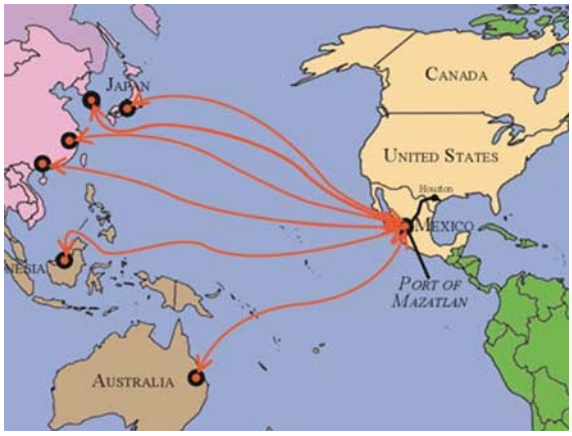


Figure 1. Port of Mazatlan geographical location.

The shortest route from Torreon, Coahuila to San Antonio, TX would be connecting Torreon to Monclova with a highway that passes though San Pedro and Cuatro Cienegas. The current highway connecting these two cities is under expansion to four lanes with an investment of 26 million dollars in 2013. A four lane highway is already in operation from Monclova to Piedras Negras, Coahuila. Piedra Negras has a port of entry to Eagle Pass, TX. The MHLC includes United States Highway 57 (US 57) and Interstate 35 (I-35) to connect Eagle Pass, TX to San Antonio, TX, and Interstate 10 (I-10) to connect San Antonio, TX to Houston, TX. The MHLC is illustrated in Figure 2.


Figure 2. International Interoceanic Mazatlan-Houston Logistic Corridor (MHLC).

Considering this logistic corridor, the driving distance from San Antonio, Texas to Torreon, Coahuila would be 775 km. The driving distance from Torreon to Durango is 247 km, and the driving distance from Durango to Mazatlan is 230 km. The total distance is 1,250 km, which is the shortest driving distance from San Antonio, TX to the Pacific Ocean. This route is shorter than the San Antonio, TX to Los Angeles, CA route by approximately 700 km.

The US MHLC hinterland is defined by dividing the contiguous US in 84 TAZs regions [4, 5] illustrated in Figure 3. A TAZ is an aggregation of Bureau of Economic Analysis (BEA) economic areas. Each BEA economic area is a geographic region, which includes one or more counties, that represents centers of economic activities. This study includes an extended hinterland of TAZs in the South Central region of the United States. This South Central region, illustrated in Figure 4, is bound by the Mississippi River, Kansas, and New Mexico.

Figure 3. Transportation Analysis Zones (TAZs) [4, 5].

In Mexico, the extended region of influence is composed of seven states: Sinaloa, Durango, Chihuahua, Zacatecas, Coahuila, Nuevo Leon, and Tamaulipas. The US and Mexico´s MHLC regions of influence are illustrated in Figure 4.

Figure 4. International Interoceanic Mazatlan-Houston Logistic Corridor hinterland.

The MHLC allows firms to offer superior products and services by: 1) connecting the Pacific and the Atlantic Oceans through the Mazatlan and the Houston seaports respectively; 2) using low-wage labor as well as low warehousing and transportation costs in the Mexican hinterland; 3) taking advantage of nonsaturated highways from Mazatlan to intersection of US 57 and I-35; and 4) combining both low-wage labor and high-technology applications. This combination can be done by manufacturing labor intensive products in Mexico and developing the advanced state of particular technologies that demand R&D resources and activities in the United States.

The San Pedro Bay ports are the busiest ports in the United States [6]. The combination of growing container volumes, larger container ships, and disruptive events adversely affect the ports´ capacity and productivity [7-9]. This combination of adverse factors makes the use of San Pedro Bay ports expensive, and therefore, the diversion of container flow to Mexican ports is feasible [6-

8,10,11]. This study is centered in the retailer sector and MNC sectors with value adding chain activities in the maquiladora segment, including machinery manufacturing, aerospace, electronics, pharmaceutical, petrochemical and plastics, and automotive. Most of the products being shipped in containers consist of electronic, metal-mechanic and plastic components, assemblies, as well as raw metal and plastic [12].

## 3. Sustainable Supply Chain Strategies

In the MHLC, trucks would be the dominant transportation for moving a wide variety of freight over a wide range of distances. The trucking industry has low entry requirements, and of all the different modes, trucks have the lowest entry cost. Air transportation is known for its high price and short lead times, while train and water transportation are known for their low price and long lead times. Truck transportation with moderate price and lead times occupies a middle ground between these extremes [13]. In terms of operation characteristics, truck transportation is advantageous on lead time, lead time reliability, availability, dependability, and frequency. However, it is limited on weight and volume capacity [13-15].

Since trucks are currently the principal mode of transportation, the MHLC is constrained by weight and volume capacity. Thus, it is assumed that retailers and MNCs requiring high containerized freight flow prefer railroad routes. Also, it is expected that the safest approach would be to operate within industry segments where speed is not an issue. Since the MHLC will start operations in the near future, more knowledge about its efficiency is required to respond to volatile demand. It is also assumed that retailers and manufacturers establishing operations in the MHLC will develop a set of related business processes and assets to create new unique capabilities in order to generate sustainable competitive advantages [16, 17]. In this study, we consider that cost incorporates elements such as inventory carrying cost, cost of mark-downs, cost of loss sales, transaction costs (including letters of credit and customs clearance), transportation, warehousing, and duties [18].

Let us try to answer which supply chain strategy will best be able to foster sustainable competitive advantages for retailers and manufacturing firms willing to establish operations in the MHLC. The answer lies in analyzing the three factors that affect supply chain strategies. The three factors that affect supply chain strategies are: the industry segment, the firm's business strategy, and the supply chain objectives and constraints [19-22].

### *3.1 The Industry Segment*

According to Fisher [23] the product type and the supply chain strategy should be aligned. In Fisher´s conceptual model, products are classified into two categories: functional or innovative. Functional products have long life cycles, and stable and predictable demand, but low profit margins. In contrast, innovative products have short life cycles, and volatile and unpredictable demand, but high profit margins. Each of these product categories requires a different kind of supply chain [23]. A responsive supply chain is capable of providing quick responses to unpredictable demand for innovative products, while an efficient supply chain transforms raw materials into parts, components, or finished products from node to node in the supply chain at the lowest possible cost for functional products. It is viable that the MHLC will provide better services for efficient supply chains managing functional products because of their stable and predictable demand.

### *3.2 The Firm's Business Strategy*

Michael Porter identified three generic strategies for building competitive advantages. These strategies are low cost, differentiation, and focus. Porter argues that cost and differentiation advantages and disadvantages will determine how well a business can position itself against its competition in a given industry [24]. All businesses satisfy customer needs by offering products and services that provide some value at a finite cost. Cost advantage means sensible products and services at affordable prices, while the differentiation advantage means paying more to obtain more. Considering Porter's generic strategies for building competitive advantages, the

described corridor will reduce investment risk and uncertainty for supply chains managing products competing through lower cost.

Two additional generic strategies are focused on creating advantages through either resources or capabilities. First of all, the resource base view of the firm (RBV) [16] strategy states that competitive advantage can be attributed to the ownership of a valuable resource that enables a company to perform activities better or more cost effectively than its competitors. In addition to the RBV strategy, the capability base strategy states that a firm´s competitive advantage originates from identifying and developing superior organizational abilities that distinguish a company in a peculiar industry segment [17]. A capability is a set of functional competences that a firm must develop to permanently deliver value to customers. Using these two strategic views, the MHLC is a resource available for firms to develop additional capabilities. It is viable that the MHLC will provide better services for products at affordable prices.

*3.3 The Supply Chain Objectives and Constraints*

Supply Chain Strategies is an emerging research area of supply chain management that requires immediate attention from both the academia and the supply chain management practitioners [21]. In this paper, we answer our first research question by using Sehgal´s [22] four supply chain drivers. Sehgal asserts that a supply chain controls four drivers that are the same whether they belong to a manufacturer or to a retailer. These four drivers are demand [25], supply [25-27], inventory [20, 28, 29] , and resources [20, 28-30]. It is important to recognize that some firms will manage not just one supply chain strategy, but several [28], and that these four drivers coexist in any supply chain. One of them, however, must guide the choice of the supply strategy [22]. Managing the flow of materials from the supply end to the demand end through a network of inventory and resource nodes is the main objective of the supply chain. The network of inventory and resource nodes is designed to absorb demand and supply signal variations to create a stable equilibrium for its operations. The natural volatility in demand and supply is stabilized by using buffers such as inventory and resource nodes as well as time [22].

Almost every firm has multiple supply chains running simultaneously for different product categories [22, 28]. A product category is a set of products with similar characteristics. Thus, retailers may manage high, moderate, or low demand product categories. Product categories consist of either: innovative product with short life cycles and volatile, unpredictable demand; or functional products with long life cycles and stable, predictable demand. The MHLC will benefit retailers with inventory and resource driven strategies. Also, these retailers should manage product families of functional products with moderate or low stable demand or demand well known in advance.

Supply chain strategies should be different for different manufacturing production strategies [30]. Each typical supply chain strategy has advantages and limitations that only work for certain scenarios [29]. In order to serve regional markets, different firms employ various production positioning strategies such as make-to-stock (MTS), make-to-order (MTO), assembly-to-order (ATO), and engineering-to-order (ETO). For our objective, however, we need to include not only manufacturing but also other operations such as procurement and delivery. Thus, production strategies should be complemented by various supply chain strategies such as build-to-order (BTO) and build-to-stock (BTS).

The build-to-order (BTO) strategy gains competitive advantages when it focuses on two aspects: demand fulfillment and lead times. In the first case, the main focus is on economies of scope, high customization, and better customer service. In the second aspect, the focus is on production efficiency. The build-to-stock (BTS) strategy focuses on economies of scale and low customization. This is a supply chain strategy in which production and operations depend on forecasted demand. It is especially suitable for one-product with low customization and/or mass production environments [29]. This strategy would gain competitive advantages where there is a high standard parts ratio along with low variance demand forecasted ahead of time. Firms using BTS strategies in the MHLC can use high monetary density products sourced over long distances, but it will usually be more practical to

use suppliers of relative low monetary density and bulky products close to the assembly plants [28].

The assembly-to-order (ATO) strategy is essentially the combination of the BTS and BTO strategies. In ATO strategies, schedules for remaining components, subassemblies, and the final assembly are not executed until customer ordered specifications are received. However, standard parts and subassemblies are acquired and manufactured according to forecast [29]. Firms implementing inventory and resource driving strategies and using BTS and ATO will get the greatest benefit from the MHLC.

## 4. Estimation of mhlc potential containerized freight traffic

The estimation of the number of containers (measured in TEU´s) shipped back and forth between the Asia-Pacific marketplace and the US MHLC hinterland through the San Pedro Bay is described in this section. Our assumption is that the upper bound of containerized traffic would be estimated by diverting all container traffic using trucks going back and forth from the San Pedro Bay to the MHLC hinterland.

The port of Mazatlan handled 39,263 TEU´s in 2012 [3]. Thus, these 39,263 TEU´s are used as a lower bound.

Levin, Nozick, and Jones [4, 5] developed gravity models to estimate both inbound and outbound containerized flow (TEUs) shipped from the Asia-Pacific marketplace, through the San Pedro Bay, to 84 Transportation Analysis Zones (TAZs) [5] and vise-versa. In those publications the 84 regions were referred to as Transportation Analysis Zones (TAZs) illustrated in Figure 3. Since the ports of Los Angeles and Long Beach are both in Los Angeles County, the authors consider these two ports together.

The gravity model developed by reference [5] synthesizes data on international trade available from PIERS Global Intelligent Solutions in 2004 and from the Carload Waybill Sample of US domestic railcar movements available from the Surface Transportation Board (STB) in 2003. In this study, once the containers arrive to US ports via sea links they are shipped to TAZs via either truck or railroad. Also, Levin, Nozick, and Jones [4] estimate containerized freight flow for exports using US Maritime Administration data for international trade instead of the data from PIERS. In this study, the authors find that more than half of all containers exported through US seaports are empty.

Using Levin, Nozick, and Jones gravity models and considering only the TAZs in the South Central US hinterland region illustrated in Figure 3, we can conclude that the containerized inbound flow would be close to 375,500 TEUs, while the containerized outbound flow would be approximately 385,500 TEUs. In total, the described corridor traffic is predicted to fluctuate between 39,263 and 761,000 TEUs once the Mazatlan-Durango highway is in full operation. The 761,000 TEUs estimation is the potential market for the corridor to the Asia-Pacific marketplace; however, significant work is required to create efficient processes in the MHLC in order to attract traffic.

In this research, we found appropriate supply chain strategies to create sustainable competitive advantages in the MHLC. However, this study, which presents a very broad perspective of the corridor, is the starting point for future research.

## 5. Conclusion and future research

We described the international interoceanic Mazatlan-Houston Logistic Corridor and its hinterland, and labeled its advantages and limitations. Since the MHLC will start operations in the near future, it is concluded that the safest approach would be to operate with industry segments where speed is not an issue. Also, the MHLC is constrained by weight and volume capacity since truck transportation is the principal mode of distribution. Therefore, retailers and MNCs are restricted to moderate or low demand volumes.

The MHLC will benefit retailers with inventory and resource driven strategies managing product families of functional products with moderate or low stable demand or demand well known in advance. The MHLC can be used by manufacturing firms using BTS and ATO with efficient inventory and resource driven supply chain strategies. These manufacturing firms are

focused on the lowest possible cost for functional products where demand remains stable and is well known in advance.

Using gravity models and considering the TAZs in the South Central US hinterland region illustrated in Figure 3, it is concluded that the bound of containerized imports and exports flow fluctuates between 39,263 and 761,000 TEUs.

In order to have a better estimation of corridor performance, we recommend performing detailed analysis to calculate operational and warehousing costs. A more detailed study of processing and customs crossing times is also recommended. In addition, decision models are required to determine the MHLC capacity, to find bottlenecks, and to make the containerized flow more efficient. Studies focused on supply chain strategies for each potential industry segment are required. Currently, we focus on imports and exports to the Asia-Pacific marketplace, but this is the opportunity to extend this study to other global marketplaces. It would be interesting and useful to estimate realistic integrated rates for this corridor; studies should be pursued in order to compare the potential services offered by the Mazatlan-Houston Logistic Corridor against those offered by alternative routes such as the Panama Canal, San Pedro Bay, and Prince Rupert.

The described corridor will also benefit the Ports to Plain corridor—a corridor connecting the central US region to Mexico and Canada. Decision models to estimate cost, flow, time, variability, and demand for this alternative are required.

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## *References*

[1] M M. Cedillo-Campos, and C. Sanchez-Ramirez, "Dynamic Self-Assessment of Supply Chains Performance: an Emerging Market Approach," Journal of Applied Research and Technology, vol. 11, no. 3, pp. 338-347, 2013.

[2] Secretaria de Comunicaciones y Transportes. La carretera Durango-Mazatlan: puente el Baluarte bicenternario. Available from: http://www.capufe.gob.mx/portal/wwwCapufe/SalaDePrensa/AutDgoMaztlnPteBaluarte.pdf.

[3] Secretaria de Comunicaciones y Transportes. Informe estadistico mensual movimiento de carga, buques, y pasageros. Available from: http://www.sct.gob.mx/fileadmin/CGPMM/U_DGP/estadisticas/2012/Mensuales/12_diciembre_2012.pdf.

[4] B. Levine, L. Nozick, and D. Jones, “Estimating an origin-destination table for US exports of waterborne containerised freight,” Maritime Economics & Logistics, vol. 11, no. 2, pp. 137-155, 2009.

[5] B. Levine, L. Nozick, and D. Jones, “Estimating an origin–destination table for US imports of waterborne containerized freight,” Transportation Research Part E: Logistics and Transportation Review, vol. 45, no. 4, pp. 611-626, Jul. 2009.

[6] R. C. Leachman, and P. Jula, “Congestion analysis of waterborne, containerized imports from Asia to the United States,” Transportation Research. Part E, Logistics & Transportation Review, vol. 47, no. 6, pp. 992-1004, 2011.

[7] J. McCray, and J. Gonzalez, “Critical infrastructure at U.S. west coast intermodal terminals: are canadian or mexican terminals and alternative?,” Transportation Research Record: Journal of the Transportation Research Board, vol. 2062, no. 1, pp. 25-31, Dec., 2008.

[8] E. Rodriguez S., M. Kubo, N. R. Angel, and M. Murayama, "Third route of Asian container cargoes to USA -the rail canal- a new route on the western coastline for Asian freight," in OCEANS MTS/IEEE, Kobe (Japan), 2004, pp. 2254-2262.

[9] L. Bearzotti, R. Gonzalez, and P. Miranda, "The Event Management Problem in a Container Terminal," Journal of Applied Research and Technology, vol. 11, no. 1, pp. 95-102, 2013.

[10] R. C. Leachman, “Port and modal allocation of waterborne containerized imports from Asia to the United States,” Transportation Research. Part E, Logistics & Transportation Review, vol. 44, no. 2, pp. 313-331, 2008.

[11] R. C. Leachman, and P. Jula, “Estimating flow times for containerized imports from Asia to the United States through the Western rail network,” Transportation Research. Part E, Logistics & Transportation Review, vol. 48, no. 1, pp. 296-309, 2012.

[12] C. Meneses, and J. R. Villalobos, "Determination of operational parameters for an efficient container service in the port of Guaymas," 11th International Material Handling Research Clocium, 2010.

[13] S. T. Webster, "Principles of supply chain management", Belmont, MA: Dynamic Ideas, 2009, pp. 280-290.

[14] D. Long, "International logistics: global supply chain management", Norwell, Mass.: Kluwer Academic Publishers, 2003, pp. 125-146.

[15] J. Mangan, C. Lalwani, and T. Butcher, Global logistics and supply chain management, Chichester, England; Hoboken, NJ: John Wiley & Sons, 2008, pp. 123-133.

[16] D. J. Collis, and C. A. Montgomery, "Competing on resources: strategy in the 1990s," Harvard Business Review, vol. 73, no. 4, pp. 118-128, 1995.

[17] G. Stalk, P. Evans, and L. E. Shulman, "Competing on capabilities: the new rules of corporate strategy," Harvard Business Review, vol. 70, no. 2, pp. 57-69, 1992.

[18] C. Martin, and D. R. Towill, "Developing market specific supply chain strategies," International Journal of Logistics Management, vol. 13, no. 1, pp. 1-14, 2002.

[19] A. Cox, D. Chicksand, and T. Yang, "The proactive alignment of sourcing with marketing and branding strategies: a food service case," Supply Chain Management: An International Journal, vol. 12, no. 5, pp. 321-333, 2007.

[20] J. D. Pagh, and M. C. Cooper, "Supply chain postponement and speculation strategies: how to choose the right strategy," Journal of Business Logistics, vol. 19, no. 2, pp. 13-33, 1998.

[21] W. Rose, I. J. S. Mann, and S. Rose, "A strategic perspective and taxonomy of supply chain strategies," IUP Journal of Operations Management, vol. 11, no. 3, pp. 6-42, 2012.

[22] V. Sehgal, "Supply chain as strategic asset the key to reaching business goals", Hoboken, New Jersey: Wiley, 2010, pp. 123-138.

[23] M. L. Fisher, "What is the right supply chain for your product?," Harvard Business Review, vol. 75, no. 2, pp. 105-116, 1997.

[24] M. E. Porter, "Competitive advantage: creating and sustaining superior performance", New York; London: Free Press; Collier Macmillan, 1985.

[25] E. A. Morash, "Supply chain strategies, capabilities, and performance," Transportation Journal (American Society of Transportation & Logistics Inc), vol. 41, no. 1, pp. 37-54, 2001.

[26] R. H. Hayes, and G. P. Pisano, "Beyond world-class: the new manufacturing strategy," Harvard Business Review, vol. 72, no. 1, pp. 77-87, 1994.

[27] S. K. Vickery, J. Jayaram, C. Droge, and R. Calantone, "The effects of an integrative supply chain strategy on customer service and financial performance: an analysis of direct versus indirect relationships," Journal of Operations Management, vol. 21, no. 5, pp. 523-539, 2003.

[28] J. C. Cooper, "Logistics strategies for global businesses," International Journal of Physical Distribution & Logistics Management, vol. 23, no. 4, pp. 12-25, 1993.

[29] W. Sen, S. Pokharel, and W. YuLei, "Supply chain positioning strategy integration, evaluation, simulation, and optimization," Computers & Industrial Engineering, vol. 46, no. 4, pp. 781-792, 2004.

[30] M. Rudberg, and J. Olhager, "Manufacturing networks and supply chains: an operations strategy perspective," Omega, vol. 31, no. 1, pp. 29-39, 2003.