Reducing Outbound Transportation Costs: A Case Study

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Abstract

The problem of decreasing truck transportation costs for Mexican firms is of great interest and a challenge due to the currently deficient supply structure. This work deals with the case of leading Mexican tobacco manufacturer that requires a reduction of its outbound transportation cost under a declining market scenario. The approach applied to achieve the objective includes the elimination of important transportation wastes through mathematical modeling techniques. Truck fill loss and distance travelled in excess are identified as the main wastes existent in the transportation of finished product from the manufacturing plant, located in Monterrey, to three regional warehousing hubs, and then, from these to 70 distribution centers located throughout the country. The application of location and/or routing models imbedded into a decision analysis scheme and supported by a GIS system is carried out to obtain the solution to several scenarios developed by the management of the company. Results and advances of their implementation are provided.

Keywords
Transportation wastes, transport cost optimization, Vehicle routing

1. Introduction.
The problem of concern in this paper is the reduction of outbound transportation cost. This is particularly of great importance for Mexican companies because of the country`s deficient logistic level of competitiveness in road transportation (IMCO 2004). The firm of concern is a leading producer and distributor of tobacco products to its Distribution Centers (DC) and retailing chains across Mexico. The national supply chain, shown in Figure 1, consists mainly of one processing plants, three consolidating hub centers, 57 regional distribution centers and 17 distribution centers of the leading convenience store in Mexico, OXXO. The transportation of the final product is outsourced to three companies; Ryder, Tres Guerras and Racing.

The firm satisfies 40% of the Mexican market with 9 brands distributing directly 200, 000 retailing points. The company has experienced two important strategic issues that have impacted unfavorably its level of competitiveness and market share; a more stringent law enforcement against smokers and; a more severe competition from other players. As a consequence, the firm has seen a decrease in its national demand. The distribution cost associated has increased during the last years forcing the upper management to establish an objective of reducing outbound transportation.

This work provides a brief description of the efforts of the company to implement the approach recommended by Di Vece et al., (2015) that has the purpose of reducing distribution cost through a change of the distribution structure and its improvement. The report consists of four sections with the initial dealing with a brief review of the literature on the problem. Then, a description of the scheme utilized is described in section 2. The application of this scheme is undertaken in section 3, and section 4 presents a summary of conclusions.
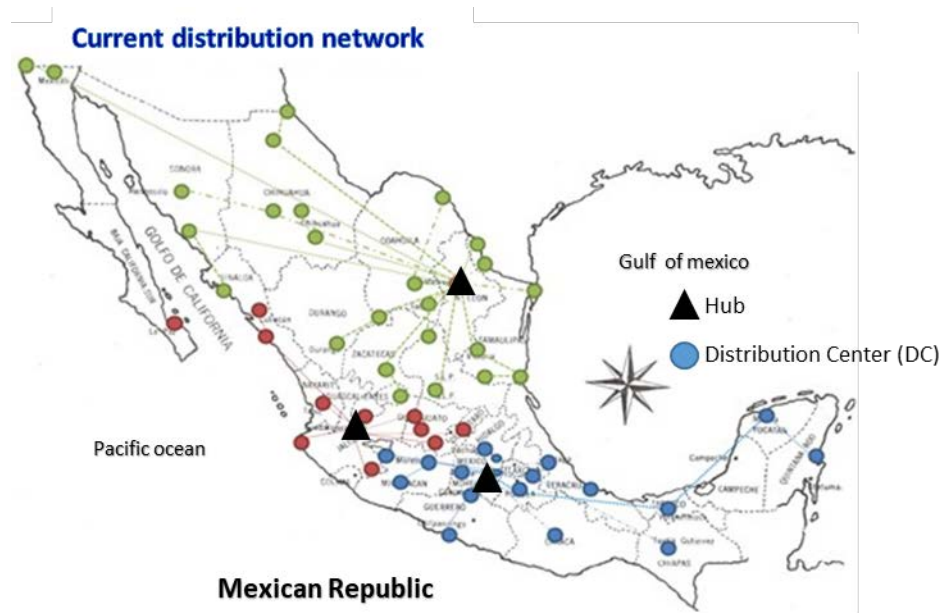
Figure 1. Description of Mexican supply chain of company of concern

2. Literature research

Transportation is the largest component of total logistics costs. This has increased very significantly to the point that companies are starting to define improvement initiatives to reduce costs. Several approaches have been developed and applied to achieve such an objective. However, the general approach suggested by Di Vece et al., (2015) and Moore (2006) proposes four stages that integrate most of the most important schemes developed. According to Moore (2006), the evolution of freight cost reduction has gone through the following stages; Negotiation of prices; streamlining operations, improving communication with carriers and; optimizing routes.

The first stage is the negotiation of transport prices. Success in this stage depends on which side (shipper or carrier) has the bargaining power. Key variables are the transportation volumes and the horizon of the deal. An additional factor to consider today is the concept of security of supply, and particularly for Mexican companies. If there are opportunities to reduce cost under this stage, then there was probably inexistent or incompetent negotiation in the past.

The next stage considers streamlining operations. This approach commonly consists of the definition and implementation of efficiency programs such as Total Quality Management or Lean programs. According to Simmons et al., (2004), eliminating unnecessary transportation can be achieved increasing transport efficiency. Original work on lean transportation was developed by Villarreal (2012) and Sternberg et al., (2013). The authors suggest the application of efficiency measures called Overall Vehicle Effectiveness (OVE) and Total Overall Vehicle Effectiveness (TOVE) and the identification of specific transportation wastes. Further work developed by Villarreal et al., (2016 a,b) provide general schemes to improve transport efficiency through waste elimination in truck transportation. Methodologies for waste elimination in the areas of railroad transportation and airline operations have been developed by Dirnberger (2003) and Lehman et al., (2010) respectively.

The third stage includes communication based initiatives such as centralizing dispatch operations (Moore et al., 1991), electronic communication of daily requirements, Collaborative Transportation Management (CTM) (Sutherland 2006; Nadarajah et al., 2007; Ergun et al., 2007a), and the like. Sutherland (2006) conceptualizes CTM as an holistic process that integrates supply chain parties and transport suppliers for the purpose of improving performance by eliminating inefficiencies. An important requirement to enable it is the implementation of information technology for real time data gathering and decision making. The concept of CTM is further elevated by the use of mathematical modeling by Ergun et al., (2007b) and other researchers as described in the next section.

Finally, the last stage involves the usage of mathematical modeling and tools to obtain optimal transportation decisions. Vehicle routing solutions (Laporte 2009; Lohatepanonto et al., 2006)), continuous moves algorithms (Moore et al., 1991; Schmid et al., 2013), and similar solutions are now possible. An important recent trend in VRP research is the movement of what has been called rich VRP models. This movement has been fueled by the need to solve real-life routing problems. A small sample of contributions is described in Schmid et al., (2010), Irnich (2008), Drexl (2011) and Hasle et al., (2007).

3. Solution methodology

The broad scheme used to identify and implement initiatives for reducing inbound transportation cost is based on the stages suggested by Di Vece et al., (2015). The four stages can be used as a reference model to assess the status of a company in the transportation function. It can also provide potential improvement initiatives. Table 1 presents a summary of the reference model.

Table 1 Description of the solution methodology (from Di Vece et al., 2015)

Price Negotiation	Operations Streamlining	Enhanced Communication	Optimization	
- Freight tariffs according to volume and horizon. - . - . - . - . - . - **Tariff negotiated when service is required.**	- Improvement strategy defined and well organized. - . - . - Isolated improvement projects without a strategic basis. - . - **No improvement efforts.**	- Transport collaboration program in place. - . - . - . - . - . - **Communication required only to place a service requirement.**	- Transport optimization model and system integrated with the supply chain. - . - Isolated transport problems modeled. - . - . - **No effort.**	- - **Advanced** ⬆ - **Incipient**

Two dimensions are considered. The first one corresponds to the original proposition by Moore (2006). The additional dimension adds the possibility of assessing the degree of advancement within each stage. For example, for the stage of Price Negotiation, the lowest level at which a company can be is where single transport service tariffs are settled as needed. Here, the advanced level is for companies that negotiate future transport requirements looking for discounted or lowest tariffs based on volume and long term horizon contracts.

At the stage of Streamlining Operations the most advanced level corresponds to the situation in which the firm has an improvement coherent strategy. Its improvement initiatives are all alienated to its corporate strategy defined to increase its level of competitiveness. The lowest level is associated to situations in which the company does not care about improvement or isolated projects are carried out.

In the stage of Enhanced Communication, the function could be positioned in the very basic level of communicating with suppliers and the rest of the supply chain only to satisfy the transport requirement as needed. However, it may also be positioned at the advanced level as part of Transport Collaboration program where a more intense degree of information flow and interaction with transport providers and the rest of the supply chain are necessary. Finally, the last stage of the evolution corresponds to the Optimization of the operations. The most advanced level considers the modelling of the transportation system as a whole, including its impact on the performance on the rest of the elements of the supply chain. If the firm does not make any effort to look for optimal solutions, this represents the lowest level.

It is important to mention that improving the performance in one stage may be required to improve in another stage(s). For example, higher levels of communication within the organization and with external parties are necessary to enable successful price negotiations or eliminating waste in operations. Transport collaboration is one initiative that requires the participation of all parties involved and the possibility of using optimization models to obtain better results.

4. Application and results

As described in the Introduction, the firm of concern is a leading producer and distributor of tobacco products to its regional hubs and distribution centers across Mexico. The company has a well-organized and integrated outbound distribution system (shown in Figure 1). The concern in this work is its outbound transportation which is totally done by external providers. The management in charge of distribution and logistics of the firm decided to establish the objective of reducing total outbound cost transportation. The paper will describe the application of the reference model proposed by Di Vece et al., (2015).

Finished product flow through the distribution system starts at the plant located in Monterrey. The next stage or echelon is composed of three hubs located in Monterrey, Guadalajara and México. Each of these hubs serves an associated regional network of distribution centers and OXXO distribution centers as shown in Figure 1. Transport is carried out by trucks in fifty routes from each of the three outsourced firms; Ryder, Tres Guerras and Racing. All finished product is transported in standard boxes filled with 345 cigarrete packages.

4.1 Original status of transportation function

The original situation of the outbound transportation area of the company can be described as incipient. According to the reference model, the position of the function is in the most rudimentary level in every concept of the model.

- Outbound transportation for finished products is responsibility of the logistics and traffic area of the company. For at least the last five years, the company was interested in maintaining the status quo of the function. Transport planning was not changed and it was only considered as a necessary activity. The number and contents of routes were kept fixed every year even though demand was decreasing every year. Therefore, there is a great opportunity for improvement. Transport tariffs were negotiated when a service was required, and supplier selection was done at the very basic level.
- Communication with suppliers was basic and only to assign a transport service.
- There was not an effort for improving the performance of this function. Optimizing the operation was not an option.

4.2 Definition of cost reduction strategy

The improvement strategy should be structured to elevate the level of each of the stages of the Reference Model. This document is concerned with the description of the initiatives undertaken for stages 1, 2 and 4.

4.2.1 Price negotiation stage

As previously mentioned, the firm has three outsourced transportation suppliers; Ryder, Tres Guerras and Racing. As shown in Figure 2, Ryder is the supplier most used with 70% of the volume and the most expensive with 59.90 M.N. pesos per kilometer. Tres Guerras is the second most important supplier. It contributes moving 24% of the volume with a cost per kilometer of 29.2 M.N. pesos. Finally, Racing participates moving 6% of the volume with a cost of 21 M.N. pesos per kilometer. Given the previous situation, several improvement avenues are possible. The most obvious is the change of external suppliers for cheaper ones. The next step involves selecting suppliers and negotiating tariffs based on volume transported and longer horizon.

4.2.2 Operations streamlining stage

Outbound transportation of finished product was done by direct FTL shipments from the plant to each hub and vehicle routes from the hubs to DC´s. Three types of trucks are used; 53 ft-trailer with capacity for 1380 boxes of FP; tortons with capacity for 780 boxes of FP and; trucks with capacity for 480 boxes. The main transportation waste identified was fill rate or truck capacity under-utilization. As illustrated in Figure 3, truck capacity utilization from the plant to the hubs averaged 85.7%, and from the hubs to the Distribution Centers is estimated in 47.2

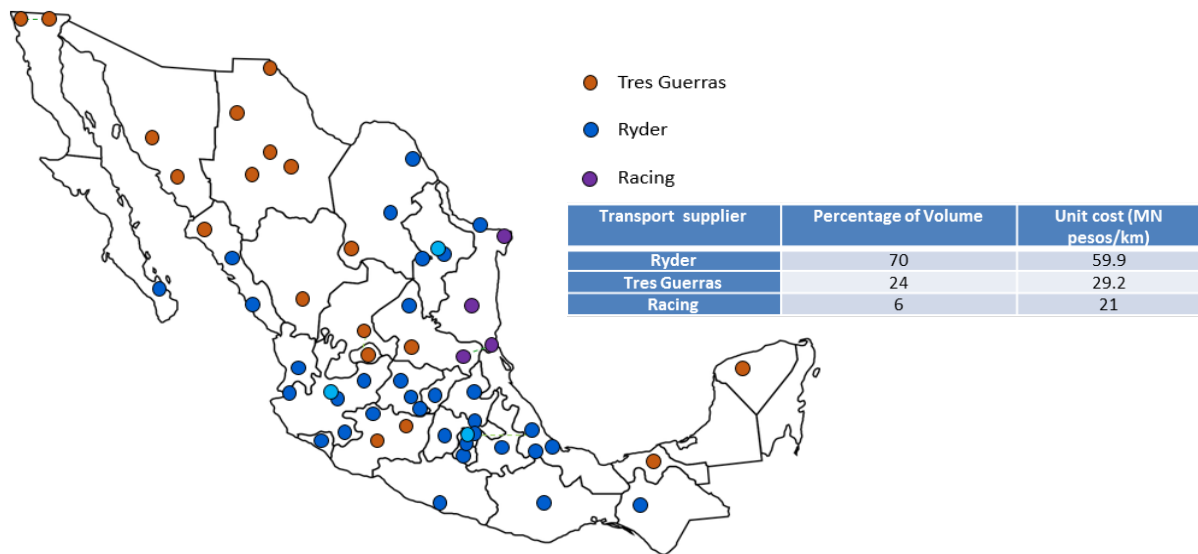| Transport supplier	Percentage of Volume	Unit cost (MN pesos/km)
Ryder	70	59.9
Tres Guerras	24	29.2
Racing	6	21

Figure 2. Summary of outsourced transportation suppliers

These numbers are computed for one-way trips, back-hauls are always empty. The alternatives available to reduce Fill loss depended on the structure of the flows of the rest of the supply chain. As mentioned previously the organization was experiencing a reduction of its market share and transport planning had not been modified accordingly. Two potential options are available; optimizing the number of hubs of the network; optimizing the number and assignment of DC´s to hubs and; redefining the distribution routes from the hubs to the DC´s.
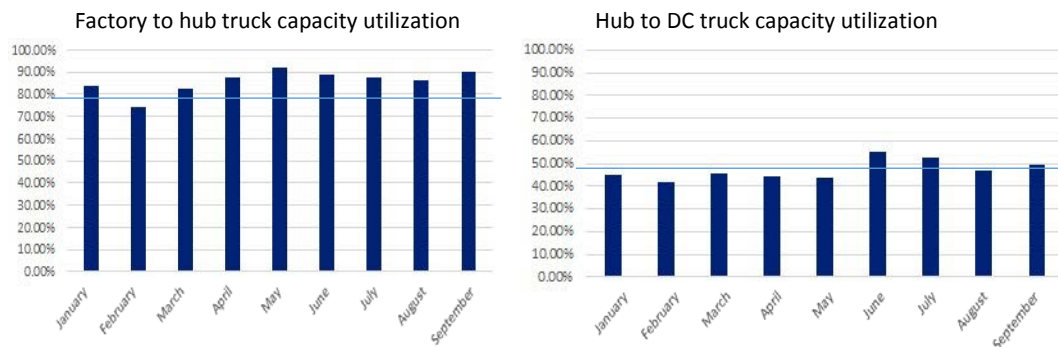

Figure 3. Truck capacity utilization rate

4.2.3 Distribution optimization stage

As shown in Figure 4, the current distribution network presents two strategic improvement areas; the possibility of requiring the addition of one or two new hubs and; the re-assignment of the CD´s to hubs. Additionally, and after carrying out the previous tasks, the redefinition of new routes from hubs to DC´s are necessary to improve the truck utilization capacity.

The initial task refers to the strategic redefinition of the structure of the network. First, it is desirable to determine the number and location of up to two new hubs in the network, additional to the ones already operating. This decision was taken with the help of the Center of Gravity model. The analysis undertaken to make the previous decision considered the assessment of three scenarios; the actual structure with the current hubs; the actual structure with the addition of one new hub and; the actual structure with two new hubs included. Each scenario was evaluated adding the assignment of DC´s to hubs with the help of the transportation model. The preferred solution is illustrated in Figure 5. This new structure includes the addition of new hubs in the cities of Chihuahua and Puebla. Finally, the last task contemplated the redefinition of distribution routes. This was realized using the software Route4me (https://route4me.com/). Figure 6 shows an example of one of the new designed routes.
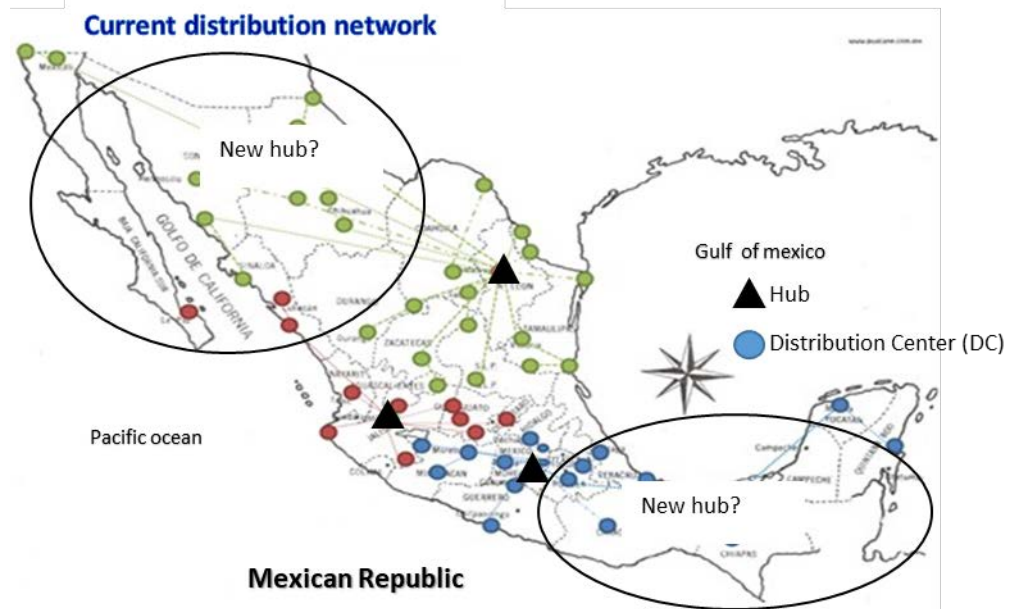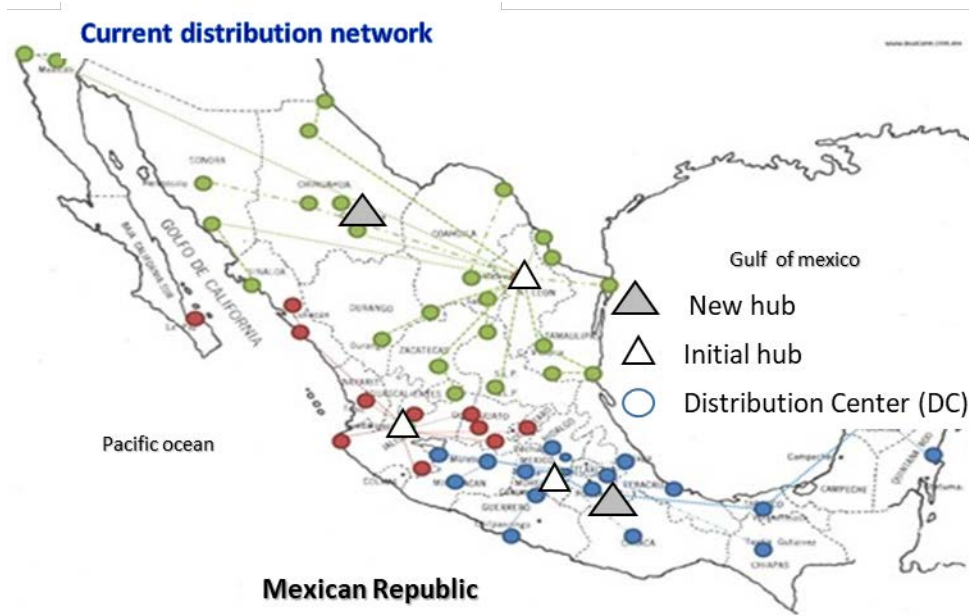
Figure 4. Description of distribution network

Figure 5. Description of new distribution structure

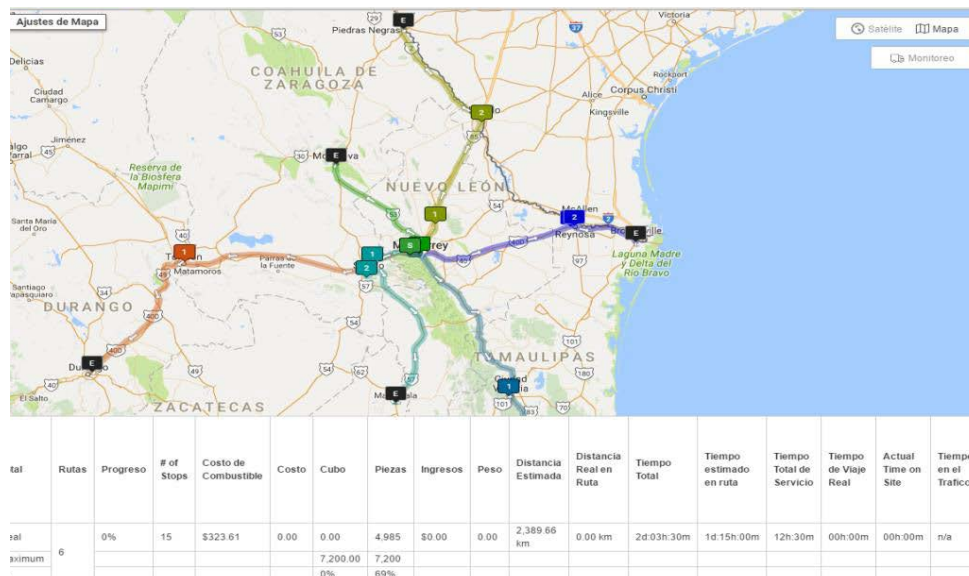| tal	Rutas	Progreso	# of Stops	Costo de Combustible	Costo	Cubo	Piezas	Ingresos	Peso	Distancia Estimada	Distancia Real en Ruta	Tiempo Total	Tiempo estimado en ruta	Tiempo Total de Servicio	Tiempo de Viaje Real	Actual Time on Site	Tiempo en el Trafico
eal	6	0%	15	$323.61	0.00	0.00	4,985	$0.00	0.00	2,389.66 km	0.00 km	2d:03h:30m	1d:15h:00m	12h:30m	00h:00m	00h:00m	n/a
aximum						7,200.00	7,200										
						0%	69%										

Figure 6. Example of a new designed route

4.3 Implementation and results

The implementation of the previously described initiatives is planned to be stage-wise. The authorization of the investment required to implement the new DC´s is expected to be done during the first quarter of year 2017. Meanwhile, the management decided to carry out the reassignment of several DC´s to new hubs, and the redefinition of various new routes. They also approved a pilot program of various new routes in the short run. The impact of the new routes on the truck capacity utilization was significant increasing from an average of 46% to the level of 74%. The projected new level of outbound transportation cost is expected to be 9% lower than the initial level.

Simultaneously, higher management approached their transport suppliers to redefine freight terms on the basis of a just cost for the same service. The company was willing to provide volume and certainty in longer contracts for the new relationship. The additional benefits obtained with the project include a better level of service for customers located in the northwestern and southeastern parts of Mexico.

5. Conclusions

As initially mentioned, the problem of concern in this paper is the reduction of outbound transportation cost. The firm of concern is a leading producer and distributor of tobacco products to its hubs and DC´s across Mexico. All the outbound transportation of FG is carried out completely by external suppliers. The management in charge of distribution and logistics of the firm decided to establish the objective of reducing inbound transportation.

The scheme used to define the improvement strategy for reducing inbound transportation cost is based on the stages suggested by Di Vece et al., (2015) and Moore (2006). In summary, this document briefly describes the efforts that are part of the first three stages: price negotiation, streamlining operations and optimization. The impact of the implementation of the initiatives is estimated as a reduction of 9% of total outbound transport cost.

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Biography

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