

A contract approach to understand decision-making in hinterland transportation

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ABSTRACT

The lead time and buffers in logistics and commodity transportation chains still offer large room for improvements and cost reductions. At global transportation chains, the foreland offers little for cost-reduction modifications, while the hinterland is the remaining keystone. Particularly for ports, the improvement of their hinterland connections is a key for sustainable growth, given the competition between ports.

Today, the most dynamically-developed commodity transport chain is the transcontinental ocean transport. And it is linked with complex hinterland distribution and collection systems. There, containers are moved by pure intermodal transportation per nature, but depending on the decision-maker they can be moved by multimodal too.

Academicians and politicians try also to intervene in the freight problematic of supply and demand interactions. Particularly, they try to regulate and control the most complicated issue: the routes and itineraries for shipping commodities. Often, instead of increasing reliability and reducing cost, politics suggests increasing the speed of environmentally friendly modes. Unfortunately, by doing so, they do not adopt the position of logisticians and consequently the measures are often not very effective to solve the problems.

To understand the complex mode of operation in hinterlands, we aim to provide a tool for analyzing impacts of parameters that adopts the logistics regime regarding transportation. To identify the logistics behaviour (shipping-lines, shippers, forwarders, carriers), this paper confronts the Incoterms schema with different decision-makers. The result of this paper provides logic deductions of the transmitted heterogeneity to actors, the structure reductions in the decision making process and the new information obtained from the contracts over the construction-process of hinterland transportation chains. This goes in the direction to correct misunderstanding policies and (some) freight theories coming from passenger transportation.

Keywords: Hinterland transport system, intermodality, freight transportation, shippers, forwarders, complex systems, transport modelling, incoterm, freight contracts.

1. INTRODUCTION

The main problematic of port businesses is located at customs, transshipment and hinterland transportation. This causes delays for exporters/importers at countries entries. To solve this problem, logistics actors divert their cargoes over the other possible ways for reaching the same destination. In consequence, the competition between ports rises at a point that the same origin/destination can be reached by the hinterland connections of several ports. Take the case of the north ports for instance, for reaching the port of Duisburg many ports can be chosen: Antwerp, Le Havre, Rotterdam, Bremen and Hamburg. Therefore, the competitiveness among ports is now given by their hinterland connections.

Since hinterlands are growing the more and more, their overlapping zones represent the keystone for attracting the transfer of goods. However, this open market causes that hinterlands with lower generalized cost covering the majority of the cargo have been diminished due to the competition (*Haralambides, 2002*). Thus, the coverage of the majority of destinations is the actual goal of ports while ensuring their main clients (clusters) inside their hinterlands. By establishing agreements with the logistics stakeholders, the ports offer all type of possible structures for shipping commodities to increase their competitive position (*Van Klink, 1995*). Now take the case of the failed position of the south European ports, they are lacking in offering facilities for shipping containers through their hinterlands, while the northern ports take an advantage by offer lower costs when bypassing through their facilities. This situation is a solution for every port at the northern competition. For illustration, take the case of shipping a container to Milan, it is cheaper and safer to shipping it from Rotterdam than from his natural are of influence: Genova (*Notteboom, 2007*).

The improvement of hinterland connections is consequently in constant development and many solutions have been appearing in the last years. From the above case, we can clearly state the importance of time and costs for logisticians. Therefore, these drivers must be considered as the key interests for politicians. By doing so, an improvement of competition will be achieved or at least will be nearer of the reality. The policies must be developed in a skilled way. The position of ports must be

taken into account and the desire to place goods from road to rail must be adapted to the real needs. Ports must be either regarded as a single or as a group – in the first case competition is fostered while in the second is complemented. Concerning the share of transportation modes, the road-haulage is the most flexible transport and even by avoiding it, its utilisation becomes a need for at least the last mille. It could be more useful to cope the problem by minimising the use of road-haulage for cases in which the competition among modes is available.

Simpler would be to understand stakeholders than to stick to a political idea. The promulgation of a policy will not be “magical” since the logistics actors will react by avoiding the cost at a maximum. Take the case of the hauliers for instance, they avoid German roads at a maximum by diverting their paths through alternative parallel French roads to avoid the payment of road tolls (*Transport and Environment, 2007*). Thus, for searching a European solution, the main actors or moreover the decision-makers must be targeted.

It is a big challenge to target the decision-makers given their heterogeneity. However, a possible identification of the logistics decision-makers has been done by the quantity of containers that are suitable to manage for a contract (*Carrillo Murillo, 2007*). The clusters issued are the local forwarder (LF), the shipper, the third-party logistics (3PL) and the fourth –party logistics (4PL). These “builders” of transportation chains are deciding for the final path that the commodities under their responsibility will follow.

However, at the top of the hierarchy of the decision-making process the first step is the selection of the builder (*Carrillo Murillo, 2007*). According to the developed concept, this first decision is made by the owner of the commodity (shipper), which will opt for selecting the builder by means of economies of scale (De Langen and Chouly, 2004). In other words, the quantity of containers to ship will drive the shipper’s decision to entrust the task of constructing the transportation chain.

To give an idea of the scope of this study, once the logistics actors can be identified, the method developed along this paper will provide the chain of structures at the decision-making process that can be launched. Depending on the quantity of the containers to ship, the shipper has no idea of the HTC that his goods will pass through. For the medium quantity of containers the shipper could manage the transportation of his own goods by a subsidiary or by establishing his own transportation department. This will provide him cost reduction and income of transportation flows. In the case he decides for picking a builder, the shipper will negotiate the decision rules for delivering the container with his builder.

The negotiation by these pairs is the transfer from the owner to the carriers' physical-labour allocating responsibilities along the GTC. Since the O/D paths do not provide enough information for mapping the containers flow, there is a possibility for extracting new information by means of contracts. From the contracts, this responsibility allocation offers an alternative method for modelling the stakeholders' behaviour.

For global trade, the International Commercial Terms (Incoterms) developed by the International Chamber of Commerce are a world-wide recognized set of specific definitions for international negotiations and define the contract responsibilities and liabilities between stakeholders. For this study, we propose to apply the Incoterms to transportation in order to extract the new information described above. From these Incoterms we aim to reveal the possible situations faced in the decision-making process. This is made by crossing the thirteen types of contracts with the drivers that fills the shippers' production function. There, a list of possible situations is stated by applying the Incoterms conditions to the transportation services.

After this introduction, the second section gives a description of the state of the art of marrying logistics with transportation, explaining the difficulties for treating the reinforcement process for logistics with classical analysis by the drivers that influence the construction of GTC. The third section provides an introduction of the interaction among stakeholders at the decision making process for the

construction of GTC, including the clusters of builders available for entrusting the shipping task. The section four is dedicated to describe the Incoterms by explaining the responsibilities assigned in contracts. The fifth section shows the development of the contract analysis and shows the results with the possible situations faced by the logistic actors. Finally, conclusions include authors' logical deductions over the homogenous behaviour of logistics actors, situations and reductions of logistics structures that facilitate the understanding of the decision-making process for the construction of transportation chains.

2. TRANSPORT FROM A LOGISTICS PERSPECTIVE

The main problematic at the containers flows is located at the beginning of the hinterland shipping process. The problematic envisaged at this study is the following: An overseas ship call is made to the port unloading thousands of containers, then, the distribution of them to the hinterland loads the possible connections and some of them are congested more than the others. This causes bottlenecks that affect even the passenger transportation. Thus, the present study tries to explain the possibility to improve the actual proved solutions by means of modelling this system.

Sound solutions emerge by including the logistics regime when considering mapping the overall path of containers. For this purpose, possible reductions can be made to the GTC orienting their analysis to the zone for improvement: the hinterlands. The foreland area (ocean or overseas shipping) is well controlled and almost reaching its optimization and maritime routes are given. The hinterland area, however, is still in development and represents the most problematic zone for freight. Then, the possibilities to improve the hyper-network (every network for every mode of transport) market are open to modifications in utilisation and represent economic drivers.

The existent problematic of transfer connection at ports represent the utilisation of the port itself. Take the case of the ports of Los Angeles and Long Beach for instance, their congestion problems do not allow them to perform efficiently to satisfy the American demand in containers, therefore, they search

solutions either by increasing their hinterland scope to a satellital marshalling yards, or by the establishing new terminals of maritime companies and developing rail connections from the Mexican ports to the border hubs (*e.g. Cuen Aranda, 2007*).

Some academicians and politicians are involved in the harbour-harbour competition and in the hinterland connections. There are many examples, where the modal share of freight should be shifted towards rail by the construction of high-speed connections. The Betuwe Line, for instance, is an electrified double-track line allowing a commercial speed of 160 km/h. Indeed, the standard freight trains generally do not move faster than 120 km/h. Other examples are the initiatives for a TGV frêt or the discussion about the benefits for freight railways induced by new ICE lines.

The characteristics in logistics actors' behaviour is directed on cost reductions. But the most important aspect when dealing with freight is to understand that the freight does not perceive the time. Thus, logisticians focus on stocks and on time at which they can react over the available market. Hence, the logisticians' goal is to reduce stocks and to operate in an environment of the maximum level of service. This is reflected by means of costs like the total logistics costs list (*Baumol, 1970*).

Logistics are constrained by the demand and supply fluctuations. These fluctuations are created over a huge amount of different products for freight. Three elements are playing an important role: the value of density, the strength of flows and the aging products. Thus, the diversity of the products is linked with the complexity of the freight system. Furthermore, this heterogeneity is transferred to the logistics actors.

Since not every actor performs at the same level and due to the broad characteristics of actors, there is a big challenge to target every one of them. However, a possible distinction of them can be achieved by grouping actors with almost the same behaviour (*follow the third section*).

The decision-making process has feedbacks and it is continuously improving, given to the stakeholders experience to reinforce their process for performing. Therefore, the logistics regime state the feedbacks obtained for the practices by adding many optimal solutions. The experience, labour and capital invested are linked with the market that stakeholders target.

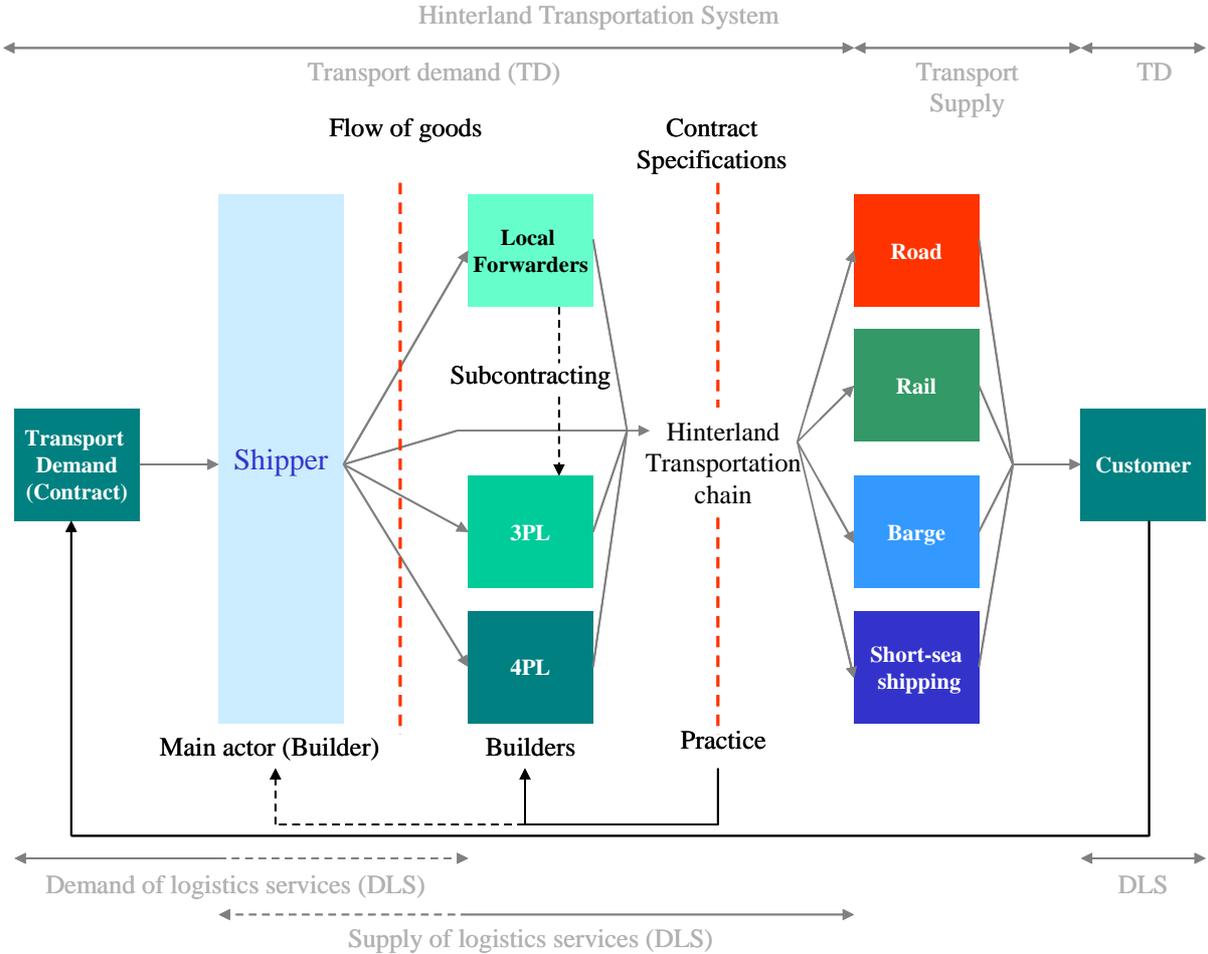


Figure 1. The conception of the hinterland transportation system for containers
 Source: Carrillo Murillo and Liedtke, 2007

The mixture of freight shipping and the stakeholders' management results in a complex system. There exists a need for analyse this system deeper than with classical approaches. A priority for tackling this system is the deep study of the components managed by logistics actors. When modelling this system, many components must be included. In fact, the present paper contributes to the analysis of the total

construction process of HTC (*figure 1*). The contract approach will show the possible situations for the main decision-maker (shipper) over the possible builders of the HTC.

3. THE DECISION-MAKING STRUCTURES

The control of hinterlands becomes to complex since many interaction structures between actors and networks are present. These structures can be explained by network externalities and logistics partners' combination between terminals and operators. Additionally, the increasing market growth of commodities and in particular for containers pushes the creation of more actors, while pulling the productions locations out of the cities.

To follow the interaction between stakeholders two steps arise: the shipper position for deciding to whom the transportation task will be entrusted and the builders' characteristics over the quantity of goods to perform.

The classification was made on the basis of history and existing relations of decision-makers (*Tongzon, 2002*). Accordingly, he distinguishes 3 kinds of shippers: those with long term contracts with shipping lines, those that outsource logistics to forwarders and those independent shippers who make transport choices themselves. Unfortunately, this classification is not yet valid since shippers are not deciding anymore for long term contracts and the emergence of forwarders has been improved (*Notteboom, 2007*). Therefore, an improvement of this classification has been done by grouping the decision-makers and establishing a hierarchy among them (*Carrillo Murillo, 2007*). This distribution is based by the quantity of containers to ship for a given contract (*figure 3*). The curve is slightly decreasing with the quantity of goods. This means the quantity represents an important aspect to negotiate the cost for the shipper to hire a logistics actor. Furthermore, according to the developed concept, the shipper must be aware of the cost that represents for him to entrust the transportation task to a builder or to perform itself the construction of the transportation chain

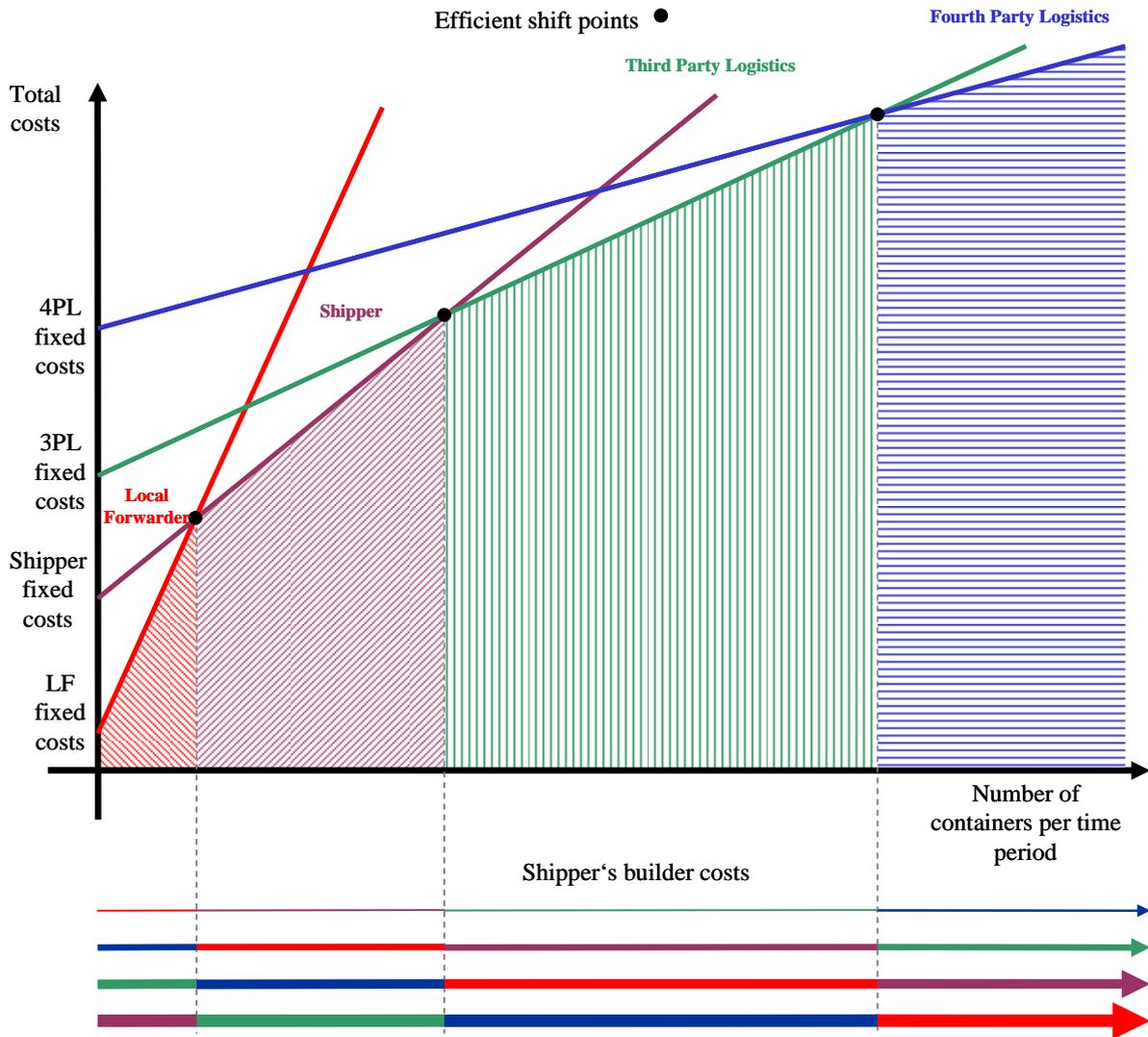


Figure 2. The hierarchical hinterland distribution

Source: Carrillo Murillo, 2007

Four logistics actors have been identified in this research by linking the size of the goods with their capability to reduce costs. These actors are mainly the local forwarder (LF), the shipper, the third- (3PL) and the fourth-party logistics. For a deep description of every actor follow (Carrillo Murillo, 2007).

An important aspect to underline is the shippers' consideration as the owner of the goods. Note that the function showed in figure 3 denotes the shipper's production function for deciding between

arranging own transportation and hiring a logistics forwarder. The slightly form is due to the capability of builders to deal with economies of scale.

4. THE INCOTERMS

The International Commerce Terms or Incoterms were created as an emergence to international trade, to make it easier and help traders in different countries to understand one another. These standard trade definitions are most commonly used in international and thus, in transport contracts. They were created to assist traders in 13 Incoterms to cover the areas on how each one works (*Incoterms, 2007*).

Mainly, they represent the responsibilities to carry-on when signing a contract. They regulate the distribution of documents, the delivering conditions of the good, the costs and the risk distribution of the operation. Unfortunately, they do not indicate the applicable legislation outside the main points reflected in the Incoterms and the operation's mode of payment (*Incoterms, 2007*). We will provide in annexe a list of the 13 Incoterms (figure 2) and a graphic representation (figure A-1) for the interpretation of the interest of each actor in annex.

The introduction of Incoterms supports the idea of why we must identify the decision-makers, besides the insight of the whole transportation chain and their know-how over the supply chain. Certainly, the roles of decision-makers may vary, according to the shipping responsibilities outlined in the contracts agreed between the seller and the buyer/importer.

Take the case of costs for a commodity, if the decision-maker only aims to deliver the commodity, he will pursue a total logistics costs minimization. Whilst in the case of carry-on the risks of this commodity, he will prefer to establish a balance between costs reduction and reliability maximisation, including flexibility, cooperation and coordination (risk sharing).

Ex-works or EXW refers to leave the commodity just outside the production site. The seller has only the responsibility concerning the good in itself. Consequently the importer becomes the responsible for the entire transportation task at the global scale.

Free Alongside Ship or FAS is called to the contract between seller and recipient assigning the sellers' responsibility to the good and delivering it until the handling at the exit port. The sellers' responsibility during this path does not consider the duty cost over the first hinterland.

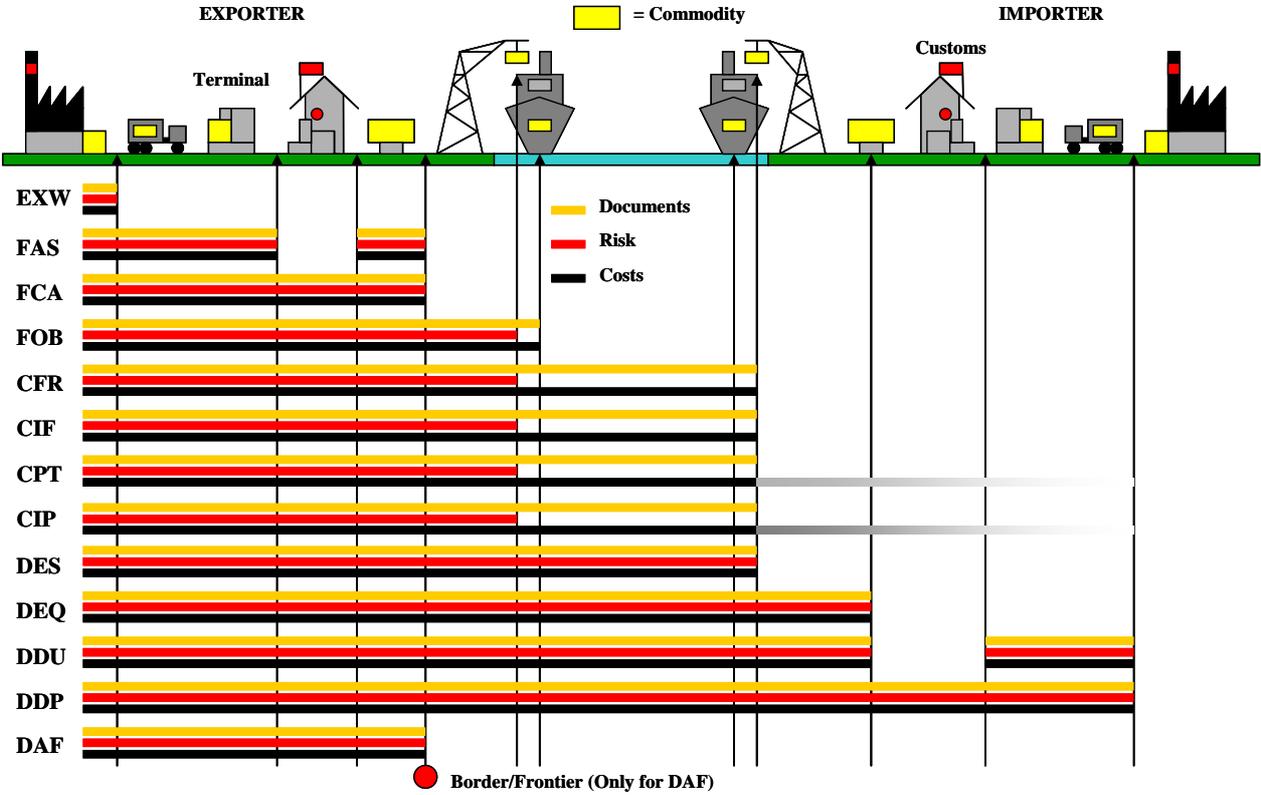


Figure 3. The graphical International Commerce Terms

Source: Authors' adaptation based on Camaracuba, 2007.

Free Carrier or FCA considers the path of the commodity to be delivered just before the first port's handling including all costs, risk and documents.

Free On Board or FOB is used for the cases of assigning the responsibility to the seller for placing the commodity in the ocean transport (ship), therefore, the seller will decide for the main transport carrier as well. The particularity of this incoterm is the limited risk assigned for the seller until the cargo is delivered for its handling.

Cost and Freight or CFR is destined to those contracts where the seller must take into account the documents and cost for placing the commodity just before the arrival handling. However, the risk assigned stops at the delivered departure handling.

Cost, Insurance and Freight or CIF is issued for ensuring the commodity for the part of seller until the arrival handling. The present incoterm fix the responsibility for the seller until the first handling of the commodity and the rest of the risk is taken by an insurance company.

Carriage Paid To or CPT means the contract of fixing responsibilities between stakeholders to a named place or destination. The risk however, remains until the first handling of the commodity.

Costs and Insurance Paid to or CIP is the same as the CPT but includes only the insurance costs to the point fixed at the contract.

Delivered At Frontier or DAF is however the least concerned for the purposes of the present study, but represents the documents, risk and cost responsibility for the seller until the good reaches the border.

Delivered Ex Ship or DES describe a contract that allocates the responsibility of the seller in all sense to deliver the good until the good is delivered for handling.

Delivered Ex Quay or DEQ contents the distribution of the responsibilities for the seller to place the good at the port.

Delivered Duty Unpaid or DDU was conceived for entrusting the whole transportation chain costs, documents and risk for the seller without any responsibility for the arrival customs.

Delivered Duty Paid can be visualized as the EXW on the other sense and therefore the whole responsibility of the path, costs, documents, and selection of the builder of the transportation chain is given to the seller.

5. THE CONTRACT ANALYSIS

The method of conditions to allocate responsibilities with the Incoterms has the possibility to be applied to the GTC. This method will show one of the main drivers for logistics actors to perform as non-conventional shipping from a first sight point of view. However, at the logistics point of view this process makes sense and certainly the drivers are related with time and cost. However the drivers are not yet included at this study and further development will focus on this direction.

The structures are then fixed in pairs and it is the interest for the shipper to decide the formation of the pair desired. The possible pairs made by contracts are the shipper and LF, the shipper and shipper, the shipper and 3PL and the shipper and 4PL.

At the incoterms, goods' responsibilities are fixed to the negotiation between the two parties (shippers). At the top of the decision making process, it is possible to have two shippers, the sender and the recipient respectively. This distribution of responsibilities between shippers will create special issues to threat for the formation of pairs. The new information is obtained, as mentioned above, by applying the incoterms to the hierarchy schema at the top of the decision-making process for GTC (*figure 1*).

Segment		EXW/DDU/ DDP	FAS	FCA / DEQ Inv	FOB	CFR/CIF/CP T/CIP/DES
Hinterland export	Inland Transport	Seller or Recipient	Sender	Sender	Sender	Sender
	Customs		Recipient	Sender	Sender	Sender
	Port		Sender	Sender	Sender	Sender
	Handling		Recipient	Recipient	Sender	Sender
Hinterland import	Ocean Transport		Recipient	Recipient	Recipient	Sender
	Handling		Recipient	Recipient	Recipient	Sender
	Port		Recipient	Recipient	Recipient	Recipient
	Customs		Recipient	Recipient	Recipient	Recipient
	Inland Transport		Recipient	Recipient	Recipient	Recipient

Table 1. Shippers' distribution of responsibilities by incoterms.

Source: Authors based in Incoterms .

The methodology distributes the main decision between the seller and the recipient. This process involves own knowledge of the transportation sector and the information available given the number of containers for a contract. The *figure 4* shows the owner of the decision for every step at the construction of the GTC. The next step is to model the suitable choice for the shippers over the possible builders (*table 5*). Note that the shipper will choose the optimum for his own production function depending on the quantity of containers (*figure 2*). However, there is an enormous reduction over the whole set of possibilities. We eliminate the non congruent possibilities - the case of hiring a forwarder for choosing the handling cost or the customs cost. Hence, *figures 5 and 6* show the issue of the contract analysis.

Segment		Small Qty	Medium Qty	Large Qty	Xlarge Qty	
Hinterland export	Inland Transport	LF	LF	Own	3PL	4PL
	Customs	LF	LF	Own	3PL	4PL
	Port	LF	LF	Own	3PL	4PL
	Handling	LF	LF	Own	3PL	4PL
Hinterland import	Ocean Transport	Carrier	Carrier	Carrier	3PL	4PL
	Handling	LF	Own	Own	3PL	4PL
	Port	LF	Own	Own	3PL	4PL
	Customs	LF/S2	Own/S2	Own/S2	3PL/S2	4PL/S2
	Inland Transport	LF	Own	Own	3PL	4PL

Table 2. The single-shipper selection.

Source: Authors applying EXW, DDP and DDU Incoterms .

We placed the results divided by the situations of single and mixed selection of builders for a more comprehensible statement. The selection of the builders for a single-shipper decision tends to generalize the construction of the GTC depending on the quantity of containers. The bigger the quantity of containers the more generalized trend for selecting builders. The table 2 shows however the possible pairs for the ex-works incoterm. However there is a particularity for the delivered duty un- and paid incoterms. They reflect the same responsibilities as the ex-works when applied inversely.

For the mixed-shipper scenarios the insight is different. The selection of the builders is well shared and this is represented by three pairs “tastes”. They are namely, the export, the handling and the half mixed shipper selection.

	Segment	Small Qty	Medium Qty	Large Qty	Xlarge Qty	
Hinterland export	Inland Transport	LF	LF	Own	3PL	4PL
	Customs	Own	Own	Own	3PL	4PL
	Port	LF	LF	Own	3PL	4PL
	Handling	Own	Own	Own	3PL	4PL
Hinterland import	Ocean Transport	Carrier	Carrier	Carrier	3PL	4PL
	Handling	LF	Own	Own	3PL	4PL
	Port	LF	Own	Own	3PL	4PL
	Customs	LF	LF	Own	3PL	4PL
	Inland Transport	LF	LF	Own	3PL	4PL

Table 3. The export mixed-shipper selection.

Source: Authors applying the FAS incoterm .

We named the export mixed-shipper selection due to the degrees of freedom for the recipient to play at the export hinterland zone. However, this is only possible for the free alongside ship incoterm. It permits to entrust the actor to pay the duties and the decision of handling at the hinterland export. Thus, the recipient can choose to involve himself at the small quantity scale for the contract. The rest of the scales follow the same trend of generalizing the builder distribution.

The handling mixed-shipper selection was named for the degree of freedom in which the recipient is able to interact out of his zone. However this statement doesn’t make any big changes since it involves only the selection of the terminal at the export hinterland. Therefore, this observation shows the

similarity with the next pair selection. Note that the decisions of the ocean transport are mainly made for a carrier. This issue is due to the impossibility of entrusting this task to a 3PL or 4PL. Their own name is symbol of acting as a subcontractor while the carrier does not.

	Segment	Small Qty	Medium Qty	Large Qty	Xlarge Qty
Hinterland	Inland Transport	LF	Own	3PL	4PL
	Customs	LF	Own	3PL	4PL
	Port	LF	Own	3PL	4PL
	Handling	Own	Own	3PL	4PL
	Ocean Transport	Carrier	Carrier	3PL	4PL
Hinterland	Handling	LF	Own	3PL	4PL
	Port	LF	Own	3PL	4PL
	Customs	LF	Own	3PL	4PL
	Inland Transport	LF	Own	3PL	4PL

Table 4. The handling mixed-shipper selection.

Source: Authors applyin, FCA and DEQ Incoterms .

The last result of the contract analysis issues the half mixed-shipper selection. This pair does not allow the recipient to interact with the export hinterland, only in his own hinterland area. The particularity is the total trend for selecting the most suitable distribution for the wellness of the transportation. Avoiding discrepancies between shippers, we note the effectiveness for the selection of pairs that certainly tackles complexity and heads towards the optimal construction of the GTC.

	Segment	Small Qty	Medium Qty	Large Qty	Xlarge Qty
Hinterland	Inland Transport	LF	Own	3PL	4PL
	Customs	LF	Own	3PL	4PL
	Port	LF	Own	3PL	4PL
	Handling	LF	Own	3PL	4PL
	Ocean Transport	Carrier	Carrier	3PL	4PL
Hinterland	Handling	LF	Own	3PL	4PL
	Port	LF	Own	3PL	4PL
	Customs	LF	Own	3PL	4PL
	Inland Transport	LF	Own	3PL	4PL

Table 5. The half mixed-shipper selection.

Source: Authors applying FOB, CFR, CIF, CPT, CIP and DES Incoterms .

The particularity for the largest scale of containers to ship is the inclusion of the ocean transport decision. Even if by definition the 4PL does not own assets, it will decide for the optimum between choosing a 3PL or a carrier firm insuring the logistics optimal.

CONCLUSIONS

The incoterms give us the opportunity to extract new information that can not be found in statistics. This process is achieved by means of allocating responsibilities on contracts. When applying the incoterms to the GTC schema, we obtain the interaction among logistics stakeholders at two steps: the first between sender and recipient (shippers) and the second the selection of the builder of every element at the GTC.

The shippers' responsibility models the behaviour before the selection. The degrees of freedom for playing at the GTC board, opens the possibility to interact at the first hinterland. However the behaviour is only modified for the small scales. This modifies the structure (pairs) of the export and the handling mixed-shipper selection. The trend of the shipper selections, no matter the type of contract, is to standardize the selection for a logistics actor.

From the heterogeneity transferred from the diversity of goods to transport to the logistics actors, the contract analysis results in an overall homogenization of the shippers' selection of builders. The trend for entrusting the construction of the transportation chains is correlated with the scale of containers for a contract. However not at every step this can be attained. There is the possibility to observe problems of asymmetric information and it is important to take the consideration of the weakness of the analysis (assumptions).

The homogenous behaviour of shippers at the top of the decision-making process is present due to the concept of their involvement at the transportation sector. The communication between stakeholders follows the negotiation process and therefore, the synergy between shippers is present for this homogenization.

Reductions of the whole set of possibilities for the distribution of responsibilities as well as for the selection of logistics actors, emerge as an aid for understanding hinterlands. Given the complexity of

these two areas at the GTC, the extraction of information via contracts offers the opportunity to understand the logistics behaviour at hinterland transportation. Therefore, further research applying this methodology is mandatory for testing the present study.

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